SA-STUDENT

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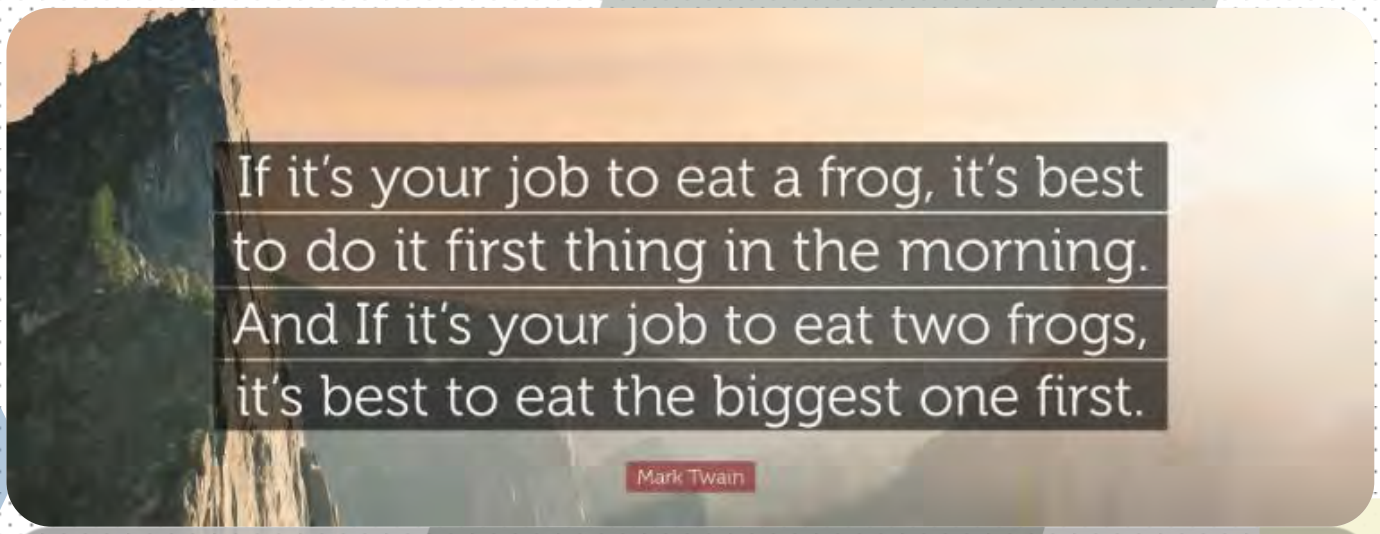


QUESTION 3/*VRAAG 3*

3.1 Motion under the influence of gravity/weight/gravitational force only. ✓✓
Beweging slegs onder die invloed van gravitasie/gewig/gravitasiekrag.
(2 or/of 0)

OR/*OF*
Motion in which the only force acting is the gravitational force.
Beweging waar die enigste krag wat inwerk gravitasiekrag is. (2)

3.2.1

Marking criteria/*Nasienkriteria*
- Formula to calculate Δt./*Formule om Δt te bereken.* ✓
- Correct substitution to calculate Δt./Korrekte v*ervanging om Δt te bereken.* ✓
- Final answer/*Finale antwoord*: 1,76 s ✓

OPTION 1/*OPSIE 1*

UPWARDS AS POSITIVE/
OPWAARTS AS POSITIEF
$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓
$-15,2 = (0) + \frac{1}{2}(-9,8)\Delta t^2$ ✓
$\Delta t = 1,76$ s ✓

DOWNWARDS AS POSITIVE/
AFWAARTS AS POSITIEF
$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓
$15,2 = (0) + \frac{1}{2}(9,8)\Delta t^2$ ✓
$\Delta t = 1,76$ s ✓

OPTION 2/*OPSIE 2*

UPWARDS AS POSITIEF/
OPWAARTS AS POSITIEF
$v_f^2 = v_i^2 + 2a\Delta y$
$v_f^2 = (0)^2 + (2)(-9,8)(-15,2)$
$v_f = -17,26\ m\cdot s^{-1}$

DOWNWARDS AS POSITIVE/
AFWAARTS AS POSITIEF
$v_f^2 = v_i^2 + 2a\Delta y$
$v_f^2 = (0)^2 + (2)(9,8)(15,2)$
$v_f = 17,26\ m\cdot s^{-1}$

UPWARDS AS POSITIVE/
OPWAARTS AS POSITIEF
$v_f = v_i + a\Delta t$ ✓
$-17,26 = (0) + (-9,8)\Delta t$ ✓
$\Delta t = 1,76$ s ✓

OR/*OF*
$\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$ ✓
$-15,2 = \left(\frac{0 - 17,26}{2}\right)\Delta t$ ✓
$\Delta t = 1,76$ s ✓

OPTION 3/*OPSIE 3*
$(E_{mech})_{top} = (E_{mech})_{bottom}$
$(E_p + E_k)_{top} = (E_p + E_k)_{bottom}$
$(mgh + \frac{1}{2}mv_i^2)_{top} = (mgh + \frac{1}{2}mv_f^2)_{bottom}$
$(9,8)(15,2) + 0 = 0 + (\frac{1}{2})(v_f)^2$
$v_f = 17,26\ m\cdot s^{-1}$

DOWNWARDS AS POSITIVE/
AFWAARTS AS POSITIEF
$v_f = v_i + a\Delta t$ ✓
$17,26 = (0) + (9,8)\Delta t$ ✓
$\Delta t = 1,76$ s ✓

OPTION 4/*OPSIE 4*
$W_{nc} = \Delta K + \Delta U$
$W_{nc} = \Delta K + mg(h_f - h_i)$
$0 = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 + mgh_f - mgh_i$
$0 = \frac{1}{2}(v_f^2 - 0) + (9,8)(15,2)$
$v_f = 17,26\ m\cdot s^{-1}$

OR/*OF*
$\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$ ✓
$15,2 = \left(\frac{0 + 17,26}{2}\right)\Delta t$ ✓
$\Delta t = 1,76$ s ✓

OPTION 5/*OPSIE 5*
$W_{net} = \Delta E_k$
$w\Delta y\cos\theta = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$
$(9,8)(15,2)\cos 180° = 0 - \frac{1}{2}(v_f)^2$
$v_f = 17,26\ m\cdot s^{-1}$

OPTION 6/*OPSIE 6* **UPWARDS AS POSITIVE/*OPWAARTS AS POSITIEF***	**DOWNWARDS AS POSITIVE/*AFWAARTS AS POSITIEF***
$F_{net}\Delta t = \Delta p = m(v_f - v_i)$ ✓Any one/ *Enige een* $mg\Delta t = m(v_f - v_i)$ ✓Any one/ *Enige een* $-9{,}8\Delta t = -17{,}26 - (0)$ ✓ $\Delta t = 1{,}76$ s ✓	$F_{net}\Delta t = \Delta p = m(v_f - v_i)$ ✓Any one/ *Enige een* $mg\Delta t = m(v_f - v_i)$ ✓Any one/ *Enige een* $9{,}8\Delta t = 17{,}26 - (0)$ ✓ $\Delta t = 1{,}76$ s ✓

(3)

3.2.2 **POSITIVE MARKING FROM QUESTION 3.2.1.**
POSITIEWE NASIEN VANAF VRAAG 3.2.1.

Marking criteria/*Nasienkriteria*

- Correct substitution to calculate Δt for ball A./*Korrekte vervanging om Δt te bereken vir bal A.* ✓
- Subtraction 1,76 – 0,81./*Aftrekking 1,76 – 0,81.* ✓
- Correct formula to calculate v_i for ball B./*Korrekte formule om v_i te bereken vir bal B.* ✓
- Correct substitution to calculate v_i for ball B./*Korrekte vervanging om v_i te bereken vir bal B.* ✓
- Final answer/*Finale antwoord:* 4,66 $m\cdot s^{-1}$ ✓ (4,66 to/*tot* 4,7)

OPTION 1/*OPSIE 1*	**OPTION 2/*OPSIE 2***
UPWARDS AS POSITIVE/ *OPWAARTS AS POSITIEF*	**UPWARDS AS POSITIVE/ *OPWAARTS AS POSITIEF***
$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓ $-3{,}2 = (0) + \frac{1}{2}(-9{,}8)(\Delta t)^2$ ✓ $\Delta t = 0{,}81$ s $\Delta t(B) = 1{,}76 - 0{,}81$ ✓ $\Delta t(B) = 0{,}95$ s $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ $(0) = v_i(0{,}95) + \frac{1}{2}(-9{,}8)(0{,}95)^2$ ✓ $v_i = 4{,}66\ m\cdot s^{-1}$ ✓	$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓ $-3{,}2 = (0) + \frac{1}{2}(-9{,}8)(\Delta t)^2$ ✓ $\Delta t = 0{,}81$ s $\Delta t(B) = 1{,}76 - 0{,}81$ ✓ $\Delta t(B) = 0{,}95$ s $v_f = v_i + a\Delta t$ $-v_i = v_i + (-9{,}8)(0{,}95)$ ✓ $v_i = 4{,}66\ m\cdot s^{-1}$ ✓
DOWNWARDS AS POSITIVE/ *AFWAARTS AS POSITIEF*	**DOWNWARDS AS POSITIVE/ *AFWAARTS AS POSITIEF***
$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓ $3{,}2 = (0) + \frac{1}{2}(9{,}8)(\Delta t)^2$ ✓ $\Delta t = 0{,}81$ s $\Delta t(B) = 1{,}76 - 0{,}81$ ✓ $\Delta t(B) = 0{,}95$ s $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ $0 = -v_i(0{,}95) + \frac{1}{2}(9{,}8)(0{,}95)^2$ ✓ $v_i = 4{,}66\ m\cdot s^{-1}$ ✓	$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓ $3{,}2 = (0) + \frac{1}{2}(9{,}8)(\Delta t)^2$ ✓ $\Delta t = 0{,}81$ s $\Delta t(B) = 1{,}76 - 0{,}81$ ✓ $\Delta t(B) = 0{,}95$ s $v_f = v_i + a\Delta t$ $v_i = -v_i + (9{,}8)(0{,}95)$ ✓ $v_i = 4{,}66\ m\cdot s^{-1}$ ✓

Calculate/*Bereken*:
$v_f = 7,92\ m\cdot s^{-1}$

OPTION 3/*OPSIE 3*
UPWARDS +/
OPWAARTS +
$v_f^2 = v_i^2 + 2a\Delta y$
$v_f^2 = (0)^2 + (2)(-9,8)(-3,2)$
$v_f = -7,92\ m\cdot s^{-1}$ →

DOWNWARDS +/
AFWAARTS +
$v_f^2 = v_i^2 + 2a\Delta y$
$v_f^2 = (0)^2 + (2)(9,8)(3,2)$
$v_f = 7,92\ m\cdot s^{-1}$ →

OPTION 4/*OPSIE 4*
$(E_{mech})_{top} = (E_{mech})_{bot}$
$(E_p + E_k)_{top} = (E_p + E_k)_{bot}$
$(mgh+½mv_i^2)_{top} = (mgh+½mv_f^2)_{bot}$
$(9,8)(3,2) + 0 = 0 + (½)(v_f)^2$
$v_f = 7,92\ m\cdot s^{-1}$ →

OPTION 5/*OPSIE 5*
$W_{nc} = \Delta K + \Delta U$
$W_{nc} = \Delta K + mg(h_f - h_i)$
$0 = ½mv_f^2 - ½mv_i^2 + mgh_f - mgh_i$
$0 = ½(v_f^2 - 0) + (9,8)(3,2)$
$v_f = 7,92\ m\cdot s^{-1}$ →

OPTION 6/*OPSIE 6*
$W_{net} = \Delta E_k$
$w\Delta y\cos\theta = ½mv_f^2 - ½mv_i^2$
$(9,8)(3,2)\cos 0° = ½v_f^2 - 0$
$v_f = 7,92\ m\cdot s^{-1}$ →

Calculate/*Bereken*:
$\Delta t(B) = 0,95$ s

UPWARDS +/
OPWAARTS +
$v_f = v_i + a\Delta t$
$-7,92 = (0) + (-9,8)\Delta t$ ✓
$\Delta t = 0,81$ s

$\Delta t(B) = 1,76 - 0,81$ ✓
$\Delta t(B) = 0,95$ s →

OR/*OF*
$\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$
$-3,2 = \left(\frac{0 - 7,92}{2}\right)\Delta t$ ✓
$\Delta t = 0,81$ s

$\Delta t(B) = 1,76 - 0,81$ ✓
$\Delta t(B) = 0,95$ s →

OR/*OF*
$\Delta y = v_i\Delta t + ½a\Delta t^2$
-12 ✓ $= -7,92\Delta t + ½(-9,8)\Delta t^2$ ✓
$\Delta t = 0,95$ s →

DOWNWARDS +/
AFWAARTS +
$v_f = v_i + a\Delta t$
$7,92 = (0) + (9,8)\Delta t$ ✓
$\Delta t = 0,81$ s

$\Delta t(B) = 1,76 - 0,81$ ✓
$\Delta t(B) = 0,95$ s →

OR/*OF*
$\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$
$3,2 = \left(\frac{0 + 7,92}{2}\right)\Delta t$ ✓
$\Delta t = 0,81$ s

$\Delta t(B) = 1,76 - 0,81$ ✓
$\Delta t(B) = 0,95$ s →

OR/*OF*
$\Delta y = v_i\Delta t + ½a\Delta t^2$
12 ✓ $= 7,92\Delta t + ½(9,8)\Delta t^2$ ✓
$\Delta t = 0,95$ s →

Calculate/*Bereken*:
$v_i = 4,66\ m\cdot s^{-1}$

UPWARDS +/
OPWAARTS +
($\Delta t_{up\ and\ down} = 0,95$ s)
$v_f = v_i + a\Delta t$ ✓
$-v_i = v_i + (-9,8)(0,95)$ ✓
$v_i = 4,66\ m\cdot s^{-1}$ ✓

OR/*OF*
($\Delta t_{up} = 0,475$ s)
$v_f = v_i + a\Delta t$ ✓
$0 = v_i + (-9,8)(0,475)$ ✓
$v_i = 4,66\ m\cdot s^{-1}$ ✓

OR/*OF*
$\Delta y = v_i\Delta t + ½a\Delta t^2$ ✓
$0 = v_i(0,95) + ½(-9,8)(0,95)^2$ ✓
$v_i = 4,66\ m\cdot s^{-1}$ ✓

DOWNWARDS +/
AFWAARTS +
$v_f = v_i + a\Delta t$ ✓
$v_i = v_i + (9,8)(0,95)$ ✓
$= -4,66$
$v_i = 4,66\ m\cdot s^{-1}$ ✓

OR/*OF*
($\Delta t_{up} = 0,475$ s)
$v_f = v_i + a\Delta t$ ✓
$0 = v_i + (9,8)(0,475)$ ✓
$= -4,66$
$v_i = 4,66\ m\cdot s^{-1}$ ✓

OR/*OF*
$\Delta y = v_i\Delta t + ½a\Delta t^2$ ✓
$0 = -v_i(0,95) + ½(9,8)(0,95)^2$ ✓
$v_i = 4,66\ m\cdot s^{-1}$ ✓

OPTION 7/*OPSIE 7*	
UPWARDS AS POSITIVE/*OPWAARTS AS POSITIEF*	**DOWNWARDS AS POSITIVE/*AFWAARTS AS POSITIEF***
$F_{net}\Delta t = \Delta p$ / $= m(v_f - v_i)$ ✓Any one /*Enige een*	$F_{net}\Delta t = \Delta p$ / $= m(v_f - v_i)$ ✓Any one /*Enige een*
$\underline{(-9,8)(0,95)}$ ✓ $= \underline{-2v_i}$ ✓✓	$\underline{(9,8)(0,95)}$ ✓ $= \underline{2v_i}$ ✓✓
$v_i = 4,66\ m\cdot s^{-1}$ ✓ $(4,655\ m\cdot s^{-1})$	$v_i = 4,66\ m\cdot s^{-1}$ $(4,655\ m\cdot s^{-1})$ ✓

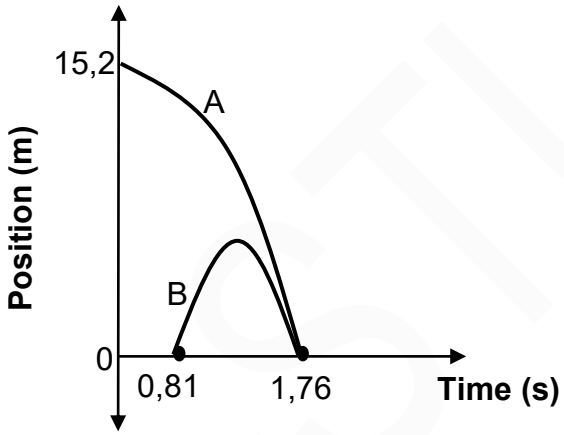
(5)

3.3 **POSITIVE MARKING FROM QUESTION 3.2.1/**
POSITIEWE NASIEN VANAF VRAAG 3.2.1

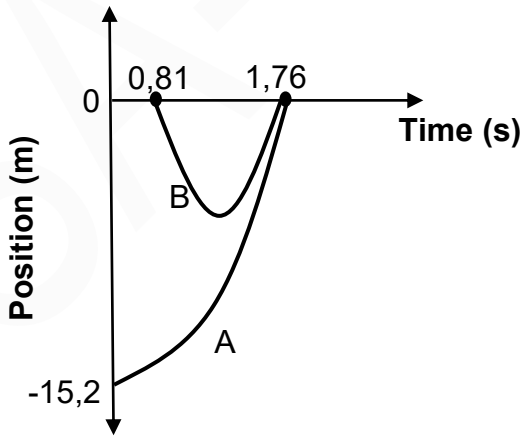
Marking criteria/*Nasienkriteria:*

- Initial position of ball A = 15,2 m and B = 0 m./*Oorspronklike posisie van A = 15,2 m en B = 0 m.* ✓
- Starting times for A = 0 s and B = 0,81 s./*Begintye van A = 0 s en B = 0,81 s.* ✓
- Both balls strike the ground at t = 1,76 s./*Albei balle tref die grond op t = 1,76 s.* ✓
- Shape of graph for ball A./*Vorm van grafiek vir bal A.* ✓
- Shape of graph for ball B./*Vorm van grafiek vir bal B.* ✓
- If graphs are drawn on seperate axis/*Indien grafieke op apparte asse geteken word:*
  max/*maks*: $^4/_5$

UPWARDS AS POSITIVE/*OPWAARTS AS POSITIEF* (CHANGED GRAPH)



DOWNWARDS AS POSITIVE/*AFWAARTS AS POSITIEF:*



(5)
[15]

2.3.1

For P/*Vir P* **RIGHT AS POSITIVE/** ***REGS AS POSITIEF***	**For P/*Vir P*** **LEFT AS POSITIVE/** ***LINKS AS POSITIEF***
$F_{net} = ma$ $T + f = ma$ $T - f = ma$ } ✓ Any one/ *Enige een*	$F_{net} = ma$ $T + f = ma$ $-T + f = ma$ } ✓ Any one/ *Enige een*
$T - 1,8$ ✓$= (1,25)(0,1)$ ✓ $T = 1,93$ N ✓ (1,925 N)	$-T + 1,8$ ✓$= (1,25)(-0,1)$ ✓ $T = 1,93$ N ✓ (1,925 N)

(4)

2.3.2

POSITIVE MARKING FROM QUESTION 2.3.1/
POSITIEWE NASIEN VANAF VRAAG 2.3.1.

RIGHT AS POSITIVE/*REGS AS POSITIEF:*

For Q/*Vir Q*

$F_{net} = ma$
$F\cos\theta - T - f = ma$
$F\cos\theta + T + f = ma$
$7,5\cos\theta - 1,93 - 2,2$ ✓$= (2)(0,1)$ ✓
$\theta = 54,74°$✓ (Range:54,55° - 54,78°)

Accept/*Aanvaar*
$\sin(90° - \theta)$

LEFT AS POSITIVE/*LINKS AS POSITIEF:*

For Q/*Vir Q*

$F_{net} = ma$
$-F\cos\theta + T + f = ma$
$F\cos\theta + T + f = ma$
$-7,5\cos\theta + 1,93 + 2,2$ ✓$= (2)(-0,1)$ ✓
$\theta = 54,74°$ ✓ (Range:54,55° - 54,78°)

Accept/*Aanvaar*
$\sin(90° - \theta)$

(3)
[13]

QUESTION 3/*VRAAG 3*

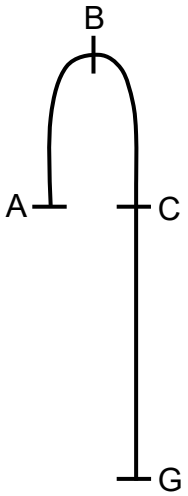
3.1 Motion under the influence of gravity/weight/gravitational force only. ✓✓
Beweging slegs onder die invloed van gravitasie/gewig/swaartekrag.
(2 or/of 0)

OR/*OF*
Motion in which the only force acting is gravity/weight/gravitational force.
Beweging waar die enigste krag wat inwerk, gravitasie/gewig/swaartekrag is.
(2 or/of 0) (2)

3.2.1

Marking criteria/*Nasienkriteria*

- Formula with Δt/*Formule met Δt* ✓
- Correct substitution into formula/*Korrekte vervanging in formule* ✓
- Final answer/*Finale antwoord*: 1,22 s ✓ (1,22 s to/*tot* 1,23 s)



OPTION 1/*OPSIE 1*

A-B:

UPWARDS AS POSITIVE/
OPWAARTS AS POSITIEF

$v_f = v_i + a\Delta t$ ✓
$0 = 12 + (-9,8)\Delta t$ ✓
$\Delta t = 1,22$ s ✓

DOWNWARDS AS POSITIVE/
AFWAARTS AS POSITIEF

$v_f = v_i + a\Delta t$ ✓
$0 = -12 + (9,8)\Delta t$ ✓
$\Delta t = 1,22$ s ✓

OPTION 2/*OPSIE 2*

B-C:

UPWARDS AS POSITIVE/
OPWAARTS AS POSITIEF

$v_f = v_i + a\Delta t$ ✓
$-12 = 0 + (-9,8)\Delta t$ ✓
$\Delta t = 1,22$ s ✓

DOWNWARDS AS POSITIVE/
AFWAARTS AS POSITIEF

$v_f = v_i + a\Delta t$ ✓
$12 = 0 + (9,8)\Delta t$ ✓
$\Delta t = 1,22$ s ✓

OPTION 3/*OPSIE 3*

A-C:

UPWARDS AS POSITIVE/
OPWAARTS AS POSITIEF

$v_f = v_i + a\Delta t$ ✓
$-12 = 12 + (-9,8)\Delta t$ ✓
$\Delta t = 2,45$ s
$\Delta t_{up} = 1,23$ s ✓

DOWNWARDS AS POSITIVE/
AFWAARTS AS POSITIEF

$v_f = v_i + a\Delta t$ ✓
$12 = -12 + (9,8)\Delta t$ ✓
$\Delta t = 2,45$ s
$\Delta t_{up} = 1,23$ s ✓

OPTION 4/*OPSIE 4*

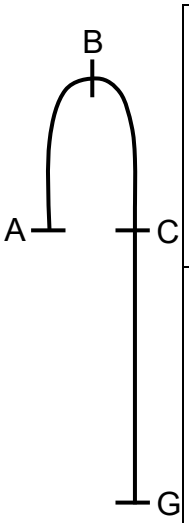
A-C:

UPWARDS AS POSITIVE/
OPWAARTS AS POSITIEF

$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓
$0 = (12)\Delta t + \frac{1}{2}(-9,8)\Delta t^2$ ✓
$\Delta t = 2,45$ s
$\Delta t_{up} = 1,23$ s ✓

DOWNWARDS AS POSITIVE/
AFWAARTS AS POSITIEF

$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓
$0 = (-12)\Delta t + \frac{1}{2}(9,8)\Delta t^2$ ✓
$\Delta t = 2,45$ s
$\Delta t_{up} = 1,23$ s ✓



OPTION 5/*OPSIE 5*
A-B OR/*OF* B-C:

$(E_{mech})_{Top/Bo} = (E_{mech})_{25\ m}$
$(E_P + E_K)_{Top/Bo} = (E_P + E_K)_{25\ m}$
$(mgh + ½mv^2)_{Top/Bo} = (mgh + ½mv^2)_{25\ m}$
$(9,8)h + 0 = 0 + (½)(12)^2$
$\Delta h = 7,35$ m

OPTION 6/*OPSIE 6*
A-B OR/*OF* B-C

$W_{nc} = \Delta K + \Delta U$
$W_{nc} = \Delta K + mg(h_f - h_i)$
$0 = ½mv_f^2 - ½mv_i^2 + mgh_f - mgh_i$
$0 = ½(0^2 - 12^2) + (9,8)\Delta h$
$\Delta h = 7,35$ m

OPTION 7/*OPSIE 7*
A-B OR/*OF* B-C

$W_{net} = \Delta E_k$
$w\Delta y\cos\theta = ½mv_f^2 - ½mv_i^2$
$(9,8)\Delta y\cos 180° = 0 - ½(12)^2$
$\Delta y = 7,35$ m

OPTION 8/*OPSIE 8*
A-B:

UPWARDS AS POSITIVE/
OPWAARTS AS POSITIEF

$v_f^2 = v_i^2 + 2a\Delta y$
$0^2 = 12^2 + 2(-9,8)\Delta y$
$\Delta y = 7,35$ m

DOWNWARDS AS POSITIVE/
AFWAARTS AS POSITIEF

$v_f^2 = v_i^2 + 2a\Delta y$
$0^2 = (-12)^2 + 2(9,8)\Delta y$
$\Delta y = -7,35$ m

OPTION 9/*OPSIE 9*
B-C:

UPWARDS AS POSITIVE/
OPWAARTS AS POSITIEF

$v_f^2 = v_i^2 + 2a\Delta y$
$(-12)^2 = 0^2 + 2(-9,8)\Delta y$
$\Delta y = -7,35$ m

DOWNWARDS AS POSITIVE/
AFWAARTS AS POSITIEF

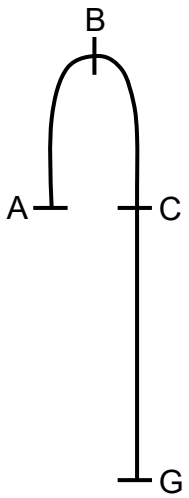
$v_f^2 = v_i^2 + 2a\Delta y$
$(12)^2 = 0^2 + 2(9,8)\Delta y$
$\Delta y = 7,35$ m

UPWARDS AS POSITIVE/
OPWAARTS AS POSITIEF

$\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$ ✓
$7,35 = \left(\frac{12 + 0}{2}\right)\Delta t$ ✓
$\Delta t = 1,23$ s ✓

DOWNWARDS AS POSITIVE/
AFWAARTS AS POSITIEF

$\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$ ✓
$-7,35 = \left(\frac{-12 + 0}{2}\right)\Delta t$ ✓
$\Delta t = 1,23$ s ✓



OPTION 10/*OPSIE 10*

A-B:

UPWARDS AS POSITIVE/
OPWAARTS AS POSITIEF:

$\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$ ✓

$\Delta y = \left(\frac{12 + 0}{2}\right)\Delta t$

$\Delta y = 6\Delta t$

$v_f^2 = v_i^2 + 2a\Delta y$

$0 = \underline{(12)^2 + 2(-9,8)(6\Delta t)}$ ✓

$\Delta t = 1,22$ s ✓

DOWNWARDS AS POSITIVE/
AFWAARTS AS POSITIEF:

$\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$ ✓

$\Delta y = \left(\frac{-12 + 0}{2}\right)\Delta t$

$\Delta y = -6\Delta t$

$v_f^2 = v_i^2 + 2a\Delta y$

$0 = \underline{(-12)^2 + 2(9,8)(-6\Delta t)}$ ✓

$\Delta t = 1,22$ s ✓

OPTION 11/*OPSIE 11*

B-C:

UPWARDS AS POSITIVE/
OPWAARTS AS POSITIEF:

$\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$ ✓

$\Delta y = \left(\frac{0 - 12}{2}\right)\Delta t$

$\Delta y = -6\Delta t$

$v_f^2 = v_i^2 + 2a\Delta y$

$-12 = \underline{(0)^2 + 2(-9,8)(-6\Delta t)}$ ✓

$\Delta t = 1,22$ s ✓

DOWNWARDS AS POSITIVE/
AFWAARTS AS POSITIEF:

$\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$ ✓

$\Delta y = \left(\frac{12 + 0}{2}\right)\Delta t$

$\Delta y = 6\Delta t$

$v_f^2 = v_i^2 + 2a\Delta y$

$\underline{12^2} = 0^2 + \underline{2(9,8)(6\Delta t)}$ ✓

$\Delta t = 1,22$ s ✓

OPTION 12/*OPSIE 12*

A-B:

UPWARDS AS POSITIVE/
OPWAARTS AS POSITIEF:

$F_{net}\Delta t = m\Delta v$
$F_{net}\Delta t = m(v_f - v_i)$
} ✓Any one/ *Enige een*

$\underline{-(9,8)\Delta t} = \underline{0 - 12}$ ✓

$\Delta t = 1,22$ s ✓

DOWNWARDS AS POSITIVE/
AFWAARTS AS POSITIEF:

$F_{net}\Delta t = m\Delta v$
$F_{net}\Delta t = m(v_f - v_i)$
} ✓Any one/ *Enige een*

$\underline{(9,8)\Delta t} = \underline{12 - 0}$ ✓

$\Delta t = 1,22$ s ✓

(3)

3.2.2

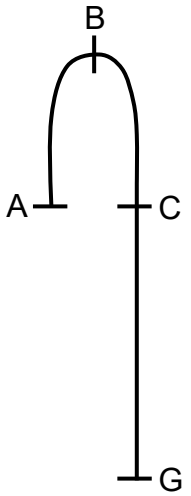
Marking criteria/*Nasienkriteria*

- Formula with v_f./*Formule met v_f.* ✓
- Correct substitution into formula./*Korrekte vervanging in formule.* ✓
- Correct final answer/*Korrekte finale antwoord*:
  25,18 m·s^{-1} ✓ (25,03 m·s^{-1} to/*tot* 25,59 m·s^{-1})
- Correct direction (only if numerical value is given)./*Korrekte rigting (slegs indien numeriese waarde gegee is).*✓

OPTION 1/*OPSIE 1*

A-G: **UPWARDS AS POSITIVE/ *OPWAARTS AS POSITIEF*:**	**A-G:** **DOWNWARDS AS POSITIVE/ *AFWAARTS AS POSITIEF*:**
$v_f^2 = v_i^2 + 2a\Delta y$ ✓	$v_f^2 = v_i^2 + 2a\Delta y$ ✓
$v_f^2 = \underline{(12)^2 + 2(-9,8)(-25)}$ ✓	$v_f^2 = \underline{(-12)^2 + 2(9,8)(25)}$ ✓
v_f = 25,18 m·s^{-1}✓ downwards ✓ *afwaarts*	v_f = 25,18 m·s^{-1}✓ downwards ✓ *afwaarts*

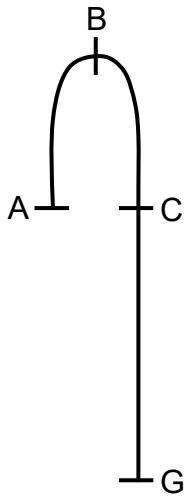
OPTION 2/*OPSIE 2*



C-G: **UPWARDS AS POSITIVE/ OPWAARTS AS POSITIEF**	**C-G:** **DOWNWARDS AS POSITIVE/ AFWAARTS AS POSITIEF**
$v_f^2 = v_i^2 + 2a\Delta y$ ✓	$v_f^2 = v_i^2 + 2a\Delta y$ ✓
$v_f^2 = \underline{(-12)^2 + 2(-9,8)(-25)}$ ✓	$v_f^2 = \underline{(12)^2 + 2(9,8)(25)}$ ✓
v_f = 25,18 m·s^{-1}✓ downwards ✓ *afwaarts*	v_f = 25,18 m·s^{-1}✓ downwards ✓ *afwaarts*

OPTION 3/*OPSIE 3*

B-G **UPWARDS AS POSITIVE/ OPWAARTS AS POSITIEF**	**B-G** **DOWNWARDS AS POSITIVE/ AFWAARTS AS POSITIEF**
$v_f^2 = v_i^2 + 2a\Delta y$ ✓	$v_f^2 = v_i^2 + 2a\Delta y$ ✓
$v_f^2 = (0)^2 + \underline{2(-9,8)(-32,35)}$ ✓	$v_f^2 = (0)^2 + \underline{2(9,8)(32,35)}$ ✓
v_f = 25,18 m·s^{-1}✓ downwards ✓ *afwaarts*	v_f = 25,18 m·s^{-1}✓ downwards ✓ *afwaarts*



OPTION 4/*OPSIE 4*

A-G:

UPWARDS AS POSITIVE/*OPWAARTS AS POSITIEF:*

$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$

$-25 = 12\Delta t + \frac{1}{2}(-9,8)\Delta t^2$

$\Delta t = 3,79$ s

A-G

$\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$ ✓

$-25 = \left(\frac{12 + v_f}{2}\right)3,79$

$v_f = -25,18\ m\cdot s^{-1}$

$\therefore v_f = 25,18\ m\cdot s^{-1}$ ✓ downwards ✓
afwaarts

B-G

$v_f = v_i + a\Delta t$ ✓

$v_f = 0 + \underline{(-9,8)(3,79 - 1,22)}$ ✓

$v_f = -25,19\ m\cdot s^{-1}$

$v_f = 25,19\ m\cdot s^{-1}$ ✓ downwards ✓
afwaarts

C-G

$v_f = v_i + a\Delta t$ ✓

$v_f = \underline{-12 + (-9,8)(1,35)}$ ✓

$v_f = -25,19\ m\cdot s^{-1}$

$v_f = 25,19\ m\cdot s^{-1}$ ✓ downwards ✓
afwaarts

A-G:
DOWNWARDS AS POSITIVE/*AFWAARTS AS POSITIEF:*

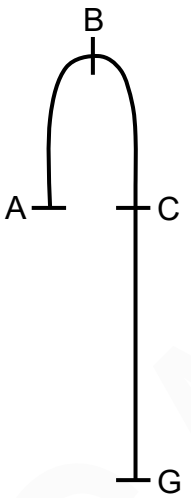
$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$
$25 = -12\Delta t + \frac{1}{2}(9,8)\Delta t^2$
$\Delta t = 3,79$ s

A-G
$\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$ ✓
$25 = \left(\frac{-12 + v_f}{2}\right)3,79$ ✓
$\therefore v_f = 25,18\ m\cdot s^{-1}$✓ downwards ✓
afwaarts

B-G
$v_f = v_i + a\Delta t$ ✓
$= 0 + (9,8)(3,79 - 1,22)$ ✓
$v_f = 25,19\ m\cdot s^{-1}$✓ downwards ✓
afwaarts

C-G
$v_f = v_i + a\Delta t$ ✓
$v_f = 12 + (9,8)(3,79 - 2(1,22))$ ✓
$v_f = 25,19\ m\cdot s^{-1}$✓ downwards ✓
afwaarts

OPTION 5/*OPSIE 5*



C-G:
UPWARDS AS POSITIVE/
OPWAARTS AS POSITIEF:

$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$
$-25 = -12\Delta t + \frac{1}{2}(-9,8)\Delta t^2$
$\Delta t = 1,34$ s

$\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$ ✓
$-25 = \left(\frac{-12 + v_f}{2}\right)1,34$ ✓
$v_f = -25,18\ m\cdot s^{-1}$
$\therefore v_f = 25,18\ m\cdot s^{-1}$✓ downwards ✓
afwaarts

C-G:
DOWNWARDS AS POSITIVE/
AFWAARTS AS POSITIEF:

$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$
$25 = 12\Delta t + \frac{1}{2}(9,8)\Delta t^2$
$\Delta t = 1,34$ s

$\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$ ✓
$25 = \left(\frac{12 + v_f}{2}\right)1,34$ ✓
$v_f = 25,18\ m\cdot s^{-1}$✓ downwards ✓
afwaarts

OPTION 6/*OPSIE 6*

$(E_{mech/meg})_i = (E_{mech/meg})_f$
$(E_P + E_K)_i = (E_P + E_K)_f$
$(mgh + \frac{1}{2}mv^2)_i = (mgh + \frac{1}{2}mv^2)_f$
✓Any one/
Enige een

$m(9,8)(25) + \frac{1}{2}m(12^2) = 0 + \frac{1}{2}mv_f^2$ ✓
$v_f = 25,18\ m\cdot s^{-1}$✓ downwards/*afwaarts* ✓

OPTION 7/*OPSIE 7*

$W_{nc} = \Delta E + \Delta E_p$
$= (E_{kf} - E_{ki}) + (E_{pf} - E_{pi})$
$= (\frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2) + (mgh_f - mgh_i)$ ✓Any one/*Enige een*

$0 = [\frac{1}{2}mv_f^2 - \frac{1}{2}m(12)^2] + [0 - m(9,8)(25)]$ ✓
$v_f = 25,18 \text{ m·s}^{-1}$✓ downwards/*afwaarts* ✓

OPTION 8/*OPSIE 8*

$W_{net} = \Delta E$
$= (E_{kf} - E_{ki})$
$= (\frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2)$ ✓Any one/*Enige een*

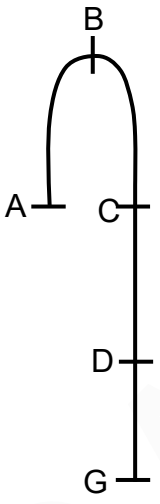
$m(9,8)(25) = \frac{1}{2}mv_f^2 - \frac{1}{2}m(12)^2$ ✓
$v_f = 25,18 \text{ m·s}^{-1}$✓ downwards/*afwaarts* ✓ (4)

3.2.3 **POSITIVE MARKING FROM QUESTION 3.2.2.**
POSITIEWE NASIEN VANAF VRAAG 3.2.2.

Marking criteria/*Nasienkriteria*
- Substitution into formula to calculate v at the top of the door ✓
  Vervanging in formule om v bokant die deur te bereken.
- Formula to calculate Δt from top to bottom of door.✓
  Formule om Δt te bere en van bo ant tot onder ant van deur.
- Substitution to calculate Δt. ✓
  Vervanging om Δt *te bereken.*
- Final answer/*Finale antwoord*: 0,07 to/*tot* 0,08 s ✓

OPTION 1/*OPSIE 1*

UPWARDS AS POSITIVE/*OPWAARTS AS POSITIEF:*



A-D:
$v_f^2 = v_i^2 + 2a\Delta y$
$v_f^2 = (12)^2 + 2(-9,8)(-23,1)$ ✓
$v_f = 24,43 \text{ m·s}^{-1}$

C-D:
$v_f^2 = v_i^2 + 2a\Delta y$
$v_f^2 = (-12)^2 + (2)(-9,8)(-23,1)$ ✓
$v_f = 24,43 \text{ m·s}^{-1}$

D-G:
$v_f^2 = v_i^2 + 2a\Delta y$
$(-25,18)^2 = (v_i)^2 + 2(-9,8)(-1,9)$ ✓
$v_i = 24,43 \text{ m·s}^{-1}$

B-D
$v_f^2 = v_i^2 + 2a\Delta y$
$v_f^2 = 0 + 2(-9,8)(-30,447)$ ✓
$= 24,43 \text{ m·s}^{-1}$

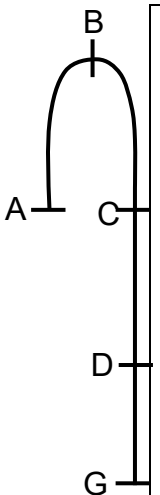
D-G:
$E_{(\text{mech top/}meg\ bo)} = E_{(\text{mech bot/}meg\ ond)}$
$(E_p + E_k)_{\text{top/}bo} = (E_p + E_k)_{\text{bot/}ond}$
$(mgh + \frac{1}{2}mv^2)_{\text{top/}bo} = (mgh + \frac{1}{2}mv^2)_{\text{bot/}ond}$
$m(9,8)(1,9) + \frac{1}{2}m(v_i)^2 = 0 + \frac{1}{2}m(25,18)^2$ ✓
$v_i = 24,43 \text{ m·s}^{-1}$

D-G:
$v_f = v_i + a\Delta t$ ✓
$-25,18 = -24,43 + (-9,8)\Delta t$ ✓
$\Delta t = 0,08 \text{ s}$ ✓

D-G:
$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓
$-1,9 = -24,43\Delta t + \frac{1}{2}(-9,8)\Delta t^2$ ✓
$\Delta t = 0,08 \text{ s}$ ✓

D-G:
$\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$ ✓
$-1,9 = \left(\frac{-24,43 - 25,18}{2}\right)\Delta t$ ✓
$\Delta t = 0,08 \text{ s}$ ✓

DOWNWARDS AS POSITIVE/*AFWAARTS AS POSITIEF:*



A-D:

$v_f^2 = v_i^2 + 2a\Delta y$

$v_f^2 = (-12)^2 + 2(9,8)(23,1)$ ✓

$v_i = 24,43\ m\cdot s^{-1}$

C-D:

$v_f^2 = v_i^2 + 2a\Delta y$

$v_f^2 = (12)^2 + (2)(9,8)(23,1)$ ✓

$v_f = 24,43\ m\cdot s^{-1}$

D-G:

$v_f^2 = v_i^2 + 2a\Delta y$

$(25,18)^2 = (v_i)^2 + 2(9,8)(1,9)$ ✓

$v_i = 24,43\ m\cdot s^{-1}$

B-D

$v_f^2 = v_i^2 + 2a\Delta y$

$v_f^2 = 0 + 2(9,8)(30,447)$ ✓

$= 24,43\ m\cdot s^{-1}$

D-G:

$E_{(\text{mech top/}meg\ bo)} = E_{(\text{mech bot/}meg\ ond)}$

$(E_p + E_k)_{top/bo} = (E_p + E_k)_{bot/ond}$

$(mgh + \frac{1}{2}mv^2)_{top/bo} = (mgh + \frac{1}{2}mv^2)_{bot/ond}$

$m(9,8)(1,9) + \frac{1}{2}m(v_i)^2 = 0 + \frac{1}{2}m(25,18)^2$ ✓

$v_i = 24,43\ m\cdot s^{-1}$

D-G:

$v_f = v_i + a\Delta t$ ✓

$25,18 = 24,43 + (9,8)\Delta t$ ✓

$\Delta t = 0,08\ s$ ✓

D-G:

$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓

$1,9 = 24,43\Delta t + \frac{1}{2}(9,8)\Delta t^2$ ✓

$\Delta t = 0,08\ s$ ✓

D-G:

$\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$ ✓

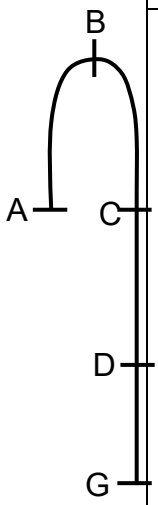
$1,9 = \left(\frac{24,43 + 25,18}{2}\right)\Delta t$ ✓

$\Delta t = 0,08\ s$ ✓

Marking criteria OPTION 2 and 3/*Nasienkriteria OPSIE 2 en 3*

- Either one of the formula to calculate Δt./*Enige een van die formules om Δt te bereken.* ✓
- Substitute into formula to calculate time from A to G or C to G/*Vervanging in formule om tyd te bereken tussen A tot G of C tot G* ✓
- Substitute into formula to calculate time from A to D or C to D/ *Vervanging in formule om tyd te bereken tussen A tot D of C tot D* ✓
- Final answer/*Finale antwoord*: 0,07 s ✓ (0,07s to/*tot* 0,08s)

OPTION 2/*OPSIE 2*



UPWARDS AS POSITIVE/ *OPWAARTS AS POSITIEF:*

A-G:

$v_f = v_i + a\Delta t$

$-25,18 = 12 + (-9,8)\ \Delta t$ ✓

$\Delta t = 3,79$ s

✓Any one/ *Enige een*

A-D:

$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$

$-23,1 = (12)\Delta t + ½(-9,8)\Delta t^2$ ✓

$\Delta t = 3,72$ s

Time from top to bottom of door/*Tyd van bokant tot onderkant van deur:*

D-G:

3,79 – 3,72 = 0,07 s ✓

DOWNWARDS AS POSITIVE/ *AFWAARTS AS POSITIEF:*

A-G:

$v_f = v_i + a\Delta t$

$25,18 = -12 + (9,8)\ \Delta t$ ✓

$\Delta t = 3,79$ s

✓Any one/ *Enige een*

A-D:

$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$

$23,1 = (-12)\Delta t + ½(9,8)\Delta t^2$ ✓

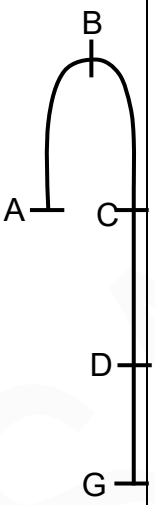
$\Delta t = 3,72$ s

Time from top to bottom/*Tyd van bokant tot onderkant van deur:*

D-G:

3,79 – 3,72 = 0,07 s ✓

OPTION 3/*OPSIE 3*



UPWARDS AS POSITIVE/ *OPWAARTS AS POSITIEF:*

C-G:

$v_f = v_i + a\Delta t$

$-25,18 = -12 + (-9,8)\ \Delta t$ ✓

$\Delta t = 1,34$ s

✓Any one/ *Enige een*

C-D:

$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓

$-23,1 = (-12)\Delta t + ½(-9,8)\Delta t^2$ ✓

$\Delta t = 1,27$ s

Time from top to bottom of door/*Tyd van bokant tot onderkant van deur:*

D-G:

1,34 – 1,27 = 0,07 s ✓

DOWNWARDS AS POSITIVE/ *AFWAARTS AS POSITIEF:*

C-G:

$v_f = v_i + a\Delta t$

$25,18 = 12 + (9,8)\ \Delta t$ ✓

$\Delta t = 1,34$ s

✓Any one/ *Enige een*

C-D:

$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓

$23,1 = (12)\Delta t + ½(9,8)\Delta t^2$ ✓

$\Delta t = 1,27$ s

Time from top to bottom of door/*Tyd van bokant tot onderkant van deur:*

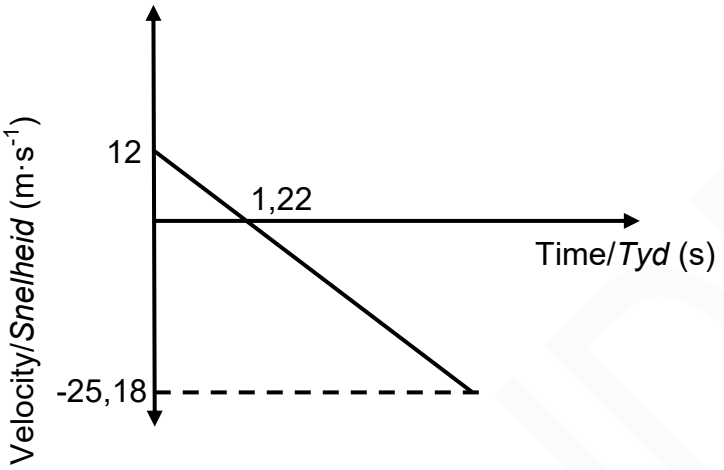
D-G:

1,34 – 1,27 = 0,07 s ✓

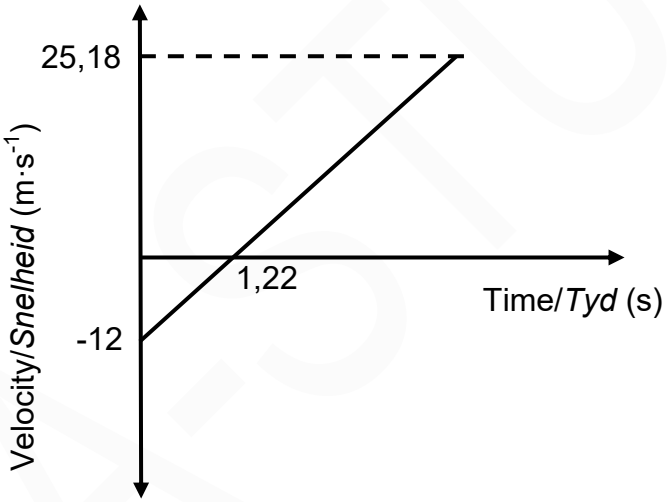
OPTION 4/*OPSIE 4*	
UPWARDS AS POSITIVE/ *OPWAARTS AS POSITIEF:*	**DOWNWARDS AS POSITIVE/ *AFWAARTS AS POSITIEF:***
G-D:	**G-D:**
$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓	$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓
$1,9$ ✓$= \underline{25,18\Delta t + \frac{1}{2}(-9,8)\Delta t^2}$ ✓	$-1,9$ ✓$= \underline{-25,18\Delta t + \frac{1}{2}(9,8)\Delta t^2}$ ✓
$\Delta t = 0,08$ s ✓ (0,077 s)	$\Delta t = 0,08$ s ✓ (0,077 s)

(4)

3.3 **POSITIVE MARKING FROM QUESTION 3.2.1 AND QUESTION 3.2.2.**
POSITIEWE NASIEN VANAF VRAAG 3.2.1 EN VRAAG 3.2.2.
UPWARDS AS POSITIVE/*OPWAARTS AS POSITIEF*:



DOWNWARDS AS POSITIVE/*AFWAARTS AS POSITIEF:*



Criteria for graph/*Kriteria vir grafiek*	
Straight line starting at v = 12 m·s^{-1} with negtive final velocity or straight line starting at v = -12 m·s^{-1} with positive final velocity. /*Reguitlyn wat begin by v = 12 m·s^{-1}met negatiewe finale snelheid of reguitlyn wat begin by v = -12 m·s^{-1}*met positiewe finale snelheid.	✓
Straight line cuts time axis at time calculated in Question 3.2.1/ *Reguitlyn sny tydas by die tyd bereken in Vraag 3.2.1.*	✓
Correct final velocity as calculated in Question 3.2.2 is indicated./*Korrekte finale snelheid soos uitgewerk in Vraag 3.2.2 is aangedui.*	✓

(3)
[16]

QUESTION 3/*VRAAG 3*

3.1

Marking criteria/*Nasienkriteria*
If any of the underlined key words/phrases in the correct context are omitted: - 1 mark per word/phrase. *Indien enige van die sleutelwoorde/frases in die korrekte konteks weggelaat word: - 1 punt per word/frase.*

An object which has been given an initial velocity and then it moves under the influence of the gravitational force only/ is in free fall. ✓✓
'n Voorwerp waaraan 'n beginsnelheid gegee is en wat dan slegs onder die invloed van die gravitasiekrag beweeg/in vryval is.

(2)

3.2.1

OPTION 1/ *OPSIE 1*	**OPTION 2/ *OPSIE 2***
UPWARDS AS POSITIVE/ ***OPWAARTS AS POSITIEF***	**Motion from top/*Beweging van bo*** **UPWARDS AS POSITIVE/** ***OPWAARTS AS POSITIEF***
$v_f = v_i + a\Delta t$ ✓	$v_f = v_i + a\Delta t$ ✓
$0 = 15 + (-9,8)\Delta t$ ✓	$-15 = 0 + (-9,8)\Delta t$ ✓
$\Delta t = 1,53$ s ✓	$\Delta t = 1,53$ s ✓
DOWNWARDS AS POSITIVE/ ***AFWAARTS AS POSITIEF***	**DOWNWARDS AS POSITIVE/** ***AFWAARTS AS POSITIEF***
$v_f = v_i + a\Delta t$ ✓	$v_f = v_i + a\Delta t$ ✓
$0 = -15 + (9,8)\Delta t$ ✓	$15 = 0 + (9,8)\Delta t$ ✓
$\Delta t = 1,53$ s ✓	$\Delta t = 1,53$ s ✓
OPTION 3/ *OPSIE 3*	**OPTION 4/ *OPSIE 4***
UPWARDS AS POSITIVE/ ***OPWAARTS AS POSITIEF***	**UPWARDS AS POSITIVE/** ***OPWAARTS AS POSITIEF***
$v_f = v_i + a\Delta t$ ✓	$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓
$-15 = 15 + (-9,8)\Delta t$ ✓	$0 = (15)\Delta t + \frac{1}{2}(-9,8)\Delta t^2$ ✓
$\Delta t = 3,06$ s	$\Delta t = 3,06$ s
Δt up $= 1,53$ s ✓	Δt up $= 1,53$ s ✓
DOWNWARDS AS POSITIVE/ ***AFWAARTS AS POSITIEF***	**DOWNWARDS AS POSITIVE/** ***AFWAARTS AS POSITIEF***
$v_f = v_i + a\Delta t$ ✓	$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓
$15 = -15 + (9,8)\Delta t$ ✓	$0 = (-15)\Delta t + \frac{1}{2}(9,8)\Delta t^2$ ✓
$\Delta t = 3,06$ s	$\Delta t = 3,06$ s
Δt up $= 1,53$ s ✓	$\Delta t_{up} = 1,53$ s ✓

(3)

Marking criteria OPTIONS 5 to 7/*Nasienkriteria OPSIES 5 tot 7*

- Any formula relating Δy and Δt/ **OR/*OF*** $F_{net}\Delta t = m\Delta v$✓
- Substitution to calculate Δt/*Vervanging om Δt te bereken* ✓
- Final answer/*finale antwoord*: 1,53 s ✓

OPTION 5/*OPSIE 5*

$(E_{mech})_{Top/Bo} = (E_{mech})_{30\ m}$

$(E_P + E_K)_{Top/Bo} = (E_P + E_K)_{30\ m}$

$(mgh + \frac{1}{2}mv^2)_{Top/Bo} = (mgh + \frac{1}{2}mv^2)_{30\ m}$

$(9,8)h + 0 = 0 + (\frac{1}{2})(15)^2$

$\Delta h = 11,48$ m

OPTION 6/*OPSIE 6*

$W_{nc} = \Delta K + \Delta U$

$W_{nc} = \Delta K + mg(h_f - h_i)$

$0 = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 + mgh_f - mgh_i$

$0 = \frac{1}{2}(0 - 15^2) + (9,8)\Delta h$

$\Delta h = 11,48$ m

OPTION 7/*OPSIE 7*

$W_{net} = \Delta E_k$

$w\Delta y\cos\theta = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$

$(9,8)\Delta y\cos 180^o = 0 - \frac{1}{2}(15)^2$

$\Delta y = 11,48$ m

OPTION A/*OPSIE A*

UPWARDS AS POSITIVE/
OPWAARTS AS POSITIEF

$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$✓

$11,48 = (15)\Delta t + \frac{1}{2}(-9,8)\Delta t^2$ ✓

$\Delta t = 1,53$ s ✓

DOWNWARDS AS POSITIVE/
AFWAARTS AS POSITIEF

$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓

$11,48 = (-15)\Delta t + \frac{1}{2}(9,8)\Delta t^2$ ✓

$\Delta t = 1,53$ s ✓

OPTION B/*OPSIE B*

$\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$ ✓

$11,48 = \left(\frac{15 + 0}{2}\right)\Delta t$ ✓

$\Delta t = 1,53$ s ✓

OPTION 8/*OPSIE 8*

UPWARDS AS POSITIVE/
OPWAARTS AS POSITIEF

$\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$ ✓

$\Delta y = \left(\frac{15 + 0}{2}\right)\Delta t$

$\Delta y = 7,5\ \Delta t$

$v_f^2 = v_i^2 + 2a\Delta y$

$0 = (15)^2 + 2(-9,8)(7,5\Delta t)$ ✓

$\Delta t = 1,53$ s ✓

DOWNWARDS AS POSITIVE/
AFWAARTS AS POSITIEF

$\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$

$\Delta y = \left(\frac{-15 + 0}{2}\right)\Delta t$

$\Delta y = -7,5\Delta t$

$v_f^2 = v_i^2 + 2a\Delta y$ ✓

$0 = (-15)^2 + 2(9,8)(-7,5\Delta t)$ ✓

$\Delta t = 1,53$ s ✓

OPTION 9/*OPSIE 9*

UPWARDS AS POSITIEF/
OPWAARTS AS POSITIEF

$F_{net}\Delta t = m\Delta v$
$F_{net}\Delta t = m(v_f - v_i)$
} ✓Any one/ *Enige een*

$-(9,8)\Delta t = 0 - 15$ ✓

$\Delta t = 1,53$ s ✓

DOWNWARDS AS POSITIEF/
AFWAARTS AS POSITIEF

$F_{net}\Delta t = m\Delta v$
$F_{net}\Delta t = m(v_f - v_i)$
} ✓Any one/ *Enige een*

$(9,8)\Delta t = 15 - 0$ ✓

$\Delta t = 1,53$ s ✓

(3)

3.2.2

POSITIVE MARKING FROM QUESTION 3.2.1/
POSITIEWE NASIEN VANAF VRAAG 3.2.1

Marking criteria/*Nasienkriteria*

- Formula to calculate Δy/*Formule om Δy te bereken* ✓
- Substitution to calculate Δy/*Vervanging om Δy te bereken* ✓
- Substitution of/*Vervanging van* 30 m ✓
- Final answer/*Finale antwoord*: 41,48 m ✓

NOTE/*AANTEKENING*

v_f and v_i can be swopped
v_f en v_i kan omgeruil word

OPTION 1/*OPSIE 1*

UPWARDS AS POSITIVE/
OPWAARTS AS POSITIEF

$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓
$= \underline{(15)(1,53) + \frac{1}{2}(-9,8)(1,53)^2}$ ✓
$= 11,48$ m

Height/*hoogte* = 11,48 + 30 ✓
= 41,48 m ✓

DOWNWARDS AS POSITIVE/
AFWAARTS AS POSITIEF

$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓
$= \underline{(-15)(1,53) + \frac{1}{2}(9,8)(1,53)^2}$ ✓
$= -11,48$ m

Height/*Hoogte* = 11,48 + 30 ✓
= 41,48 m ✓

OPTION 2/*OPSIE 2*

UPWARDS AS POSITIVE/
OPWAARTS AS POSITIEF

$v_f^2 = v_i^2 + 2a\Delta y$ ✓
$\underline{0 = (15)^2 + (2)(-9,8)\Delta y}$ ✓
$\Delta y = 11,48$ m

Height/*hoogte* = 11,48 + 30 ✓
= 41,48 m ✓

DOWNWARDS AS POSITIVE/
AFWAARTS AS POSITIEF

$v_f^2 = v_i^2 + 2a\Delta y$ ✓
$\underline{0 = (-15)^2 + (2)(9,8)\Delta y}$ ✓
$\Delta y = -11,48$ m

Height/*Hoogte* = 11,48 + 30 ✓
= 41,48 m ✓

OPTION 3/*OPSIE 3*

UPWARDS AS POSITIEF/
OPWAARTS AS POSITIEF

$\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$ ✓

$\Delta y = \left(\frac{15+0}{2}\right)(1,53)$ ✓
$= 11,48$ m

Height/*Hoogte* = 11,48 + 30 ✓
= 41,48 m ✓

DOWNWARDS AS POSITIVE/
AFWAARTS AS POSITIEF

$\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$ ✓

$\Delta y = \left(\frac{-15+0}{2}\right)(1,53)$ ✓
$= -11,48$ m

Height/*Hoogte* = 11,48 + 30 ✓
= 41,48 m ✓

OPTION 4/*OPSIE 4*

UPWARDS AS POSITIVE/
OPWAARTS AS POSITIEF

$v_f^2 = v_i^2 + 2a\Delta y$ ✓
$v_f^2 = \underline{(-15)^2 + (2)(-9,8)(-30)}$ ✓
$v_f = -28,51\ m\cdot s^{-1}$

$v_f^2 = v_i^2 + 2a\Delta y$
$\underline{(-28,51)^2 = (0)^2 + (2)(-9,8)\Delta y}$ ✓
$\Delta y = 41,48$ m
Height/*Hoogte* = 41,48 m ✓

DOWNWARDS AS POSITIVE/
AFWAARTS AS POSITIEF

$v_f^2 = v_i^2 + 2a\Delta y$ ✓
$v_f^2 = \underline{(15)^2 + (2)(9,8)(30)}$ ✓
$v_f = 28,51\ m\cdot s^{-1}$

$v_f^2 = v_i^2 + 2a\Delta y$
$\underline{(28,51)^2 = (0)^2 + (2)(9,8)\Delta y}$ ✓
$\Delta y = 41,48$ m

Height/*Hoogte* = 41,48 m ✓

OPTION 5/ *OPSIE 5*

$(E_{mech})_{Top/Bo} = (E_{mech})_{30\ m}$
$(E_P + E_K)_{Top/Bo} = (E_P + E_K)_{30\ m}$
$(mgh + ½\ mv^2)_{Top/Bo} = (mgh + ½\ mv^2)_{30\ m}$ ✓Any one/*Enige een*
$(9,8)h + 0 = (9,8)(30✓) + (½)(15)^2$ ✓
h = 41,48 m ✓

OPTION 6/*OPSIE 6*

$W_{net} = \Delta E_k$
$w\Delta x\cos 180° = ½m(v_f^2 - v_i^2)$ ✓Any one/*Enige een*
$(9,8)(\Delta x)\cos 180° = ½(0 - 15^2)$ ✓
Δx = 11,47 m
Height above the ground/*hoogte bokant grond*= 30 +✓ 11,47 = 41,48 m ✓

OPTION 7/*OPSIE 7*

$W_{nc} = \Delta E_p + \Delta E_k$
$0 = mg(h_f - h_i) + ½m(v_f^2 - v_i^2)$ ✓Any one/*Enige een*
$0 = (9,8)(h_f - 0) + ½(0 - 15^2)$ ✓
h = 11,47 m
Height above the ground/*hoogte bokant grond*= 30 +✓ 11,47 = 41,48 m ✓ (4)

3.3 **POSITIVE MARKING FROM QUESTION 3.2.2/**
POSITIEWE NASIEN VANAF VRAAG 3.2.2

Marking criteria/*Nasienkriteria*

- Formula/*Formule* ✓
- Substitute to calculate Δy_B /*Vervang om Δy_B te bereken* ✓
- Substitute to calculate Δy_C/*Vervang om Δy_c te bereken* ✓
- Substitute/*Vervang* Δt + 0,5 or/*of* Δt – 0,5 ✓
- Equating y_B and y_C ✓
- Final answer/*Finale antwoord:* 1,71 s ✓

OPTION 1/*OPSIE 1*

UPWARDS AS POSITIVE/*OPWAARTS AS POSITIEF*

Take y_C as height of disc above ground at meeting point / *neem hoogte y_C as die hoogte van teiken bokant grond by ontmoetingspunt*:

$\Delta y_C = v_i\Delta t + ½a\Delta t^2$ ✓
$y_C - 30 = 15\Delta t + ½(-9,8)\Delta t^2$ ✓
$y_C = 15\Delta t - 4,9\Delta t^2 + 30$….. (1)

Take y_B as height of ball above ground at meeting point/*Neem hoogte y_B as die hoogte van bal bokant grond by ontmoetingspunt*:

$\Delta y_B = v_i\Delta t + ½a\Delta t^2$
$y_B - 0 = 40(\Delta t - 0,5✓) + ½(-9,8)(\Delta t - 0,5✓)^2$ ✓
$y_B = 44,9t - 21,225 - 4,9t^2$…..(2)

At meeting point/*By ontmoetingspunt*:

$y_C = y_B$
$15\Delta t - 4,9\Delta t^2 + 30 = 44,9t - 21,225 - 4,9t^2$ ✓
Δt = 1,71 s ✓

DOWNWARDS AS POSITIVE/
AFWAARTS AS POSITIEF

Take y_C as height of disc above ground at meeting point/*neem hoogte y_C as die hoogte van teiken bokant grond by ontmoetingspunt*:

$\Delta y_C = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓
$y_C - 30 = \underline{-15\Delta t + \frac{1}{2}(9,8)\Delta t^2}$ ✓
$y_C = -15\Delta t + 4,9\Delta t^2 + 30$….. (1)

Take y_B as height of ball above ground at meeting point/*neem hoogte y_B as die hoogte van bal bokant grond by ontmoetingspunt*:

$\Delta y_B = v_i\Delta t + \frac{1}{2}a\Delta t^2$
$y_B - 0 = \underline{-40}(\Delta t - 0,5$✓$) \underline{+ \frac{1}{2}(9,8)}(\Delta t - 0,5$✓$)^2$ ✓
$y_B = -44,9t + 21,225 + 4,9t^2$…..(2)

At meeting point/*By ontmoetingspunt*:

$y_C = y_B$ ∴ $\underline{-15\Delta t + 4,9\Delta t^2 + 30 = -44,9t + 21,225 + 4,9t^2}$ ✓
$\Delta t = 1,71$ s ✓

<u>OPTION 2</u>/*<u>OPSIE 2</u>*
UPWARDS AS POSITIVE/*OPWAARTS AS POSITIEF:*

$\Delta y_C = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓
$= \underline{15\Delta t + \frac{1}{2}(-9,8)\Delta t^2}$ ✓
$= 15\Delta t - 4,9\Delta t^2$….. (1)

$\Delta y_B = v_i\Delta t + \frac{1}{2}a\Delta t^2$
$= \underline{40}(\Delta t - 0,5$✓$) \underline{+ \frac{1}{2}(-9,8)}\ (\Delta t - 0,5$✓$)^2$ ✓

Δy_C in terms of/*in terme van* Δy_B:
$30 + \Delta y_C = 40(\Delta t - 0,5) + \frac{1}{2}(-9,8)(\Delta t - 0,5)^2$
$\Delta y_C = -4,9\Delta t^2 + 44,9\Delta t - 51,225$ …..(2)

Equate (1) and (2)/*Stel (1) en (2) gelyk:*
$\underline{15\Delta t = 44,9\Delta t - 51,225}$ ✓
$\Delta t = 1,71$ s ✓

DOWNWARDS AS POSITIVE/*AFWAARTS AS POSITIEF:*

$\Delta y_C = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓
$= \underline{-15\Delta t + \frac{1}{2}(9,8)\Delta t^2}$ ✓
$= 4,9\Delta t^2 - 15\Delta t$ …..(1)

$\Delta y_B = v_i\Delta t + \frac{1}{2}a\Delta t^2$
$= \underline{-40}(\Delta t - 0,5$✓$) \underline{+ \frac{1}{2}(9,8)}(\Delta t - 0,5$✓$)^2$ ✓

Δy_C in terms of/*in terme van* Δy_B:
$30 + \Delta y_C = (-40)(t - 0,5) + \frac{1}{2}(9,8)(\Delta t - 0,5)^2$
$\Delta y_C = 4,9\Delta t^2 - 44,9\Delta t + 51,225$…..(2)

Equate (1) and (2)/S*tel (1) en (2) gelyk*:
$\underline{-15\Delta t = -44,9\Delta t + 51,225}$ ✓
$\Delta t = 1,71$ s ✓

OPTION 3/*OPSIE 3*

UPWARDS AS POSITIVE/*OPWAARTS AS POSITIEF*

$\Delta y_C = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓

$= \underline{15}(\Delta t + 0,5\checkmark) \underline{+ \frac{1}{2}(-9,8)}(\Delta t + 0,5)^2$ ✓

$= -4,9t^2 + 10,1\Delta t + 6,275$…..(1)

$\Delta y_B = v_i\Delta t + \frac{1}{2}a\Delta t^2$

$= \underline{40\Delta t + \frac{1}{2}(-9,8)\Delta t^2}$ ✓

Δy_C in terms of/*in terme van* Δy_B:

$30 + \Delta y = 40\Delta t + \frac{1}{2}(-9,8)t^2$

$\Delta y = -4,9\Delta t^2 + 40t - 30$ …..(2)

Equate (1) and (2)/S*tel (1) en (2) gelyk*:

$\underline{10,1\Delta t + 6,275 = 40\Delta t - 30}$ ✓

$\Delta t = 1,21$ s

$\Delta t_{TOT} = 1,21 + 0,5$

$= 1,71$ s ✓

DOWNWARDS AS POSITIVE/*AFWAARTS AS POSITIEF*

$\Delta y_C = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓

$= \underline{-15}(\Delta t + 0,5\checkmark) \underline{+ \frac{1}{2}(9,8)}(\Delta t + 0,5)^2$ ✓

$= 4,9\Delta t^2 - 10,1\Delta t + 6,275$…..(1)

$\Delta y_B = v_i\Delta t + \frac{1}{2}a\Delta t^2$

$= \underline{-40\Delta t + \frac{1}{2}(9,8)\Delta t^2}$ ✓

Δy_C in terms of/*in terme van* Δy_B:

$30 + \Delta y = -40\Delta t + \frac{1}{2}(9,8)t^2$

$\Delta y = -4,9\Delta t^2 - 40\Delta t - 30$…..(2)

Equate (1) and (2)/S*tel (1) en (2) gelyk*:

$\underline{-10,1\Delta t + 6,275 = -40\Delta t - 30}$ ✓

$\Delta t = 1,21$ s

$\Delta t_{TOT} = 1,21 + 0,5$

$= 1,71$ s ✓

OPTION 4/*OPSIE 4*

Marking criteria:	***Nasienkriteria:***
• Formula: $\Delta y_C = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓	• *Formule:* $\Delta y_C = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓
• Substitute to calculate Δy_B ✓	• *Vervang om Δy_B te bereken* ✓
• Substitute to calculate Δy_C ✓	• *Vervang om Δy_c te bereken* ✓
• Substitute $\Delta t = 0,5$ ✓	• *Vervang* $\Delta t = 0,5$ ✓
• Adding Δy_B and Δy_C ✓	• *Som van Δy_B en Δy_C* ✓
• Final answer: 1,71 s ✓	• *Finale antwoord:* 1,71 s ✓

UPWARDS AS POSITIVE/*OPWAARTS AS POSITIEF*

Displacement of C after 0,5 s/*Verplasing van C na 0,5 s*

$\Delta y_C = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓

$= 15(0,5) + \frac{1}{2}(-9,8)(\underline{0,5}\checkmark)^2$

$\Delta y_C = 6,28$ m

Velocity of C after 0,5 s/ *Snelheid van C na 0,5 s*

$v_f = v_i + a\Delta t$

$= 15 + (-9,8)(0,5)$

$= 10,10\ m\cdot s^{-1}$

Displacement of C at meeting point/*Verplasing van C by ontmoetingspunt*

$\Delta y_C = v_i\Delta t + \frac{1}{2}a\Delta t^2$

$= \underline{10,1\Delta t + \frac{1}{2}(-9,8)\Delta t^2}$ ✓

$= 10,1\Delta t - 4,9\Delta t^2$

Displacement of B at meeting point/*Verplasing van B by ontmoetingspunt*

$\Delta y_B = v_i\Delta t + \frac{1}{2}a\Delta t^2$

$= \underline{40\Delta t + \frac{1}{2}(-9,8)\Delta t^2}$ ✓

$= 40t - 4,9t^2$

At meeting point/*By ontmoetingspunt*:

$\underline{\Delta y_C + \Delta y_B = -[10,1\Delta t - 4,9\Delta t^2] + 40\Delta t - 4,9\Delta t^2}$ ✓

$36,28 = -10,10\Delta t + 40\Delta t$

$\Delta t = 1,21$ s

$\Delta t_{tot} = 1,21 + 0,5 = 1,71$ s ✓

DOWNWARDS AS POSITIVE/*AFWAARTS AS POSITIEF*
Displacement of C after 0,5 s/*Verplasing van C na 0,5 s*
$\Delta y_C = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓
$= -15(0,5) + \frac{1}{2}(9,8)(\underline{0,5}\checkmark)^2$
$\Delta y_C = -6,28$ m

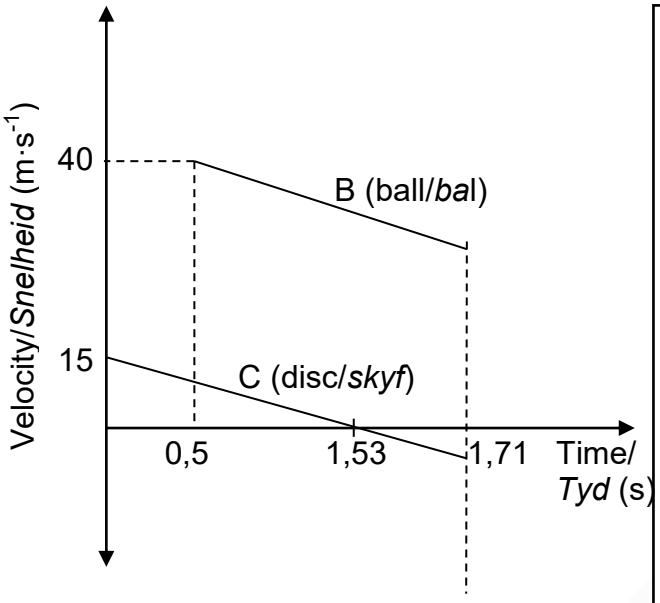
Velocity of C after 0,5 s/ *Snelheid van C na 0,5 s*
$v_f = v_i + a\Delta t$
$= -15 + (9,8)(0,5)$
$= -10,10\ m\cdot s^{-1}$

Displacement of C at meeting point/*Verplasing van C by ontmoetingspunt*
$\Delta y_C = v_i\Delta t + \frac{1}{2}a\Delta t^2$
$= \underline{-10,1\Delta t + \frac{1}{2}(9,8)\Delta t^2}$ ✓
$= -10,1\Delta t + 4,9\Delta t^2$

Displacement of B at meeting point/*Verplasing van B by ontmoetingspunt*
$\Delta y_B = v_i\Delta t + \frac{1}{2}a\Delta t^2$
$= \underline{-40\Delta t + \frac{1}{2}(9,8)\Delta t^2}$ ✓
$= -40t + 4,9t^2$
At meeting point/*By ontmoetingspunt*:
$\underline{\Delta y_C + \Delta y_B = -[-10,1\Delta t + 4,9\Delta t^2] - 40\Delta t + 4,9\Delta t^2}$✓
$-36,28 = 10,10\Delta t - 40\Delta t$
$\Delta t = 1,21$ s
$\Delta t_{tot} = 1,21 + 0,5 = 1,71$ s ✓

(6)

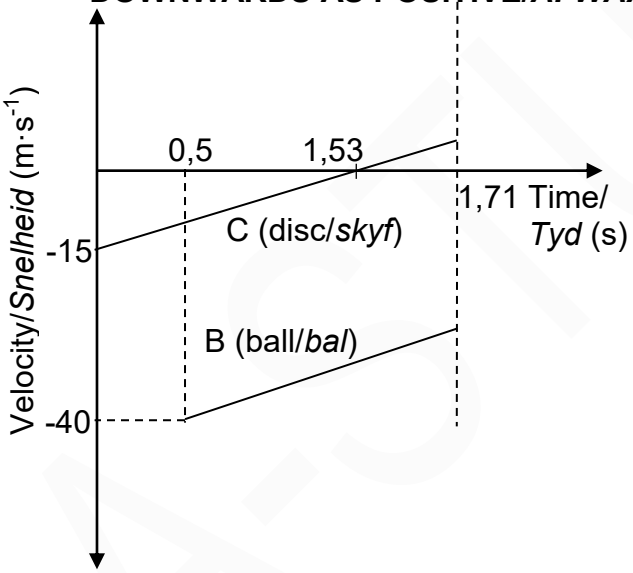
3.4 **POSITIVE MARKING FROM QUESTIONS 3.2.1 AND 3.3 /**
POSITIEWE NASIEN VANAF VRAE 3.2.1 EN 3.3.
UPWARDS AS POSITIVE/*OPWAARTS AS POSITIEF*



Marking criteria:
- Initial velocities 40 and 15 and straight lines ✓
- B starting at 0,5 s ✓
- Parallel lines with negative gradient ✓
- Time at which disc reaches maximum height (answer from 3.2.1) 1,53 s ✓
- Time at which B hits C (answer from 3.3) 1,71 s ✓

Nasienkriteria:
- *Aanvanklike snelhede* 40 *en* 15 en reguitlyne ✓
- *B begin by 0,5 s*✓
- *Parallelle lyne met negatiewe gradiënt* ✓
- *Tyd wanneer skyf maks hoogte bereik (antwoord van 3.2.1)* 1,53 s ✓
- *Tyd wanneer B vir C tref (antwoord van 3.3)* 1,71s ✓

DOWNWARDS AS POSITIVE/*AFWAARTS AS POSITIEF*



Marking criteria:
- Initial velocities -40 and -15 and straight lines ✓
- B starting at 0,5 s ✓
- Parallel lines with positive gradient ✓
- Time at which disc reaches maximum height (answer from 3.2.1) 1,53 s ✓
- Time at which B hits C (answer from 3.3) 1,71 s ✓

Nasienkriteria:
- *Aanvanklike snelhede* -40 *en* -15 en reguitlyne ✓
- *B begin by 0,5 s*✓
- *Parallelle lyne met positiewe gradiënt* ✓
- *Tyd wanneer skyf maks hoogte bereik (antwoord van 3.2.1)* 1,53 s ✓
- *Tyd wanneer B vir C tref (antwoord van 3.3)* 1,71s ✓

(5)
[20]

QUESTION 3/*VRAAG 3*

3.1 No/*Nee* ✓

ANY ONE/*ENIGE EEN*:

- Gravitational force is not the only force acting on the balloon. /There are other forces acting on the balloon. ✓
  Gravitasiekrag is nie die enigste krag wat op die ballon inwerk nie./Daar is ander kragte wat op die ballon inwerk.
- Its acceleration is not 9,8 $m\cdot s^{-2}$/is zero.
  Sy versnelling is nie 9,8 $m\cdot s^{-2}$/is nul.
- It has constant velocity/no acceleration.
  Dit het 'n konstante snelheid/geen versnelling nie. (2)

3.2.1

OPTION 1/*OPSIE 1*	
UPWARDS AS POSITIVE/ *OPWAARTS AS POSITIEF*	**DOWNWARDS AS POSITIVE/ *AFWAARTS AS POSITIEF***
$v_f^2 = v_i^2 + 2a\Delta y$ ✓	$v_f^2 = v_i^2 + 2a\Delta y$ ✓
$\underline{(-62,68)^2 = v_i^2 + 2(-9,8)(-200)}$ ✓	$\underline{(62,68)^2 = v_i^2 + 2(9,8)(200)}$ ✓
$v_i = 2,96\ m\cdot s^{-1}$ ✓	$v_i = -2,96\ m\cdot s^{-1}$ $= 2,96\ m\cdot s^{-1}$ ✓

OPTION 2/*OPSIE 2*

$(E_{mech/meg})_{200\ m} = (E_{mech/meg})_{bottom/onder}$
$(E_P + E_K)_{200\ m} = (E_P + E_K)_{bottom/onder}$
$(mgh + ½\ mv^2)_{200\ m} = (mgh + ½\ mv^2)_{bottom/onder}$
} ✓Any one/*Enige een*

$\underline{m(9,8)(200) + ½m(v^2) = 0 + ½m(62,68)^2}$ ✓
$v_i = 2,96\ m\cdot s^{-1}$ ✓

NOTE/*LET WEL*
Mass may be omitted during substitution.
Massa mag uitgelaat word tydens vervanging.

OPTION 3/*OPSIE 3*

$W_{nc} = \Delta E_p + \Delta E_k$
$0 = mg(h_f - h_i) + ½m(v_f^2 - v_i^2)$
} ✓Any one/*Enige een*

$\underline{0 = m(9,8)(0 - 200) + ½m(62,68^2 - v_i^2)}$ ✓
$v_i = 2,96\ m\cdot s^{-1}$ ✓

NOTE/*LET WEL*
Mass may be omitted during substitution.
Massa mag uitgelaat word tydens vervanging.

OPTION 4/*OPSIE 4*

$W_{net} = \Delta E_k$
$F_{net}\Delta x\cos\theta = ½m(v_f^2 - v_i^2)$
$mg\Delta x\cos\theta = ½m(v_f^2 - v_i^2)$
} ✓Any one/*Enige een*

$\underline{m(9,8)(200) = + ½m(62,68^2 - v_i^2)}$ ✓
$v_i = 2,96\ m\cdot s^{-1}$ ✓

NOTE/*LET WEL*
Mass may be omitted during substitution.
Massa mag uitgelaat word tydens vervanging. (3)

3.2.2 **POSITIVE MARKING FROM QUESTION 3.2.1/**
POSITIEWE NASIEN VANAF VRAAG 3.2.1

Marking criteria/*Nasienkriteria*

- Formula to calculate Δt of stone **A** ✓
  *Formule om Δt van klip **A** te bereken*
- Substitution to calculate Δt of stone **A** ✓
  *Vervanging om Δt van klip **A** te bereken*
- Final answer/*Finale antwoord*: 6,70 s ✓ **Accept/*Aanvaar:*** (6,69 to/*tot* 6,7)

NOTE: The calculation of Δt for **A** might be split up into two parts.
LET WEL: *Die berekening van Δt vir **A** kan in twee dele opgedeel word.*

OPTION 1/*OPSIE 1*	
UPWARDS AS POSITIVE/ ***OPWAARTS AS POSITIEF***	**DOWNWARDS AS POSITIVE/** ***AFWAARTS AS POSITIEF***
$v_f = v_i + a\Delta t$ ✓	$v_f = v_i + a\Delta t$ ✓
$-62,68 = 2,96 + (-9,8)\Delta t$ ✓	$62,68 = -2,96 + 9,8\Delta t$ ✓
$\Delta t = 6,70$ s ✓ (6,698)	$\Delta t = 6,70$ s ✓ (6,698)
OPTION 2/*OPSIE 2*	
UPWARDS AS POSITIVE/ ***OPWAARTS AS POSITIEF***	**DOWNWARDS AS POSITIVE/** ***AFWAARTS AS POSITIEF***
$\Delta y = v_i\Delta t + ½ a\Delta t^2$ ✓	$\Delta y = v_i\Delta t + ½ a\Delta t^2$ ✓
$-200 = (2,96)\Delta t + ½ (-9,8)\Delta t^2$ ✓	$200 = (-2,96)\ \Delta t + ½ (9,8)\Delta t^2$ ✓
$\Delta t = 6,70$ s ✓ (6,697)	$\Delta t = 6,70$ s ✓ (6,697)
OPTION 3/*OPSIE 3*	
UPWARDS AS POSITIVE/ ***OPWAARTS AS POSITIEF***	**DOWNWARDS AS POSITIVE/** ***AFWAARTS AS POSITIEF***
$\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$ ✓	$\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$ ✓
$-200 = \left(\frac{+2,96 + (-62,68)}{2}\right)\Delta t$ ✓	$200 = \left(\frac{-2,96 + 62,68}{2}\right)\Delta t$ ✓
$\Delta t = 6,70$ s ✓ (6,698)	$\Delta t = 6,70$ s ✓ (6,698)
OPTION 4/*OPSIE 4*	
UPWARDS AS POSITIVE/ ***OPWAARTS AS POSITIEF***	**DOWNWARDS AS POSITIVE/** ***AFWAARTS AS POSITIEF***
From 200 m upwards: *Vanaf 200 m opwaarts*: $v_f = v_i + a\Delta t$ ✓ $0 = 2,96 + (-9,8)\Delta t$ ✓ $\Delta t = 0,3$ s (0,302) From max h downwards: *Vanaf maks h afwaarts*: $v_f = v_i + a\Delta t$ $-62,68 = 0 + (-9,8)\Delta t$ $\Delta t = 6,40$ s (6,369) $t_A = 0,3 + 6,40 = 6,7$ s ✓	From 200 m upwards: *Vanaf 200 m opwaarts*: $v = v_i + a\Delta t$ ✓ $0 = -2,96 + (9,8)\Delta t$ ✓ $\Delta t = 0,3$ s (0,302) From max h downwards: *Vanaf maks h afwaarts*: $v_f = v_i + a\Delta t$ $62,68 = 0 + (9,8)\Delta t$ $\Delta t = 6,40$ s (6,369) $t_A = 0,3 + 6,40 = 6,7$ s ✓

OPTION 5/*OPSIE 5*	
UPWARDS AS POSITIVE/ ***OPWAARTS AS POSITIEF***	**DOWNWARDS AS POSITIVE/** ***AFWAARTS AS POSITIEF***
From 200 m upwards: *Vanaf 200 m opwaarts:* $v_f = v_i + a\Delta t$ ✓ $0 = 2,96 + (-9,8)\Delta t$ ✓ $\Delta t = 0,3$ s (0,302) From 200 m downwards: *Vanaf 200 m afwaarts:* $v_f = v_i + a\Delta t$ $-62,68 = -2,96 + (-9,8)\Delta t$ $\Delta t = 6,09$ s (6,094) $t_A = 2(0,3) + 6,09 = 6,69$ s ✓	From 200 m upwards: *Vanaf 200 m opwaarts:* $v_f = v_i + a\Delta t$ ✓ $0 = -2,96 + (9,8)\Delta t$ ✓ $\Delta t = 0,3$ s (0,302) From 200 m downwards: *Vanaf 200 m afwaarts:* $v_f = v_i + a\Delta t$ $62,68 = 2,96 + (9,8)\Delta t$ $\Delta t = 6,09$ s (6,094) $t_A = 2(0,3) + 6,09 = 6,69$ s ✓
OPTION 6/*OPSIE 6*	
UPWARDS AS POSITIVE/ ***OPWAARTS AS POSITIEF***	**DOWNWARDS AS POSITIVE/** ***AFWAARTS AS POSITIEF***
$F_{net}\Delta t = m(v_f - v_i)$ ✓ $mg\Delta t = m(v_f - v_i)$ $g\Delta t = v_f - v_i$ $(-9,8)\Delta t = (-62,68) - (2,96)$ ✓ $\Delta t = 6,69$ s ✓	$F_{net}\Delta t = m(v_f - v_i)$ ✓ $mg\Delta t = m(v_f - v_i)$ $g\Delta t = v_f - v_i$ $(9,8)\Delta t = 62,68 - (-2,96)$ ✓ $\Delta t = 6,69$ s ✓

(3)

3.2.3 **POSITIVE MARKING FROM QUESTION 3.2.1 and QUESTION 3.2.2/**
POSITIEWE NASIEN VANAF VRAAG 3.2.1 en VRAAG 3.2.2

Marking criteria/*Nasienkriteria*

- Formula to calculate Δy of stone **B** ✓
  Formule om Δy *van klip **B** te bereken*
- Substitution of t = 1,7 s ✓ (t_A – 5)
  Vervanging van t = 1,7 s (t_A – 5)
- Substitution to calculate Δy of stone **B** ✓
  *Vervanging om Δy van klip **B** te bereken*
- Substitution to calculate Δy of balloon ✓
  Vervanging om Δy van ballon te bereken
- Calculating distance between balloon and stone **B** ✓
  Berekening van afstand tussen ballon en klip **B**
- Final answer/*Finale antwoord*: 14,16 m ✓ (14,11 to/*tot* 14,16)

OPTION 1/*OPSIE 1*	
UPWARDS AS POSITIVE/ ***OPWAARTS AS POSITIEF***	**DOWNWARDS AS POSITIVE/** ***AFWAARTS AS POSITIEF***
Stone B/*Klip B*:	**Stone B/*Klip B*:**
$\Delta y = v_i\Delta t + \frac{1}{2} a\Delta t^2$ ✓ $= \underline{2,96(6,7 - 5) + \frac{1}{2}(-9,8)(6,7 - 5)^2}$ ✓ (✓) = -9,13 m (-9,09 to/*tot* -9,13)	$\Delta y = v_i\Delta t + \frac{1}{2} a\Delta t^2$ ✓ $= \underline{-2,96(6,7 - 5) + \frac{1}{2}(9,8)(6,7 - 5)^2}$ ✓ (✓) = 9,13 m (9,09 to/tot 9,13)
Distance travelled by stone **B**: 9,13 m *Afstand afgelê deur klip **B**: 9,13 m*	Distance travelled by stone **B**: 9,13 m *Afstand afgelê deur klip **B**: 9,13 m*
Hot-air balloon/*Lugballon*	**Hot-air balloon/*Lugballon***
$\Delta y = v_i\Delta t + \frac{1}{2} a\Delta t^2$ $= \underline{2,96(6,7 - 5)}$ ✓ + 0 = 5,03 m	$\Delta y = v_i\Delta t + \frac{1}{2} a\Delta t^2$ $= \underline{-2,96(6,7 - 5)}$ ✓ + 0 = -5,03 m
Distance travelled by hot-air balloon/ *Afstand afgelê deur lugballon:* 5,03 m	Distance travelled by hot-air balloon/ *Afstand afgelê deur lugballon:* 5,03 m
Distance between hot-air balloon and stone **B**/*Afstand tussen lugballon en klip **B*** = $\underline{9,13 + 5,03}$ ✓ = 14,16 m ✓ (14,11 - 14,16)	Distance between hot-air balloon and stone **B**/*Afstand tussen lugballon en klip **B*** = $\underline{9,13 + 5,03}$ ✓ = 14,16 m ✓ (14,11 - 14,16)

<table>
<tr>
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OPTION 2/*OPSIE 2*
UPWARDS AS POSITIVE/
OPWAARTS AS POSITIEF
Stone B/*Klip B*:
$v_f = v_i + a\Delta t$
$= 2,96 + (-9,8)(6,70 \overset{\checkmark}{-} 5)$
$= -13,7\ m\cdot s^{-1}$
$v_f^2 = v_i^2 + 2a\Delta y$ ✓
$(-13,7)^2 = (2,96)^2 + 2(-9,8)\Delta y$ ✓
$\Delta y = -9,13$ m
Distance travelled by stone **B:** 9,13 m
*Afstand afgelê deur klip **B:** 9,13 m*

Hot-air balloon/*Lugballon*
$\Delta y = v_i\Delta t + ½\ a\Delta t^2$
$= -2,96(6,70 - 5) + 0$ ✓
$= -5,03$ m
Distance travelled by hot-air balloon/
Afstand afgelê deur lugballon: 5,03 m

Distance between hot-air balloon and stone **B**/*Afstand afgelê deur lugballon en klip **B*** = 9,13+ 5,03 ✓
= 14,16 m ✓ (14,11 - 14,16)

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DOWNWARDS AS POSITIVE/
AFWAARTS AS POSITIEF
Stone B/*Klip B*:
$v_f = v_i + a\Delta t$
$= -2,96 + (9,8)(6,70 \overset{\checkmark}{-} 5)$
$= 13,7\ m\cdot s^{-1}$
$v_f^2 = v_i^2 + 2a\Delta y$ ✓
$(13,7)^2 = (-2,96)^2 + 2(9,8)\Delta y$ ✓
$\Delta y = 9,13$ m
Distance travelled by stone **B:** 9,13 m
*Afstand afgelê deur klip **B:** 9,13 m*

Hot-air balloon/*Lugballon*
$\Delta y = v_i\Delta t + ½\ a\Delta t^2$
$= -2,96(6,70 - 5) + 0$ ✓
$= -5,03$ m
Distance travelled by hot-air balloon/
Afstand afgelê deur lugballon: 5,03 m

Distance between hot-air balloon and stone **B**/*Afstand afgelê deur lugballon en klip **B*** = 9,13+ 5,03 ✓
= 14,16 m ✓ (14,11 - 14,16)

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OPTION 3/*OPSIE 3*
UPWARDS AS POSITIVE/
OPWAARTS AS POSITIEF
Stone B/*Klip B*:
$v_f = v_i + a\Delta t$
$= 2,96 + (-9,8)(6,70 \overset{\checkmark}{-} 5)$
$= -13,7\ m\cdot s^{-1}$
$\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$ ✓
$= \left(\frac{+2,96 + (-13,7)}{2}\right)(6,70 - 5)$ ✓
$= -9,13$ m
Distance travelled by stone **B:** 9,13 m
*Afstand afgelê deur klip **B:** 9,13 m*

Hot-air balloon/*Lugballon*
$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$
$= 2,96(6,70 - 5) + 0$ ✓
$= 5,03$ m
Distance travelled by hot-air balloon/
Afstand afgelê deur lugballon: 5,03 m

Distance between hot-air balloon and stone **B**/*Afstand afgelê deur lugballon en klip **B*** = 9,13 + 5,03 ✓
= 14,16 m ✓ (14,11 - 14,16)

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DOWNWARDS AS POSITIVE/
AFWAARTS AS POSITIEF
Stone B/*Klip B*:
$v_f = v_i + a\Delta t$
$= -2,96 + (9,8)(6,70 \overset{\checkmark}{-} 5)$
$= 13,7\ m\cdot s^{-1}$
$\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$ ✓
$= \left(\frac{-2,96 + (13,7)}{2}\right)(6,70 - 5)$ ✓
$= 9,13$ m
Distance travelled by stone **B:** 9,13 m
*Afstand afgelê deur klip **B:** 9,13 m*

Hot-air balloon/*Lugballon*
$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$
$= -2,96(6,70 - 5) + 0$ ✓
$= -5,03$ m
Distance travelled by hot-air balloon/
Afstand afgelê deur lugballon: 5,03 m

Distance between hot-air balloon and stone **B**/*Afstand afgelê deur lugballon en klip **B*** = 9,13+ 5,03 ✓
= 14,16 m ✓ (14,11 - 14,16)

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</table>

OPTION 4/*OPSIE 4*	
UPWARDS POSITIVE/ *OPWAARTS POSITIEF*:	**DOWNWARDS POSITIVE/** *AFWAARTS POSITIEF:*
Stone B/*Klip B*:	**Stone B/*Klip B*:**
$v_f = v_i + a\Delta t$	$v_f = v_i + a\Delta t$
$= 2,96 + (-9,8)(6,70 \overset{\checkmark}{-} 5)$	$= -2,96 + (9,8)(6,70 \overset{\checkmark}{-} 5)$
$= -13,7\ m\cdot s^{-1}$	$= 13,7\ m\cdot s^{-13}$
Balloon's height after 5 s: 214,8 m	Balloon's height after 5 s: 214,8 m
Ballon se hoogte na 5 s: 214,8 m	*Ballon se hoogte na 5 s: 214,8 m*
$E_{mech/meg})_{214,8\ m} = (E_{mech/meg})_{1,7\ s}$	$(E_{mech/meg})_{214,8\ m} = (E_{mech/meg})_{1,7\ s}$
$(E_P + E_K)_{214,8\ m} = (E_P + E_K)_{1,7\ s}$ ✓	$(E_P + E_K)_{214,8\ m} = (E_P + E_K)_{1,7\ s}$ ✓
$(mgh + ½\ mv^2) = (mgh + ½\ mv^2)_{1,7s}$	$(mgh + ½\ mv^2) = (mgh + ½\ mv^2)_{1,7s}$
$\underline{(9,8)(214,9)+½(2,96)^2 =}$	$\underline{(9,8)(214,8)+½(2,96)^2 =}$
$\underline{(9,8)h+½(13,7)^2}$ ✓	$\underline{(9,8)h+½(13,7)^2}$ ✓
$\therefore h = 205,67\ m$	$\therefore h = 205,67\ m$
Distance travelled by stone **B/** *Afstand afgelê deur klip **B**:* 214,8 – 205,67 = 9,13 m	Distance travelled by stone **B/** *Afstand afgelê deur klip **B**:* 214,8 – 205,67 = 9,13 m
Hot-air balloon/*Lugballon*	**Hot-air balloon/*Lugballon***
$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$	$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$
$= \underline{2,96(6,70 - 5)}$ ✓ + 0	$= \underline{-2,96(6,70 - 5)}$ ✓ + 0
$= 5,03\ m$	$= -5,03\ m$
Distance travelled by hot-air balloon/ *Afstand afgelê deur lugballon:* 5,03 m	Distance travelled by hot-air balloon/ *Afstand afgelê deur lugballon:* 5,03 m
Distance between hot-air balloon and stone **B**/*Afstand tussen lugballon en klip **B***: $\underline{9,13 + 5,03}$ ✓ = 14,16 m ✓ (14,11 to/*tot* 14,16)	Distance between hot-air balloon and stone **B**/*Afstand tussen lugballon en klip **B***: 9,13 + 5,03 ✓ = 14,16 m ✓ (14,11 to/*tot* 14,16)

<table>
<tr><td><u>OPTION 5/OPSIE 5</u>
UPWARDS AS POSITIVE/
OPWAARTS AS POSITIEF
<u>Stone B/Klip B</u>:
$v_f = v_i + a\Delta t$
$= 2,96 + (-9,8)(6,70 \overset{\checkmark}{-} 5)$
$= - 13,7\ m{\cdot}s^{-1}$
$W_{net} = \Delta E_K$ ✓
$F_{net}\Delta x\cos\theta = ½mv_f^2 - ½mv_i^2$
$= ½m(v_f^2 - v_i^2)$
$(9,8)\Delta h\cos 0° = \underline{½(13,7^2 – 2,96^2)}$ ✓
$\Delta h = 9,13$ m

Distance travelled by stone B/
Afstand afgelê deur klip B: 9,13 m

<u>Hot-air balloon/Lugballon</u>
$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$
$= \underline{2,96(6,70 - 5)}$ ✓ + 0
$= 5,03$ m
Distance travelled by hot-air balloon/
Afstand afgelê deur lugballon: 5,03 m

Distance between hot-air balloon and stone B/Afstand tussen lugballon en klip B: $\underline{9,13 + 5,03}$ ✓ = 14,16 m ✓
(14,11 to/tot 14,16)</td><td>DOWNWARDS AS POSITIVE/
AFWAARTS AS POSITIEF
<u>Stone B/Klip B</u>:
$v_f = v_i + a\Delta t$
$= -2,96 + (9,8)(6,70 \overset{\checkmark}{-} 5)$
$= 13,7\ m{\cdot}s^{-1}$
$W_{net} = \Delta E_K$ ✓
$F_{net}\Delta x\cos\theta = ½mv_f^2 - ½mv_i^2$
$= ½m(v_f^2 - v_i^2)$
$(9,8)\Delta h\cos 0° = \underline{½(13,7^2 – 2,96^2)}$ ✓
$\Delta h = 9,13$ m

Distance travelled by stone B/
Afstand afgelê deur klip B: 9,13 m

<u>Hot-air balloon/Lugballon</u>
$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$
$= \underline{-2,96(6,70 - 5)}$ ✓ + 0
$= -5,03$ m
Distance travelled by hot-air balloon/
Afstand afgelê deur lugballon: 5,03 m

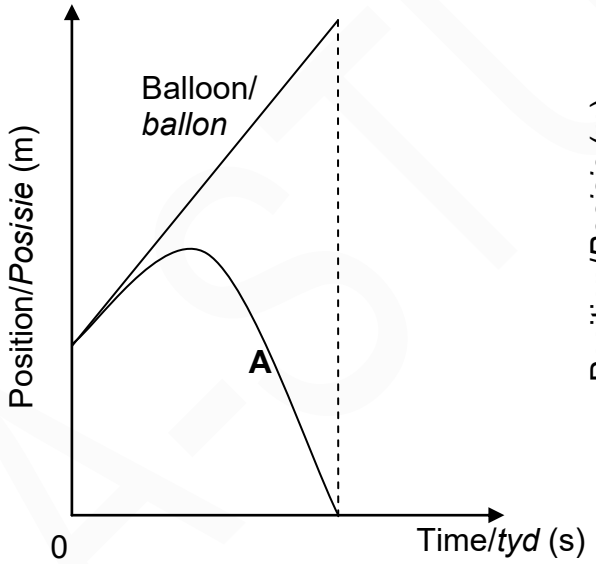
Distance between hot-air balloon and stone B/Afstand tussen lugballon en klip B: 9,13+ 5,03 ✓ = 14,16 m ✓
(14,11 to/tot 14,16)</td></tr>
<tr><td colspan="2"><u>OPTION 6/OPSIE 6</u>
Using relative velocities/Deur relatiewe snelhede te gebruik:</td></tr>
<tr><td>UPWARDS AS POSITIVE/
OPWAARTS AS POSITIEF
$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓
$= (\overset{\checkmark}{2,96} - \overset{\checkmark}{2,96})(1,7) + \frac{1}{2}(-9,8)(\overset{\checkmark}{1,7})^2$
$= -14,16$ m
Distance between hot-air balloon and stone B/Afstand tussen lugballon en klip B: 14,16 m ✓</td><td>DOWNWARDS AS POSITIVE/
AFWAARTS AS POSITIEF
$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓
$= (\overset{\checkmark}{2,96} - \overset{\checkmark}{2,96})(1,7) + \frac{1}{2}(9,8)(\overset{\checkmark}{1,7})^2$
$= 14,16$ m ✓</td></tr>
</table>

OPTION 7/*OPSIE 7*
UPWARDS AS POSITIVE/
OPWAARTS AS POSITIEF
$\Delta y = v_i\Delta t + \frac{1}{2} a\Delta t^2$ ✓
$= \underline{(2,96)(1,7) + \frac{1}{2}(-9,8)(1,7)^2}$ ✓ ✓
$= -9,13$ m
Distance travelled by stone **B:** 9,13 m
*Afstand afgelê deur klip **B:** 9,13 m*

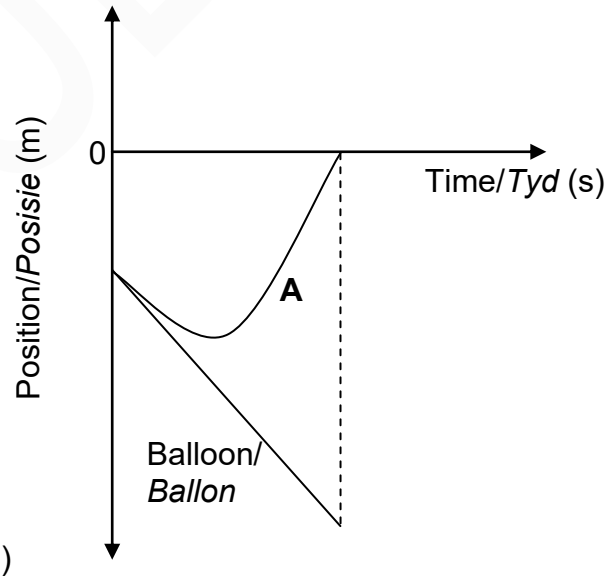
DOWNWARDS AS POSITIVE/
AFWAARTS AS POSITIEF
$\Delta y = v_i\Delta t + \frac{1}{2} a\Delta t^2$ ✓
$= \underline{(-2,96)(1,7) + \frac{1}{2}(9,8)(1,7)^2}$ ✓ ✓
$= 9,13$ m

Height of stone B from the ground = 200 + 14,8 – 9,13 = 205,63 m
Hoogte van klip B vanaf die grond:
Height of balloon from the ground = 200 + (6,7)(2,96)✓ = 219,83 m
Hoogte van ballon vanaf die grond:
Distance between B and the balloon = 219,83 – 205,63 ✓ = 14,16 m✓
Afstand tussen B en die ballon: (6)

3.3 **UPWARDS POSITIVE**
OPWAARTS POSITIEF



DOWNWARDS POSITIVE
AFWAARTS POSITIEF



Criteria for graph/*Kriteria vir grafiek*	
Correct shape for stone **A** not starting from 0 m./*Korrekte vorm vir klip **A** wat nie by 0 m begin nie.*	✓
Correct shape and initial position for hot-air balloon. /*Korrekte vorm en aanvanklike posisie vir lugballon.*	✓
Gradient for hot-air balloon is higher than that of stone **A** until stone **A** reaches the maximum height./*Gradiënt vir lugballon is groter as dié vir klip **A** totdat klip **A** sy maksimum hoogte bereik.*	✓
Both graphs starting at the same position and ending at the same time. / *Beide grafieke begin by dieselfde posisie en eindig by dieselfde tyd*.	✓

(4)
[18]

QUESTION 3/*VRAAG 3*

3.1 Weight / gravitational force / *Gewig / Gravitasiekrag* ✓

Accept/Aanvaar:
Gravity /*Gravitasie* (1)

3.2 9,8 $m \cdot s^{-2}$ ✓ downwards / *afwaarts* ✓ (2)

3.3 3 (m) ✓ (1)

3.4.1

OPTION 1/*OPSIE 1*

Gradient/*Gradiënt* = $\frac{y_2 - y_1}{x_2 - x_1}$

$-9,8$ ✓ $= \left(\frac{0 - v_i}{1,02 - 0}\right)$ ✓

$v_i = 10\ m \cdot s^{-1}$ ✓ (9,996)

OPTION 2/*OPSIE 2*	
UPWARDS AS POSITIVE/ *OPWAARTS AS POSITIEF*	**DOWNWARDS AS POSITIVE/ *AFWAARTS AS POSITIEF***
$v_f = v_i + a\Delta t$ ✓	$v_f = v_i + a\Delta t$ ✓
$0 = v_i + (-9,8)(1,02)$ ✓	$0 = v_i + (9,8)(1,02)$ ✓
$v_i = 10\ m \cdot s^{-1}$ ✓ (9,996)	$v_i = -10$
	$v_i = 10\ m \cdot s^{-1}$ ✓ (9,996)
OPTION 3/*OPSIE 3*	
UPWARDS AS POSITIVE/ *OPWAARTS AS POSITIEF*	**DOWNWARDS AS POSITIVE/ *AFWAARTS AS POSITIEF***
$v_f = v_i + a\Delta t$ ✓	$v_f = v_i + a\Delta t$ ✓
$-v = v + (-9,8)(2,04)$ ✓	$v = -v + (9,8)(2,04)$ ✓
$v = 10\ m \cdot s^{-1}$ ✓ (9,996)	$v = -10$
	$v = 10\ m \cdot s^{-1}$ ✓ (9,996)
OPTION 4/ *OPSIE 4*	
UPWARDS AS POSITIVE/ *OPWAARTS AS POSITIEF*	**DOWNWARDS AS POSITIVE/ *AFWAARTS AS POSITIEF***
$\Delta y = v_i\Delta t + \frac{1}{2} a\Delta t^2$ ✓	$\Delta y = v_i\Delta t + \frac{1}{2} a\Delta t^2$ ✓
$0 = v_i(2,04) + \frac{1}{2}(-9,8)(2,04)^2$ ✓	$0 = v_i(2,04) + \frac{1}{2}(9,8)(2,04)^2$ ✓
$v_i = 10\ m \cdot s^{-1}$ ✓ (9,996)	$v_i = -10$
	$v_i = 10\ m \cdot s^{-1}$ ✓ (9,996)

OPTION 5/*OPSIE 5* **UPWARDS POSITIVE/ *OPWAARTS POSITIEF*:**	**DOWNWARDS POSITIVE/ *AFWAARTS POSITIEF:***
$\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$ $= \underbrace{\left(\frac{v_i + 0}{2}\right)(1{,}02)}$ $v_f^2 = v_i^2 + 2a\Delta y$ ✓ $0^2 = v_i^2 + 2(-9{,}8)\left(\frac{v_i + 0}{2}\right)(1{,}02)$ ✓ $v_i = 10\ m\cdot s^{-1}$ ✓ (9,996)	$\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$ $= \underbrace{\left(\frac{v_i + 0}{2}\right)(1{,}02)}$ $v_f^2 = v_i^2 + 2a\Delta y$ ✓ $0^2 = v_i^2 + 2(9{,}8)\left(\frac{v_i + 0}{2}\right)(1{,}02)$ ✓ $v_i = -10\ m\cdot s^{-1}$ $v_i = 10\ m\cdot s^{-1}$ ✓ (9,996)

From maximum height to projection point/
Vanaf maksimum hoogte tot punt van projeksie:

OPTION 6/OPSIE 6 **UPWARDS POSITIVE/ *OPWAARTS POSITIEF***	**DOWNWARDS AS POSITIVE/ *AFWAARTS POSITIEF***
$v_f = v_i + a\Delta t$ ✓ $v_f = 0 + (-9{,}8)(1{,}02)$ $v_f = 10\ m\cdot s^{-1}$ $v_i = 10\ m\cdot s^{-1}$ ✓	$v_f = v_i + a\Delta t$ ✓ $v_f = 0 + (9{,}8)(1{,}02)$ ✓ $v_f = 10\ m\cdot s^{-1}$ $v_i = 10\ m\cdot s^{-1}$ ✓

OPTION 7/*OPSIE 7*	**OPTION 8/*OPSIE 8***
$(E_p + E_k)_{top/bo} = (E_p + E_k)_{bottom/onder}$ ✓ $mgh + 0 = 0 + \frac{1}{2}mv^2$ $(9{,}8)(5{,}09796) = \frac{1}{2}v^2$ ✓ $(2)(9{,}8)(5{,}09796) = v^2$ $v_i = 10\ m\cdot s^{-1}$ ✓ (9,996)	$W_{net} = \Delta E_k$ ✓ $F_{net}\Delta y\cos\theta = \frac{1}{2}m(v_f^2 - v_i^2)$ $ma\Delta y\cos\theta = \frac{1}{2}m(v_f^2 - v_i^2)$ $(0{,}06)(9{,}8)(5{,}09796) = \frac{1}{2}(0{,}06)(v_f^2 - 0^2)$ ✓ $v_i = 10\ m\cdot s^{-1}$ ✓ (9,996)

OPTION 9/*OPSIE 9*
$W_{nc} = \Delta E_p + \Delta E_k$ ✓ $0 = mg(h_f - h_i) + \frac{1}{2}m(v_f^2 - v_i^2)$ $0 = (0{,}06)(9{,}8)(h_f - 0) + \frac{1}{2}(0{,}06)(0^2 - v_i^2)$ ✓ $v_i = 10\ m\cdot s^{-1}$ ✓ (9,996)

OPTION 10/*OPSIE 10*
$F_{net}\Delta t = m\Delta v$ ✓ $(0{,}06)(-9{,}8)(1{,}02) = (0{,}06)(0 - v_i)$ ✓ $v_i = 10\ m\cdot s^{-1}$ ✓ (9,996)

(3)

3.4.2 **POSITIVE MARKING FROM QUESTION 3.4.1 /**
POSITIEWE NASIEN VANAF VRAAG 3.4.1

Marking criteria OPTIONS 1-5/*Nasienkriteria OPSIES 1-5*

- Appropriate formula / *Geskikte formule*✓
- Substitution / *Vervanging* ✓
- Adding answer to 3/*Tel 3 by antwoord* ✓
- Final answer/ *Finale antwoord* 8,1 m ✓ (8,098 – 8,102)

OPTION 1/ *OPSIE 1*	
UPWARDS AS POSITIVE/ ***OPWAARTS AS POSITIEF***	**DOWNWARDS AS POSITIVE/** ***AFWAARTS AS POSITIEF***
$v_f^2 = v_i^2 + 2a\Delta y$ ✓	$v_f^2 = v_i^2 + 2a\Delta y$ ✓
$0^2 = (10)^2 + 2(-9,8)\Delta y$ ✓	$0^2 = (-10)^2 + 2(9,8)\Delta y$ ✓
$\Delta y = -5,1$ m (-5,102)	$\Delta y = 5,1$ m (5,102)
↓	↓
h = 5,1 + 3 ✓	h = 5,1 + 3 ✓
= 8,1 m✓ (8,102)	= 8,1 m✓(8,102)
OPTION 2/ *OPSIE 2*	
UPWARDS AS POSITIVE/ ***OPWAARTS AS POSITIEF***	**DOWNWARDS AS POSITIVE/** ***AFWAARTS AS POSITIEF***
$\Delta y = v_i\Delta t + \frac{1}{2} a\Delta t^2$✓	$\Delta y = v_i\Delta t + \frac{1}{2} a\Delta t^2$✓
$= (10)(1,02) + \frac{1}{2}(-9,8)(1,02)^2$ ✓	$= (-10)(1,02) + \frac{1}{2}(9,8)(1,02)^2$ ✓
$\Delta y = 5,1$ m (5,102)	$\Delta y = -5,1$ m (-5,102)
↓	↓
h = 5,1 + 3 ✓	h = 5,1 + 3 ✓
= 8,1 m ✓(8,102)	= 8,1 m ✓(8,102)
OPTION 3/*OPSIE 3*	
UPWARDS POSITIVE/ ***OPWAARTS POSITIEF*:**	**DOWNWARDS POSITIVE/** ***AFWAARTS POSITIEF:***
$\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$ ✓	$\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$ ✓
$= \left(\frac{0-10}{2}\right)(1,02)$ ✓	$= \left(\frac{0+10}{2}\right)(1,02)$ ✓
$\Delta y = -5,1$ m	$\Delta y = 5,1$ m
↓	↓
h = 5,1 + 3 ✓	h = 5,1 + 3 ✓
= 8,1 m ✓	= 8,1 m ✓
OPTION 4/ *OPSIE 4*	
UPWARDS AS POSITIVE/ ***OPWAARTS AS POSITIEF***	**DOWNWARDS AS POSITIVE/** ***AFWAARTS AS POSITIEF***
$\Delta y = v_i\Delta t + \frac{1}{2} a\Delta t^2$✓	$\Delta y = v_i\Delta t + \frac{1}{2} a\Delta t^2$ ✓
$= 0 + \frac{1}{2}(-9,8)(1,02)^2$ ✓	$= 0 + \frac{1}{2}(9,8)(1,02)^2$ ✓
$\Delta y = -5,1$ m (-5,098)	$\Delta y = 5,1$ m (5,098)
↓	↓
h = 5,1 + 3 ✓	h = 5,1 + 3 ✓
= 8,1 m ✓ (8,098)	= 8,1 m ✓ (8,098)

OPTION 5/*OPSIE 5*

$W_{net} = \Delta E_k$
$w\Delta y\cos 180° = ½m(v_f^2 - v_i^2)$ } ✓Any one/*Enige een*
$(0,06)(9,8)(\Delta y)\cos 180° = ½(0,06)(0 - 10^2)$ ✓
$\Delta y = 5,1$ m
↓
$h = 5,1 + 3$ ✓
$= 8,1$ m ✓

OPTION 6/ *OPSIE 6*

$(E_{mech})_{3\ m(ref/verw)} = (E_{mech})_{Top/Bo}$
$(E_P + E_K)_{3\ m(ref/verw)} = (E_P + E_K)_{Top/Bo}$
$(mgh + ½ mv^2)_{3\ m\,(ref/verw)} = (mgh + ½ mv^2)_{Top/Bo}$ } ✓Any one/*Enige een*
$(0) + ½(0,06)(10)^2 = (0,06)(9,8)(h) + 0$ ✓
$h = 5,1$ m
$h = 5,1$ m
↓
$h = 5,1 + 3$ ✓
$= 8,1$ m ✓

Marking criteria OPTIONS 7 to 9/*Nasienkriteria OPSIES 7 tot 9*

- Appropriate formula / *Geskikte formule*✓
- Substitution / *Vervanging* ✓✓
- Final answer/ *Finale antwoord*: 8,1 m ✓

OPTION 7/ *OPSIE 7*

UPWARDS AS POSITIVE/
OPWAARTS AS POSITIEF

$\Delta y = v_i\Delta t + ½ a\Delta t^2$ ✓
$-3 = -10\,\Delta t + ½(-9,8)\Delta t^2$ ✓
$\Delta t = 2,31$ s (2,306)

$\Delta y = v_i\Delta t + ½ a\Delta t^2$
$= 0 + ½(-9,8)(2,31 - 1,02)^2$ ✓
$\Delta y = -8,15$ m (8,1)
$h = 8,15$ m (8,1) ✓

DOWNWARDS AS POSITIVE/
AFWAARTS AS POSITIEF

$\Delta y = v_i\Delta t + ½ a\Delta t^2$ ✓
$+3 = -10\,\Delta t + ½(9,8)\Delta t^2$ ✓
$\Delta t = 2,31$ s (2,306)

$\Delta y = v_i\Delta t + ½ a\Delta t^2$
$= 0 + ½(9,8)(2,31 - 1,02)^2$ ✓
$\Delta y = 8,15$ m (8,1)
$h = 8,15$ m (8,1) ✓

OPTION 8/ *OPSIE 8*

$(E_{mech})_{3\ m\ (ref/verw)} = (E_{mech})_{Top/Bo}$
$(E_P + E_K)_{3\ m(ref/verw)} = (E_P + E_K)_{Top/Bo}$
$(mgh + ½ mv^2)_{3\ m(ref/verw)} = (mgh + ½ mv^2)_{Top/Bo}$ } ✓Any one/*Enige een*
$(0,06)(9,8)(3) + ½(0,06)(10)^2$ ✓ $= (0,06)(9,8)(h) + 0$ ✓
$h = 8,1$ m ✓

OPTION 9/*OPSIE 9*

$W_{nc} = \Delta E_p + \Delta E_k$
$0 = mg(h_f - h_i) + ½m(v_f^2 - v_i^2)$ } ✓Any one/*Enige een*
$0 = (0,06)(9,8)(h_f - 3)$ ✓ $+ ½(0,06)(0 - 10^2)$ ✓
$h = 8,1$ m ✓

Marking criteria Options 10 to 11/*Nasienkriteria Opsies 10 tot 11*

- Formula / *Formule*✓
- Substitution to calculate v_f/ *Vervanging om v_f te bereken*✓
- Substitution to calculate Δy/ *Vervanging om Δy te bereken*✓
- Final answer / *Finale antwoord*: 8,1 m ✓

OPTION 10/*OPSIE 10*

UPWARDS AS POSITIVE/
OPWAARTS AS POSITIEF
MAXIMUM HEIGHT TO GROUND/
MAKSIMUM HOOGTE TOT GROND

$v_f^2 = v_i^2 + 2a\Delta y$ ✓
$= \underline{(10)^2 + 2(-9,8)(-3)}$ ✓
$v_f = -12,60$
$v_f = 12,6\ m\cdot s^{-1}$ (12,62)

$v_f^2 = v_i^2 + 2a\Delta y$
$\underline{(-12,60)^2 = (0)^2 + 2(-9,8)\Delta y}$ ✓
$\Delta y = -8,1$ m
$\Delta y = 8,1$ m ✓(8,102 - 8,103)

DOWNWARDS AS POSITIVE/
AFWAARTS AS POSITIEF
MAXIMUM HEIGHT TO GROUND/
MAKSIMUM HOOGTE TOT GROND

$v_f^2 = v_i^2 + 2a\Delta y$ ✓
$= \underline{(-10)^2 + 2(9,8)(3)}$ ✓
$v_f = 12,60\ m\cdot s^{-1}$(12,62)

$v_f^2 = v_i^2 + 2a\Delta y$
$\underline{(12,60)^2 = (0)^2 + 2(9,8)\ \Delta y}$ ✓
$\Delta y = 8,1$ m ✓(8,102 - 8,103)

OPTION 11/*OPSIE 11*

UPWARDS AS POSITIVE/
OPWAARTS AS POSITIEF
FROM BALCONY TO GROUND/
VANAF BALKON TOT GROND

$v_f^2 = v_i^2 + 2a\Delta y$✓
$= \underline{(-10)^2 + 2(-9,8)(-3)}$ ✓
$v_f = -12,60$
$v_f = 12,6\ m\cdot s^{-1}$

$v_f = v_i + a\Delta t$
$-12,60 = 0 + (-9,8)\Delta t$
$\Delta t = 1,29$ s (1,286)

$\Delta y = v_i\Delta t + ½\ a\Delta t^2$
$= \underline{0 + ½\ (-9,8)(\ 1,29)^2}$ ✓
$\Delta y = -8,1$ m (-8,098)
$h_1 = 8,1$ m ✓ (8,098 – 8,102)

DOWNWARDS AS POSITIVE/
AFWAARTS AS POSITIEF
FROM BALCONY TO GROUND/
VANAF BALKON TOT GROND

$v_f^2 = v_i^2 + 2a\Delta y$ ✓
$= \underline{(10)^2 + 2(9,8)(3)}$ ✓
$v_f = 12,6\ m\cdot s^{-1}$

$v_f = v_i + a\Delta t$
$12,60 = 0 + (9,8)\Delta t$
$\Delta t = 1,29$ s (1,286)

$\Delta y = v_i\Delta t + ½\ a\Delta t^2$
$= \underline{0 + ½\ (9,8)(1,29)^2}$ ✓
$\Delta y = 8,1$ m (8,098)
$h_1 = 8,1$ m ✓ (8,098 – 8,102)

OPTION 12/*OPSIE 12*

Displacement = Area between the graph and the t-axis
Verplasing = Area tussen die grafiek en die t-as
= Area of a triangle/*Area van „n driehoek* ✓
= ½ bh
= ½ (1,02)(9,996) ✓
= 5,09796 m
Height h/*Hoogte h* = 3 + 5,09796 ✓
= 8,09796 m ✓(8,09796 – 8,102) (4)

3.5 **POSITIVE MARKING FROM QUESTIONS 3.4.1 and 3.4.2**
***POSITIEWE NASIEN VANAF VRAE 3.4.1 en* 3.4.2**

Marking criteria/*Nasienkriteria*
Calculation of / *Berekening* van 10,78 m·s^{-1} or/*of* 12,60 m·s^{-1} or/*of* 5,93 m:
- Any suitable formula/*Enige geskikte formule*✓
- Any correct substitution/*Enige korrekte vervanging*✓

W calculation/*berekening*:
- Formula/*Formule* ✓
- Difference in calculated velocities/height/*Verskil in berekende snelhede/hoogtes*✓
- Correct substitution/*Korrekte vervanging*✓
- Final answer/*Finale antwoord*: -1,28 J ✓

OPTION 1/*OPSIE 1*
When ball is on ground/*Wanneer bal op grond is*:
Work done by the floor = change in E_k ($\Delta E_p = 0$)
Arbeid verrig deur vloer = *verandering* in E_k ($\Delta E_p = 0$)

UPWARDS AS POSITIVE/
OPWAARTS AS POSITIEF
$v_f = v_i + a\Delta t$ ✓
$0 = v_i + (-9,8)(1,1)$ ✓
$v_i = 10,78$ m·s^{-1}

$v_f^2 = v_i^2 + 2a\Delta y$
$= (10)^2 + 2(-9,8)(-3)$
$v_f = -12,60$
$v_f = 12,6$ m·s^{-1} (12,62)

OR
$v_f^2 = v_i^2 + 2a\Delta y$
$= (0)^2 + 2(-9,8)(-8,1)$
$v_f = -12,60$
$v_f = 12,6$ m·s^{-1} (12,62)

DOWNWARDS AS POSITIVE/
AFWAARTS AS POSITIEF
$v_f = v_i + a\Delta t$ ✓
$0 = v_i + (9,8)(1,1)$ ✓
$v_i = -10,78$
$v_i = 10,78$ m·s^{-1}

$v_f^2 = v_i^2 + 2a\Delta y$
$= (-10)^2 + 2(9,8)(3)$
$v_f = 12,60$ m·s^{-1} (12,62)

$W_{net} = \Delta E_k$
$W_{nc} = \Delta E_p + \Delta E_k$
✓Any one/*Enige een*

$= 0 + ½(0,06)(10,78^2 - 12,60^2)$ ✓ ✓
$= -1,28$ J ✓ (-1,2785)

OPTION 2/*OPSIE 2*

Comparing differences in heights/*vergelyk verskil in hoogtes*:
Work done by the floor = change in E_k ($\Delta E_p = 0$)
Arbeid verrig deur vloer = verandering in E_k ($\Delta E_p = 0$)

UPWARDS AS POSITIVE
OPWAARTS AS POSITIEF

$\Delta y = v_i\Delta t + \frac{1}{2} a\Delta t^2$ ✓
$= \underline{0 + \frac{1}{2}(-9,8)(1,1)^2}$ ✓
$= -5,93$ m
$\Delta y = 5,93$ m (5,929)

DOWNWARDS AS POSITIVE
AFWAARTS AS POSITIEF

$\Delta y = v_i\Delta t + \frac{1}{2} a\Delta t^2$ ✓
$= \underline{0 + \frac{1}{2}(9,8)(1,1)^2}$ ✓
$= -5,93$ m
$\Delta y = 5,93$ m

$W_{nc} = \Delta E_p + \Delta E_k$ ✓
$= mg(h_f - h_i) + \frac{1}{2}m(v_f^2 - v_i^2)$
$= \underline{(0,06)(9,8)(5,93 \text{ ✓} 8,10) + 0}$ ✓
$= -1,28$ J ✓

OPTION 3/*OPSIE 3*

Comparing differences in heights/*vergelyk verskil in hoogtes*:
Work done by floor/*arbeid verrig deur vloer* = Change/*Verandering* in E_p

UPWARDS AS POSITIVE
OPWAARTS AS POSITIEF

$v_f = v_i + a\Delta t$
$0 = v_i + (-9,8)(1,1)$
$v_i = 10,78 \text{ m·s}^{-1}$

$\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$ ✓
$= \underline{\left(\frac{10,78 + 0}{2}\right)(1,1)}$ ✓
$\Delta y = 5,93$ m

OR/*OF*

$v_f^2 = v_i^2 + 2a\Delta y$ ✓
$0 = \underline{(10,78)^2 + 2(-9,8)\,\Delta y}$ ✓
$\Delta y = 5,93$ m

DOWNWARDS AS POSITIVE
AFWAARTS AS POSITIEF

$v_f = v_i + a\Delta t$
$0 = v_i + (9,8)(1,1)$
$v_i = -10,78$
$v_i = 10,78 \text{ m·s}^{-1}$

$\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$ ✓
$= \underline{\left(\frac{-10,78 - 0}{2}\right)(1,1)}$ ✓
$\Delta y = -5,93$ m

OR/OF

$v_f^2 = v_i^2 + 2a\Delta y$ ✓
$0 = \underline{(-10,78)^2 + 2(9,8)\,\Delta y}$ ✓
$\Delta y = -5,93$ m
$\Delta y = 5,93$ m

$W_{nc} = \Delta E_p + \Delta E_k$ ✓
$= mg(h_f - h_i) + \frac{1}{2}m(v_f^2 - v_i^2)$
$= \underline{(0,06)(9,8)(5,93 \text{ ✓} 8,10) + 0}$ ✓
$= -1,28$ J ✓

(6)
[17]

2.4.2 **POSITIVE MARKING FROM QUESTION 2.3**
POSITIEWE NASIEN VANAF VRAAG 2.3
Moving to the right/*Beweeg na regs*
Velocity decreases/*snelheid neem af* ✓

Accelerates/Net force to left /*Versnelling/netto krag na links*✓✓

OR/*OF*
As the tension force decreases, the net force/acceleration acts in the opposite direction of motion /to the left. ✓✓
Soos die spanning afneem, is daar 'n netto krag/versnelling in die teenoorgestelde rigting / na links

Moving to the left/Beweeg na links
Velocity increases/*snelheid neem toe* ✓
Accelerates/Net force to left /*Versnelling/netto krag na links*✓✓ (3)
[16]

QUESTION 3/*VRAAG 3*

3.1 (Motion of an object) under the influence of gravity (weight) only. ✓✓ (2 or 0)
(Beweging van 'n voorwerp) slegs onder die invloed van gravitasie (gewig).

OR/*OF*
(Motion in which) the only force acting on the object is gravity (weight).
(Beweging waar) die enigste krag wat op die voorwerp inwerk, gravitasie (gewig) is. (2)

3.2.1 $\Delta t = 0,67 - 0,64 = 0,03$ s ✓✓ (2)

3.2.2

OPTION 1/*OPSIE 1* $\Delta t = \frac{(1,90 - 0,67)}{2}$ ✓ = 0,62 s ✓ (0,615 s)	**OPTION 2/*OPSIE 2*** $\Delta x = v_i\Delta t + ½ a\Delta t^2$ $(-1,85) = 0 + ½ (-9,8)\Delta t^2$ ✓ Δt = 0,61 s ✓ (0,6145 s)
OPTION 3/*OPSIE 3* $\Delta t = \frac{(1,90 + 0,67)}{2} = 1,285$ s $\Delta t = 1,285 - 0,67$ ✓ = 0,62 s ✓ (0,615 s)	**OPTION 4/*OPSIE 4*** $v_f^2 = v_i^2 + 2a\Delta x$ $0 = v_i^2 + 2(-9,8)(1,85)$ $v_i = 6,02$ m·s^{-1} $v_f = v_i + a\Delta t$ $0 = 6,02 + (-9,8)\Delta t$ ✓ Δt = 0,61 s ✓

(2)

3.2.3

POSITIVE MARKING FROM QUESTION 3.2.2
POSITIEWE NASIEN VANAF VRAAG 3.2.2

Marking Criteria/*Nasienriglyne*

- Any appropriate formula/*Enige geskikte formule* ✓
- Correct substitution/*Korrekte vervanging* ✓
- Final answer/*Finale antwoord*: 5,94 to 6,08 $m\cdot s^{-1}$ ✓

OPTION 1/*OPSIE 1*

Upwards positive/*Opwaarts positief*

$v_f = v_i + a\Delta t$ ✓

$0 = v_i + (-9,8)(0,62)$ ✓

$v_i = 6,08\ m\cdot s^{-1}\ (6,076\ m\cdot s^{-1})$ ✓

Downwards positive/*Afwaarts positief*

$v_f = v_i + a\Delta t$ ✓

$0 = v_i + (9,8)(0,62)$ ✓

$v_i = -6,08$

$\therefore 6,08\ m\cdot s^{-1}\ (6,076\ m\cdot s^{-1})$ ✓

OPTION 2/*OPSIE 2*

Upwards positive/*Opwaarts positief*

$\Delta y = v_i\Delta t + \frac{1}{2} a\Delta t^2$ ✓

$1,85 = v_i\,(0,62) + \frac{1}{2}\,(-9,8)\,(0,62)^2$ ✓

$v_i = 6,02\ m\cdot s^{-1}\ (6,022\ m\cdot s^{-1})$ ✓

Downwards positive/*Afwaarts positief*

$\Delta y = v_i\Delta t + \frac{1}{2} a\Delta t^2$ ✓

$1,85 = v_i\,(0,62) + \frac{1}{2}\,(9,8)\,(0,62)^2$ ✓

$v_i = -6,02$

$\therefore\ v_i = 6,02\ m\cdot s^{-1}\ (6,022\ m\cdot s^{-1})$ ✓

OPTION 3/*OPSIE 3*

Motion from top to bottom /
Beweging vanaf bo na onder

Downwards positive/*Afwaarts positief*

$v_f^2 = v_i^2 + 2a\Delta y$ ✓

$v_f^2 = 0 + 2(9,8)(1,85)$ ✓

$v_f = 6,02\ m\cdot s^{-1}$ ✓

initial velocity/*beginsnelheid*=$6,02\ m\cdot s^{-1}$

Upwards positive/*Opwaarts positief*

$v_f^2 = v_i^2 + 2a\Delta y$ ✓

$v_f^2 = 0 + 2(-9,8)(-1,85)$ ✓

$v_f = 6,02\ m\cdot s^{-1}$ ✓

initial velocity/*beginsnelheid*=$6,02\ m\cdot s^{-1}$

Motion from bottom to top
Beweging vanaf onder na bo

Downwards positive/*Afwaarts positief*

$v_f^2 = v_i^2 + 2a\Delta y$ ✓

$0^2 = v_i^2 + 2(9,8)(-1,85)$ ✓

$v_i = 6,02\ m\cdot s^{-1}$ ✓

Upwards positive/*Opwaarts positief*

$v_f^2 = v_i^2 + 2a\Delta y$ ✓

$0 = v_i^2 + 2(-9,8)(1,85)$ ✓

$v_i = 6,02\ m\cdot s^{-1}$ ✓

OPTION 4/*OPSIE 4*

Upwards positive/*Opwaarts positief*

$\Delta y = v_i\Delta t + \frac{1}{2} a\Delta t^2$ ✓

$0 = v_i(1,23) + \frac{1}{2}\,(-9,8)(1,23)^2$ ✓

$v_i = 6,03\ m\cdot s^{-1}$ ✓

Downwards positive/*Afwaarts positief* $\Delta y = v_i\Delta t + \frac{1}{2} a\Delta t^2$ ✓

$0 = v_i(1,23) + \frac{1}{2}\,(9,8)(1,23)^2$ ✓

$v_i = -6,03\ m\cdot s^{-1}$

speed/*spoed* = $6,03\ m\cdot s^{-1}$ ✓

OPTION 5/*OPSIE 5*

$\Delta y = \left(\frac{v_f + v_i}{2}\right)\Delta t$ ✓

$1,85 = \left(\frac{0 + v_i}{2}\right)(0,62)$ ✓

$v_i = 5,97\ m\cdot s^{-1}$ ✓

OPTION 6/*OPSIE 6*

$F_{net}\Delta t = m\Delta v$
$F_{net}\Delta t = m(v_f - v_i)$ } ✓

$m(9,8)(0,62) = m(0 - v_i)$ ✓

$v_i = 6,08\ m\cdot s^{-1}$ ✓

OPTION 7/*OPSIE 7*

$(E_p + E_k)_{floor/vloer} = (E_p + E_k)_{top/bo}$ ✓

$(mgh + \frac{1}{2} mv^2)_{floor/vloer} = (mgh + \frac{1}{2} mv^2)_{top/bo}$

$0 + \frac{1}{2} v^2 = (9,8)(1,85) + 0$ ✓

$v = 6,02\ m\cdot s^{-1}$ ✓

(3)

3.2.4

OPTION/*OPSIE* 1, 2, 3, 4: Marking criteria/*Nasienriglyne*

Calculate initial velocity:
Bereken aanvanklike snelheid:
- Appropriate formula/*Geskikte formule* ✓
- Substitution/*Vervanging* ✓

Calculate/*Bereken* Δt:
- Appropriate formula/*Geskikte formule* ✓
- Substitution/*Vervanging* ✓
- 1,97 s + Δt ✓
- Fin answer/*Fin antwoord*: 2,95 – 2,97 s ✓

Calculate initial velocity: / *Bereken beginsnelheid*

OPTION 1/*OPSIE 1*

Downwards positive/*Afwaarts positief*

$v_f^2 = v_i^2 + 2a\Delta y$ ✓

$0 = v_i^2 + 2(9,8)(-1,2)$ ✓

$v_i = -4,85\ m\cdot s^{-1}$

Upwards positive/*Opwaarts positief*

$v_f^2 = v_i^2 + 2a\Delta y$ ✓

$0 = v_i^2 + 2(-9,8)(1,2)$ ✓

$v_i = 4,85\ m\cdot s^{-1}$

OPTION 2/*OPSIE 2*

$(E_{mech})_{top} = (E_{mech})_{bot/ond}$
$(E_p + E_k)_{top} = (E_p + E_k)_{Bot/Ond}$ } ✓Any one/ *Enige een*

$(mgh + ½mv^2)_{top} = (mgh + ½mv^2)_{Bot/Ond}$

$(9,8)(1,2) + 0 = 0 + (½)v^2$ ✓

$v_i = 4,85\ m\cdot s^{-1}$ upwards */opwaarts*

OPTION 3/*OPSIE 3*

$W_{nc} = \Delta E_p + \Delta E_k$

$0 = (0 - mgh) + ½m(v_f^2 - v_i^2)$ } ✓Any one/ *Enige een*

$0 = -(9,8)(1,2) + ½v_i^2$ ✓

$v_i = 4,85\ m\cdot s^{-1}$ upwards */opwaarts*

OPTION 4/*OPSIE 4*

$W_{net} = \Delta E_k$

$w\Delta x\cos 180° = ½m(v_f^2 - v_i^2)$ } ✓Any one/ *Enige een*

$(9,8)(1,2)\cos 180° = ½v_i^2$ ✓

$v_i = -4,85\ m\cdot s^{-1}$

Calculate time Δt / *Bereken tyd Δt*

Upwards positive
Opwaarts positief

$\Delta y = v_i\Delta t + ½\ a\Delta t^2$ ✓

$1,2 = (4,85)\Delta t + ½(-9,8)\Delta t^2$ ✓

$\Delta t = 0,4898$ s / 0,5 s

$t = 1,97 + 2(0,4898)$ ✓

$= 2,95$ s / 2,97 s ✓

OR/*OF*

$\Delta y = v_i\Delta t + ½\ a\Delta t^2$ ✓

$0 = (4,85)\Delta t + ½(-9,8)\Delta t^2$ ✓

$\Delta t = 0,9898$ s (or $\Delta t = 0$)

$t = 1,97 + 0,9898$ ✓ $= 2,96$ s ✓

Downwards positive
Afwaarts positief

$\Delta y = v_i\Delta t + ½a\Delta t^2$ ✓

$1,2 = (-4,85)\Delta t + ½(9,8)\Delta t^2$ ✓

$\Delta t = 0,4898$ s / 0,5 s

$t = 1,97 + 2(0,4898)$ ✓

$= 2,95$ s / 2,97 s ✓

OR/*OF*

$\Delta y = v_i\Delta t + ½a\Delta t^2$ ✓

$0 = (4,85)\Delta t + ½(9,8)\Delta t^2$ ✓

$\Delta t = 0,9898$ s (or $\Delta t = 0$)

$t = 1,97 + 0,9898$ ✓ $= 2,96$ s ✓

OR/*OF*

$v_f = v_i + a\Delta t$ ✓

$-4,85 = 4,85 + (-9,8)\Delta t$ ✓

$\Delta t = 0,9898$ s

$\Delta t = 1,97 + 0,9898$ ✓ $= 2,96$ s ✓

OR/*OF*

Upwards positive
Opwaarts positief

$v_f = v_i + a\Delta t$ ✓

$0 = 4,85 + (-9,8)\Delta t$ ✓

$\Delta t = 0,4949$ s

$\Delta t = 1,97 + (2)(0,4949)$ ✓

$= 2,96$ s ✓

OR/*OF*

$\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$ ✓

$1,2 = \left(\frac{0 + 4,85}{2}\right)\Delta t$ ✓ $\Delta t = 0,4948$s

$\Delta t_{total} = 2(0,4948) = 0,99$ s

$\Delta t = 1,97 + 0,99$ ✓ $= 2,96$ s ✓

OPTION 5/*OPSIE 5*	**OPTION 5: Marking criteria/ *OPSIE 5: Nasienriglyne***
Downwards positive/*Afwaarts positief* $\Delta y = v_i\Delta t + \frac{1}{2} a\Delta t^2$ ✓ $\underline{1,2}$ ✓= $\underline{0 + \frac{1}{2}(9,8)\,\Delta t^2}$✓ $\Delta t = 0,49$ s t = 1,97 + ✓ 2(0,49) ✓ = 2,96 s ✓ Upwards positive/*Opwaarts positief* $\Delta y = v_i\Delta t + \frac{1}{2} a\Delta t^2$ ✓ $\underline{-1,2}$ ✓= $\underline{0 + \frac{1}{2}(-9,8)\Delta t^2}$✓ $\Delta t = 0,49$ s t = 1,97 + ✓ 2(0,49) ✓ = 2,96 s ✓	• Formula ✓/*Formule* • Substitution/*Vervanging* $\Delta y = 1,2$ ✓ • Substitution/*Vervanging* $0 + \frac{1}{2}(9,8)\,\Delta t^2$ • 1,97 s + ✓ • 2 Δt ✓ • Final answer/*Finale antwoord*: 2,95 - 2,97 s ✓

(6)
[15]

QUESTION 4/*VRAAG 4*

4.1 (Linear) momentum (of an object) is the $\underline{\text{product of mass and velocity}}$. ✓✓
(Liniêre) momentum (van 'n voorwerp) is die $\underline{\text{produk van massa en snelheid.}}$
(2 or/*of* 0) (2)

4.2.1

OPTION 1/*OPSIE 1*
East as positive/*Oos as positief*
$\sum p_i = \sum p_f$ $m_p v_{pi} + m_Q v_{Qi} = m_p v_{pf} + m_Q v_{Qf}$ } ✓Any one/*Enige een* $\underline{(0,16)(10) + (0,2)(-15)}$ ✓= $\underline{(0,16)(-5) + (0,2)v_{Qf}}$ ✓ $v_{Qf} = -3\ m\cdot s^{-1}$ $v_{Qf} = 3\ m\cdot s^{-1}$ ✓ west/*wes* ✓
OPTION 2/*OPSIE 2*
West as positive/*Wes as positief*
$\sum p_i = \sum p_f$ $m_p v_{pi} + m_Q v_{Qi} = m_p v_{pf} + m_Q v_{Qf}$ } ✓Any one/*Enige een* $\underline{(0,16)(-10) + (0,2)(15)}$ ✓= $\underline{(0,16)(5) + (0,2)Q_{Nf}}$ ✓ $v_{Qf} = 3\ m\cdot s^{-1}$ ✓ west/*wes* ✓
OPTION 3/*OPSIE 3*
$\Delta p_p = -\Delta p_Q$ ✓ $\underline{(0,16)(-5 - 10)}$ ✓= $\underline{-(0,2)(v - (-15))}$✓ $v = -3\ m\cdot s^{-1}$ $= 3\ m\cdot s^{-1}$ ✓west/*wes* ✓

(5)

QUESTION 3/*VRAAG 3*

3.1 (Motion during which) the only force acting is the force of gravity. ✓✓
(*Beweging waartydens) die enigste krag wat inwerk gravitasiekrag is.*
(2 or/*of* 0) (2)

3.2

Marking criteria/*Nasienriglyne:*
- Any appropriate formula for Δy/*Enige toepaslike formule vir Δy*✓
- Whole substitution to calculate 5,1 m /*Hele vervanging om 5,1 m te bereken* ✓
- 40 + answer from calculation/*antwoord van berekening* ✓
- Final answer/*Finale antwoord*: 45,10 m ✓(Accept/*aanvaar* 45,1 m)

OPTION 1/*OPSIE 1*

UPWARDS AS POSITIVE/*OPWAARTS AS POSITIEF:*

$v_f^2 = v_i^2 + 2a\Delta y$ ✓
$0 = (10)^2 + (2)(-9,8)\Delta y$ ✓
$\Delta y = 5,10$ m (5,102 m)

Height = 40 + 5,10 ✓
= 45,10 m ✓

DOWNWARDS AS POSITIVE/*AFWAARTS AS POSITIEF:*

$v_f^2 = v_i^2 + 2a\Delta y$ ✓
$0 = (-10)^2 + (2)(9,8)\Delta y$ ✓
$\Delta y = -5,10$ m (5,102)

Height = 40 + 5,10 ✓
= 45,10 m ✓

OPTION 2/*OPSIE 2*

UPWARDS AS POSITIVE/*OPWAARTS AS POSITIEF:*

$v_f = v_i + a\Delta t$
$0 = (10) + (-9,8)\Delta t$
$\Delta t = 1,02$ s

$\Delta y = v_i\Delta t + ½ a\Delta t^2$ ✓
$= (10)(1,02) + ½ (-9,8)(1,02)^2$ ✓
$= 5,10$ m

Height = 40 + 5,10 ✓
= 45,10 m ✓

Accept swopping of v_i and v_f
Aanvaar die omruiling van v_i en v_f

OR/*OF*

$\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$ ✓
$= \left(\frac{10 + 0}{2}\right)(1,02)$ ✓
$= 5,10$ m

DOWNWARDS AS POSITIVE/*AFWAARTS AS POSITIEF:*

$v_f = v_i + a\Delta t$
$0 = (-10) + (9,8)\Delta t$
$\Delta t = 1,02$ s

$\Delta y = v_i\Delta t + ½ a\Delta t^2$ ✓
$= (-10)(1,02) + ½ (9,8)(1,02)^2$ ✓
$= 5,10$ m
Height = 40 + 5,10 ✓
= 45,10 m ✓

Accept swopping of v_i and v_f
Aanvaar die omruiling van v_i en v_f

OPTION 3/OPSIE 3

UPWARDS AS POSITIVE/*OPWAARTS AS POSITIEF:*

$\Delta y = v_i\Delta t + \frac{1}{2} a\Delta t^2$
$0 = (10)\,\Delta t + \frac{1}{2}(-9,8)\Delta t^2$
$\Delta t = 2,04$ s

½ Δt

$\Delta y = v_i\Delta t + \frac{1}{2} a\Delta t^2$ ✓
$= \underline{(10)(1,02) + \frac{1}{2}(-9,8)(1,02)^2}$ ✓
$= 5,10$ m

Height = 40 + ✓5,10
= 45,10 m ✓

DOWNWARDS AS POSITIVE/*AFWAARTS AS POSITIEF:*

$\Delta y = v_i\Delta t + \frac{1}{2} a\Delta t^2$
$0 = (-10)\,\Delta t + \frac{1}{2}(9,8)\Delta t^2$
$\Delta t = 2,04$ s

½ Δt

$\Delta y = v_i\Delta t + \frac{1}{2} a\Delta t^2$ ✓
$= \underline{(-10)(1,02) + \frac{1}{2}(9,8)(1,02)^2}$ ✓
$= -5,10$ m

Height = 40 + 5,10 ✓
= 45,10 m ✓

OPTION 4/*OPSIE 4*

UPWARDS AS POSITIVE/*OPWAARTS AS POSITIEF:*

$\Delta y = v_i\Delta t + \frac{1}{2} a\Delta t^2$
$0 = (10)\Delta t + \frac{1}{2}(-9,8)\Delta t^2$
$\Delta t = 2,04$ s

½ Δt

$\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$ ✓
$= \underline{\left(\frac{10 + 0}{2}\right)(1,02)}$ ✓
$= 5,10$ m

Accept swopping of v_i and v_f
Aanvaar die omruiling van v_i en v_f

Height = 40 + 5,10 ✓
= 45,10 m ✓

DOWNWARDS AS POSITIVE/*AFWAARTS AS POSITIEF:*

$\Delta y = v_i\Delta t + \frac{1}{2} a\Delta t^2$
$0 = (-10)\,\Delta t + \frac{1}{2}(9,8)\Delta t^2$
$\Delta t = 2,04$ s

½ Δt

$\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$ ✓
$= \underline{\left(\frac{-10 + 0}{2}\right)(1,02)}$ ✓
$= -5,10$ m

Accept swopping of v_i and v_f
Aanvaar die omruiling van v_i en v_f

Height = 40 + 5,10 ✓
= 45,10 m ✓

OPTION 5/*OPSIE 5*

$E_{(mech/meg)roof/dak} = E_{(mech/meg)top/bo}$
$(E_p + E_k)_{roof/dak} = (E_p + E_k)_{top/bo}$
$(mgh + ½ mv^2)_{roof/dak} = (mgh + ½ mv^2)_{top/bo}$ ✓Any one/*Enige een*
$[m(9,8)(0) + ½m(10)^2 = m(9,8)(h)+ 0)]$ ✓
$h = 5,10$ m

Height = 40 + 5,10 ✓
= 45,10 m ✓

OPTION 6/*OPSIE 6*

$W_{net} = \Delta E_k$ ✓
$w\Delta x\cos\theta = ½ mv_f^2 – ½ mv_i^2$
$(m)(9,8)\Delta x\cos 180^o = 0 – ½ m(10)^2$ ✓
$\Delta x = 5,10$ m

Height = 40 + 5,10 ✓
= 45,10 m ✓

OPTION 7/*OPSIE 7*

$W_{nc} = \Delta E_p + \Delta E_k$ ✓
$0 = m(9,8)(h_f – 0) + ½ m(0 – 10^2)$ ✓
$h_f = 5,10$ m

Height = 40 + 5,10 ✓
= 45,10 m ✓

OPTION 8/*OPSIE 8*

Marking criteria/*Nasienriglyne:*
- Appropriate formula/*Toegepaste formule* ✓
- Substitution left/*Vervanging links* ✓
- Substitution right/*Vervanging regs*✓
- Final answer/*Finale antwoord*: 45,10 m ✓

$E_{(mech/meg)roof/dak} = E_{(mech/meg)top/bo}$
$(E_p + E_k)_{roof/dak} = (E_p + E_k)_{top/bo}$
$(mgh + ½ mv^2)_{roof/dak} = (mgh + ½ mv^2)_{top/bo}$ ✓Any one/*Enige een*
$m(9,8)(40) + ½m(10)^2$ ✓$= m(9,8)(h)+ 0)$ ✓
$h = 45,10$ m ✓ (4)

3.3 $9,8\ m\cdot s^{-2}$ ✓ downwards/*afwaarts* ✓ (2)

3.4

Marking criteria/*Nasienriglyne*

- Calculation/use of 10,26 m./*Berekening/gebruik van 10,26 m.* ✓
- Appropriate formula to calculate Δt/*Toepaslike formule om Δt te bereken*✓
- Substitution for stone A/*Vervanging vir klip A* ✓
- Substitution for stone B/*Vervanging vir klip B* ✓
- Calculating time difference between two stones. /*Berekening van tydverskil tussen klippe.* ✓
- Final answer/*Finale antwoord*: 1,34 (s) ✓

OPTION 1/*OPSIE 1*

UPWARDS AS POSITIVE/*OPWAARTS AS POSITIEF:*

Displacement from roof to meeting point /*Verplasing vanaf dak tot ontmoetingspunt* = -40 + 29,74 = - 10,26 m

Stone/*Klip* A

$\Delta y_A = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓

$-10,26$ ✓$= \underline{10\Delta t + \frac{1}{2}(-9,8)\Delta t^2}$ ✓

$\Delta t = 2,79$ s

Stone/*Klip* B

$\Delta y_B = v_i\Delta t + \frac{1}{2}a\Delta t^2$

$\underline{-10,26 = 0 + \frac{1}{2}(-9,8)\Delta t^2}$ ✓

$\Delta t = 1,45$ s (1,447 s)

$x = \underline{2,79 - 1,45}$ ✓ = 1,34 (s) ✓

OR/*OF*

$[-10,26 = 0(2,79 - x) + \frac{1}{2}(-9,8)(\underline{2,79 - x})^2$✓$]$✓

$x = 1,34$ (s)✓

$v_f^2 = v_i^2 + 2a\Delta y$

$= 0^2 + 2(-9,8)(-10,26)$

$v_f = -14,18\ m\cdot s^{-1}$

$v_f = v_i + a\Delta t$

$\underline{-14,18 = 0 + (-9,8)\Delta t}$✓

$\Delta t = 1,45$ s

$x = 2,79 - 1,45$ ✓

$= 1,34$ (s) ✓

DOWNWARDS AS POSITIVE/*AFWAARTS AS POSITIEF:*

Displacement from roof to meeting point /*Verplasing vanaf dak tot ontmoetingspunt* = 40 - 29,74 = 10,26 m

Stone/*Klip* A

$\Delta y_A = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓

$10,26$✓$= \underline{-10\Delta t + \frac{1}{2}(9,8)\Delta t^2}$ ✓

$\Delta t = 2,79$ s

Stone/*Klip* B

$\Delta y_B = v_i\Delta t + \frac{1}{2}a\Delta t^2$

$\underline{10,26 = 0 + \frac{1}{2}(9,8)\Delta t^2}$ ✓

$\Delta t = 1,45$ s (1,447 s)

$x = 2,79 - 1,45$ ✓ = 1,34 (s) ✓

OR/*OF*

$[-10,26 = 0(2,79 - x) + \frac{1}{2}(-9,8)(\underline{2,79 - x})^2$✓$]$✓

$x = 1,34$ (s) ✓

$v_f^2 = v_i^2 + 2a\Delta y$

$= 0^2 + 2(9,8)(10,26)$

$v_f = 14,18\ m\cdot s^{-1}$

$v_f = v_i + a\Delta t$

$\underline{14,18 = 0 + (9,8)\Delta t}$✓

$\Delta t = 1,45$ s

$x = 2,79 - 1,45$ ✓

$= 1,34$ (s) ✓

OPTION 2/*OPSIE 2*

UPWARDS AS POSITIVE/*OPWAARTS AS POSITIEF:*

Displacement from roof to meeting point /*Verplasing vanaf dak tot ontmoetingspunt*= - 40 + 29,74 = - 10,26 m

Displacement of stone A from max height to meeting point/ *Verplasing van klip A vanaf maksimum hoogte tot ontmoetingspunt* = -15,36 m

Stone/*Klip* A

$v_f = v_i + a\Delta t$
$0 = 10 + (-9,8)\Delta t$
$\Delta t = 1,02$ s

$\Delta y_A = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓
$-15,36 = 0 + \frac{1}{2}(-9,8)\Delta t^2$ ✓
$\Delta t = 1,77$ s
$\Delta t_{tot} = 1,77 + 1,02 = 2,79$s

Stone/*Klip* B

$\Delta y_B = v_i\Delta t + \frac{1}{2}a\Delta t^2$
$-10,26$ ✓$= 0 + \frac{1}{2}(-9,8)\Delta t^2$ ✓
$\Delta t = 1,45$ s (1,447 s)

$x = 2,79 - 1,45$ ✓ $= 1,34$ (s) ✓

$v_f^2 = v_i^2 + 2a\Delta y$
$= 0^2 + 2(-9,8)(-10,26)$
$v_f = -14,18\ m\cdot s^{-1}$

$v_f = v_i + a\Delta t$
$-14,18 = 0 + (-9,8)\Delta t$✓
$\Delta t = 1,45$ s

$x = 2,79 - 1,45$ ✓
$= 1,34$ (s) ✓

DOWNWARDS AS POSITIVE/*AFWAARTS AS POSITIEF:*

Displacement from roof to meeting point /*Verplasing vanaf dak tot ontmoetingspunt*= 40 - 29,74 = 10,26 m ✓

Displacement of ball A from max height to meeting point/ *Verplasing van bal A vanaf maksimum hoogte tot ontmoetingspunt* = 15,36 m

Stone/*Klip* A

$v_f = v_i + a\Delta t$
$0 = -10 + (9,8)\Delta t$
$\Delta t = 1,02$ s

$\Delta y_A = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓
$15,36 = 0 + \frac{1}{2}(9,8)\Delta t^2$ ✓
$\Delta t = 1,77$ s
$\Delta t_{tot} = 1,77 + 1,02 = 2,79$s

Stone/*Klip* B

$\Delta y_B = v_i\Delta t + \frac{1}{2}a\Delta t^2$
$10,26 = 0 + \frac{1}{2}(9,8)\Delta t^2$ ✓
$\Delta t = 1,45$ s (1,447 s)

$x = 2,79 - 1,45$ ✓ $= 1,34$ (s) ✓

$v_f^2 = v_i^2 + 2a\Delta y$
$= 0^2 + 2(9,8)(10,26)$
$v_f = 14,18\ m\cdot s^{-1}$

$v_f = v_i + a\Delta t$
$14,18 = 0 + (9,8)\Delta t$✓
$\Delta t = 1,45$ s

$x = 2,79 - 1,45$ ✓
$= 1,34$ (s) ✓

OPTION 3/*OPSIE 3*

UPWARDS AS POSITIVE/*OPWAARTS AS POSITIEF:*

Displacement of stones A and B from roof to meeting point/*Verplasing van klippe A en B vanaf dak tot by ontmoetingspunt* = - 40 + 29,74
= - 10,26 m

Stone/*Klip* A

$v_f = v_i + a\Delta t$
$0 = 10 + (-9,8)\Delta t$
$\Delta t = 1,02$ s

$\Delta y_A = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓
$-10,26$ ✓ $= \underline{-10 + \frac{1}{2}(-9,8)\,\Delta t^2}$ ✓
$\Delta t = 0,75$ s
$\Delta t_{tot} = 1,02 + 1,02 + 0,75 = 2,79$ s

Stone/*Klip* B

$\Delta y_B = v_i\Delta t + \frac{1}{2}a\Delta t^2$
$\underline{-10,26 = 0 + \frac{1}{2}(-9,8)\Delta t^2}$ ✓
$\Delta t = 1,45$ s (1,447 s)

$x = 2,79 - 1,45$ ✓ $= 1,34$ (s) ✓

$v_f^2 = v_i^2 + 2a\Delta y$
$= 0^2 + 2(-9,8)(-10,26)$
$v_f = -14,18\ m\cdot s^{-1}$

$v_f = v_i + a\Delta t$
$\underline{-14,18 = 0 + (-9,8)\Delta t}$ ✓
$\Delta t = 1,45$ s

$x = 2,79 - 1,45$ ✓
$= 1,34$ (s) ✓

DOWNWARDS AS POSITIVE/*AFWAARTS AS POSITIEF:*

Displacement of stones A and B from roof to meeting point/*Verplasing van klippe A en B vanaf dak tot by ontmoetingspunt* = 40 - 29,74 = 10,26 m

Stone/*Klip* A

$v_f = v_i + a\Delta t$
$0 = -10 + (9,8)\Delta t$
$\Delta t = 1,02$ s

$\Delta y_A = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓
$10,26$ ✓ $= \underline{10 + \frac{1}{2}(9,8)\Delta t^2}$ ✓
$\Delta t = 0,75$s
$\Delta t_{tot} = 1,02 + 1,02 + 0,75 = 2,79$ s

Stone/*Klip* B

$\Delta y_B = v_i\Delta t + \frac{1}{2}a\Delta t^2$
$\underline{10,26 = 0 + \frac{1}{2}(9,8)\Delta t^2}$ ✓
$\Delta t = 1,45$ s (1,447 s)

$x = 2,79 - 1,45$ ✓ $= 1,34$ (s) ✓

$v_f^2 = v_i^2 + 2a\Delta y$
$= 0^2 + 2(9,8)(10,26)$
$v_f = 14,18\ m\cdot s^{-1}$

$v_f = v_i + a\Delta t$
$\underline{14,18 = 0 + (9,8)\Delta t}$ ✓
$\Delta t = 1,45$ s

$x = 2,79 - 1,45$ ✓
$= 1,34$ (s) ✓

OPTION 4/*OPSIE 4*

UPWARDS AS POSITIVE/*OPWAARTS AS POSITIEF:*

Displacement from roof to meeting point /*Verplasing vanaf dak tot ontmoetingspunt* = - 40 + 29,74 = - 10,26 m

Stone/*Klip* A

$\Delta y_A = v_i\Delta t + \frac{1}{2}a\Delta t^2$
$-5,10 = 0 + \frac{1}{2}(-9,8)\Delta t^2$
$\Delta t = 1,02$ s

$\Delta y_A = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓
$-10,26$ ✓$= \underline{-10 + \frac{1}{2}(-9,8)\Delta t^2}$ ✓
$\Delta t = 0,75$s
$\Delta t_{tot} = 1,02 + 1,02 + 0,75 = 2,79$ s

Stone/*Klip* B

$\Delta y_B = v_i\Delta t + \frac{1}{2}a\Delta t^2$
$\underline{-10,26 = 0 + \frac{1}{2}(-9,8)\Delta t^2}$ ✓
$\Delta t = 1,45$ s (1,447 s)

$x = 2,79 - 1,45$ ✓$= 1,34$ (s) ✓

$v_f^2 = v_i^2 + 2a\Delta y$
$= 0^2 + 2(-9,8)(-10,26)$
$v_f = -14,18\ m\cdot s^{-1}$

$v_f = v_i + a\Delta t$
$\underline{-14,18 = 0 + (-9,8)\Delta t}$✓
$\Delta t = 1,45$ s

$x = 2,79 - 1,45$ ✓
$= 1,34$ (s) ✓

DOWNWARDS AS POSITIVE/*AFWAARTS AS POSITIEF:*

Displacement from roof to meeting point /*verplasing vanaf dak tot by ontmoetingspunt* = 40 - 29,74 = 10,26 m

Stone/*Klip* A

$\Delta y_A = v_i\Delta t + \frac{1}{2}a\Delta t^2$
$5,10 = 0 + \frac{1}{2}(9,8)\Delta t^2$
$\Delta t = 1,02$ s

$\Delta y_A = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓
$10,26$ ✓$= \underline{10 + \frac{1}{2}(9,8)\Delta t^2}$ ✓
$\Delta t = 0,75$s
$\Delta t_{tot} = 1,02 + 1,02 + 0,75 = 2,79$ s

Stone/*Klip* B

$\Delta y_B = v_i\Delta t + \frac{1}{2}a\Delta t^2$
$\underline{10,26 = 0 + \frac{1}{2}(9,8)\Delta t^2}$ ✓
$\Delta t = 1,45$ s (1,447 s)

$x = 2,79 - 1,45$ ✓$= 1,34$ (s) ✓

$v_f^2 = v_i^2 + 2a\Delta y$
$= 0^2 + 2(9,8)(10,26)$
$v_f = 14,18\ m\cdot s^{-1}$

$v_f = v_i + a\Delta t$
$\underline{14,18 = 0 + (9,8)\Delta t}$✓
$\Delta t = 1,45$ s

$x = 2,79 - 1,45$ ✓
$= 1,34$ (s) ✓

OPTION 5/*OPSIE 5*

UPWARDS AS POSITIVE/*OPWAARTS AS POSITIEF:*

Displacement from roof to meeting point /*Verplasing vanaf dak tot ontmoetingspunt* = - 40 + 29,74 = - 10,26 m

Displacement of stone A from max height to meeting point/ *Verplasing van klip A vanaf maksimum hoogte tot ontmoetingspunt* = -15,36 m

Stone/*Klip* A

$v_f^2 = v_i^2 + 2a\Delta y$
$v_f^2 = (0)^2 + (2)(-9,8)(-15,36)$
$v_f = -17,35\ m\cdot s^{-1}$

$v_f = v_i + a\Delta t$
$-17,35 = 0 + (-9,8)\Delta t$ ✓
$\Delta t = 1,77\ s$ ✓

$\Delta t_{tot} = 1,02 + 1,77 = 2,79\ (s)$

Stone/*Klip* B

$\Delta y_B = v_i\Delta t + \frac{1}{2}a\Delta t^2$
$-10,26$ ✓ $= 0 + \frac{1}{2}(-9,8)\Delta t^2$ ✓
$\Delta t = 1,45\ s\ (1,447\ s)$

$x = 2,79 - 1,45$ ✓ $= 1,34\ (s)$ ✓

$v_f^2 = v_i^2 + 2a\Delta y$
$= 0^2 + 2(-9,8)(-10,26)$
$v_f = -14,18\ m\cdot s^{-1}$

$v_f = v_i + a\Delta t$
$-14,18 = 0 + (-9,8)\Delta t$ ✓
$\Delta t = 1,45\ s$

$x = 2,79 - 1,45$ ✓
$= 1,34\ (s)$ ✓

DOWNWARDS AS POSITIVE/*AFWAARTS AS POSITIEF:*

Displacement from roof to meeting point /*Verplasing vanaf dak tot ontmoetingspunt*= 40 - 29,74 = 10,26 m

Displacement of stone A from max height to meeting point/ *Verplasing van klip A vanaf maksimum hoogte tot ontmoetingspunt* = 15,36 m

Stone/*Klip* A

$v_f^2 = v_i^2 + 2a\Delta y$
$v_f^2 = (0)^2 + (2)(9,8)(15,36)$
$v_f = -17,35\ m\cdot s^{-1}$

$v_f = v_i + a\Delta t$
$17,35 = 0 + (9,8)\Delta t$ ✓
$\Delta t = 1,77\ s$ ✓

$\Delta t_{tot} = 1,02 + 1,77 = 2,79\ (s)$

Stone/*Klip* B

$\Delta y_B = v_i\Delta t + \frac{1}{2}a\Delta t^2$
$10,26$ ✓ $= 0 + \frac{1}{2}(9,8)\Delta t^2$ ✓
$\Delta t = 1,45\ s\ (1,447\ s)$

$x = 2,79 - 1,45$ ✓ $= 1,34\ (s)$ ✓

$v_f^2 = v_i^2 + 2a\Delta y$
$= 0^2 + 2(9,8)(10,26)$
$v_f = 14,18\ m\cdot s^{-1}$

$v_f = v_i + a\Delta t$
$14,18 = 0 + (9,8)\Delta t$ ✓
$\Delta t = 1,45\ s$

$x = 2,79 - 1,45$ ✓
$= 1,34\ (s)$ ✓

OPTION 6/*OPSIE 6*

UPWARDS AS POSITIVE/*OPWAARTS AS POSITIEF:*

Displacement from roof to meeting point/*Verplasing vanaf dak tot by ontmoetingspunt* = - 40 + 29,74 = - 10,26 m

Stone/*Klip* A

$v_f^2 = v_i^2 + 2a\Delta y$
$v_f^2 = (-10)^2 + (2)(-9,8)(-10,26)$
$v_f = -17,35\ m\cdot s^{-1}$

$v_f = v_i + a\Delta t$
$-17,35 = -10 + (-9,8)\Delta t$ ✓
$\Delta t = 0,75\ s$ ✓

Ball A: $\Delta t = 1,02 + 1,02 + 0,75 = 2,79\ (s)$

Stone/*Klip* B

$\Delta y_B = v_i\Delta t + \frac{1}{2}a\Delta t^2$
$-10,26$ ✓ $= 0 + \frac{1}{2}(-9,8)\Delta t^2$ ✓
$\Delta t = 1,45\ s\ (1,447\ s)$

$x = 2,79 - 1,45$ ✓ $= 1,34\ (s)$ ✓

$v_f^2 = v_i^2 + 2a\Delta y$
$= 0^2 + 2(-9,8)(-10,26)$
$v_f = -14,18\ m\cdot s^{-1}$

$v_f = v_i + a\Delta t$
$-14,18 = 0 + (-9,8)\Delta t$ ✓
$\Delta t = 1,45\ s$

$x = 2,79 - 1,45$ ✓
$= 1,34\ (s)$ ✓

DOWNWARDS AS POSITIVE/*AFWAARTS AS POSITIEF:*

Displacement from roof to meeting point/*Verplasing vanaf dak tot by ontmoetingspunt* = 40 - 29,74 = 10,26 m

Stone/*Klip* A

$v_f^2 = v_i^2 + 2a\Delta y$
$v_f^2 = [(10)^2 + (2)(9,8)(10,26)$
$v_f = 17,35\ m\cdot s^{-1}$

$v_f = v_i + a\Delta t$
$17,35 = 10 + (9,8)\Delta t$ ✓
$\Delta t = 0,75\ s$ ✓

Ball A: $\Delta t = 1,02 + 1,02 + 0,75 = 2,79\ (s)$

Stone/*Klip* B

$\Delta y_B = v_i\Delta t + \frac{1}{2}a\Delta t^2$
$10,26$ ✓ $= 0 + \frac{1}{2}(9,8)\Delta t^2$ ✓
$\Delta t = 1,45\ s\ (1,447\ s)$

$x = 2,79 - 1,45$ ✓ $= 1,34\ (s)$ ✓

$v_f^2 = v_i^2 + 2a\Delta y$
$= 0^2 + 2(9,8)(10,26)$
$v_f = 14,18\ m\cdot s^{-1}$

$v_f = v_i + a\Delta t$
$14,18 = 0 + (9,8)\Delta t$ ✓
$\Delta t = 1,45\ s$

$x = 2,79 - 1,45$ ✓
$= 1,34\ (s)$ ✓ (6)

3.5.1 d ✓ **Accept / *Aanvaar*** (0 – e; 0 – d; d – e) (1)

3.5.2 a ✓ (1)

3.5.3 f ✓ (1)

3.5.4 c ✓ (1)

[18]

QUESTION 3/*VRAAG 3*

3.1 Motion of an object under the influence of gravity/gravitational force (weight) only✓✓.
Beweging van 'n voorwerp slegs onder die invloed van gravitasie/gravitasie krag (gewig).

OR/*OF*
Motion in which the only force acting on the object is gravity/weight. ✓✓
Beweging waar die enigste krag wat op die voorwerp inwerk, gravitasie/gewig is.

ACCEPT/*AANVAAR*
Vertical motion in which friction/air resistance is absent. ✓✓
Vertikale beweging waar wrywing/lugweerstand afwesig is.

Motion in air with an acceleration of 9,8 $m \cdot s^{-2}$. ✓✓
Beweging in lug met 'n versnelling van 9,8 $m \cdot s^{-2}$. (2)
NOTE: 2 OR ZERO/ *2 of nul*

3.2.1

OPTION 1/*OPSIE 1*
Upwards positive/*Opwaarts positief*:
$v_f = v_i + a\Delta t$ ✓
$0 = \underline{v_i + (-9,8)(1,53)}$ ✓
$\therefore v_i = 14,99\ m \cdot s^{-1}$ ($15\ m \cdot s^{-1}$) ✓
Downwards positive/*Afwaarts positief*
$v_f = v_i + a\Delta t$ ✓
$0 = \underline{v_i + (9,8)(1,53)}$ ✓
$\therefore v_i = -14,99\ m \cdot s^{-1}$
$v_i = 14,99\ m \cdot s^{-1}$ ($15\ m \cdot s^{-1}$) ✓

OPTION 2/*OPSIE 2*
$F_{net} = ma$
$= 9,8\ (m)$
$F_{net}\ \Delta t = m\Delta v$✓
$\underline{(9,8)(m)(1,53) = (m)(v_f - 0)}$ ✓
$v_f = 14,99\ m \cdot s^{-1}$ ($15\ m \cdot s^{-1}$) ✓

OPTION 3/*OPSIE 3*
Upwards positive/*Opwaarts positief*:
$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓
$\underline{0 = v_i(3,06) + \frac{1}{2}(-9,8)(3,06)^2}$✓
$v_i = 14,99\ m \cdot s^{-1}$✓($15\ m \cdot s^{-1}$)

Downwards positive/*Afwaarts positief*
$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓
$\underline{0 = v_i(3,06) + \frac{1}{2}(9,8)(3,06)^2}$✓
$v_i = 14,99\ m \cdot s^{-1}$✓ ($15\ m \cdot s^{-1}$)

NOTE: initial and final velocities can be swopped if starting from top, as long as sign of g is changed accordingly.
LW: v_f en v_i kan omgeruil word indien van bopunt begin, solank teken van g dienooreenkomstig verander word. (3)

3.2.2

OPTION 1/*OPSIE 1*
POSITIVE MARKING FROM 3.2.1/ *Positiewe nasien vanaf 3.2.1*
Upwards positive/*Opwaarts positief*:
$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓
$= \underline{14,99\ (1,53) + \frac{1}{2}\ (-9,8)(1,53)^2}$ ✓
$= 11,47$ m✓(11,46-11,48)
Maximum height is/*Maksimum hoogte is* 11,47 m

Downwards positive/*Afwaarts positief*
$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓
$= -\underline{14,99\ (1,53) + \frac{1}{2}\ (9,8)(1,53)^2}$ ✓
$= -11,47$ m (11,46-11,48)
Maximum height is /*Maksimum hoogte is* 11,47 m✓

OPTION 2/*OPSIE 2*
POSITIVE MARKING FROM 3.2.1/ *Positiewe nasien vanaf 3.2.1*
Upwards positive/*Opwaarts positief*:
$v_f^2 = v_i^2 + 2a\Delta y$✓
$\underline{0 = (14,99)^2 + 2(-9,8)(\Delta y)}$✓
$\Delta y = 11,47$ m·✓(11,46-11,48)
Maximum height reached is/*Maksimum hoogte bereik is* 11,47 m

Downwards positive/*Afwaarts positief:*
$v_f^2 = v_i^2 + 2a\Delta y$✓
$\underline{0 = (-14,99)^2 + 2(9,8)(\Delta y)}$✓
$\Delta y = -11,47$ m·(11,46-11,48)
Maximum height reached is/*Maksimum hoogte bereik is* 11,47 m✓

OPTION 3/*OPSIE 3*
POSITIVE MARKING FROM 3.2.1/ *Positiewe nasien vanaf 3.2.1*
Upwards positive/*Opwaarts positief*:
$$\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t \quad ✓$$
$$= \left(\frac{(14,99 + 0)}{2}\right)(1,53)\ ✓$$
$\Delta y = 11,47$ m✓
Maximum height reached is /*Maksimum hoogte bereik is* 11,47 m

Downwards positive/*Afwaarts positief:*
$$\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t \ ✓$$
$$= \left(\frac{(-14,99 + 0)}{2}\right)(1,53)✓$$
$\Delta y = -11,47$ m (11,46-11,48)
Maximum height reached is /*Maksimum hoogte bereik is* 11,47 m✓

OPTION 4/*OPSIE 4*
POSITIVE MARKING FROM 3.2.1

$\Delta E = \Delta K + \Delta U$
$\frac{1}{2} mv_i^2 + mgh_i = \frac{1}{2} mv_f^2 + mgh_f$ } 1 mark for any✓ / *1 punt vir enige*

$\frac{1}{2} (14,994)^2 + (9,8)(0) = 0 + 9,8\ h_f$ ✓
$h_f = 11,47$ m✓ (11,46-11,48)
Maximum height reached is /*Maksimum hoogte bereik is* 11,47 m

OR/*OF*
$\Delta K = - \Delta U$✓
$\frac{1}{2} m(v_f^2 - v_i^2) = - mg(h_f - h_i)$
$\frac{1}{2} (0 - 14,99^2) = - 9,8(h_f - 0)$ ✓
$h_f = 11,47$ m (11,46-11,48)
Maximum height reached is /*Maksimum hoogte bereik is* 11,47 m✓ (3)

3.3 **OPTION 1/*OPSIE 1***
POSITIVE MARKING FROM 3.2.1
Upwards positive/*Opwaarts positief*:
$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2$ ✓
$= (14,99)(4) + \frac{1}{2} (- 9,8)(4)^2$✓
$= -18,4$ m
Position is 18,4 m downwards (below the edge of the roof) ✓ / *Posisie is 18,4 m afwaarts (onder die kant van die dak).*

Downwards positive/*Afwaarts positief*
$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2$ ✓
$= (-14,99)(4) + \frac{1}{2} (9,8)(4)^2$✓
$= 18,4$ m
Position is 18,4 m downwards (below the edge of the roof) ✓/ *Posisie is 18,4 m afwaarts (onder die kant van die dak)*

OPTION 2/*OPSIE 2*
POSITIVE MARKING FROM 3.2.1
Upwards positive/*Opwaarts positief*:

$v_f = v_i + a\Delta t$
$= (14,99) + (-9,8)\ (4)$
$= -\ 24,2\ m\cdot s^{-1}$
$v_f^2 = v_i^2 + 2a\Delta y$✓
$(-24,2)^2 = (14,99)^2 + 2(-9,8)(\Delta y)$✓
$\Delta y = -\ 18,4\ m\cdot$
Ball is 18,4 m downwards (below the edge of the roof) / *Bal is 18,4 m afwaarts (onder die kant van die dak)*✓

Downwards positive/*Afwaarts positief:*

$v_f = v_i + a\Delta t$
$= (-14,99) + (9,8)\ (4)$
$= 24,2\ m\cdot s^{-1}$
$v_f^2 = v_i^2 + 2a\Delta y$✓
$(24,2)^2 = (-14,99)^2 + 2(9,8)(\Delta y)$✓
$\Delta y = 18,4\ m\cdot$
Ball is 18,4 m downwards (below the edge of the roof)✓/ *Bal is 18,4 m afwaarts (onder die kant van die dak)*

OPTION 3/*OPSIE 3*
POSITIVE MARKING FROM 3.2.1
Upwards positive/*Opwaarts positief*:

$$\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t \quad ✓$$
$$= \left(\frac{(14,99 - 24,2)}{2}\right)(4)\ ✓$$

$v_f = v_i + a\Delta t$
$= (14,99) + (-9,8)\ (4)$
$= -\ 24,2\ m\cdot s^{-1}$

$\Delta y = -\ 18,4\ m$
Ball is 18,4 m downwards (below the edge of the roof) ✓ / *Bal is 18,4 m afwaarts (onder die kant van die dak).*

Downwards positive/*Afwaarts positief:*

$$\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t \quad ✓$$
$$= \left(\frac{(-14,99 + 24,2)}{2}\right)(4)\ ✓$$

$v_f = v_i + a\Delta t$
$= (-14,99) + (9,8)\ (4)$
$= 24,2\ m\cdot s^{-1}$

$\Delta y = 18,4\ m$
Ball is 18,4 m downwards (below the edge of the roof) ✓ / *Bal is 18,4 m afwaarts (onder die kant van die dak.)*

OPTION 4/*OPSIE 4*
Total time to return to starting point/*totale tyd terug na beginpunt*
= 2(1,53) = 3,06 s
∴ time from reference point to ground/ *tyd vanaf verwysingspunt tot by grond*
= (4 – 3,06) = 0,94 s
$\Delta y = v_i\Delta t + ½ (g)\Delta t^2$ ✓
$= (14,99)(0,94) + ½(9,8)(0,94)^2$ ✓
= 18,43 m ✓downwards (below the edge of the roof) /*afwaarts (onder die kant van die dak.* (3)

3.4 No/*Nee*✓
The motion of the ball is only dependent on its initial velocity✓✓/the initial velocity depends on the time taken to reach maximum height.
Die beweging van die bal is slegs afhanklik van sy beginsnelheid./die aanvanklike snelheid hang af van die tyd wat dit neem om maksimum hoogte te bereik.

ACCEPT for 1 mark/ *AANVAAR vir 1 punt:*

The ball will still be in the air.✓
Die bal sal nog steeds in die lug wees.

OR/*OF*
The ball is still falling.✓
Die bal is steeds besig om te val.

OR/*OF*
The ball would not have reached the ground.✓
Die bal sal nog nie die grond bereik het nie.

OR/OF
The motion of the ball is independent of the height of the building. ✓
Die beweging van die bal is onafhanklik van die hoogte van die gebou.

NOTE: If learners gave separate answers for 3.2 and 3.3, mark them together. Thus, if one answer is correct and the other incorrect 0/3 (3)
LW: Indien leerders twee afsonderlike antwoorde gee vir 3.2 en 3.3, sien as geheel na. Dus, indien een verkeerd is, 0/3 **[14]**

QUESTION 3/*VRAAG 3*

3.1

Downwards/*Afwaarts* ✓

The only force acting on the object is the gravitational force/weight which acts downwards.✓/*Die enigste krag wat op die voorwerp inwerk is die gravitasiekrag/gewig wat afwaarts inwerk.*

ACCEPT/*AANVAAR*:
The only force acting is gravitational/weight.✓/*Die enigste krag wat inwerk is gravitasie/gewig*

OR/*OF*
Gravitational force/weight acts downwards.✓/*Gravitasiekrag/gewig werk afwaarts*

OR/*OF*
The ball is in free-fall / *Die bal in vry-val* ✓

OR/OF
(Gravitational) acceleration is downwards/(*Gravitasionele) versnelling is afwaarts* (2)

3.2

OPTION 1/*OPSIE 1*
Upward positive/*Opwaarts positief*
$v_f = v_i + a\Delta t$ ✓
$0 = 7,5 + (-9,8)\Delta t$ ✓
$\Delta t = 0,77$ s ✓

Downward positive/*Afwaarts positief*
$v_f = v_i + a\Delta t$ ✓
$0 = -7,5 + (9,8)\Delta t$ ✓
$\Delta t = 0,77$ s ✓

OPTION 2/*OPSIE 2*
Upward positive
Opwaarts positief
At highest point v_f is zero
By hoogste punt is v_f nul
$v_f^2 = v_i^2 + 2a\Delta y$
$0 = (7,5)^2 + (2)(-9,8)\Delta y$
$\Delta y = 2,87$ (2,869) m

$\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$ ✓
$2,87 = \frac{7,5 + 0}{2}\ \Delta t$ ✓

$\Delta t = 0,77$ s✓

OPTION 2/OPSIE 2
Downward positive
Afwaarts positief
At highest point v_f is zero
By hoogste punt is v_f nul
$v_f^2 = v_i^2 + 2a\Delta y$
$0 = (-7,5)^2 + (2)(9,8)\Delta y$
$\Delta y = -2,87$ (-2,869) m

$\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$ ✓
$-2,87 = \frac{-7,5 + 0}{2}\ \Delta t$ ✓

$\Delta t = 0,77$ s✓

OPTION 3/*OPSIE 3*	**OPTION 3/OPSIE 3**
Upward positive	**Downward positive**
Opwaarts positief	***Afwaarts positief***
$F_{net}\Delta t = m(v_f - v_i)$ ✓	$F_{net}\Delta t = m(v_f - v_i)$ ✓
$mg\Delta t = m(v_f - v_i)$	$mg\Delta t = m(v_f - v_i)$
$(-9,8)\Delta t = 0 - 7,5$ ✓	$(9,8)\Delta t = 0 - (-7,5)$ ✓
$\therefore \Delta t = 0,76531$ s (0,77 s) ✓	$\therefore \Delta t = 0,76531$ s (0,77 s)✓

OPTION 4/*OPSIE 4*	**OPTION 4/*OPSIE 4***
Upward positive	**Downward positive**
Opwaarts positief	***Afwaarts positief***
(Top to Bottom / *Bo na onder*)	(Top to Bottom /*Bo na onder*)
$v_f = v_i + a\Delta t$ ✓	$v_f = v_i + \Delta t$ ✓
$-7,5 = 0 + (-9,8)\Delta t$ ✓	$7,5 = 0 + (9,8)\Delta t$✓
$\therefore \Delta t = 0,76531$ s (0,77 s) ✓	$\therefore \Delta t = 0,76531$ s (0,77 s) ✓

OPTION 5/*OPSIE 5*	**OPTION 5/*OPSIE 5***
Upward positive	**Downward positive**
Opwaarts positief	***Afwaarts positief***
(Top to Bottom/ *Bo na onder*)	(Top to Bottom / *Bo na onder*)
$v_f^2 = v_i^2 + 2a\Delta y$	$v_f^2 = v_i^2 + 2a\Delta y$
$(7,5)^2 = (0)^2 + 2(-9,8)\Delta y$	$(7,5)^2 = (0)^2 + 2(9,8)\Delta y$
$\Delta y = -2,87$ m	$\Delta y = 2,87$ m
$\Delta y = v_i\Delta t + ½ a\Delta t^2$ ✓	$\Delta y = v_i\Delta t + ½ a\Delta t^2$ ✓
$-2,87 = (0)\Delta t + ½ (-9,8)(\Delta t)^2$ ✓	$2,87 = (0)\Delta t + ½ (9,8)\Delta t^2$ ✓
$\Delta t = 0,765$ s ✓	$\Delta t = 0,765$ s ✓

(3)

NOTES for marking QUESTION 3.3 ***AANTEKENINGE vir merk van VRAAG 3.3***	
Formula mark/*Formule punt*	✓
Substitution mark /*Vervangingspunt*	✓✓
Mark for height/distance / *Punt vir hoogte/afstand*	✓
Mark for comparison/*Punt vir vergelyking*	✓
Mark for conclusion/*Punt vir gevolgtrekking*	✓

3.3

OPTION 1/*OPSIE 1*

Upward positive/*Opwaarts positief*

At highest point v_f is zero/*By hoogste punt is v_f nul*

$v_f^2 = v_i^2 + 2a\Delta y$ ✓

0✓ = $(7,5)^2$ + (2)(-9,8)Δy ✓

Δy = 2,87 (2,869) m✓

This is higher than height needed to reach point **T** (2,1 m)✓therefore the ball will pass point **T**.✓

*Dit is hoer as die hoogte benodig om punt **T** (2,1 m) te bereik dus sal die bal punt **T** verbygaan.*

Downward positive/*Afwaarts positief*

At highest point v_f is zero/*By hoogste punt is v_f nul*

$v_f^2 = v_i^2 + 2a\Delta y$ ✓

0✓ = $(-7,5)^2$ + (2)(9,8)Δy✓

Δy = - 2,87 (-2,869) m✓

This is higher than height needed to reach point **T** (2,1 m)✓therefore the ball will pass the target. ✓

*Dit is hoer as die hoogte benodig om punt **T** (2,1 m) te bereik dus sal die bal punt **T** verbygaan.*

OPTION 2/*OPSIE 2* (POSITIVE MARKING FROM 3.2)

Upward positive/*Opwaarts positief*

$\Delta y = v_i\Delta t + ½ a\Delta t^2$✓

$\Delta y = (7,5)(0,77)$ ✓ + ½ $(-9,8)(0,77)^2$✓

Δy = 2,87 m (2,86 m)✓

This is higher than height needed to reach point **T** (2,1 m)✓therefore the ball will pass point **T**. ✓

*Dit is hoer as die hoogte benodig om punt **T** (2,1 m) te bereik dus sal die bal punt **T** verbygaan.*

Downward positive/*Afwaarts positief*

$\Delta y = v_i\Delta t + ½ a\Delta t^2$✓

$\Delta y = (-7,5)(0,77)$ ✓ + ½ $(9,8)(0,77)^2$✓

Δy = -2,87 m (2,869 m)✓

This is higher than the height needed to reach point **T** (2,1 m)✓therefore the ball will pass point **T**. ✓

*Dit is hoer as die hoogte benodig om punt **T** (2,1 m) te bereik dus sal die bal punt **T** verbygaan.*

OPTION 3/*OPSIE 3*

$(E_{mech})_{Top/Bo} = (E_{mech})_{Ground/Grond}$
$(E_P + E_K)_{Top} = (E_P + E_K)_{Bottom/Onder}$
$(mgh + ½ mv^2)_{Top/Bo} = (mgh + ½ mv^2)_{Bottom/Onder}$

1 mark for any
1 punt vir enige

$(9,8)(h) + 0$ ✓$= \underline{0 + (½)(7,5)^2}$ ✓
h = 2,87 m (2,869 m)✓

This is higher than height needed to pass the target (2,1 m)✓<u>therefore the ball will pass the target</u>.✓
*Dit is hoer as die hoogte benodig om punt **T** (2,1 m) verby te gaan dus sal die bal punt **T** verbygaan.*

OPTION 4/*OPSIE 4*

$W_{net} = \Delta E_K$
$mg\Delta x\cos\theta = ½ mv_f^2 - ½ mv_i^2$ ✓
$\underline{(9,8)\Delta x\cos 180^o}$✓ $= \underline{0 - ½(7,5)^2}$✓
Δx = 2,87 m (2,869 m)✓

This is higher than point height needed to pass point **T** (2,1 m)✓<u>therefore the ball will pass point **T**</u>. ✓
*Dit is hoer as die hoogte benodig om punt **T** (2,1 m) verby te gaan dus sal die bal punt **T** verbygaan.*

OPTION 5/*OPSIE 5*

Upward positive/*Opwaarts positief*

If the highest point is y_f then $\Delta y = (y_f - y_{1,6})$ At highest point v_f is zero
Indien die hoogste punt y_f is, dan is $\Delta y = (y_f - y_{1,6})$. *By hoogste punt is v_f* nul
$v_f^2 = v_i^2 + 2a\Delta y$ ✓
0✓ $= [\underline{(7,5)^2 + (2)(-9,8)}(y_f - 1,6)]$✓
y_f = 4,47 (4,469) m✓

Yes ✓✓
OR/*OF*
This point (4,47m) is higher than point **T** ✓✓ (or even the required height of 2,1 m) therefore the ball will pass point **T**.
Ja ✓✓
*Dit is hoer as die hoogte benodig om punt **T** (2,1 m) te bereik dus sal die bal punt **T** verbygaan.*

Downward positive/*Afwaarts positief*

If the highest point is y_f then $\Delta y = (y_f - y_{1,6})$ At highest point v_f is zero
Indien die hoogste punt y_f is, dan is $\Delta y = (y_f - y_{1,6})$. *By hoogste punt is v_f* nul
$v_f^2 = v_i^2 + 2a\Delta y$ ✓
0✓ $= [\underline{(-7,5)^2 + (2)(9,8)}\{y_f - (-1,6)\}]$ ✓
y_f = -4,47 (-4,469) m✓
height is/*hoogte is* 4,47 m.
This point (4,47 m) is higher than point **T**✓✓ (or even the required height of 2,1 m) <u>therefore the ball will pass point **T**</u>.
*Hierdie punt (4,47 m) is hoer as punt **T** (of selfs die benodigde hoogte van 2,1 m) dus sal die bal punt **T** verbygaan.*

OPTION 6/*OPSIE 6* (POSITIVE MARKING FROM 3.2)

Upward positive/*Opwaarts positief*

If the highest point is y_f then $\Delta y = (y_f - y_{1,6})$ At highest point v_f is zero
Indien die hoogste punt y_f is, dan is $\Delta y = (y_f - y_{1,6})$. By hoogste punt is v_f nul
$\Delta y = v_i\Delta t + \frac{1}{2} a\Delta t^2$✓
$(y_f - 1,6) = (7,5)(0,77)$ ✓ + ½ $(-9,8)(0,77)^2$✓
$y_f = 4,47$ m (4,469 m)✓

This point (4,47m) is higher than point **T** ✓✓ (or even the required height of 2,1 m) therefore the ball will pass point **T**.
*Hierdie punt (4,47 m) is hoer as punt **T** (of selfs die benodigde hoogte van 2,1 m) dus sal die bal punt **T** verbygaan.*

Downward positive/*Afwaarts positief*

If the highest point is y_f then $\Delta y = (y_f - y_{1,6})$ At highest point v_f is zero
Indien die hoogste punt y_f is, dan is $\Delta y = (y_f - y_{1,6})$. By hoogste punt is v_f nul
$\Delta y = v_i\Delta t + \frac{1}{2} a\Delta t^2$✓
$\{y_f - (-1,6)\} = (-7,5)(0,765)$ ✓ + ½ $(9,8)(0,765)^2$✓
$y_f = -4,47$ m (-4,469 m)✓

This point (4,47m) is higher than point T✓✓ (or even the required height of (2,1m) therefore the ball will pass point **T.**
*Hierdie punt (4,47 m) is hoer as punt **T** (of selfs die benodigde hoogte van 2,1 m) dus sal die bal punt **T** verbygaan.*

OPTION 7/*OPSIE 7* (POSITIVE MARKING FROM 3.2)

Upward positive/*Opwaarts positief*

$$\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t \quad ✓$$
$$= \left(\frac{0 + 7,5}{2}\right)(0,77) \quad ✓✓$$
$$= 2,89 \text{ m} ✓$$

This is higher than height needed to pass the target (2,1 m)✓therefore the ball will pass the target.✓
Dit is hoer as die hoogte benodig om die teiken verby te gaan (2,1 m) dus sal die bal die teiken verbygaan.

OPTION 7/*OPSIE 7* (POSITIVE MARKING FROM 3.2

Downward positive/*Afwaarts positief*

$$\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t \quad ✓$$
$$= \frac{0 - 7,5}{2}(0,77) \quad ✓✓$$
$$= -2,89 \text{ m} ✓$$

Height /*Hoogte* is 2,89m
This is higher than height needed to pass the target (2,1 m)✓therefore the ball will pass the target.✓
Dit is hoer as die hoogte benodig om die teiken verby te gaan (2,1 m) dus sal die bal die teiken verbygaan.

OPTION 8/*OPSIE 8*

Upward positive/*Opwaarts positief*

At highest point v_f is zero/*By hoogste punt is v_f nul*

$v_f^2 = v_i^2 + 2a\Delta y$ ✓

0✓ $= v_i^2 - (2)(9,8)(2,1)$ ✓

$v_i = 6,42\ m\cdot s^{-1}$ ✓

This is the actual velocity needed to reach the target.

The given velocity is greater than the actual velocity needed. ✓

The ball will pass the target. ✓

Dit is die werklike snelheid benodig om die teiken te bereik

Die gegewe snelheid is groter as die werklike snelheid benodig

Die bal sal die teiken verbygaan.

Downward positive/*Afwaarts positief*

At highest point v_f is zero

$v_f^2 = v_i^2 + 2a\Delta y$ ✓

0✓ $= v_i^2 + (2)(9,8)(-2,1)$ ✓

$v_i = 6,42\ m\cdot s^{-1}$ ✓

This is the actual velocity needed to pass the target.

The given velocity is greater than the actual velocity needed. ✓

The ball will reach the target. ✓

Dit is die werklike snelheid benodig is om die teiken te verby te gaan.

Die gegewe snelheid is groter as die werklike snelheid benodig

Die bal sal die teiken verbygaan.

OPTION 9/*OPSIE 9*

$W_{nc} = \Delta E_p + \Delta E_k$ ✓

$0 = mgh_f - mgh_i + \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$

0 ✓$= \underline{(9,8)h_f - (9,8)(1,6) + \frac{1}{2}(0)^2 - \frac{1}{2}(7,5)^2}$✓

$0 = (9,8)h_f - 43,805$

$\therefore h_f = 4,47\ m$ ✓

$\therefore$ The ball will pass point **T** ✓✓

*Die bal sal punt **T** verbygaan.*

OPTION 10/*OPSIE 10*
POSITIVE MARKING FROM 3.2 / POSITIEWE NASIEN VANAF 3.2
Upward positive/*Opwaarts positief*
Δt(max. height/*maks. hoogte*) = 0,77 s
$\Delta y = v_i\Delta t + ½ a\Delta t^2$ ✓
2,1✓ = (7,5)Δt + ½ (-9,8)Δt^2 ✓
∴ Δt = 0,36 s ✓
∴ Δt (max height/*maks.hoogte*, 0,77 s) > Δt (to pass point **T**/ om **T** *verby te gaan,* 0,36 s) ✓
∴ The ball passed point **T** ✓
*Die bal het punt **T** verbygegaan.*
Downward positive/*Afwaarts positief*
Δt (max height) = 0,77 s
$\Delta y = v_i\Delta t + ½ a \Delta t^2$ ✓
2,1✓= (7,5)Δt + ½ (-9,8)Δt^2 ✓
∴ Δt = 0,36 s✓
∴ Δt (max height, 0,77 s) > Δt (to reach point T, 0,36 s) ✓
∴ The ball passed point **T** ✓
*Die bal het punt **T** verbygegaan*

OPTION 11/*OPSIE 11*
Upward positive/*Opwaarts positief*
$\Delta y = v_i\Delta t + ½ a\Delta t^2$✓
(3,7 – 1,6)✓ = 7,5 Δt + ½ (- 9,8) Δt^2 ✓
Δt = 0,375 s ✓
The time to pass point **T** is less than time to reach maximum height ✓. Ball will pass point **T**.✓
*Die tyd om punt **T** verby te gaan, is minder as tyd om maksimum hoogte te bereik.. Bal sal punt **T** verbygaan*

Downward positive/*Afwaarts positief*
$\Delta y = v_i\Delta t + ½ a\Delta t^2$✓
(3,7 – 1,6)✓ = -7,5 Δt + ½ (9,8) Δt^2 ✓
Δt = 0,375 s ✓
The time to reach point **T** is less than time to reach maximum height ✓. Ball will pass point **T**.✓
*Die tyd om punt **T** verby te gaan, is minder as tyd om maksimum hoogte te bereik.. Bal sal punt **T** verbygaan*

OPTION 12/*OPSIE 12*

Upward positive/*Opwaarts positief*

$v_f^2 = v_i^2 + 2a\Delta y$ ✓
$v_f^2 = (7,5)^2$ ✓$+ 2(-9,8)(2,1)$ ✓
$v_f = 3,88\ m\cdot s^{-1}$ ✓

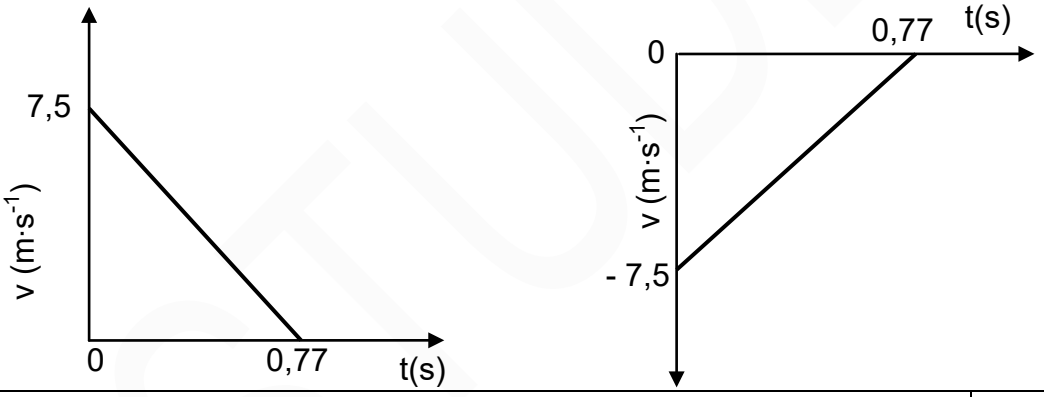
Velocity at **T** is $3,88\ m\cdot s^{-1}$ therefore the ball still moving towards its maximum height ✓✓
*Snelheid by **T** is 3,88 ·m·s^{-1} dus beweeg die bal steeds opwaarts na maksimum hoogte*

Downward positive/*Afwaarts positief*

$v_f^2 = v_i^2 + 2a\Delta y$ ✓
$v_f^2 = (-7,5)^2$ ✓$+ 2(9,8)(-2,1)$✓
$v_f = -3,88\ m\cdot s^{-1}$✓

Velocity at **T** is $-3,88\ m\cdot s^{-1}$ therefore the ball is still moving towards its maximum height ✓✓
*Snelheid by **T** is -3,88 ·m·s^{-1} dus beweeg die bal steeds opwaarts na maksimum hoogte* (6)

3.4 **POSITIVE MARKING FROM 3.2 / *POSITIEWE NASIEN VANAF 3.2***



Notes/*Notas*:	
Initial velocity and time for final velocity shown *Beginsnelheid en tyd vir finale snelheid aangedui.*	✓
Correct straight line (including orientation) drawn *Korrekte reguitlyn (insluitend oriëntasie) geteken.*	✓

(2)
[13]

QUESTION 4/*VRAAG 4*

4.1 Momentum is the product of the mass of an object and its velocity ✓✓
Momentum is die produk van die massa van 'n voorwerp en sy snelheid.
[NOTE/LET WEL: 2 or/of 0] (2)

4.2 To the left/*Na links* ✓
Newton's third law/*Newton se derde wet* ✓

ACCEPT/*AANVAAR*:
Principle of conservation of linear momentum / law of action-reaction
Beginsel van behoud van lineêre momentum/wet van aksie-reaksie
Newton's third law **and** Newton's second law/*Newton se derde wet **en** Newton se tweede wet* (2)

2.4 3 s✓ (1)

2.5 **Y**✓
Graph **Y** represents the motion of Q after the string breaks.
The graph Y shows a decreasing velocity ✓with a negative acceleration. ✓
This is because the net force (friction) acting on Q is in the opposite direction to its motion, ✓ (accept: only frictional force acts on Q).

Grafiek Y verteenwoordig die beweging van Q na die toutjie breek
Die versnelling is negatief vir grafiek Y en toon 'n afnemende snelheid
Dit is omdat wrywing op Q inwerk (4)
[17]

QUESTION 3/*VRAAG 3*

3.1 10 m·s^{-1}✓ (1)

3.2 The gradient represents the acceleration due to gravity (*g) which is constant* for free fall. ✓
Die helling verteenwoordig die versnelling as gevolg van gravitasie (g) wat konstant vir vry-val is.

[The graphs represent free fall/*Die grafieke verteenwoordig vryval*] (1)

3.3.1

POSITIVE MARKING FROM QUESTION 3.1
POSITIEWE NASIEN VANAF VRAAG 3.1

OPTION 1/*OPSIE 1*

$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓ $= (10)(2) + \frac{1}{2}(9,8)(2^2)$ ✓ $= 39,6$ m Height/*Hoogte*= 39,6 m ✓	$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$✓ $= (-10)(2) + \frac{1}{2}(-9,8)(2^2)$ ✓ $= -39,6$ m Height/*Hoogte* = 39,6 m ✓

OPTION 2/*OPSIE 2*

$\Delta x = \frac{(v_i + v_f)}{2}\Delta t$ ✓

$\Delta x = \left(\frac{10 + 29,6}{2}\right)(2)$ ✓

$\Delta x = 39,6\ m$ ✓

OPTION 3/*OPSIE 3*

$v_f^2 = v_i^2 + 2a\Delta x$ ✓

$(29,6)^2 = (10)^2 + 2(9,8)a\Delta x$ ✓

$\Delta x = 39,6\ m$ ✓

OPTION 4/*OPSIE 4*

Height = Area under the graph
Hoogte = Area onder die grafiek
Any one/*Enige een*✓
=Area of/*van* ☐+Area of/*van* △
= (10)(2)+(½)(2)(19,6) ✓
= 39,6 m ✓

OPTION 5/*OPSIE 5*

Height = Area of trapezium = *Hoogte = Area van trapesium* ✓
= ½ (10 +29,6) x 2 ✓= 39,6 m ✓

(3)

3.3.2

OPTION 1/*OPSIE 1*	**OPTION 2/*OPSIE 2***
$v_f = v_i + a\Delta t$ ✓ 0 = -25 + (9,8)(Δt) ✓ Δt = 2,55 s Total time T/*Totale tyd* = 8 +2,55 ✓ = 10,55 s ✓	$v_f = v_i + a\Delta t$ ✓ 0 = 25 + (-9,8)(Δt) ✓ Δt = 2,55 s Total time T/*Totale tyd* = 8 +2,55 ✓ = 10,55 s ✓
OPTION 3/*OPSIE 3*	**OPTION 4/*OPSIE 4***
$v_f^2 = v_i^2 + 2a\Delta x$ ✓ $\Delta x = 31{,}89\ m$ $\Delta x = \frac{(v_i + v_f)}{2}\Delta t$ $31{,}89 = \left(\frac{25+0}{2}\right)\Delta t$ ✓ $\Delta t = 2{,}55\ s$ Total time T/*Totale tyd* = 8 +2,55 ✓ = 10,55 s ✓	$\boldsymbol{E_{Mi} = E_{Mf}}$ $\boldsymbol{W_{nc} = 0}$ $\boldsymbol{W_{net} = \Delta E_K}$ ✓ $\boldsymbol{W_{con} = \Delta E_K}$ $\boldsymbol{\Delta E_K + \Delta E_P = 0}$ $\boldsymbol{E_{Ki} + E_{Pi} = E_{Kf} + E_{Pf}}$ $\boldsymbol{\frac{1}{2}mv_i^2 + mgh_i = \frac{1}{2}mv_f^2 + mgh_f}$ $\boldsymbol{\frac{1}{2}(25)^2 + 0 = 0 + 9{,}8h_f}$ $\Delta x = 31{,}89\ m$ $\Delta x = \frac{(v_i + v_f)}{2}\Delta t$ $31{,}89 = \left(\frac{25+0}{2}\right)\Delta t$ ✓ $\Delta t = 2{,}55\ s$ Total time T/*Totale tyd* = 8 +2,55 ✓ = 10,55 s ✓
OPTION 5/*OPSIE 5*	If values of v_i and v_f are swopped around,and a negative time is obtained, give 1 mark for formula and 1 mark for adding calculated time to 8 s, (max 2/4).
Slope of graph = 9,8 ✓ $= \frac{0-(-25)}{T-8}$ ✓ ✓ Total time T/*Totale tyd* = 10,55 s ✓	

(4)

3.4.1 0,2 s✓ (1)

3.4.2 4,955 s✓✓ (2)

3.4.3 - 27 ($m \cdot s^{-1}$) ✓[Must include the negative/*Moet negatief insluit*] (1)

3.5 Inelastic./*Onelasties*✓
The speeds at which it strikes and leaves the ground are not the same/The kinetic energies will not be the same ✓
Die spoed waarmee dit die grond tref en die grond verlaat is nie dieselfde nie./Die kinetiese energieë sal nie dieselfde wees nie (2)
[16]

QUESTION 4/*VRAAG 4*

4.1 The total linear momentum of a closed (isolated) system remains constant (is conserved). ✓✓
Die totale lineêre momentum in 'n geslote sisteem bly konstant (bly behoue)

OR/*OF*
In an isolated system, the total linear momentum before collision is equal to the total linear momentum after collision ✓✓
In 'n geïsoleerde sisteem is die totale lineêre momentum voor botsing gelyk aan die totale lineêre momentum na botsing.
(If key words isolated and total missing -1 mark for each.) (2)

4.2 $\Sigma p_i = \Sigma p_f$
$m_1v_{1i} + m_2v_{2i} = m_1v_{1f} + m_2v_{2f}$ } Any one/ *Enige een* ✓

For the system cat-skate board **A**/*Vir die sisteem kat-skaatsplank*
$\underline{(3,5)(0) + (2,6)(0)}$ ✓ = $\underline{(3,5)v_{skateboard/skaatsplank} + (2,6)(3)}$ ✓

$v_{skateboard/skaatsplank}$ = 2,23 m·s^{-1}✓ to the left/*na links*✓

ACCEPT/AANVAAR v = -2,23 m·s^{-1}✓✓ (5)

4.3 $F_{net}\,\Delta t = \Delta p = mv_f - mv_i$✓
= (3,5)(1,28 - 0) ✓
= 4,48 N·s (4,48 kg·ms^{-1}) ✓

OR/*OF*
$F_{net}\,\Delta t = \Delta p = mv_f - mv_i$✓
= (2,6)(1,28 - 3) ✓
= -4,48 N·s (4,48 kg·ms^{-1})
∴ Δp = 4,48 N·s✓ (3)
[10]

QUESTION 3/*VRAAG 3*

3.1 Motion under the influence of gravity/weight/gravitational force only. ✓✓
Beweging slegs onder die invloed van gravitasie/gewig/gravitasiekrag.

OR/*OF*
Motion in which the only force considered is gravitational. ✓✓
Beweging waar die enigste krag wat in ag geneem word, gravitasie is. (2)

NOTE:/*LET WEL*
If ONLY is omitted minus 1 mark.
Indien SLEGS uitgelaat is, trek 1 punt af.

3.2

OPTION 1/*OPSIE 1*

UPWARDS AS POSITIVE/*OPWAARTS AS POSITIEF*

$\Delta y = v_i\Delta t + \frac{1}{2} a\Delta t^2$ ✓
$= \frac{(0)(1) + \frac{1}{2}(-9,8)(1^2)}{}$ ✓
$= -4,9$ m
Height/*hoogte* = $2\Delta y$
$= (2)(4,9)$
$= 9,8$ m ✓

DOWNWARDS AS POSITIVE/*AFWAARTS AS POSITIEF*

$\Delta y = v_i\Delta t + \frac{1}{2} a\Delta t^2$ ✓
$= \frac{(0)(1) + \frac{1}{2}(9,8)(1^2)}{}$ ✓
$= 4,9$ m
Height/*hoogte* = $2\Delta y$
$= (2)(4,9)$
$= 9,8$ m ✓

OPTION 2/*OPSIE 2*

UPWARD POSITIVE/*OPWAARTS POSITIEF*	**DOWNWARD POSITIVE/*AFWAARTS POSITIEF***
$v_f = v_i + a\Delta t$ $= 0 + (-9,8)(1)$ $= -9,8\ m\cdot s^{-1}$	$v_f = v_i + a\Delta t$ $= 0 + (9,8)(1)$ $= 9,8\ m\cdot s^{-1}$
$\Delta x = \left(\frac{v_i + v_f}{2}\right)\Delta t$ ✓ $= \left(\frac{0 + (-9,8)}{2}\right)(1)$ ✓ $= -4,9$ m	$\Delta x = \left(\frac{v_i + v_f}{2}\right)\Delta t$ ✓ $= \left(\frac{0 + (9,8)}{2}\right)(1)$ ✓ $= 4,9$ m
Height/*hoogte* = $(2)(4,9)$ $= 9,8$ m ✓	Height/*hoogte* = $(2)(4,9)$ $= 9,8$ m ✓

OPTION 3/*OPSIE 3*	
UPWARD POSITIVE/*OPWAARTS POSITIEF*	**DOWNWARD POSITIVE/*AFWAARTS POSITIEF***
$v_f = v_i + a\Delta t$ $= 0 + (-9,8)(1)$ $= -9,8\ m\cdot s^{-1}$ $v_f^2 = v_i^2 + 2a\Delta y$✓ $(-9,8)^2 = 0 + (2)(-9,8)\Delta y$ ✓ $\Delta y = -4,9\ m$ Height/*hoogte* $= 2\Delta y$ $= (2)(4,9)$ Height/*hoogte* $= 9,8\ m$✓	$v_f = v_i + a\Delta t$ $= 0 + (9,8)(1)$ $= 9,8\ m\cdot s^{-1}$ $v_f^2 = v_i^2 + 2a\Delta y$✓ $(9,8)^2 = 0 + (2)(9,8)\Delta y$ ✓ $\Delta y = 4,9\ m$ Height/*hoogte* $= 2\Delta y$ $= (2)(4,9)$ Height/*hoogte* $= 9,8\ m$✓

OPTION 4/*OPSIE 4*	
UPWARD POSITIVE/*OPWAARTS POSITIEF*	**DOWNWARD POSITIVE/*AFWAARTS POSITIEF***
$v_f = v_i + a\Delta t$ $= 0 + -9,8(1)$ $v_f = -9,8\ m\cdot s^{-1}$	$v_f = v_i + a\Delta t$ $= 0 + 9,8(1)$ $= 9,8\ m\cdot s^{-1}$
$E_{(mech/meg)Top/Bo} = E_{(mech/meg\ at/by\ B)}$ ✓ $(E_p + E_k)_{Top} = (E_p + E_k)_{at\ B}$ $(mgh + \frac{1}{2}mv^2)_{Top/Bo} = (mgh + \frac{1}{2}mv^2)_{at/by\ B}$ $(9,8)(h) + 0 = (9,8)\frac{1}{2}(h) + (\frac{1}{2})(9,8^2)$ ✓ $h = 9,8\ m$ ✓	

OPTION 5/*OPSIE 5*	
UPWARD POSITIVE/*OPWAARTS POSITIEF*	**DOWNWARD POSITIVE/*AFWAARTS POSITIEF***
$v_f = v_i + a\Delta t$ $= 0 + -9,8(1)$ $v_f = -9,8\ m\cdot s^{-1}$	$v_f = v_i + a\Delta t$ $= 0 + 9,8(1)$ $= 9,8\ m\cdot s^{-1}$
$W_{net} = \Delta K$✓ $mg\Delta x\cos\theta = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$ $(9,8)\frac{1}{2}h\cos 0^o = \frac{1}{2}(9,8^2 - 0)$ ✓ $h = 9,8\ m$✓	

OPTION 6/*OPSIE 6*	
UPWARD POSITIVE/*OPWAARTS POSITIEF*	**DOWNWARD POSITIVE/*AFWAARTS POSITIEF***
$v_f = v_i + a\Delta t$ $= 0 + -9,8(1)$ $v_f = -9,8\ m\cdot s^{-1}$	$v_f = v_i + a\Delta t$ $= 0 + 9,8(1)$ $v_f = 9,8\ m\cdot s^{-1}$
$W_{nc} = \Delta K + \Delta U$✓ $0 = (\frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2) + (mg\frac{1}{2}h - mgh)$ $(9,8)(\frac{1}{2}h) = (\frac{1}{2})(9,8^2 - 0)$ ✓ $h = 9,8\ m$✓	

(3)

3.3

OPTION 1/*OPSIE 1*

UPWARDS AS POSITIVE/*OPWAARTS AS POSITIEF*

$v_f^2 = v_i^2 + 2a\Delta y$✓
$= 0 + (2)(-9,8)(-9,8)$ ✓
$v_f = 13,86\ m\cdot s^{-1}$ ✓

DOWNWARDS AS POSITIVE/*AFWAARTS AS POSITIEF*

$v_f^2 = v_i^2 + 2a\Delta y$✓
$= 0 + (2)(9,8)(9,8)$ ✓
$v_f = 13,86\ m\cdot s^{-1}$ ✓

OR/*OF*

FROM POINT B/ *VANAF PUNT B*

UPWARDS AS POSITIVE/*OPWAARTS AS POSITIEF*

$v_f^2 = v_i^2 + 2a\Delta y$✓
$= (-9,8)^2 + (2)(-9,8)(-4,9)$ ✓
$v_f = -13,86\ m\cdot s^{-1}$
Magnitude $= 13,86 m\cdot s^{-1}$✓

DOWNWARDS AS POSITIVE/*AFWAARTS AS POSITIEF*

$v_f^2 = v_i^2 + 2a\Delta y$✓
$= (9,8)^2 + (2)(9,8)(4,9)$ ✓
$v_f = 13,86\ m\cdot s^{-1}$ ✓ (3)

OPTION 2/*OPSIE 2*

$\Delta y = v_i\Delta t + \frac{1}{2} a\Delta t^2$
$-9,8 = 0 + \frac{1}{2}(-9,8)\Delta t^2$
$\Delta t = 1,41$ s

$v_f = v_i + a\Delta t$
$= 0 + (-9,8)(1,41)$ ✓
$= -13,82\ m\cdot s^{-1}$
Magnitude $= 13,82\ m\cdot s^{-1}$ ✓ (3)

1 mark for either of the two/
1 punt vir enige van die twee

3.4

OPTION 1/*OPSIE 1*

POSITIVE MARKING FROM 3.3/*POSITIEWE NASIEN VANAF 3.3*

UPWARDS AS POSITIVE/*OPWAARTS AS POSITIEF*

$v_f^2 = v_i^2 + 2a\Delta y$ ✓
$0 = v_i^2 + (2)(-9,8)(4,9)$ ✓
$v_i = 9,8\ m\cdot s^{-1}$

$F_{net}\Delta t = m\Delta v$
$F_{net}\Delta t = m(v_f - v_i)$ ✓
$F_{net}(0,2)$ ✓ $= 0,4[9,8 - (-13,86)]$ ✓
$F_{net} = 47,32$ N✓

1 mark for any
1 punt vir enige een

UPWARDS AS POSITIVE/*OPWAARTS AS POSITIEF*

$v_f^2 = v_i^2 + 2a\Delta y$✓
$0 = v_i^2 + (2)(9,8)(-4,9)$ ✓
$v_i = -9,8\ m\cdot s^{-1}$

$F_{net}\Delta t = m\Delta v$
$F_{net}\Delta t = m(v_f - v_i)$ ✓

1 mark for any
1 punt vir enige een

$F_{net}(0,2)$ ✓$= 0,4[-9,8 - (13,86)]$✓
$F_{net} = -47,32$ N
$F_{net} = 47,32$ N✓

If calculation of 9,8 $m\cdot s^{-1}$ is not shown and it is substituted **correctly** award 1 mark/*Indien berekening van 9,8 $m\cdot s^{-1}$ nie getoon is nie en dit is **korrek** vervang ken 1 punt toe*

OPTION 2/*OPSIE 2*
POSITIVE MARKING FROM 3.3/ *POSITIEWE NASIEN VANAF 3.3*

$E_{mech\ top/bo} = E_{(mech\ ground/meg\ grond)}$
$(E_p + E_k)_{top} = (E_p + E_k)_{bottom/onder}$
$(mgh + ½\ mv^2)_{top/bo} = (mgh + ½\ mv^2)_{bottom/onder}$ ✓

1 mark for any
1 punt vir enige een

$(0,4)(9,8)(4,9) + 0 = ½(0,4)v_f^2$ ✓
$v_i = 9,8\ m\cdot s^{-1}$

$F_{net}\Delta t = m\Delta v$
$F_{net}\Delta t = m(v_f - v_i)$ ✓

1 mark for any
1 punt vir enige een

$F_{net}(0,2)$ ✓ $= 0,4[9,8 - (-13,86)]$✓
$F_{net} = 47,32$ N✓

If calculation of 9,8 $m\cdot s^{-1}$ is not shown and it is substituted **correctly** award 1 mark/*Indien berekening van 9,8 $m\cdot s^{-1}$ nie getoon is nie en dit is **korrek** vervang ken 1 punt toe*

(6)

OPTION 3/*OPSIE 3*
POSITIVE MARKING FROM 3.3/ *POSITIEWE NASIEN VANAF 3.3*

$v_f = v_i + a\Delta t$ ✓
$9,8 = -13,86$ ✓$+ a(0,2)$ ✓
$a = 118,3\ m\cdot s^{-2}$

$F_{net} = ma$ ✓
$= (0,4)(118,3)$ ✓
$= 47,32$ N ✓

(6)
[14]

QUESTION 3 / *VRAAG 3*

3.1

OPTION 1/*OPSIE 1*	
Upwards positive ***Opwaarts positief:*** $v_f = v_i + a\Delta t$✓ $0 = (12) + (-9,8)(\Delta t)$ ✓ $\Delta t = 1,22$ s✓	**Downwards positive** ***Afwaarts positief:*** $v_f = v_i + a\Delta t$✓ $0 = (-12) + (9,8)(\Delta t)$ ✓ $\Delta t = 1,22$ s✓

OPTION 2/*OPSIE 2*	
Upwards positive ***Opwaarts positief:*** $v_f^2 = v_i^2 + 2a\Delta y$ $0 = 12^2 + 2(-9,8)\Delta y$✓ $\Delta y = 7,35$ $\Delta y = v_i\Delta t + ½\ a\Delta t^2$✓ $7,35 = 12\Delta t + ½\ (-9,8)\Delta t^2$ $\Delta t = 1,22$ s✓	**Downwards positive** ***Afwaarts positief:*** $v_f^2 = v_i^2 + 2a\Delta y$ $0 = (-12)^2 + 2(9,8)\Delta y$✓ $\Delta y = -7,35$ $\Delta y = v_i\Delta t + ½\ a\Delta t^2$✓ $-7,35 = -12\Delta t + ½\ (9,8)\ \Delta t^2$ $\Delta t = 1,22$ s✓

OPTION 3/*OPSIE 3*	
Upwards positive ***Opwaarts positief:*** $v_f^2 = v_i^2 + 2a\Delta y$ $0 = 12^2 + 2(-9,8)\Delta y$✓ $\Delta y = 7,35$ m $\Delta x = \left(\frac{v_i + v_f}{2}\right)\Delta t$ ✓ $7,35 = \frac{(12+0)}{2}\Delta t$ $\Delta t = 1,22$ s✓	**Downwards positive** ***Afwaarts positief:*** $v_f^2 = v_i^2 + 2a\Delta y$ $0 = (-12)^2 + 2(9,8)\Delta y$✓ $\Delta y = -7,35$ m $\Delta x = \left(\frac{v_i + v_f}{2}\right)\Delta t$ ✓ $-7,35 = \frac{(-12+0)}{2}\Delta t$ $\Delta t = 1,22$ s✓

OPTION 4/*OPSIE 4*	
$(E_{mech})_A = (E_{mech})_{top}$ $(½\ mv^2 + mgh)_A = (½\ mv^2 + mgh)_{top}$ $\underline{½m(12)^2} + 0 = 0 + \underline{m(9,8)(h)}$ ✓ $\therefore h = \Delta y = 7,35$ m	$\Delta x = \left(\frac{v_i + v_f}{2}\right)\Delta t$ ✓ $7,35 = \frac{(12+0)}{2}\Delta t$ $\Delta t = 1,22$ s✓
OR/OF $W_{net} = \Delta E_k$ $F_{net}\Delta y\cos\theta = ½\ m(v_f^2 - v_i^2)$ $\underline{m(9,8)\Delta y\cos 180^o} = \underline{½\ m(0^2 - (12)^2)}$✓ $\Delta y = 7,35$ m	
OR/*OF* $\Delta E_p + \Delta E_k = 0$ $mg(h_f - h_i) + ½\ m(v_f^2 - v_i^2) = 0$ $\underline{m(9,8)(h - 0)} + \underline{½(m)(0 - 12^2)} = 0$✓ $\therefore h = \Delta y = 7,35$ m	

OPTION 5/*OPSIE 5*	
Upwards positive ***Opwaarts positief:*** $F_{net}\Delta t = m(v_f - v_i)$ ✓ $mg\Delta t = m(v_f - v_i)$ $(-9,8)\Delta t = (0 - 12)$ ✓ $\Delta t = 1,2245$ s ✓	**Downwards positive** ***Afwaarts positief:*** $F_{net}\Delta t = m(v_f - v_i)$ ✓ $mg\Delta t = m(v_f - v_i)$ $(9,8)\Delta t = (0 - (-12))$ ✓ $\Delta t = 1,2245$ s ✓

OPTION 6/*OPSIE 6*	
Upwards positive ***Opwaarts positief:*** $\Delta y = v_i\Delta t + ½ a\Delta t^2$ ✓ $0 = 12\Delta t + ½ (-9,8)\Delta t^2$ $\Delta t = 2,4490$ s $\Delta t = ½ (2,4490)$✓ $= 1,2245$ s ✓	**Downwards positive** ***Afwaarts positief:*** $\Delta y = v_i\Delta t + ½ a\Delta t^2$ ✓ $0 = -12\Delta t + ½ (9,8)\Delta t^2$ $\Delta t = 2,4490$ s $\Delta t = ½ (2,4490)$ ✓ $= 1,2245$ s ✓

(3)

3.2

OPTION 1/*OPSIE 1*	
Upwards positive ***Opwaarts positief:*** $v_f = v_i + a\Delta t$✓ $\underline{-3v = -v}$✓ + $\underline{(-9,8)(1,22)}$ ✓ $v = 5,98$ m·s^{-1}✓(5,978 – 6,03 m·s^{-1})	**Downwards positive** ***Afwaarts positief:*** $v_f = v_i + a\Delta t$✓ $\underline{3v = v}$✓ + $\underline{(9,8)(1,22)}$ ✓ $v = 5,98$ m·s^{-1}✓(5,978 – 6,03 m·s^{-1})

OPTION 2/*OPSIE 2*	
Upwards positive ***Opwaarts positief:*** $F_{net}\Delta t = m(v_f - v_i)$ ✓ $mg\Delta t = m(v_f - v_i)$ $(-9,8)(1,2245)$✓ = $\underline{-3v - (-v)}$✓ $v = 6,00$ m·s^{-1} ✓	**Downwards positive** ***Afwaarts positief:*** $F_{net}\Delta t = m(v_f - v_i)$ ✓ $mg\Delta t = m(v_f - v_i)$ $(9,8)(1,2245)$✓ = $3v - v$✓ $v = 6,00$ m·s^{-1} ✓

(4)

3.3

OPTION 1/*OPSIE 1*	
Upwards positive ***Opwaarts positief:*** $\Delta y = v_i\Delta t + ½a\Delta t^2$✓ $= \underline{(-5,98)(2,44) + ½(-9,8)(2,44)^2}$✓ $= -43,764$ $\therefore h = 43,76$ m✓ (43,764 – 44,08 m)	Downwards positive *Afwaarts positief:* $\Delta y = v_i\Delta t + ½a\Delta t^2$✓ $= \underline{(5,98)(2,44) + ½(9,8)(2,44)^2}$ ✓ $= 43,764$ $\therefore h = 43,76$ m✓(43,764 – 44,08)

OPTION 2/*OPSIE 2*	
Upwards positive ***Opwaarts positief*** $v_f = v_i + a\Delta t$ $v_f = -5,98 + (-9,8)(2,44)$ $v_f = -29,892\ m\cdot s^{-1}$ $v_f^2 = v_i^2 + 2a\Delta y$ ✓ $(-29,892)^2 = (-5,98)^2 + 2(-9,8)\Delta y$ ✓ $\Delta y = -43,763$ m $\therefore h = 43,76$ m ✓(43,764 – 44,08)	**Downwards positive** ***Afwaarts positief:*** $v_f = v_i + a\Delta t$ $v_f = 5,98 + 9,8(2,44)$ $= 29,892\ m\cdot s^{-1}$ $v_f^2 = v_i^2 + 2a\Delta y$ ✓ $(29,892)^2 = (5,98)^2 + 2(9,8)\Delta y$ ✓ $\Delta y = 43,76$ m $\therefore h = 43,76$ m ✓(43,764 – 44,08)

OPTION 3/*OPSIE 3*	
Upwards positive ***Opwaarts positief*** $v_f = v_i + a\Delta t$ $v_f = -5,98 + (-9,8)(2,44)$ $v_f = -29,892\ m\cdot s^{-1}$ $\Delta x = \left(\frac{v_i + v_f}{2}\right)\Delta t$ ✓ $= \left(\left(\frac{-30 + (-6,00)}{2}\right)(2,4490)\right)$ ✓ $\Delta x = -44,082$ m h = 44,082 m ✓	**Downwards positive** ***Afwaarts positief:*** $v_f = v_i + a\Delta t$ $v_f = 5,98 + 9,8(2,44)$ $= 29,892\ m\cdot s^{-1}$ $\Delta x = \left(\frac{v_i + v_f}{2}\right)\Delta t$ ✓ $= \left(\left(\frac{30 + 6,00}{2}\right)(2,4490)\right)$ ✓ $\Delta x = 44,082$ m h = 44,082 m ✓

OPTION 4/*OPSIE 4*	
Upwards positive ***Opwaarts positief*** **For A/ *Vir A*** $v_f = v_i + a\Delta t$ $-12 = 12 + (-9,8)\Delta t$ $\Delta t = 2,45$ s **For B/ *Vir B*** $\Delta x = v_i\Delta t + ½\ a\Delta t^2$ ✓ $= (-5,98)(2,45) + ½\ (-9,8)(2,45)^2$ ✓ $= -44,06$ m h = 44,06 m ✓	**Downwards positive** ***Afwaarts positief:*** **For A/ *Vir A*** $v_f = v_i + a\Delta t$ $12 = -12 + (9,8)\Delta t$ $\Delta t = 2,45$ s **For B/ *Vir B*** $\Delta x = v_i\Delta t + ½\ a\Delta t^2$ ✓ $= (5,98)(2,45) + ½\ (9,8)(2,45)^2$ ✓ $= 44,06$ m h = 44,06 m ✓

(3)

OPTION 5/*OPSIE 5*	
Upwards positive ***Opwaarts positief*** $\Delta y = v_i\Delta t + ½a\Delta t^2$ ✓ $\Delta y_A = 12\Delta t + ½\ a\Delta t^2$ $\Delta y_B = -6\Delta t + ½\ a\Delta t^2$ $\Delta y_A - \Delta y_B = 12\Delta t - (-6\Delta t)$ $0 - \Delta y_B = 18\Delta t$ ✓ $= 18(2,44)$ $= 43,92$ m h = 43,92 m ✓	**Downwards positive** ***Afwaarts positief:*** $\Delta y = v_i\Delta t + ½a\Delta t^2$ ✓ $\Delta y_A = -12\Delta t + ½\ a\Delta t^2$ $\Delta y_B = 6\Delta t + ½\ a\Delta t^2$ $\Delta y_A - \Delta y_B = 12\Delta t - (-6\Delta t)$ $0 - \Delta y_B = -18\Delta t$ ✓ $= -18(2,44)$ $= 43,92$ m h = 43,92 m ✓

(3)

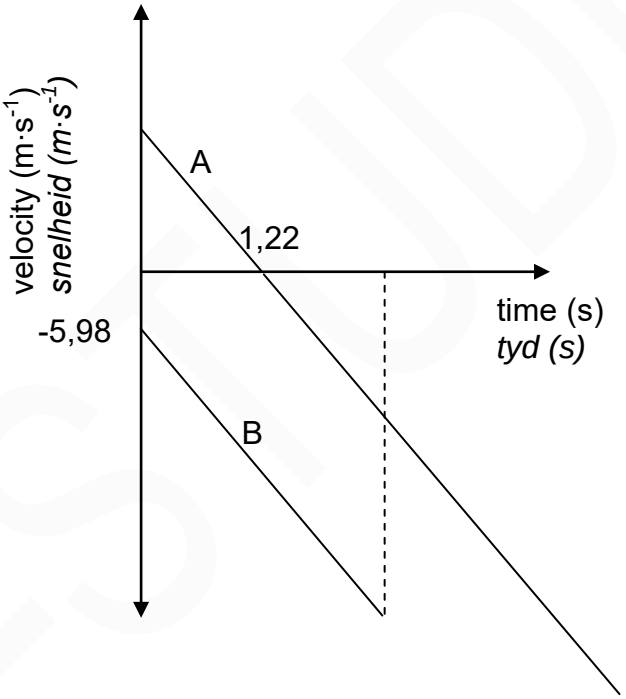
OPTION 6/*OPSIE 6*	
Upwards positive ***Opwaarts positief*** $W_{net} = \Delta E_k$ ✓ $mg\Delta y\cos\theta = ½ m(v_f^2 - v_i^2)$ $\underline{(-9,8)h\cos 0^o} = \underline{½ (-20)^2} - \underline{½ (-6)^2}$ ✓ h = 44,082 m ✓	**Downwards positive** ***Afwaarts positief:*** $W_{net} = \Delta E_k$ ✓ $mg\Delta y\cos\theta = ½ m(v_f^2 - v_i^2)$ $\underline{(9,8)h\cos 0^o} = \underline{½ (20)^2} - \underline{½ (6)^2}$ ✓ h = 44,082 m ✓

OPTION 7/*OPSIE 7*
$(E_p + E_k)_{top/bo} = (E_p + E_k)_{bottom/onder}$ $mgh_i + ½ mv_i^2 = mgh_f + ½ mv_f^2$ ✓ $\underline{(9,8)h} + \underline{½ (6)^2} = (9,8)(0) + ½ (30)^2$ ✓ h = 44,082 m ✓

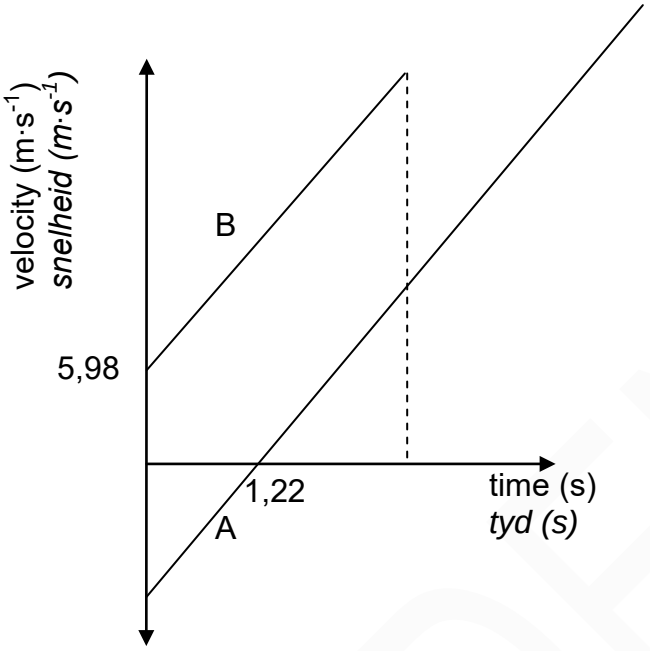
(3)

3.4

UPWARDS AS POSITIVE/*OPWAARTS AS POSITIEF*



DOWNWARDS AS POSITIVE/*AFWAARTS AS POSITIEF*



Criteria for graph/*Kriteria vir grafiek*	**Marks/*Punte***
Time 1,22 s shown **correctly**/*Tyd 1,22 s **korrek** getoon*	✓
Initial velocity for stone B at time t = 0 correctly shown with correct signs / *Aanvanklike snelheid vir klip B korrek met korrekte tekens getoon*	✓
Two sloping parallel lines with A **crossing** the time axis /*Twee skuins parallelle lyne met A wat die tyd-as **kruis***	✓
Straight line graph for A parallel to graph B, extending beyond the time when B hits the ground/ *Reguitlyn grafiek A parallel aan grafiek B verleng verby die tyd wanneer B die grond tref*	✓

(4)
[14]

QUESTION 4 /*VRAAG 4*

4.1 The <u>total</u> linear momentum in an <u>isolated</u>/<u>closed</u> system is constant.✓✓
Die <u>totale</u> liniêre momentum in 'n <u>geïsoleerde</u> <u>(geslote)</u> sisteem is konstant

OR/*OF*
In an <u>isolated</u>/<u>closed</u> system, <u>total</u> linear momentum before collision is equal to <u>total</u> linear momentum after collision. ✓✓
In 'n <u>geïsoleerde (geslote)</u> sisteem is die <u>totale</u> liniêre momentum voor die botsing gelyk aan die <u>totale</u> momentum na die botsing. (2)

4.2 $\Sigma p_i = \Sigma p_f$ ✓

$m_B v_{Bi} + m_b v_{bi} = m_B v_{Bf} + m_b v_{bf}$

$\Delta p_{bullet} = -\Delta p_{block}$
$\underline{(0,015)(400)}$✓ + 0 = $(0,015)v_{Bf}$ + $\underline{2(0,7)}$✓
V_{Bf} = 306,67 (306,666)$m \cdot s^{-1}$✓ (4)

2.2

2.2.1 Any two particles (objects) in the universe will attract each other with a force which is directly proportional to the product of the masses ✓and inversely proportional to the square of the distance between them (their centres). ✓
Enige twee deeltjies (voorwerpe) in die heelal sal mekaar aantrek met 'n krag wat direk eweredig is aan die produk van hul massas en omgekeerd eweredig is aan die kwadraat van die afstand tussen hul (middelpunte). (2)

2.2.2 Increases/*Neem toe*✓

Gravitational force is inversely proportional to the square of the distance between the (centres of the) objects✓
Gravitasiekrag is omgekeerd eweredig aan die kwadraat van die afstand tussen die voorwerpe se middelpunte

OR/*OF*

$F \alpha \frac{1}{r^2}$ ✓

(2)
[18]

QUESTION/*VRAAG 3*

3.1 The only force acting on the ball is the gravitational force. ✓✓
Die enigste krag wat op die bal inwerk is die gravitasiekrag.

OR/*OF*
The only force acting on the ball is its weight.
Die enigste krag wat op die bal inwerk is sy gewig.

ACCEPT/*AANVAAR*
The only force acting on the ball is gravity.
Die enigste krag wat op die bal inwerk is gravitasie. (2)

3.2.1

OPTION 1/*OPSIE 1*	
UPWARDS AS POSITIVE ***OPWAARTS AS POSITIEF*** $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓ $= \frac{(10)(3) + \frac{1}{2}(-9,8)(3^2)}{}$ ✓ $= -14,10$ Height of building = 14,10 m ✓ *Hoogte van gebou = 14,10 m*	**DOWNWARDS AS POSITIVE** ***AFWAARTS AS POSITIEF*** $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓ $= \frac{(-10)(3) + \frac{1}{2}(9,8)(3^2)}{}$ ✓ $= 14,10$ m ✓ Height of building = 14,10 m *Hoogte van gebou = 14,10 m*

OPTION 2/*OPSIE 2*	
UPWARD AS POSITIVE ***OPWAARTS AS POSITIEF*** For maximum height *Vir maksimum hoogte* $v_f = v_i + a\Delta t$ $0 = 10 + (-9,8)\Delta t$ $\Delta t = 1,02$ s Time taken from point A to ground *Tyd geneem vanaf punt A tot grond* $= 3 - 2(1,02) = 0,96$ s $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓ $= \frac{(-10)(0,96) + \frac{1}{2}(-9,8)(0,96^2)}{}$ ✓ $= -14,1184$ Height of building = 14,12 m ✓ *Hoogte van gebou = 14,12 m*	**UPWARD AS NEGATIVE** ***OPWAARTS AS NEGATIEF*** For maximum height *Vir maksimum hoogte* $v_f = v_i + a\Delta t$ $0 = -10 + (9,8)\Delta t$ $\Delta t = 1,02$ s Time taken from point A to ground *Tyd geneem vanaf punt A tot grond* $= 3 - 2(1,02) = 0,96$ s $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓ $= \frac{(10)(0,96) + \frac{1}{2}(9,8)(0,96^2)}{}$ ✓ $= 14,1184$ m ✓ Height of building = 14,12 m *Hoogte van gebou = 14,12 m*

OPTION 3/*OPSIE 3*	
UPWARD AS POSITIVE ***OPWAARTS AS POSITIEF*** $v_f = v_i + a\Delta t$ $= 10 + (-9,8)(3)$ $= -19,40$ $v_f^{\ 2} = v_i^{\ 2} + 2a\Delta y$ ✓ $\underline{(-19,4)^2 = (10)^2 + 2(-9,8)\Delta y}$ ✓ $\Delta y = -14,10$ m Height of building = 14,10 m ✓ *Hoogte van gebou = 14,10 m*	**UPWARD AS NEGATIVE** ***OPWAARTS AS NEGATIEF*** $v_f = v_i + a\Delta t$ $= -10 + (9,8)(3)$ $= 19,40$ $v_f^{\ 2} = v_i^{\ 2} + 2a\Delta y$ ✓ $\underline{(19,4)^2 = (-10)^2 + 2(9,8)\Delta y}$ ✓ $\Delta y = 14,10$ m ✓ Height of building = 14,10 m *Hoogte van gebou = 14,10 m*

OPTION 4/OPSIE 4 **UPWARD AS POSITIVE** ***OPWAARTS AS POSITIEF***	**UPWARD AS NEGATIVE** ***OPWAARTS AS NEGATIEF***
$v_f = v_i + a\Delta t$ $= (-10) + (-9,8)(0,96)$ $= -19,408$ $v_f^{\ 2} = v_i^{\ 2} + 2a\Delta y$✓ $(-19,408)^2 = (10)^2 + 2(-9,8)\Delta y$✓ $\Delta y = 14,12$ m Height of building = 14,12 m✓ *Hoogte van gebou = 14,12 m*	$v_f = v_i + a\Delta t$ $= 10 + (9,8)(0,96)$ $= 19,408$ $v_f^{\ 2} = v_i^{\ 2} + 2a\Delta y$✓ $(19,408)^2 = (-10)^2 + 2(9,8)\Delta y$✓ $\Delta y = 14,12$ m ✓ Height of building = 14,12 m *Hoogte van gebou = 14,12 m*

OPTION 5/*OPSIE 5*	
$W_{net} = \Delta Ek = \Delta K$ $mg\Delta x\cos 0^o = ½\ m(v_f^{\ 2} - v_i^{\ 2})$ $(9,8)\Delta x = ½\ (19,408^2 - 10^2)$ ✓ $\Delta x = 14,12$ m Height of building = 14,12 m✓ *Hoogte van gebou = 14,12 m*	✓any one/*enige een* $v_f = v_i + a\Delta t$ $= 10 + (9,8)(3)$ $= 19,40$

OPTION 6/*OPSIE 6*	
$E_{mechA} = E_{mechB}$ $(E_k + E_p)_A = (E_k + E_p)_B$ $½\ mv^2 + mgh = ½\ mv^2 + 0$ $½(10)^2 + (9,8)h = ½(19,40)^2$ ✓ Height of building = 14,12 m✓ *Hoogte van gebou = 14,12 m*	✓any one/*enige een* $v_f = v_i + a\Delta t$ $= 10 + (9,8)(3)$ $= 19,40$

OPTION 7/*OPSIE 7*	
$W_{nc} = \Delta E_p + \Delta E_k$✓ $0 = mg(h_f - h_i) + ½m(v_f^{\ 2} - v_i^{\ 2})$ $0 = m(9,8)(0 - h_i) + ½m(19,408^2 - 10^2)$ ✓ Height of building = 14,12 m✓ *Hoogte van gebou = 14,12 m*	$v_f = v_i + a\Delta t$ $= 10 + (9,8)(3)$ $= 19,40$

OPTION 8/*OPSIE 8*	
UPWARD AS POSITIVE ***OPWAARTS AS POSITIEF***	**UPWARD AS NEGATIVE** ***OPWAARTS AS NEGATIEF***
$v_f = v_i + a\Delta t$ $= (10) + (-9,8)(3)$ $= -19,40\ m\cdot s^{-1}$ $\Delta y = \frac{v_i + v_f}{2}\ \Delta t$ ✓ $\Delta y = \frac{(10 - 19,40)}{2}\ 3$ ✓ Height of building = 14,12 m✓ *Hoogte van gebou = 14,12 m*	$v_f = v_i + a\Delta t$ $= 10 + (9,8)(3)$ $= 19,40\ m\cdot s^{-1}$ $\Delta y = \frac{v_i + v_f}{2}\ \Delta t$ ✓ $\Delta y = \frac{(-10 + 19,40)}{2}\ 3$ ✓ $\Delta y = 14,12$ m✓ Height of building = 14,12 m *Hoogte van gebou = 14,12 m*

(3)

3.2.2 ***OPTION 1/OPSIE 1***

UPWARDS AS POSITIVE ***OPWAARTS AS POSITIEF***	**DOWNWARDS AS POSITIVE** ***AFWAARTS AS POSITIEF***
$v_f = v_i + a\Delta t$✓ $= \underline{(10) + (-9,8)(3)}$ ✓ $= -19,40\ m\cdot s^{-1}$ Speed = 19,40 $m\cdot s^{-1}$✓ *Spoed = 19,40 $m\cdot s^{-1}$*	$v_f = v_i + a\Delta t$✓ $= \underline{(-10) + (9,8)(3)}$ ✓ $= 19,40\ m\cdot s^{-1}$ ✓ Speed = 19,40 $m\cdot s^{-1}$ *Spoed = 19,40 $m\cdot s^{-1}$*
OPTION 2/OPSIE 2 **UPWARDS AS POSITIVE** ***OPWAARTS AS POSITIEF*** $v_f^2 = v_i^2 + 2a\Delta x$ ✓ $= (-10)^2 + 2(-9,8)(-14,1)$ $v_f = 19,4\ m\cdot s^{-1}$ ✓	 **DOWNWARDS AS POSITIVE** ***AFWAARTS AS POSITIEF*** $v_f^2 = v_i^2 + 2a\Delta x$ ✓ $= (10)^2 + 2(9,8)(14,1)$ ✓ $v_f = 19,4\ m\cdot s^{-1}$ ✓

POSITIVE MARKING FROM QUESTION 3.2.1
POSITIEWE NASIEN VANAF VRAAG 3.2.1
OPTION 3/OPSIE 3

UPWARDS AS POSITIVE ***OPWAARTS AS POSITIEF***	**DOWNWARDS AS POSITIVE** ***AFWAARTS AS POSITIEF***
$\Delta y = \frac{v_i + v_f}{2}\ \Delta t$ ✓ $-14,12 = \frac{(10 + v_f)}{2}\ 3$ ✓ $v_f = 19,41 m\cdot s^{-1}$ Speed = 19,41 $m\cdot s^{-1}$✓ *Spoed = 19,41 $m\cdot s^{-1}$*	$\Delta y = \frac{v_i + v_f}{2}\ \Delta t$ ✓ $+14,12 = \frac{(-10 + v_f)}{2}\ 3$ ✓ $v_f = 19,41 m\cdot s^{-1}$✓ Speed = 19,41 $m\cdot s^{-1}$ *Spoed = 19,41 $m\cdot s^{-1}$*

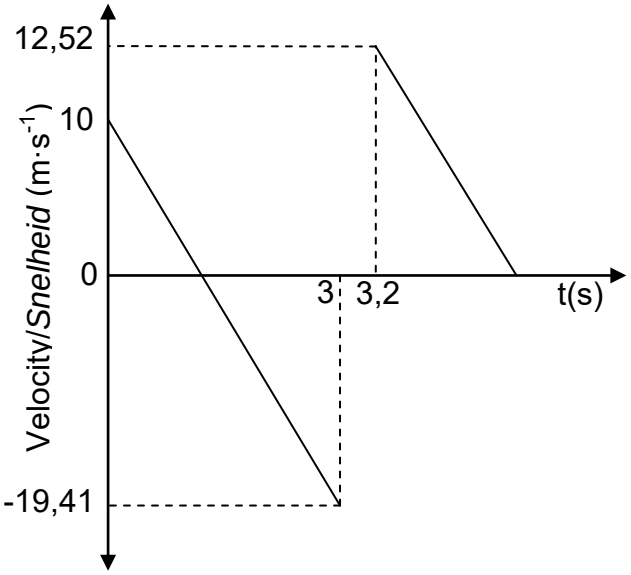
(3)

3.2.3

OPTION 1/*OPSIE 1* **UPWARDS AS POSITIVE** ***OPWAARTS AS POSITIEF***	 **DOWNWARDS AS POSITIVE** ***AFWAARTS AS POSITIEF***
$v_f^2 = v_i^2 + 2a\Delta y$✓ $\underline{0 = v_i^2 + (2)(-9,8)(8)}$ ✓ $v_i = 12,52\ m\cdot s^{-1}$✓ Speed = 12,52 $m\cdot s^{-1}$ *Spoed = 12,52 $m\cdot s^{-1}$*	$v_f^2 = v_i^2 + 2a\Delta y$✓ $\underline{0 = v_i^2 + (2)(9,8)(-8)}$ $v_i = -12,52\ m\cdot s^{-1}$ Speed = 12,52 $m\cdot s^{-1}$ ✓ *Spoed = 12,52 $m\cdot s^{-1}$*
OPTION 2/*OPSIE 2* **UPWARDS AS POSITIVE** ***OPWAARTS AS POSITIEF*** $\Delta x = v_i\Delta t + \frac{1}{2}a\Delta t^2$ $-8 = 0 + \frac{1}{2}(-9,8)\Delta t^2$ $\Delta t = 1,28$ s $v_f = v_i + a\Delta t$ ✓ $0 = v_i + (-9,8)(1,28)$✓ $v_i = 12,52\ m\cdot s^{-1}$✓ Speed = 12,52 $m\cdot s^{-1}$ *Spoed = 12,52 $m\cdot s^{-1}$*	 **DOWNWARDS AS POSITIVE** ***AFWAARTS AS POSITIEF*** $\Delta x = v_i\Delta t + \frac{1}{2}a\Delta t^2$ $8 = 0 + \frac{1}{2}(9,8)\Delta t^2$ $\Delta t = 1,28$ s $v_f = v_i + a\Delta t$ ✓ $0 = v_i + (9,8)(1,28)$✓ $v_i = -12,52\ m\cdot s^{-1}$ Speed = 12,52 $m\cdot s^{-1}$ ✓ *Spoed = 12,52 $m\cdot s^{-1}$*

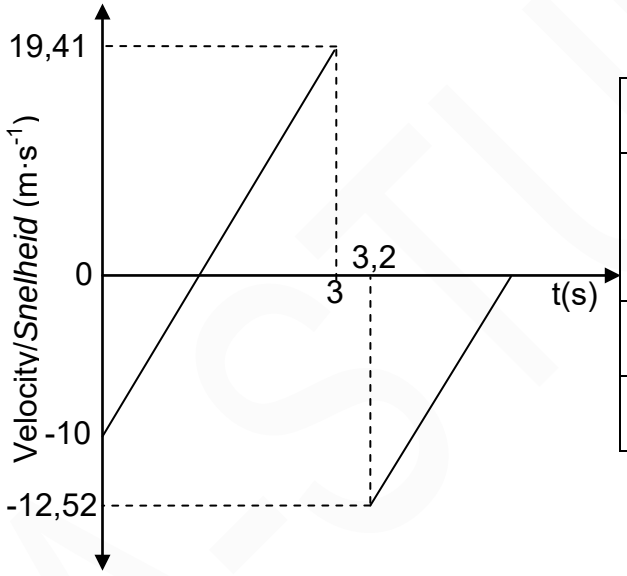
(3)

3.3 **UPWARDS AS POSITIVE/*OPWAARTS AS POSITIEF***



CHECKLIST FOR MARKING ***RIGLYNE VIR NASIEN***	
Each line correctly drawn with calculated velocities. 1 x 2 *Elke lyn korrek geteken met berekende waardes 1 x 2*	✓✓
Mark for lines being parallel *Twee parallelle lyne korrek geteken*	✓
Times 3 s and 3,2 s correctly shown *Tye 3 s en 3,2 s korrek getoon*	✓

3.3 **DOWNWARDS AS POSITIVE/*AFWAARTS AS POSITIEF***



CHECKLIST FOR MARKING ***RIGLYNE VIR NASIEN***	
Each line correctly drawn with calculated velocities. 1 x 2 *Elke lyn korrek geteken met berekende waardes 1 x 2*	✓✓
Mark for lines being parallel *Twee parallelle lyne korrek geteken*	✓
Times 3 s and 3,2 s correctly shown *Tye 3 s en 3,2 s korrek getoon*	✓

(4)
[15]

QUESTION 3/*VRAAG 3*

3.1 (Motion of) an object in which the only force acting is the gravitational force. ✓✓
Beweging van 'n voorwerp waarop die gravitasiekrag die enigste krag is wat op die voorwerp inwerk.

OR/*OF*
(Motion of)an object which has been given an initial velocity and which follows a path *entirely* determined by the effects of gravitational acceleration/force. ✓✓
Beweging van 'n voorwerp waaraan 'n beginsnelheid gegee is en wat 'n baan volg wat deur die effekte van gravitasionele versnelling bepaal word/ gravitasiekrag.

OR/*OF*
The (motion of)an object that is projected, thrown or shot either upwards or downwards into the air and on which the only force considered/acting is gravitational. ✓✓
Die beweging van 'n voorwerp wat geprojekteer word, gegooi word of wat opwaarts geskiet is of afwaarts geskiet is in die lug en waar die enigste krag op die voorwerp inwerk, gravitasie is. (2)

Note/: ***Let Wel*** 2 or/*of* 0

3.2 No/*Nee* ✓
The balloon is not accelerating at the rate of 9,8 $m \cdot s^{-2}$/moving with constant velocity/acceleration is 0 $m \cdot s^{-2}$✓

Die ballon versnel nie teen 9,8 $m \cdot s^{-2}$ nie/beweeg teen konstante snelheid dus is versnelling 0 $m \cdot s^{-2}$ (2)

OR/OF
There are other forces (e.g.,friction) acting on the balloon besides gravity./*Daar is ander kragte wat op die ballon inwerk behalwe (buiten) gravitasie*✓
Net force acting on the balloon is zero/*Die nettokrag (resultante krag) op die ballon is nul*

3.3

OPTION 1/*OPSIE 1*
Upward positive/*Opwaarts positief*
$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2$✓
-22✓ = $(-1,2)\ \Delta t + \frac{1}{2} (-9,8) \Delta t^2$✓
Δt = 2 s✓

Downward positive/*Afwaarts positief*
$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2$✓
22✓ = $(1,2)\ \Delta t + \frac{1}{2} (9,8) \Delta t^2$✓
Δt = 2 s✓

OPTION 2/*OPSIE 2*

Upward positive/*Opwaarts positief*

$v_f^2 = v_i^2 + 2a\Delta y$

$v_f^2 = (-1,2)^2 + (2)(-9,8)(-22)$ ✓

$v_f = -20,8\ m\cdot s^{-1}$

$v_f = v_i + a\Delta t$

$-20,8 = -1,2 + -9,8\Delta t$ ✓

$\Delta t = 2\ s$ ✓

For both equations/*vir beide vergelykings* ✓

Downward positive/*Afwaarts positief*

$v_f^2 = v_i^2 + 2a\Delta y$

$v_f^2 = (1,,2)^2 + (2)(9,8)(22)$ ✓

$v_f = 20,8\ m\cdot s^{-1}$

$v_f = v_i + a\Delta t$

$20,8 = 1,2 + 9,8\Delta t$ ✓

$\Delta t = 2\ s$ ✓

For both equations/*vir beide vergelykings* ✓

OPTION 3/*OPSIE 3*

Upward positive/*Opwaarts positief*

$v_f^2 = v_i^2 + 2a\Delta y$

$v_f^2 = [(-1,2)^2 + (2)(-9,8)(-22)]$ ✓

$v_f = -20,8\ m\cdot s^{-1}$

$\Delta y = \frac{v_i + v_f}{2}\Delta t$

$-22 = \left(\frac{-1.2 + -20,8}{2}\right)\Delta t$ ✓

$\Delta t = 2\ s$ ✓

For both equations/*vir beide vergelykings* ✓

Downward positive/*Afwaarts positief*

$v_f^2 = v_i^2 + 2a\Delta y$

$v_f^2 = [1,2^2 + (2)(9,8)(22)]$ ✓

$v_f = 20,8\ m\cdot s^{-1}$

$\Delta y = \frac{v_i + v_f}{2}\Delta t$

$22 = \left(\frac{1.2 + 20,8}{2}\right)\Delta t$ ✓

$\Delta t = 2\ s$ ✓

For both equations/*vir beide vergelykings* ✓

OPTION 4/ *OPSIE 4*

$(E_{mech})_{Top/Bo} = (E_{mech})_{Ground/Grond}$
$(E_P + E_K)_{Top} = (E_P + E_K)_{Bottom/Onder}$
$(mgh + ½ mv^2)_{Top/Bo} = (mgh + ½ mv^2)_{Bottom/Onder}$
$W_{net} = \Delta E_K$

1 mark for any
1 punt vir enige

$(9,8)(22) + ½ (1,2)^2 = 0 + (½)(v_f{}^2)$ ✓
$v_f = 20,80 \text{ m·s}^{-1}$
$v_f = v_i + a\Delta t$
$20,8 = 1,2 + 9,8\Delta t$✓
$\Delta t = 2$ s✓

NOTES/*AANTEKENINGE*:
Each substitution must include the correct values of 22 m and the velocity of 1,2 m·s^{-1}
Elke vervanging moet die korrekte waardes van 22 m en die snelheid van 1,2 m.s^{-1} insluit.
The values of v_f and v_i can also be used with $F_{net}\Delta t = \Delta p = (p_f - p_i) = (mv_f - mv_i)$ *Die waardes van v_f en v_i kan ook met $F_{net}\Delta t = \Delta p = (p_f - p_i) = (mv_f - mv_i)$ gebruik word.* (4)

3.4

Upward positive/Opwaarts positief
POSITIVE MARKING FROM QUESTION 3.3/*POSITIEWE NASIEN VANAF VRAAG 3.3*

$v_f = v_i + a\Delta t$ ✓
$0 = 15 + (-9,8)\Delta t$✓
$\Delta t = 1,53$ s
Total time elapsed = $2 + 1,53 + 0,3$✓
Totale tyd verstryk = 3,83 s

For addition/*vir optelling*

OR/OF

Displacement of the balloon/
Verplasing van ballon:
$\Delta y = v_i\Delta t + ½ a\Delta t^2$
$= -(1,2)(3,83)$ ✓
$= -4,6$ m
Height /*Hoogte:*
$= 22 - 4,6$✓
$= 17,4$m✓

OR/OF

$y_f = y_i + \Delta y$
$= [22 – (1,2)(3,83)]$✓ ✓
$= 17,4$ m
Height/*Hoogte* = 17,4 m✓

Downward Positive/Afwaarts positief
POSITIVE MARKING FROM QUESTION 3.3/*POSITIEWE NASIEN VANAF VRAAG 3.3*

$v_f = v_i + a\Delta t$ ✓
$0 = -15 + (9,8)\Delta t$✓
$\Delta t = 1,53$ s
Total time elapsed = $\underline{2 + 1,53 + 0,3}$✓
Totale tyd verstryk = 3,83 s

For addition/*vir optelling*

OR/OF

Displacement of the balloon/
Verplasing van ballon:
$\Delta y = v_i\Delta t + \frac{1}{2} a\Delta t^2$
$= (1,2)(3,83)$ ✓
$= 4,6$ m
Height /*Hoogte:*
$= \underline{22 - 4,6}$✓
$= 17,4$m✓

OR/OF

$y_f = y_i + \Delta y$
$= [-22 + (1,2)(3,83)]$✓ ✓
$= -17,4$ m
Height/*Hoogte* = 17,4 m✓

(6)
[14]

QUESTION 4/*VRAAG 4*

4.1 It is the <u>product of the resultant/net force acting on an object</u>✓ and <u>the time the resultant/net force acts on the object</u>. ✓
Dit is die produk van die resulterende/netto krag wat op die voorwerp inwerk en die tyd wat die resulterende/netto krag op die voorwerp inwerk. (2)
NOTE: **ONLY 1 MARK FOR "CHANGE IN MOMENTUM"/*SLEGS 1 PUNT VIR VERANDERING IN MOMENTUM***

4.2.1
$p = mv$✓
$= (0,03)(700)$ ✓
$= 21$ kg·m·s^{-1}✓

Note: 2/3 if $\Delta p = (p_f - p_i) = (mv_f - mv_i)$ is used.
Let Wel: 2/3 indien $\Delta p = (p_f - p_i) = (mv_f - mv_i)$ *gebruik is*. (3)

OPTION 2/*OPSIE 2*	**OPTION 3/*OPSIE 3***
For the 1,5 kg block/*Vir die 1,5 kg blok* $F_{net} = ma$ $F_x + (-T) + (-f_k) = ma$ ✓ $25\cos 30^o - T - f_k = 1{,}5a$ $(25\cos 30^o - T) - 4{,}08$ ✓$= 1{,}5a$ $17{,}571 - T = 1{,}5a$ …….(1) For the 3 kg block *Vir die 3 kg blok* $T - f_k = 3a$ $T - 4{,}41$✓ $= 3a$ ……(2) $35{,}142 - 2T = T - 4{,}41$ $T = 13{,}18$ N ✓ ✓either one *enigeen*	For the 1,5 kg block/*Vir die 1,5 kg blok* $F_{net} = ma$ $F_x + (-T) + (-f_k) = ma$ ✓ $25\cos 30^o - T - f_k = 1{,}5a$ $(25\cos 30^o - T) - 4{,}08$ ✓$= 1{,}5a$ $17{,}571 - T = 1{,}5a$ …….(1) $a = \frac{17{,}571 - T}{1{,}5}$ For the 3 kg block *Vir die 3 kg blok* $T - f_k = 3a$ $T - 4{,}41$✓ $= 3a$ ……(2) $a = \frac{T - 4{,}41}{3}$ $\frac{17{,}571 - T}{1{,}5} = \frac{T - 4{,}41}{3}$ $T = 13{,}18$ N✓ ✓either one *enigeen*

(5)
[18]

QUESTION 3/*VRAAG 3*

3.1 The motion of an object under the influence of gravity/weight/gravitational force only / Motion in which the only force acting is the gravitational force.✓✓
Die beweging van 'n voorwerp slegs onder die invloed van swaartekrag/gewig gravitasiekrag.
Beweging waarin die enigste krag wat op die liggaam inwerk, die gravitasiekrag is. (2)

3.2.1

OPTION 1/*OPSIE 1*	**OPTION 2/*OPSIE 2***
Upwards positive/*Opwaarts positief:*	**Upwards positive/*Opwaarts positief:***
$v_f^2 = v_i^2 + 2a\Delta y$ ✓ $= 0^2 + (2)(-9{,}8)$✓(-20)✓ $v_f = 19{,}80$ m·s^{-1} ✓	$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ $-20 = 0 + \frac{1}{2}(-9{,}8)\Delta t^2$✓ $\Delta t = 2{,}02$ s $v_f = v_i + a\Delta t$ $= 0 + (-9{,}8)(2{,}02)$ ✓ $= -19{,}80$ m·s^{-1} $= 19{,}80$ m·s^{-1} ✓ ✓either one *enigeen*
Downwards positive ***Afwaarts positief*** $v_f^2 = v_i^2 + 2a\Delta y$ ✓ $= 0^2 + (2)(9{,}8)$✓(20)✓ $v_f = 19{,}80$ m·s^{-1}✓	**Downwards positive** ***Afwaarts positief*** $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ $20 = 0 + \frac{1}{2}(9{,}8)\Delta t^2$✓ $\Delta t = 2{,}02$ s $v_f = v_i + a\Delta t$ $= 0 + (9{,}8)(2{,}02)$✓ $= 19{,}80$ m·s^{-1}✓ ✓either one *enigeen*

OPTION 3/*OPSIE 3*
$(E_{mech})_{Top/Bo} = (E_{mech})_{Ground/Grond}$
$(E_P + E_K)_{Top} = (E_P + E_K)_{Bottom/Onder}$
$(mgh + ½ mv^2)_{Top/Bo} = (mgh + ½ mv^2)_{Bottom/Onder}$
$\underline{(9,8)(20) + 0}$✓ = $\underline{(0 + ½v_f^{\ 2})}$✓
$v_f = 19,80\ m\cdot s^{-1}$✓

✓1 mark for any
1 punt vir enige

OPTION 4/*OPSIE 4*
$W_{nc} = \Delta E_p + \Delta E_k$ ✓
$0 = mg\Delta h + ½ m\Delta v^2$
0✓ = $\underline{m(9,8)(0 - 20) + ½ m(v_f^2 - 0)}$ ✓
$v_f = 19,80\ m\cdot s^{-1}$✓

OPTION 5/*OPSIE 5*
$W_{net} = \Delta E_k$ ✓
$mg\Delta x\cos 0^o = ½ m(v_f^2 - 0)$
$\underline{m(9,8)(20)(1)}$✓ = $½ mv_f^2$ ✓
$v_f = 19,80\ m\cdot s^{-1}$✓ (4)

3.2.2 **POSITIVE MARKING FROM QUESTION 3.2.1/*POSITIEWE NASIEN VANAF VRAAG 3.2.1***

OPTION 1/*OPSIE 1*
Downwards positive/*Afwaarts positief*
$v_f = v_i + a\Delta t$ ✓
$\underline{19,80 = 0 + (9,8)\Delta t}$ ✓
$\Delta t = 2,02$ s ✓
Upwards positive/*Opwaarts positief*
$v_f = v_i + a\Delta t$ ✓
$\underline{-19,80 = 0 + (-9,8)\Delta t}$ ✓
$\Delta t = 2,02$ s ✓

OPTION 2/*OPSIE 2*

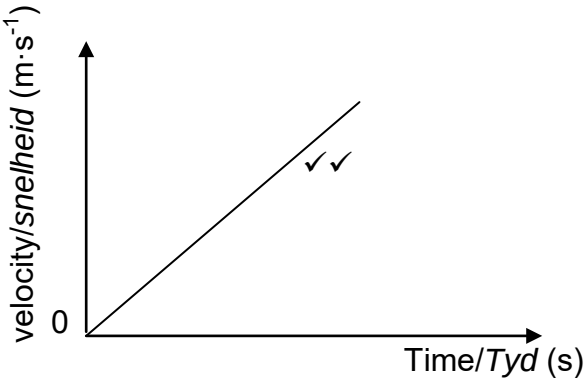
Upwards positive/*Opwaarts positief:*
$\Delta y = v_i\Delta t + ½ a\Delta t^2$✓
$\underline{-20 = 0 + ½ (-9,8)\ \Delta t^2}$✓
$\Delta t = 2,02$ s✓

Downwards Positive/*Afwaarts positief*
$\Delta y = v_i\Delta t + ½ a\Delta t^2$✓
$\underline{20 = 0 + ½ (9,8)\ \Delta t^2}$✓
$\Delta t = 2,02$ s✓

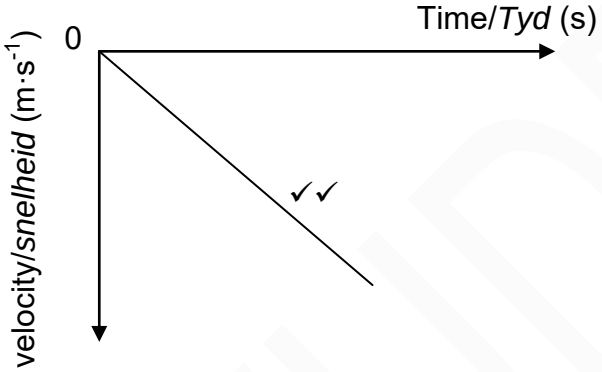
OPTION 3/*OPSIE 3*
Downwards positive/*Afwaarts positief:*
$\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$ ✓
$20 = \left(\frac{0 + 19,80}{2}\right)(\Delta t)$✓
$\Delta t = 2,02$ s✓

Upwards positive/*Opwaarts positief:*
$\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$ ✓
$-20 = \left(\frac{0 - 19,80}{2}\right)(\Delta t)$ ✓
$\Delta t = 2,02$ s✓ (3)

3.3 **Downward positive/*Afwaarts positief***



Upward positive/*Opwaarts positief*



Notes/*Aantekeninge*

✓✓	Straight line through the origin. *Reguitlyn deur die oorsprong*

(2)
[11]

QUESTION 3/*VRAAG 3*

3.1

3.1.1

OPTION 1/*OPSIE 1*

Upwards positive/*Opwaarts positief*:

$v_f^2 = v_i^2 + 2a\Delta y$ ✓

$v_f^2 = (-2)^2 + 2(-9,8)(-45)$ ✓

$v_f = 29,76\ m\cdot s^{-1}$ ✓

Downwards positive/*Afwaarts positief:*

$v_f^2 = v_i^2 + 2a\Delta y$ ✓

$v_f^2 = (2)^2 + 2(9,8)(45)$ ✓

$v_f = 29,76\ m\cdot s^{-1}$ ✓ $(29,77\ m\cdot s^{-1})$

OPTION 2/*OPSIE 2*

Upwards positive/*Opwaarts positief*:

$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓

for either equation/*vir beide vergelykings*

$-45 = -2\Delta t + \frac{1}{2}(-9,8)\Delta t^2$

$-4,9\ \Delta t^2 - 2\Delta t + 45 = 0$

$4,9\ \Delta t^2 + 2\Delta t - 45 = 0$ ✓

$\Delta t = 2,83$

$v_f = v_i + a\ \Delta t$

$v_f = 0 + (-9,8)(2,83)$

$v_f = -29,73\ m\ s^{-1}$ ✓

Downwards positive/*Afwaarts positief:*

$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓

for either equation/*vir beide vergelykings*

$45 = 2\Delta t + \frac{1}{2}(9,8)\Delta t^2$

$4,9\ \Delta t^2 + 2\Delta t - 45 = 0$ ✓

$\Delta t = 2,83$

$v_f = v_i + a\ \Delta t$

$v_f = 0 + (9,8)(2,83)$

$v_f = 29,73\ m\ s^{-1}$ ✓

OPTION 3/*OPSIE 3*

Downwards positive/*Afwaarts positief:*

$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓

for either equation/*vir beide vergelykings*

$45 = 2\Delta t + \frac{1}{2}(9,8)\Delta t^2$

$4,9\ \Delta t^2 + 2\Delta t - 45 = 0$ ✓

$\Delta t = 2,83$

$\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$

$45 = \frac{2 + v_f}{2}\ 2,83$

$v_f = 29,80 m\ s^{-1}$ ✓

Upwards positive/*Opwaarts positief*:

$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓

for either equation/*vir beide vergelykings*

$-45 = -2\Delta t + \frac{1}{2}(-9,8)\Delta t^2$

$-4,9\ \Delta t^2 - 2\Delta t + 45 = 0$

$4,9\ \Delta t^2 + 2\Delta t - 45 = 0$ ✓

$\Delta t = 2,83$

$\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$

$-45 = \frac{-2 + v_f}{2}\ 2,83$ ✓

$v_f = -29,80 m\ s^{-1}$ ✓

OPTION 4/*OPSIE 4*

$E_{mech\ at\ top} = E_{\ mech\ at\ surface\ of\ water}$

$\frac{1}{2} mv_i^2 + mgh_i = \frac{1}{2} mv_f^2 + mgh_f$ ✓

$\frac{1}{2}(2)^2 + 9{,}8(45) = \frac{1}{2} v_f^2 + 0$ ✓

$v_f = 29{,}76\ m{\cdot}s^{-1}$ ✓

OPTION 5/OPSIE 5

$W_{net} = \Delta K$ ✓

$F_g \Delta h \cos\theta = \frac{1}{2} m (v_f^2 - v_i^2)$

$mg \Delta h \cos\theta = \frac{1}{2} m (v_f^2 - v_i^2)$

$9{,}8(45)\cos 0 = \frac{1}{2} (v_f^2 - 2^2)$ ✓

$v_f = 29{,}76\ m{\cdot}s^{-1}$ ✓ (3)

3.1.2

POSITIVE MARKING FROM 3.1
POSITIEWE NASIEN VANAF 3.1

OPTION 1/*OPSIE 1*

Upwards positive/*Opwaarts positief*:

The balls hit the water at the same instant./*Die balle tref die water gelyktydig*

$v_f = v_i + a\Delta t$ ✓

Ball/*Bal* **A**

$-29{,}76 = -2 + (-9{,}8)\ \Delta t$`

$\Delta t = 2{,}83$ s ✓

∴ for ball/*vir bal* **B**

$\Delta t_B = 2{,}83 - 1 = 1{,}83$ s

∴ for ball/*vir bal* **B**

$\Delta t_B = 2{,}83 - 1 = 1{,}83$ s ✓

POSITIVE MARKING FROM 3.1
POSITIEWE NASIEN VANAF 3.1

OPTION1/*OPSIE 1*

Downwards positive/*Afwaarts positief*

The balls hit the water at the same instant./*Die balle tref die water gelyktydig*

$v_f = v_i + a\Delta t$ ✓

Ball/*Bal* **A**

$29{,}76 = 2 + (9{,}8)\ \Delta t$`

$\Delta t = 2{,}83$ s ✓

∴ for ball/*vir bal* **B**

$\Delta t_B = 2{,}83 - 1 = 1{,}83$ s

∴ for ball/*vir bal* **B**

$\Delta t_B = 2{,}83 - 1 = 1{,}83$ s ✓

OPTION 2

Upwards positive/*Opwaarts positief*:

Ball/*Bal* A

$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2$ ✓

$-45 = -2\Delta t + \frac{1}{2}(-9{,}8)\Delta t^2$

$-4{,}9\ \Delta t^2 - 2\Delta t + 45 = 0$

$4{,}9\ \Delta t^2 + 2\Delta t - 45 = 0$

$\Delta t = 2{,}83$ ✓

∴ for ball/*vir bal* **B**

$\Delta t_B = 2{,}83 - 1 = 1{,}83$ s ✓

Downwards positive/*Afwaarts positief:*

$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2$ ✓

$45 = 2\Delta t + \frac{1}{2}(9{,}8)\Delta t^2$

$4{,}9\ \Delta t^2 + 2\Delta t - 45 = 0$

$\Delta t = 2{,}83$ ✓

∴ for ball/*vir bal* **B**

$\Delta t_B = 2{,}83 - 1 = 1{,}83$ s ✓

OPTION 3 **Downwards positive/*Afwaarts positief:*** Ball/*Bal* A $\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$ ✓ $45 = \frac{2 + 29,76}{2}\ \Delta t$ $\Delta t = 2,83$ ✓ ∴ for ball/*vir bal* **B** $\Delta t_B = 2,83 - 1 = 1,83$ s ✓	**Upwards positive/*Opwaarts positief*:** Ball/*Bal* A $\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$ ✓ $-45 = \frac{-2 - 29,76}{2}\ \Delta t$ $\Delta t = 2,83$ ✓ ∴ for ball/*vir bal* **B** $\Delta t_B = 2,83 - 1 = 1,83$ s ✓

(3)

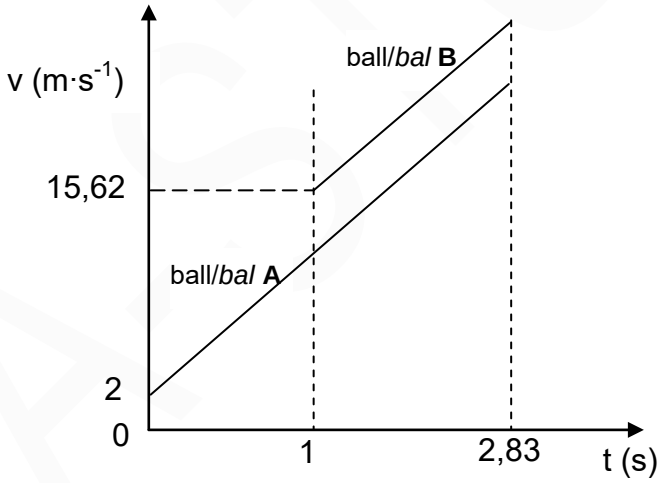
3.1.3

POSITIVE MARKING FROM 3.2/*POSITIEWE NASIEN VANAF 3.2* **Upwards positive/*Opwaarts positief*:** $\Delta t_B = 1.83$s ✓ $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓ -45 ✓ $= v_i\ (1,83) + \frac{1}{2}\ (-9.8)(1,83)^2$ ✓ $v_i = -15,62\ m{\cdot}s^{-1}$ ✓	**Downwards positive/*Afwaarts positief:*** $\Delta t_B = 1.83$s ✓ $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓ 45 ✓ $= v_i\ (1,83) + \frac{1}{2}\ (9.8)(1,83)^2$ ✓ $v_i = 15,62\ m{\cdot}s^{-1}$ ✓

(5)

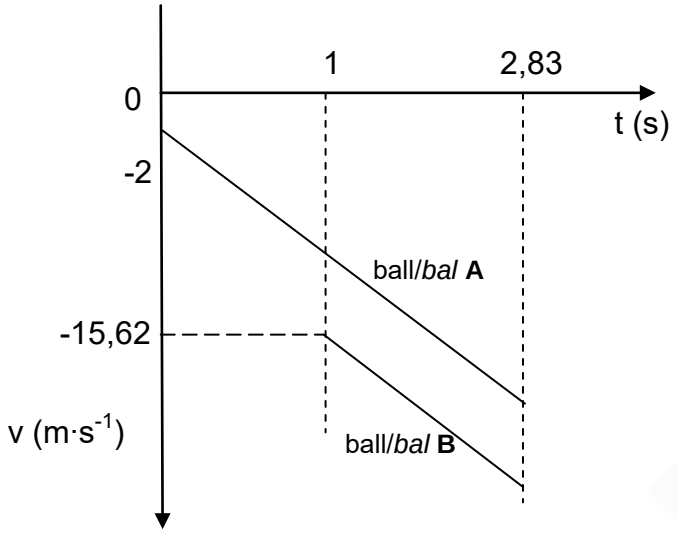
3.2

POSITIVE MARKING FROM 3.1.2; 3.1.3/*POSITIEWE NASIEN VANAF 3.1.2; 3.1.3*
CONSIDER MOTION DOWNWARD AS POSITIVE/*BESKOU BEWEGING AFWAARTS AS POSITIEF*



CRITERIA FOR MARKING/*KRITERIA VIR NASIEN*	
1 mark for each initial velocity shown/*1 punt vir elke beginsnelheid aangedui* (For/*Vir* A 2 $m{\cdot}s^{-1}$ for/*vir* B 15,62 $m{\cdot}s^{-1}$)	✓✓
Time of release of ball/*Tyd van vrystelling van bal* **B** t= 1s	✓
Time of flight for both balls must be indicated as same on time axis/*Vlugtyd van beide balle moet op dieselfde tydas aangetoon word* (2,83 s)	✓
Shape: Lines must be parallel or nearly so/*Vorm: Lyne moet parallel of amper parallel wees*	✓

CONSIDER MOTION UPWARD AS POSITIVE/*BESKOU OPWAARTSE BEWEGING AS POSITIEF*



CRITERIA FOR MARKING/*KRITERIA VIR NASIEN*	
1 mark for each initial velocity shown/*1 punt vir elke beginsnelheid aangedui* (For/*Vir* A -2 m·s^{-1} for/*vir* B -15,62 m·s^{-1})	✓✓
Time of release of ball/*Tyd van vrystelling van bal* **B** t= 1s	✓
Time of flight for both balls must be indicated as same on time axis/*Vlugtyd van beide balle moet op dieselfde tydas aangetoon word* (2,83 s)	✓
Shape: Lines must be parallel or nearly so/*Vorm: Lyne moet parallel of amper parallel wees*	✓

(5)
[16]

QUESTION/*VRAAG 3*

3.1 An object upon which the only force✓ acting is the force of gravity.✓
'n Voorwerp waarop die enigste krag wat inwerk, swaartekrag is

ACCEPT/AANVAAR
An object that falls freely ✓with an acceleration of (g) 9,8 $m \cdot s^{-2}$ ✓
'n Voorwerp wat vryval met 'n versnelling van (g) 9,8 $m \cdot s^{-2}$

An object that is launched ✓(or synonyms) with an initial velocity under the influence of the force of gravity.✓
'n Voorwerp wat met 'n beginsnelheid geprojekteer ✓(of sinonieme) word onder die invloed van die gravitasiekrag✓ (2)

3.2.1

OPTION 1/*OPSIE 1*	
Upward positive ***Opwaarts positief***	**Downward positive** ***Afwaarts positief***
$v_f = v_i + a\Delta t$ ✓ $-30 = 30$✓ + $(-9,8)\Delta t$✓ $\Delta t = 6,12$ s✓	$v_f = v_i + a\Delta t$ ✓ $30 = -30$✓ + $(9,8)\Delta t$✓ $\Delta t = 6,12$ s✓

OPTION 2/*OPSIE 2*	
Upward positive ***Opwaarts positief***	**Downward positive** ***Afwaarts positief***
$v_f = v_i + a\Delta t$ ✓ $0 = 30$✓ + $(-9,8)\Delta t$✓ $\Delta t = 3,06$ s Total time/*Totale tyd* = (2)(3,06) = 6,12 s ✓	$v_f = v_i + a\Delta t$ ✓ $0 = -30$✓ + $(9,8)\Delta t$✓ $\Delta t = 3,06$ s Total time/*Totale tyd* = (2)(3,06) = 6,12 s ✓

OPTION 3/*OPSIE 3*	
Upward positive ***Opwaarts positief***	**Downward positive** ***Afwaarts positief***
$\Delta y = v_i\Delta t + ½ a\Delta t^2$✓ $0 = (30)\ \Delta t$✓ +½ $(-9,8)\Delta t^2$✓ $\Delta t = 6,12$ s✓	$\Delta y = v_i\Delta t + ½ a\Delta t^2$✓ $0 = (-30)\ \Delta t$✓ +½ $(9,8)\Delta t^2$✓ $\Delta t = 6,12$ s✓

OPTION 4/*OPSIE 4*	
Upward positive ***Opwaarts positief***	**Downward positive** ***Afwaarts positief***
$F_{net}\Delta t = \Delta p = (mv_f - mv_i)$✓ $mg\Delta t = m(v_f - v_i)$ $9,8\Delta t$✓ = (30-(-30))✓ $\Delta t = 6,12$ s✓	$F_{net}\Delta t = \Delta p = (mv_f - mv_i)$✓ $mg\Delta t = m(v_f - v_i)$ $-9,8\Delta t$ ✓= (-30-30)✓ $\Delta t = 6,12$ s✓

OPTION 5/*OPSIE 5*	
Upward positive ***Opwaarts positief*** From top to bottom/*Van bo na onder* $v_f = v_i + a\Delta t$ ✓ $-\underline{30 = 0}$ ✓$+ (-9,8)\Delta t$✓ $\Delta t = 3,06$ s Total time/totale tyd = 2(3,06) = 6,12 s✓	**Downward positive** ***Afwaarts positief*** From top to bottom/*Van bo na onder* $v_f = v_i + a\Delta t$ ✓ $\underline{30 = 0}$✓ $+ (9,8)\Delta t$✓ $\Delta t = 3,06$ s Total time/totale tyd = 2(3,06) = 6,12 s✓

(4)

3.2.2

POSITIVE MARKING FROM QUESTION 3.2.1 /*POSITIEWE NASIEN VANAF VRAAG 3.2.1*

OPTION 1/*OPSIE 1*
Upward positive/*Opwaarts positief*

$\Delta y = v_i\Delta t + \frac{1}{2} a\Delta t^2$
$\Delta y_{last} = \Delta y_{(6,12)} - \Delta y_{(5,12)}$ ✓

$= \{30(6,12) + \frac{1}{2}(-9,8)(6,12)^2\}$✓ $- \{30\ \underline{(5,12) + \frac{1}{2}(-9,8)(5,12)^2}\}$✓
$= -25,076$
Distance/*Afstand* = $|\Delta y| = 25,08$ m✓

OR/*OF*

POSITIVE MARKING FROM QUESTIONS 3.2.1
POSITIEWE NASIEN VANAF VRAAG 3.2.1
Downward positive/*Afwaarts positief*

$\Delta y = v_i\Delta t + \frac{1}{2} a\Delta t^2$
$\Delta y_{last} = \Delta y_{(6,12)} - \Delta y_{(5,12)}$ ✓

$= \{-30(6,12) + \frac{1}{2}(9,8)(6,12)^2\}$✓ $- \{-30(5,12) + \frac{1}{2}(9,8)(5,12)^2\}$✓
$= 25,076$
Distance/*Afstand* = $|\Delta y| = 25,08$ m✓

OPTION 2/*OPSIE 2* **Upward positive** **Opwaarts positief** $v_f = v_i + a\Delta t$ $= 0 + (-9,8)(2,06)$ ✓ $= -20,188\ m\cdot s^{-1}$ $\Delta y = v_i\Delta t + ½\ a\Delta t^2$ ✓ $= \underline{(-20,188)(1) + ½\ (-9,8)(1)^2}$ ✓ $= -25,09$ m Distance /*Afstand* = $\lvert\Delta y\rvert$ = 25,09 m ✓ **OR/*OF*** $\Delta y = \left(\frac{v_f + v_i}{2}\right)\Delta t$ ✓ $= \left(\frac{-20,188 + (-30)}{2}\right)(1)$ ✓ $= -25,09$ m Distance /*Afstand* = $\lvert\Delta y\rvert$ = 25,09 m ✓ **OR/*OF*** $v_f^2 = v_i^2 + 2a\Delta x$ ✓ $\underline{(-30)^2 = (-20,188)^2 + 2(-9,8)\Delta x}$ ✓ $\Delta x = -25,12$ m Distance /*Afstand* = $\lvert\Delta y\rvert$ = 25,12 m ✓	**Downward positive** **Afwaarts positief** $v_f = v_i + a\Delta t$ $= 0 + (9,8)(2,06)$ ✓ $= 20,188\ m\cdot s^{-1}$ $\Delta y = v_i\Delta t + ½\ a\Delta t^2$ ✓ $= \underline{(20,188)(1) + ½\ (9,8)(1)^2}$ ✓ $= 25,09$ m Distance /*Afstand* = $\lvert\Delta y\rvert$ = 25,09 m ✓ **OR/*OF*** $\Delta y = \left(\frac{v_f + v_i}{2}\right)\Delta t$ ✓ $= \left(\frac{20,188 + 30}{2}\right)(1)$ ✓ $= 25,09$ m Distance /*Afstand* = $\lvert\Delta y\rvert$ = 25,09 m ✓ **OR/*OF*** $v_f^2 = v_i^2 + 2a\Delta x$ ✓ $\underline{(30)^2 = (20,188)^2 + 2(9,8)\Delta x}$ ✓ $\Delta x = 25,12$ m Distance /*Afstand* = $\lvert\Delta y\rvert$ = 25,12 m ✓
OPTION 3/*OPSIE 3* $v_f = v_i + a\Delta t$ $= 0 + (-9,8)(2,06)$ ✓ $= -20,188\ m\cdot s^{-1}$ $\Delta y = \left(\frac{v_f + v_i}{2}\right)\Delta t$ ✓ $= \left(\frac{-20,188 + 30}{2}\right)(5,12)$ ✓ $= 25,12$ m Distance /*Afstand* = $\lvert\Delta y\rvert$ = 25,12 m ✓	$v_f = v_i + a\Delta t$ $= 0 + (9,8)(2,06)$ ✓ $= 20,188\ m\cdot s^{-1}$ $\Delta y = \left(\frac{v_f + v_i}{2}\right)\Delta t$ ✓ $= \left(\frac{20,188 - 30}{2}\right)(5,12)$ ✓ $= -25,12$ m Distance /*Afstand* = $\lvert\Delta y\rvert$ = 25,12 m ✓

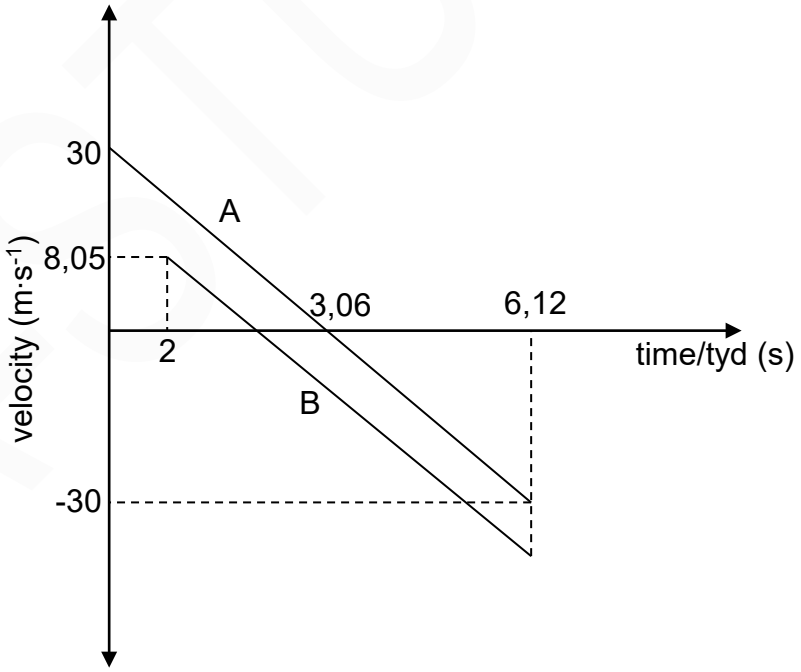
OPTION 4/*OPSIE* 4		
Upward positive **Opwaarts positief** Distance travelled in the first second = distance travelled in the last second *Afstand afgelê in die eerste sekonde = afstand afgelê in laaste sekonde* $\Delta y = v_i\Delta t + \frac{1}{2}\Delta t^2$ ✓ $= (30)(1) + \frac{1}{2}(-9,8)(1)^2$ ✓ $= 25,1$ m ✓ Distance /*Afstand* = $\lvert\Delta y\rvert$ = 25,1 m ✓	**Downward positive** **Afwaarts positief** Distance travelled in the first second = distance travelled in the last second *Afstand afgelê in die eerste sekonde = afstand afgelê in laaste sekonde* $\Delta y = v_i\Delta t + \frac{1}{2}\Delta t^2$✓ $= (-30)(1) + \frac{1}{2}(9,8)(1)^2$ ✓ $= -25,1$ m ✓ Distance /*Afstand* = $\lvert\Delta y\rvert$ = 25,1 m ✓	(4)

3.3

POSITIVE MARKING FROM QUESTION 3.2.1 ***POSITIEWE NASIEN VANAF VRAAG 3.2.1***		
Upward positive ***Opwaarts positief***	**Downward positive** ***Afwaarts positief***	
$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$✓ -50✓$= [v_i(4,12)] + [\frac{1}{2}(-9,8)(4,12)^2]$✓ $v_i = 8,05$ m·s^{-1} speed/*spoed* = 8,05 m·s^{-1}✓	$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$✓ 50✓$= v_i(4,12) + [\frac{1}{2}(9,8)(4,12)^2]$✓ $v_i = -8,05$ m·s^{-1} speed/*spoed* = 8,05 m·s^{-1}✓	(4)

3.4

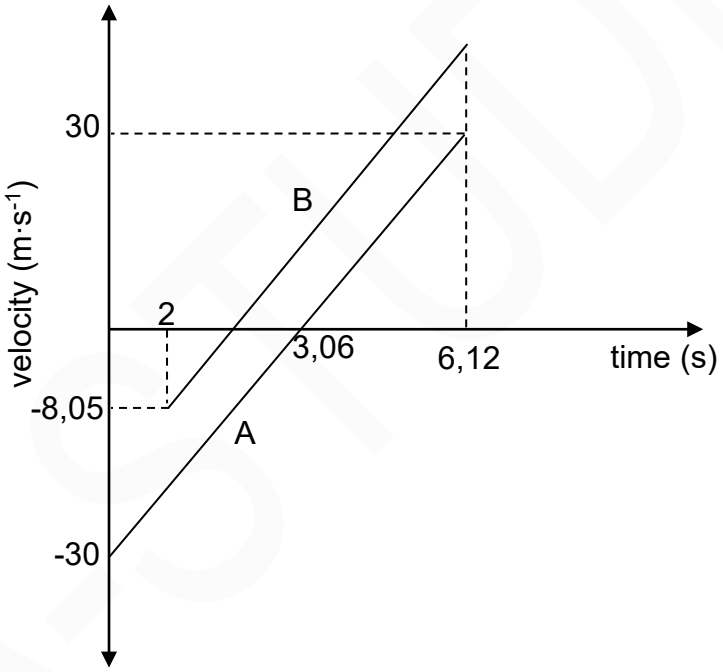
POSITIVE MARKING FROM QUESTIONS 3.2.1 AND 3.2.2 ***POSITIEWE NASIEN VANAF VRAAG 3.2.1 EN 3.2.2*** **Upward positive/ *Opwaarts positief***



Criteria/*Kriteria*	**Marks/*Punte***
Correct shape of A *Korrekte vorm van A*	✓
Correct shape of Graph B parallel to A below A *Korrekte vorm van Grafiek parallel met A onder A*	✓
Time at which both A and B reach the ground (6,12 s) *Tyd wat beide A en B die grond bereik (6,12 s)*	✓
Time for A to reach the maximum height (3,06 s) shown *Tyd vir A om maksimum hoogte te bereik (3,06 s) aangedui*	✓

NOTE/*LET WEL*
Do not penalise if velocities are not indicated
Moenie penaliseer indien snelhede nie aangedui is nie

3.4 **POSITIVE MARKING FROM QUESTIONS 3.2.1 AND 3.2.2**
POSITIEWE NASIEN VANAF VRAAG 3.2.1 EN 3.2.2
Downward positive/*Afwaarts positief*



Criteria/*Kriteria*	**Marks/*Punte***
Correct shape of A *Korrekte vorm van A*	✓
Correct shape of Graph B parallel to A above A *Korrekte vorm van Grafiek parallel met A bo A*	✓
Time at which both A and B reach the ground (6,12 s) *Tyd wat beide A en B die grond bereik (6,12 s)*	✓
Time for A to reach the maximum height (3,06 s) shown *Tyd vir A om maksimum hoogte te bereik (3,06 s) aangedui*	✓

(4)
[18]

QUESTION 3/*VRAAG 3*

3.1.

OPTION 1/*OPSIE 1*	
Upwards positive/*Opwaarts positief:*	**Downwards positive/*Afwaarts positief:***
$v_f = v_i + a\Delta t$✓ -16✓ = $\underline{16 - 9{,}8(\Delta t)}$ ✓ Δt = 3,27s✓	$v_f = v_i + a\Delta t$✓ 16✓ = $\underline{-16 + 9{,}8(\Delta t)}$ ✓ Δt = 3,27s✓

(4)

OPTION 2/*OPSIE 2*	
Upwards positive/*Opwaarts positief:*	**Downwards positive/*Afwaarts positief:***
$v_f = v_i + a\Delta t$✓ To the top/*By bopunt*: 0✓ = $\underline{16 - 9{,}8(\Delta t)}$ ✓ Δt = 1,63s Total time/*Totale tyd* = 1,63 x 2 = 3,26(7) s✓	$v_f = v_i + a\Delta t$✓ To the top/*By bopunt*: 0✓ = $\underline{-16 + 9{,}8(\Delta t)}$ ✓ Δt = 1,63s Total time/*Totale tyd* = 1,63 x 2 = 3,26(7) s✓

(4)

3.1

OPTION 3/*OPSIE 3*	
Upwards positive/*Opwaarts positief:*	**Downwards positive/*Afwaarts positief:***
$\Delta y = v_i\Delta t + \frac{1}{2} a\Delta t^2$✓ 0✓ = $\underline{16\Delta t + \frac{1}{2}(-9{,}8)\Delta t^2}$✓ $\Delta t(16 - 4{,}9\Delta t) = 0$ Δt = 0 or/*of* 3,27 s Time taken/*Tyd geneem* = 3,27 s (accept/*aanvaar* 3,26 s) ✓	$\Delta y = v_i\Delta t + \frac{1}{2} a\Delta t^2$✓ 0✓ = $\underline{-16\Delta t + \frac{1}{2}(9{,}8)\Delta t^2}$✓ $\Delta t(-16 + 4{,}9\Delta t) = 0$ Δt = 0 or/*of* 3,27 s Time taken/*Tyd geneem* = 3,27 s (accept/*aanvaar* 3,26 s) ✓

(4)

OPTION 4/*OPSIE 4*	
Upwards positive/*Opwaarts positief:*	**Downwards positive/*Afwaarts positief:***
$v_f^2 = v_i^2 + 2a\Delta y$ At highest point/*By hoogste punt* $\underline{0 = 16^2 + 2(-9{,}8)\Delta y}$✓ Δy = 13,06 m $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$✓ $\underline{13{,}06 = 16\Delta t - 4{,}9\Delta t^2}$✓ Δt =1,62 or 1,65 Total time/*Totale tyd* = (1,62/1,65)x2 = 3,24 s✓or/*of* 3,3 s	$v_f^2 = v_i^2 + 2a\Delta y$ At highest point/*By hoogste punt* $\underline{0 = (-16)^2 + 2(9{,}8)\Delta y}$✓ Δy = 13,06 m $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$✓ $\underline{13{,}06 = -16\Delta t + 4{,}9\Delta t^2}$✓ Δt =1,62 or 1,65 Total time/*Totale tyd* = (1,62/1,65) x 2 = 3,24 s✓or/*of* 3,3 s

(4)

OPTION 5/*OPSIE 5* **Upwards positive/*Opwaarts positief:***	**Downwards positive/*Afwaarts positief:***
$v_f^2 = v_i^2 + 2a\Delta y$ At highest point/*By hoogste punt* $0 = 16^2 + 2(-9,8)\Delta y$✓ $\Delta y = 13,06$ m $\Delta y = \left(\frac{v_f + v_i}{2}\right)\Delta t$ ✓ $13,06 = \left(\frac{0+16}{2}\right)\Delta t$ ✓ $\Delta t = 1,63$ s Total time/*totale tyd* = 3,26 s✓	$v_f^2 = v_i^2 + 2a\Delta y$ At highest point/*By hoogste punt* $0 = (-16)^2 + 2(9,8)\Delta y$✓ $\Delta y = -13,06$ m $\Delta y = \left(\frac{v_f + v_i}{2}\right)\Delta t$ ✓ $-13,06 = \left(\frac{0-16}{2}\right)\Delta t$ ✓ $\Delta t = 1,63$ s Total time/*totale tyd* = 3,26 s✓

(4)

3.1

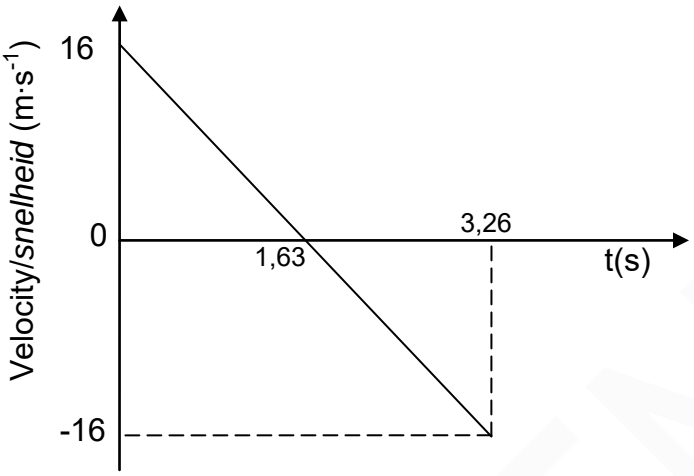
OPTION 6 /*OPSIE 6* **Upwards positive/*Opwaarts positief:***	**Downwards positive/*Afwaarts positief:***
$F_{net}\ \Delta t = \Delta p$✓ $mg\ \Delta t = m\ (v_f - v_i)$ $-9,8\Delta t$ ✓= $(0 - 16)$ ✓ $\Delta t = 1,63$ s Total time/*Totale tyd* = (1,63)(2) = 3,26 s✓	$F_{net}\ \Delta t = \Delta p$✓ $mg\ \Delta t = m\ (v_f - v_i)$ $9,8\Delta t$ ✓= $\{0 – (-16)\}$ ✓ $\Delta t = 1,63$ s Total time/*Totale tyd* = (1,63)(2) = 3,26 s✓

(4)

OPTION 7 /*OPSIE 7* **Upwards positive/*Opwaarts positief:***	**Downwards positive/*Afwaarts positief:***
$F_{net}\ \Delta t = \Delta p$✓ $mg\ \Delta t = m\ (v_f - v_i)$ $-9,8\Delta t$ ✓= $[-16 – (+16)]$ ✓ $\Delta t = 3,26$ s Total time/*Totale tyd* = 3,26 s✓	$F_{net}\ \Delta t = \Delta p$✓ $mg\ \Delta t = m\ (v_f - v_i)$ $9,8\Delta t$ ✓= $[16 – (-16)]$ ✓ $\Delta t = 3,26$ s Total time/*Totale tyd* = 3,26 s ✓

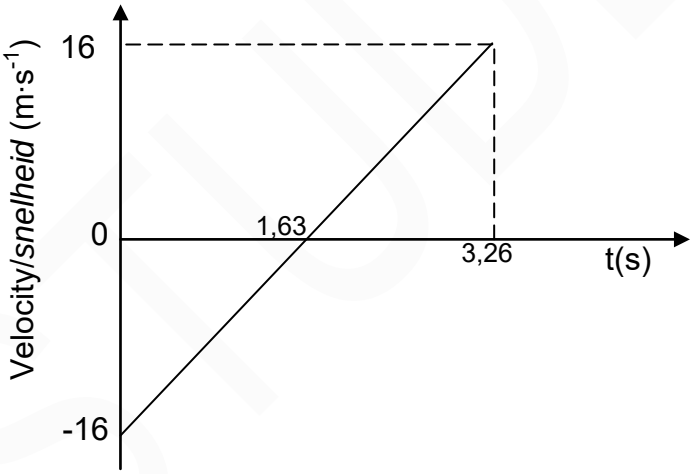
(4)

3.2 **POSITIVE MARKING FROM 3.1./*POSITIEWE NASIEN VANAF 3.1***
Upwards positive/*Opwaarts positief:*



(3)

POSITIVE MARKING FROM 3.2./*POSITIEWE NASIEN VANAF 3.2*
Downwards positive/*Afwaarts positief:*



Criteria for graph/*Kriteria vir grafiek*	**Marks/*Punte***
Correct shape for line extending beyond t = 1,63 s. *Korrekte vorm vir lyn verleng verby t = 1,63 s*	✓
Initial velocity correctly indicated as shown. *Beginsnelheid korrek aangedui soos getoon.*	✓
Time to reach maximum height and time to return to the ground correctly shown. *Tyd om maksimum hoogte te bereik en om na die grond terug te keer.*	✓

(3)

3.3

OPTION 1 / *OPSIE 1*

Upwards positive/*Opwaarts positief:*

Take y_A as height of ball A from the ground. (no penalising)/Neem y_A as hoogte van bal A vanaf die grond. (geen penalisering)

$\Delta y_A = v_i\Delta t + \frac{1}{2} a\Delta t^2$ ✓

$y_A - 0 = 16\Delta t + \frac{1}{2}(-9,8)\Delta t^2$

$=16\Delta t - 4,9\Delta t^2$✓

Take y_B as height of ball B from the ground./Neem y_B as hoogte van bal B vanaf die grond.

$\Delta y_B = v_i\Delta t + \frac{1}{2} a\Delta t^2$

$y_B - 30 = (v_i\Delta t + \frac{1}{2} a\Delta t^2)$

$y_B = 30 - [-9(\Delta t - 1) + \frac{1}{2}(-9,8)(\Delta t - 1)^2$✓

$= 34,1 + 0,8\Delta t - 4,9\ \Delta t^2$✓

$y_A = y_B$

$\therefore 16\Delta t - 4,9\Delta t^2 = 34,1 + 0,8\Delta t - 4,9\Delta t^2$

$15,2\Delta t = 34,1$

$\Delta t = 2,24$ s ✓

$y_A = 16\ (2,24) - 4,9(2,24)^2$

$= 11,25$ m✓ (6)

Downwards positive/*Afwaarts positief:*

Take y_A as height of ball A from the ground.(no penalising)/Neem y_A as hoogte van bal A vanaf die grond. (geen penalisering)

$\Delta y_A = v_i\Delta t + \frac{1}{2} a\Delta t^2$ ✓

$y_A - 0 = -16\Delta t + \frac{1}{2}(9,8)\Delta t^2$

$= -16\Delta t + 4,9\Delta t^2$✓

Take y_B as height of ball B from the ground/Neem as hoogte van bal B vanaf die grond..

$\Delta y_B = v_i\Delta t + \frac{1}{2} a\Delta t^2$

$y_B - 30 = -(v_i\Delta t + \frac{1}{2} a\Delta t^2)$

$y_B = 30 - [9(\Delta t - 1) + \frac{1}{2}(9,8)(\Delta t - 1)^2$✓

$= 34,1 + 0,8\Delta t - 4,9\ \Delta t^2$ ✓

$y_A = y_B$

$16\Delta t - 4,9\Delta t^2 = 34,1 + 0,8\Delta t - 4,9\Delta t^2$

$15,2\Delta t = 34,1$

$\Delta t = 2,24$ s✓

$\Delta y_A = (-16\ (2,24) + 4,9(2,24)^2)$

$= 11,25$ m✓ (6)

3.3

OPTION 2/*OPSIE 2*

Upwards positive/*Opwaarts positief:*

$\Delta y_A = v_i\Delta t + \frac{1}{2} a\Delta t^2$ ✓

$= 16\Delta t + \frac{1}{2}(-9,8)\Delta t^2$

$= 16\Delta t - 4,9\Delta t^2$ ✓

Distance travelled by ball A = $y_A = 16\Delta t - 4,9\Delta t^2$

$\Delta y_B = v_i\Delta t + \frac{1}{2} a\Delta t^2$

$= -9(\Delta t - 1) + \frac{1}{2}(-9,8)(\Delta t - 1)^2$ ✓

$= 0,8\Delta t - 4,9\Delta t^2 + 4,1$ ✓

Distance travelled by ball B = $y_B = 0,8\Delta t - 4,9\Delta t^2 + 4,1$

$y_A + (-y_B) = 30$

$16\Delta t - 4,9\Delta t^2 - (0,8\Delta t - 4,9\Delta t^2 + 4,1) = 30$

$15,2\Delta t = 34,1$

$\Delta t = 2,24$ s ✓

$\therefore \Delta y_A = v_i\Delta t + \frac{1}{2} a\Delta t^2$

$y_A = 16\ (2,24) - 4,9(2,24)^2$

$= 11,25$ m✓

(6)

3.3

Downwards positive/*Afwaarts positief:*

$y_A = v_i\Delta t + \frac{1}{2} a\Delta t^2$ ✓

$= -16\Delta t + \frac{1}{2}(9,8)\Delta t^2$

$= -16\Delta t + 4,9\Delta t^2$ ✓

$y_B = v_i\Delta t + \frac{1}{2} a\Delta t^2$

$= 9(\Delta t - 1) + \frac{1}{2}(9,8)(\Delta t - 1)^2$ ✓

$= -0,8\Delta t + 4,9\Delta t^2 - 4,1$ ✓

$(-y_A) + y_B = 30$

$-(-16\Delta t + 4,9\Delta t^2) - 0,8\Delta t + 4,9\Delta t^2 - 4,1 = 30$

$15,2\Delta t = 34,1$

$\Delta t = 2,24$ s ✓

$\therefore \Delta y_A = v_i\Delta t + \frac{1}{2} a\Delta t^2$

$\Delta y_A = -16\ (2,24) + 4,9(2,24)^2$

$= -11,25$ m

∴Height of ball A/*Hoogte van bal A* = 11,25 m✓

(6)

OPTION 3/*OPSIE 3*

Upwards positive/*Opwaarts positief:*

$v_f = v_i + a\Delta t$

After 1 s, speed of ball A/*Spoed van bal A na 1 s*

$v_f = 16 + (-9,8)(1)$

$= 6,2\ m\cdot s^{-1}$

Distance travelled by ball A in 1 s/*Afstand deur bal A afgelê in 1 s*

$\Delta y_A = v_i\Delta t + ½\ a\Delta t^2$ ✓

$= (16)(1) + ½(-9,8)1^2$

$= 11,1$ m

For ball A, after 1 s/*Vir bal A na 1 s*

$\Delta y_A = 6,2\Delta t - 4,9\Delta t^2$ ✓

For ball/*Vir bal* **B,**

$\Delta y_B = v_i\Delta t + ½\ a\Delta t^2$

$= -9\Delta t + ½(-9,8)\Delta t^2$✓

$y_A + (-y_B) = (30 - 11,1) = 18,9$

$6,2\Delta t - 4,9\Delta t^2 - [-9\Delta t + ½(-9,8)\Delta t^2] = 18,9$

$15,2\Delta t = 18,9$

$\Delta t = 1,24$ s ✓

The balls meet after/*Die balle ontmoet na* (1,24 +1) = 2,24 s✓

$\Delta y_A = [6,2\ (1,24) - 4,9\ (1,24)^2]$

$= 0,154$ m

Meeting point/*Ontmoetingspunt* = (11,1 + 0,154) = 11,25 m✓

OR/*OF*

$\Delta y = (-9)(1,24) + ½\ (-9,8)(1,24)^2$ ✓

$= -18,69$ m

Meeting point/*Ontmoetingspunt* = (30 -18,69) = 11,31 m✓ (6)

Downwards positive/*Afwaarts positief:*
$v_f = v_i + a\Delta t$
After 1 s, speed of ball A/*Spoed van bal A na 1 s*
$v_f = -16 + (9,8)(1)$
$= -6,2\ ms^{-1}$
Distance travelled by ball A in 1 s/*Afstand deur bal A afgelê in 1 s*
$\Delta y_A = v_i\Delta t + ½\ a\Delta t^2$ ✓
$= (-16)(1) + ½(9,8)(1)^2$
$= -11,1$ m
For ball A, after 1 s/*Vir bal A na 1 s*
$\Delta y_A = -6,2\Delta t + 4,9\Delta t^2$✓

For ball/*Vir bal* **B**
$\Delta y_B = v_i\Delta t + ½\ a\Delta t^2$
$= 9\Delta t + ½(9,8)\Delta t^2$✓

$-\Delta y_A + \Delta y_B = 18,9$
$6,2\Delta t - 4,9\Delta t^2 + [9\Delta t + ½(9,8)\Delta t^2] = 18,9$
$15,2\Delta t = 18,9$
$\Delta t = 1,24$ s✓

The balls meet after/*Die balle ontmoet na* (1,24 +1) = 2,24 s✓
$\Delta y_A = -6,2\ (1,24) + 4,9\ (1,24)^2$
$= -0,154$ m
Meeting point/*Ontmoetingspunt* = (-11,1 - 0,154) = 11,25 m✓

OR/*OF*
$\Delta y = (9)(1,24) + ½\ (9,8)(1,24)^2$ ✓
$= 18,69$ m
Meeting point/*Ontmoetingspunt* = (30 -18,69) = 11,31 m✓ (6)
[13]

OR/*OF*

For 4 kg block/*Vir 4 kg blok*
Fnet - ma
$\underline{T - (mg \sin\theta + f_k) = 4a}$
$\underline{T - (4 \times 9,8 \sin 30^o + 10) = 4a}$✓
T- 29,6 = 4a
T = 29,6 + (4)(0,61) ✓
= 32,04 N✓ (6)
[16]

QUESTION 3/*VRAAG 3*

3.1 Free fall/*Vrye val*

ACCEPT/*AANVAAR*
Vertically accelerated motion/projectile motion.
Vertikale versnelde beweging /projektielbeweging (1)

3.2.1 **Downward motion as positive**
Afwaartse beweging as positief

$\Delta y = v_i \Delta t + ½ a\Delta t^2$✓
30✓ = $\underline{v_i (1,5) + ½ (9,8)(1,5)^2}$ ✓
v_i = 12,65 m·s^{-1}✓

Upward motion as positive
Opwaartse beweging as positief

$\Delta y = v_i \Delta t + ½ a\Delta t^2$✓
-30✓ = $\underline{v_i (1,5) + ½ (-9,8)(1,5)^2}$ ✓
v_i = 12,65 m·s^{-1}✓ (4)

Notes / *Aantekeninge*
Accept/*Aanvaar*
g or/*of* a
$\Delta x = v_i \Delta t + ½ a\Delta t^2$✓
$s = ut + ½ at^2$

3.2.2

OPTION 1/*OPSIE 1*	**Notes / *Aantekeninge***
Positive marking from QUESTION 3.2.1 ***Positiewe nasien vanaf VRAAG 3.2.1***	For/*Vir* **XB**
Downward motion as positive ***Afwaartse beweging as positief***	Accept/*Aanvaar* g or/*of* a $v^2 = u^2 + 2as$
$v_f^2 = v_i^2 + 2a\Delta y$✓ $12,65^2$ ✓= $\underline{0 + 2(9,8)\ \Delta y}$✓ Δy = 8,16 m✓ Height/*Hoogte* **XC** = **XB + BC** (30 + 8,16) = 38,16 m Height is/*Hoogte is* 38,16 m✓	The height must be written down in order to score the final mark. *Die hoogte moet neergeskryf word om die finale punt te kry.*

Upward motion as positive
Opwaartse beweging as positief
$v_f^2 = v_i^2 + 2a\Delta y$✓
$(-12,65)^2$ ✓= $\underline{0 + 2(-9,8)\ \Delta y}$✓
Δy = - 8,16 m✓
Height/*Hoogte* **XC = XB + BC**
(-30) +(- 8,16) = -38,16 m
Height is /*Hoogte is* 38,16 m) ✓

(5)

OPTION /*OPSIE 2*	**Notes / *Aantekeninge***
Positive marking from QUESTION 3.2.1 ***Positiewe nasien vanaf VRAAG 3.2.1***	**Start with time for XB** ***Begin met tyd vir XB***
Downward motion as positive ***Afwaartse beweging as positief*** $v_B = v_X + a\Delta t$✓ $\underline{12,65 = 0 + 9,8\Delta t}$✓ Δt = 1,29 s $\Delta y = v_i\Delta t + ½\ a\Delta t^2$✓ $= \underline{0 + ½\ (9,8(1,29)^2}$✓ Δy = 8,15 m Height/*Hoogte* **XC = XB + BC** (30 + 8,15) = 38,15 m✓	Accept/*Aanvaar* g or/*of* a v=u+at $v^2 = u^2 + 2as$ $s = ut + ½\ at^2$
Upward motion as positive ***Opwaartse beweging as positief*** $v_B = v_X + a\Delta t$✓ $\underline{-12,65 = 0 + (-)9,8\Delta t}$✓ Δt = 1,29 s $\Delta y = v_i\Delta t + ½\ a\Delta t^2$✓ $= \underline{0 + ½\ (-9,8(1,29)^2}$✓ Δy = -8,15 m Height/*Hoogte* **XC = XB + BC** (-30) + (-8,15) = 38,15 m✓	

(5)

OPTION 3/*OPSIE 3* **Positive marking from QUESTION 3.2.1** ***Positiewe nasien vanaf VRAAG 3.2.1***	**Notes / *Aantekeninge***
Downward motion as positive ***Afwaartse beweging as positief*** $v_C = v_B + a\Delta t$✓ $= \underline{12,65 + 9,8\ (1,5)}$ ✓ $= 27,35\ m{\cdot}s^{-1}$ $v_C^2 = v_X^2 + 2a\Delta y$✓ $\underline{(27,35)^2 = 0 + 2(9,8)\ \Delta y}$✓ $\therefore \Delta y = 38,16$ m Height is /*Hoogte is* 38,16 m✓ **Upward motion as positive** ***Opwaartse beweging as positief*** $v_C = v_B + a\Delta t$✓ $= -\underline{12,65 + (-9,8)\ (1,5)}$ ✓ $= -27,35\ m{\cdot}s^{-1}$ $v_C^2 = v_X^2 + 2a\Delta y$✓ $\underline{(-27,35)^2 = 0 + 2(-9,8)\ \Delta y}$✓ $\therefore \Delta y = -38,16$ m Height/*Hoogte* = 38,16m✓	start with velocity at C Accept/*Aanvaar* g or/*of* a $v = u+at$ $v^2 = u^2 + 2as$ The height must be written down in order to score the final mark. *Die hoogte moet neergeskryf word om die finale punt te kry.*

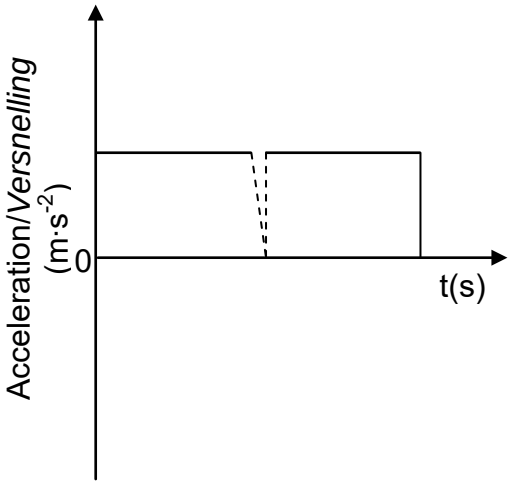
(5)

OPTION 4/*OPSIE 4* **Positive marking from QUESTION 3.2.1** ***Positiewe nasien vanaf VRAAG 3.2.1***	**Notes / *Aantekeninge***
$\Delta U + \Delta K = 0$✓ $(mgh + 0)$ ✓ $= 0 + (½\ m(12,65)^2)$✓ $h = 8,16$ m✓ $XC = h + 30$ $= (30 + 8,16)$ $= 38,16$ m✓	Accept/*Aanvaar* $mgh_i + ½\ mv_i^2 = mgh_f + ½\ mv_f^2$ Take point B as the zero position and XH = h *Neem punt B is nul posisie en XH = h*

(5)

3.3

OPTION 1/*OPSIE 1*

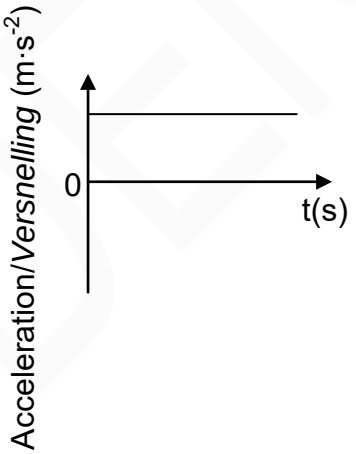


Notes / *Aantekeninge*

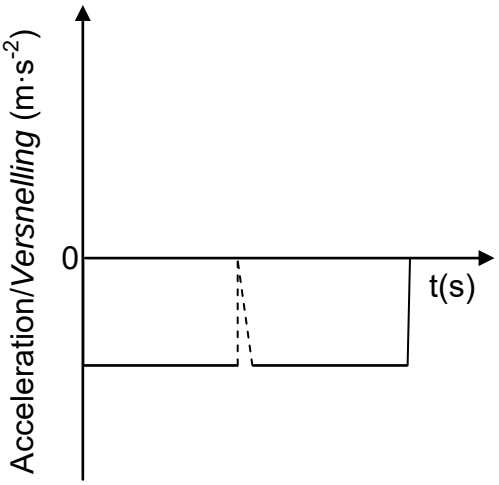
Criteria/*Kriteria*	Mark/Punt
For **each** line correctly drawn as shown *Vir **elke** lyn korrek geteken soos getoon*	✓✓
Both axes correctly labelled *Beide asse korrek benoem*	✓

Accept/*Aanvaar*

Only 2 marks for this answer/Slegs 2 punte vir hierdie antwoord



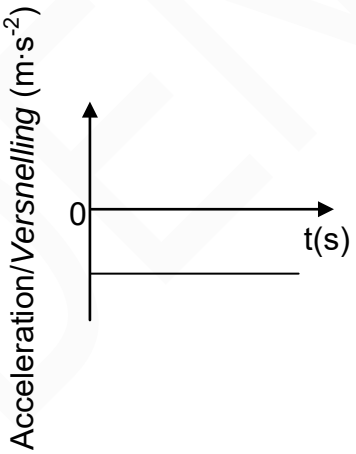
OPTION 2/*OPSIE 2*



Notes / *Aantekeninge*

Criteria/*Kriteria*	Mark/*Punt*
For **each** line correctly drawn as shown *Vir **elke** lyn korrek geteken soos getoon*	✓✓
Both axes correctly labelled *Beide asse korrek benoem*	✓

Only 2 marks for this answer/Slegs 2 punte vir hierdie antwoord



(3)
[13]

OPTION 3/*OPSIE 3*

$F_{net} = ma$✓

For 5 kg block/*Vir 5 kg-blok*

$T_2 + (-mg) + (-T_1) = ma$

$250 - (5)(9,8) - T_1$✓$= 5\ a$ ✓

$201 - T_1 = 5\ a$

$T_1 = 201 - 5a$.....(1)

$\therefore a = \frac{201 - T_1}{5}$

For 20 kg block/*Vir 20 kg-blok* ,

$T_1 + (-mg) = ma$.....(2)

$T_1 + [-(20)(9,8)]$ ✓ $= 20a$

$\therefore T_1 - 196 = 20(\frac{201 - T_1}{5})$✓

$\therefore T_1 = 200$ N✓ (6)

2.4 **Q** ✓ (1)
[12]

QUESTION 3/*VRAAG 3*

3.1 An object moving / Motion under the influence of gravity / weight / gravitational force only (and there are no other forces such as friction).✓✓ (2 or/*of* 0)
('n Voorwerp wat / Beweging slegs onder die invloed van swaartekrag / gewig / gravitasiekrag (en daar is geen ander kragte soos wrywing nie). (2)

3.2

OPTION 1/*OPSIE 1*	
Upwards positive/*Opwaarts positief:*	**Downwards positive/*Afwaarts positief:***
$\Delta y = v_i\Delta t + ½\ a\Delta t^2$✓	$\Delta y = v_i\Delta t + ½\ a\Delta t^2$✓
0 ✓$= 15\ \Delta t + ½\ (-9,8)\ \Delta t^2$✓	0✓ $= -15\ \Delta t + ½\ (9,8)\ \Delta t^2$✓
$\Delta t = 3,06$ s	$\Delta t = 3,06$ s
It takes/*Dit neem* 3,06 s✓	It takes/*Dit neem* 3,06 s✓

(4)

OPTION 2/*OPSIE 2*	
Upwards positive/*Opwaarts positief:*	**Downwards positive/*Afwaarts positief:***
$v_f = v_i + a\Delta t$✓	$v_f = v_i + a\Delta t$✓
0✓ $= 15 + (-9,8)\Delta t$✓	0✓ $= -15 + (9,8)\Delta t$✓
$\Delta t = 1,53$ s	$\Delta t = 1,53$ s
It takes (2)(1,53) = 3,06 s✓	It takes/*Dit neem* 3,06 s✓

(4)

OPTION 3 / *OPSIE 3*	
Upwards positive/*Opwaarts positief:*	**Downwards positive/*Afwaarts positief:***
$v_f = v_i + a\Delta t$✓	$v_f = v_i + a\Delta t$✓
-15 ✓$= 15 + (-9,8)\Delta t$✓	15 ✓$= -15 + (9,8)\Delta t$✓
$\Delta t = 3,06$ s✓	$\Delta t = 3,06$ s✓

(4)

OPTION 4/*OPSIE 4*	
Upwards positive/*Opwaarts positief:*	**Downwards positive /*Afwaarts positief:***
$F_{net}\ \Delta t = \Delta p$✓ $mg\ \Delta t = m\ (v_f - v_i)$ $\Delta t = \frac{(0-15)}{-9,8}$✓✓ $\Delta t = 1,53$ s It takes/*Dit neem* (2)(1,53s) = 3,06 s✓	$F_{net}\ \Delta t = \Delta p$✓ $mg\ \Delta t = m\ (v_f - v_i)$ $\Delta t = \frac{0-(-15)}{9,8}$✓✓ $\Delta t = 1,53$ s It takes/*Dit neem* (2)(1,53s) = 3,06 s✓

(4)

OPTION 5/*OPSIE 5*	
Upwards positive/*Opwaarts positief:*	**Downwards positive/*Afwaarts positief:***
$F_{net}\ \Delta t = \Delta p$✓ $mg\ \Delta t = m\ (v_f - v_i)$ $\Delta t = \frac{-15-(15)}{-9,8}$✓✓ $= 3,06$ s✓	$F_{net}\ \Delta t = \Delta p$✓ $mg\ \Delta t = m\ (v_f - v_i)$ $\Delta t = \frac{15-(-15)}{9,8}$✓✓ $\Delta t = 3,06$ s✓

(4)

OPTION 5/*OPSIE 6*	
Upwards positive/*Opwaarts positief:*	**Downwards positive/*Afwaarts positief:***
$v_f^2 = v_i^2 + 2a\Delta y$ ✓ For ball A/*Vir bal A* $0 = (15)^2 + 2\ (-9,8)\Delta y$✓ $\Delta y_A = 11,48$ m $\Delta y = \left(\frac{v_f + v_i}{2}\right)\Delta t$ $11,48 = \left(\frac{15+0}{2}\right)\Delta t$✓ $\Delta t = 1,53$ s It takes/*Dit neem* (2)(1,53s) = 3,06 s✓	$v_f^2 = v_i^2 + 2a\Delta y$ ✓ For ball A/*Vir bal A* $0 = (-15)^2 + 2\ (9,8)\Delta y$✓ $\Delta y_A = -11,48$ m $\Delta y = \left(\frac{v_f + v_i}{2}\right)\Delta t$ $-11,48 = \left(\frac{-15+0}{2}\right)\Delta t$ ✓ $\Delta t = 1,53$ s It takes/*Dit neem* (2)(1,53s) = 3,06 s✓

3.3

OPTION 1/*OPSIE 1*

Upwards positive/*Opwaarts positief:*

$v_f^2 = v_i^2 + 2a\Delta y$ ✓
For ball A/*Vir bal A*
$0 = (15)^2$✓ + 2 (-9,8)Δy✓
Δy_A = 11,48 m

When A is at highest point
Wanneer A op hoogste punt is

$\Delta y_B = v_i\Delta t + ½ a\Delta t^2$
$= 0 + ½ (-9,8) (1,53)^2$✓✓
Δy_B = -11,47 m
Δy_B = 11,47 m downward/*afwaarts*

Distance/*Afstand* = $y_A + y_B$
= 11,47 + 11,48 ✓
= 22,95 m✓

Downwards positive/*Afwaarts positief:*

$v_f^2 = v_i^2 + 2a\Delta y$ ✓
For ball A/*Vir bal A*
$0 = (-15)^2$✓ + 2 (9,8)Δy✓
Δy_A = -11,48 m

When A is at highest point
Wanneer A op hoogste punt is

$\Delta y_B = v_i\Delta t + ½ a\Delta t^2$
$= 0 + ½ (9,8) (1,53)^2$✓✓
Δy_B = 11,47 m
Δy_B = 11,47 m downward/*afwaarts*

Distance/*Afstand* = $y_A + y_B$
= 11,48 + 11,47 ✓
= 22,95 m✓

OPTION 2/*OPSIE 2*

Upwards positive/*Opwaarts positief:*

At maximum height $v_f = 0$:
By maksimum hoogte $v_f = 0$:

Ball/*Bal* A
$\Delta y_A = v_i\Delta t + ½ a\Delta t^2$✓
= 15 (1,53) ✓ + ½ (-9,8) $(1,53)^2$✓
= 11,48 m

When A is at highest/point
Wanneer A op hoogste punt is

$\Delta y_B = v_i\Delta t + ½ a\Delta t^2$
$= 0 + ½ (-9,8) (1,53)^2$✓✓
Δy_B = -11,47 m
Δy_B = 11,47 m downward/*afwaarts*

Distance/*Afstand* = $y_A + y_B$
= 11,48 + 11,47✓
= 22,95 m✓

Downwards positive/*Afwaarts positief:*

At maximum height $v_f = 0$:
By maksimum hoogte $v_f = 0$:

Ball/*Bal* A
$\Delta y_A = v_i\Delta t + ½ a\Delta t^2$✓
= (-15) (1,53) ✓+ ½ (9,8) $(1,53)^2$✓
= -11,48 m

When A is at highest point
Wanneer A by hoogste punt is

$\Delta y_B = v_i\Delta t + ½ a\Delta t^2$
$= 0 + ½ (-9,8) (1,53)^2$✓✓
Δy_B = -11,47 m
Δy_B = 11,47 m downward/*afwaarts*

Distance/*Afstand* = ($y_A + y_B$)
= 11,48 + 11,47 ✓
= 22,95 m✓ (7)

OPTION 3/*OPSIE 3*

Upwards positive/*Opwaarts positief:*

Ball A/*Bal A*
$\Delta y_A = v_i\Delta t + \frac{1}{2} a\Delta t^2$✓
$\Delta y_A = 15(1,53)$ ✓$+ \frac{1}{2}(-9,8)(1,53)^2$✓
$= 11,48$ m

For ball B/*Vir bal B*
$v_f = v_i + a\Delta t$
$v_f = 0 + (-9,8)(1,53)$
$v_f = 14,99\ m\cdot s^{-1}$

$v_f^2 = v_i^2 + 2a\Delta x$
$14,99^2$✓ $= 0 + 2(-9,8)\ \Delta y_B$✓
$\Delta y_B = -11,47$ (m)
$= 11,47$ m downward/*afwaarts*

Distance/*Afstand* $= (y_A + y_B)$
$= 11,48 + 11,47$✓
$= 22,95$ m✓

Downwards positive/*Afwaarts positief:*

Ball A/*Bal A*
$y_A = v_i\Delta t + \frac{1}{2} a\Delta t^2$✓
$\Delta y_A = -15\ (1,53)$ ✓ $+ \frac{1}{2}(9,8)(1,53)^2$✓
$= -11,48$ (m)
$= 11,48$ m upward/*opwaarts*

For ball B/*Vir bal B*
$v_f = v_i + a\Delta t$
$v_f = 0 + (9,8)(1,53)$
$v_f = 14,99\ m\cdot s^{-1}$

$v_f^2 = v_i^2 + 2a\Delta x$
$14,99^2$ ✓$= 0 + 2(9,8)\ \Delta y_B$✓
$\Delta y_B = 11,47$ (m)

Distance/*Afstand* $= (y_A + y_B)$
$= 11,48 + 11,47$✓
$= 22,95$ m✓

(7)

OPTION 4/*OPSIE 4*

Upwards positive/*Opwaarts positief:*

Ball A/*Bal A*
$\Delta y_A = \frac{v_i + v_f}{2}\Delta t$ ✓ $= \frac{(15 + 0)}{2}(1,53)$ ✓
$= 11,48$ m

For ball B/*Vir bal B*
$v_f = v_i + a\Delta t$
$= 0 + (-9,8)(1,53)$
$= -15\ m\cdot s^{-1}$
$\Delta y = \frac{v_i + v_f}{2}\Delta t = \frac{(0 - 15)\times 1,53}{2}$ ✓
$= -11,47$ m
$= 11,47$ m downward/*afwaarts*
Distance/*Afstand* $= (y_A + y_B)$
$= 11,48 + 11,47$✓
$= 22,95$ m✓

Downwards positive/*Afwaarts positief:*

Ball A/*Bal A*
$\Delta y_A = \frac{v_i + v_f}{2}\Delta t$ ✓ $= \frac{(-15 + 0)}{2}(1,53)$ ✓
$= -11,48$ (m)
$= 11,48$ m upwards/*opwaarts*

$v_f = v_i\Delta t + a\Delta t$
$= 0 + (9,8)(1,53)$
$= 15\ m\cdot s^{-1}$
$\Delta y = \frac{v_i + v_f}{2}\Delta t = \frac{(0 + 15)\times 1,53}{2}$ ✓
$= 11,47$m

Distance/*Afstand* $= y_A + y_B$
$= 11,48 + 11,47$✓
$= 22,95$ m✓

(7)

OPTION 5/*OPSIE 5*

Upwards positive/*Opwaarts positief:*

Ball A/*Bal A*
$W_{net} = \Delta K$✓

OR/*OF*
$\frac{1}{2} m(v_f^2 - v_i^2) = mg(h_f - h_i)\cos\theta$
$\frac{1}{2} m(0 - 15^2)$ ✓$= m(9,8)h_f\cos 180^o$ ✓
h = 11,48 m

OR/*OF*
For Ball B when A is at highest point./ *Vir Bal B wanneer A by sy hoogste punt is.*

$v_f = v_i + a\Delta t$
$= 0 + (-9,8)(1,53) = -15\ m\cdot s^{-1}$ ✓
$\Delta y = \frac{v_i + v_f}{2}\Delta t = \frac{(0 - 15) \times 1,53}{2}$ ✓
=-11,48 m
= 11,48 m downward/*afwaarts*

Distance/*Afstand* = $y_A + y_B$
= 11,48 + 11,48✓
= 22,96 m✓

Downwards positive/*Afwaarts positief:*

Ball A/*Bal A*
$W_{net} = \Delta K$✓

OR/*OF*
$\frac{1}{2} m(v_f^2 - v_i^2) = mg(h_f - h_i)\cos\theta$
$\frac{1}{2} m(0 - 15^2)$ ✓$= m(9,8)h_f\cos 180^o$ ✓
h = 11,48 m

OR/*OF*
For Ball B when A is at highest point./ *Vir Bal B wanneer A by sy hoogste punt is.*

$v_f = v_i + a\Delta t$
$= 0 + (9,8)(1,53) = 15\ m\cdot s^{-1}$ ✓
$\Delta y = \frac{v_i + v_f}{2}\Delta t = \frac{(0 + 15)(1,53)}{2}$ ✓
= 11,48 m downward/*afwaarts*

Distance/*Afstand* = $y_A + y_B$
= 11,48 + 11,48✓
= 22,96 m✓

(7)

OPTION 7/*OPSIE 7*

Upwards positive/*Opwaarts positief:*
Ball A
$\frac{1}{2} m v_i^2 + mgh_i = \frac{1}{2} m v_f^2 + mgh_f$✓
$\frac{1}{2} m(15^2)$ ✓ $+0 = \frac{1}{2} m(0) + m(9,8)h$ ✓
h = 11,48 m

OR/*OF*
For Ball B when A is at highest point.
Vir Bal B wanneer A by sy hoogste punt is.

$v_f = v_i + a\Delta t$
$= 0 + (-9,8)(1,53)$
$= -15\ m\cdot s^{-1}$
$\Delta y = \frac{v_i + v_f}{2}\Delta t$ ✓
$= \frac{(0 - 15)(1,53)}{2}$ ✓
=-11,48 m
= 11,48 m downward/*afwaarts*
Distance/*Afstand* = $y_A + y_B$
= 11,48 + 11,48✓
= 22,96 m✓

Downwards positive/*Afwaarts positief:*
Ball A
$\frac{1}{2} m v_i^2 + mgh_i = \frac{1}{2} m v_f^2 + mgh_f$✓
$\frac{1}{2} m(15^2)$ ✓ $+0 = \frac{1}{2} m(0) + m(9,8)h$ ✓
h = 11,48 m

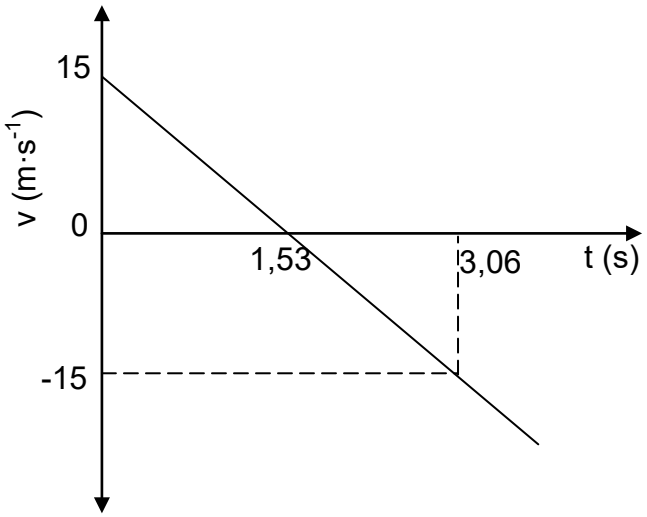
OR/*OF*
For Ball B when A is at highest point.
Vir Bal B wanneer A by sy hoogste punt is.

$v_f = v_i + a\Delta t$
$= 0 + (9,8)(1,53)$
$= 15\ m\cdot s^{-1}$
$\Delta y = \frac{v_i + v_f}{2}\Delta t$ ✓
$= \frac{(0 + 15)(1,53)}{2}$ ✓
= 11,48 m downward/*afwaarts*

Distance/*Afstand* = $y_A + y_B$
= 11,48 + 11,48✓
= 22,96 m✓

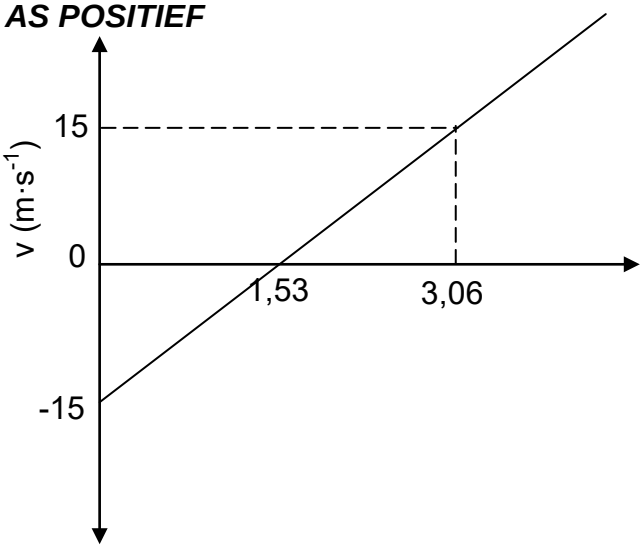
(7)

3.4



(4)
[17]

CONSIDER MOTION DOWNWARD AS POSITIVE/*BESKOU BEWEGING AFWAARTS AS POSITIEF*



Criteria/*Kriteria*	**Marks/*Punte***
Graph starts at correct Initial velocity shown./*Grafiek begin by korrekte beginsnelheid aangetoon.*	✓
Time for maximum height shown (1,53 s)./*Tyd vir maksimum hoogte aangetoon.(1,53 s)*	✓
Time for return shown (3,06 s) /*Tyd om terug te keer (3,06) aangetoon.*	✓
Shape/*Vorm*: Straight line extending beyond 3,06 s/ *Reguitlyn wat verby 3,06 s strek.*	✓

(4)
[17]

SECTION B/*AFDELING B*

QUESTION 3/*VRAAG 3*

3.1

3.1.1 Upwards / *Opwaarts* ✓ (1)

3.1.2 Downwards / *Afwaarts*✓ (1)

3.2 Q ✓
Weight is the only force acting on the rocket. ✓
Gewig is die enigste krag wat op die vuurpyl inwerk. (2)

3.3

OPTION 1/*OPSIE 1* **Upwards positive/*Opwaarts positief*:** $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓ $\therefore$ -225,6 ✓ = (112,8)Δt ✓ + ½(-9,8)Δt^2 ✓ $\therefore$ Δt = 24,87 s ↘ Total time/*Totale tyd*: 4 + ✓ 24,87 = 28,87 s ✓ **Downwards positive/*Afwaarts positief:*** $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓ $\therefore$ 225,6 ✓ = (-112,8)Δt ✓ + ½(9,8)Δt^2 ✓ $\therefore$ Δt = 24,87 s ↘ Total time/*Totale tyd*: 4 + ✓ 24,87 = 28,87 s ✓	**Notes/*Aantekeninge:*** Accept/*Aanvaar:* g or/*of* a $s = ut + \frac{1}{2}at^2$ $\Delta x = v_i\Delta t + \frac{1}{2}a\Delta t^2$
OPTION 2/*OPSIE 2* **Upwards positive/*Opwaarts positief:*** $v_f^2 = v_i^2 + 2a\Delta y$ $\therefore v_f^2 = (112,8)^2 + 2(-9,8)(-225,6)$ ✓ $\therefore$ v_f = 130,94 m·s^{-1} ↘ $\Delta y = (\frac{v_i + v_f}{2})\Delta t$ ✓ -225,6 ✓ = $(\frac{112,8 - 130,94}{2})\Delta t$ ✓ $\therefore$ Δt = 24,87 s ↓ Total time/*Totale tyd* : 4 + ✓ 24,87 = 28,87 s ✓ **Downwards positive/*Afwaarts positief:*** $v_f^2 = v_i^2 + 2a\Delta y$ $\therefore v_f^2$ = (-112,8)^2 + 2(9,8)(225,6) ✓ $\therefore$ v_f = 130,94 m·s^{-1} ↘ $\Delta y = (\frac{v_i + v_f}{2})\Delta t$ ✓	**Notes/*Aantekeninge:*** Accept/*Aanvaar:* g or/*of* a $v_f^2 = vi^2 + 2a\Delta x$ $v^2 = u^2 + 2as$ $\Delta x = \left(\frac{v_i + v_f}{2}\right)\Delta t$ $s = \left(\frac{u+v}{2}\right)t$

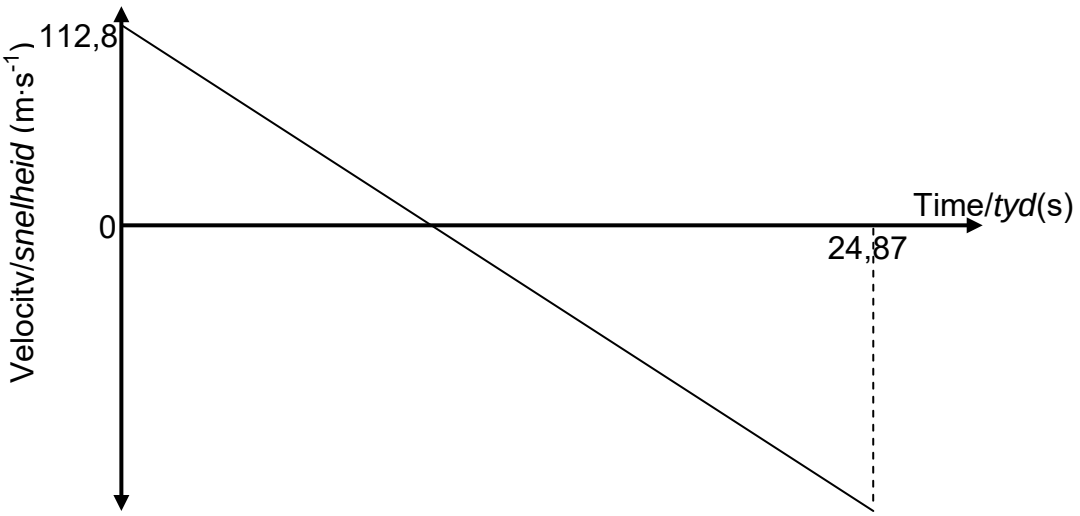
$225,6$ ✓ $= (\frac{-112,8+130,94}{2})\Delta t$ ✓ $\therefore \Delta t = 24,87$ s Total time/*Totale tyd*: 4 + ✓ 24,87 = 28,87 s ✓	

OPTION 3/*OPSIE 3* **Upwards positive/*Opwaarts positief*:** Time from point where fuel is used up to maximum height /*Tyd vanaf punt waar brandstof opgebruik is tot maksimum hoogte* : $v_f = v_i + a\Delta t$ ✓ $\therefore$ 0 = 112,8 + (-9,8)Δt ✓ $\therefore \Delta t = 11,51$ s Time from maximum height to ground / *Tyd vanaf maksimum hoogte tot die grond*: $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ $= (112,8)(11,51) + ½(-9,8)(11,51)^2$ $\therefore \Delta y = 649,18$ m Maximum height/*Maksimum hoogte*: 225,6 + 649,18 = 874,78 m $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓ $\therefore$ -874,78 = (0)Δt + ½(-9,8)Δt^2 ✓ $\therefore \Delta t = 13,36$ s Total time / *Totale tyd*: 4 + ✓ 11,51 + 13,36 = 28,87 s ✓	**Notes/*Aantekeninge:*** Accept/*Aanvaar:* g or/*of* a v = u + at $v_f^2 = vi^2 + 2a\Delta x$ $v^2 = u^2 + 2as$ $s = ut + \frac{1}{2}at^2$ $\Delta x = v_i\Delta t + \frac{1}{2}a\Delta t^2$
Downwards positive/Afwaarts *positief:* Time from point where fuel is used up to maximum height/ *Tyd vanaf punt waar brandstof opgebruik is tot maksimum hoogte*: $v_f = v_i + a\Delta t$ ✓ $\therefore$ 0 = -112,8 + (9,8)Δt ✓ $\therefore \Delta t = 11,51$ s Time from maximum height to ground: *Tyd vanaf maksimum hoogte tot die grond*: $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ $= (-112,8)(11,51) + ½(9,8)(11,51)^2$ $\therefore \Delta y = -649,18$ m Maximum height/ *Maksimum hoogte*: 225,6 + 649,18 = 874,78 m $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓ $\therefore$ 874,78 = (0)Δt + ½(9,8)Δt^2 ✓ $\therefore \Delta t = 13,36$ s Total time/*Totale tyd* 4 + ✓ 11,51 + 13,36 = 28,87 s ✓	**Notes/*Aantekeninge:*** Accept/*Aanvaar:* g or/*of* a v = u + at $v_f^2 = vi^2 + 2a\Delta x$ $v^2 = u^2 + 2as$ $s = ut + \frac{1}{2}at^2$ $\Delta x = v_i\Delta t + \frac{1}{2}a\Delta t^2$

(6)

3.4 **OPTION 1/*OPSIE 1***

Upwards positive/*Opwaarts positief:*



Criteria for graph/*Kriteria vir grafiek:*	**Marks/ *Punte***
Graph starts at (0; 112,8)./ *Grafiek begin by (0; 112,8).*	✓
Graph is a straight line with a gradient. /*Grafiek is 'n reguitlyn met 'n gradiënt.*	✓
Graph has a negative gradient./*Grafiek het 'n negatiewe gradiënt.*	✓
POSITIVE MARKING FROM QUESTION 3.3./*POSITIEWE NASIEN VANAF VRAAG 3.3.* Graph extends below x-axis until t = 24,87 s. *Grafiek verleng onder x-as tot t = 24,87s.*	✓
Graph extends below the x-axis to a magnitude of the velocity greater than (112,8 m·s^{-1}). / *Tweede deel van grafiek verleng onder die x-as tot 'n grootte van die snelheid groter as (112,8 m·s^{-1}).*	✓

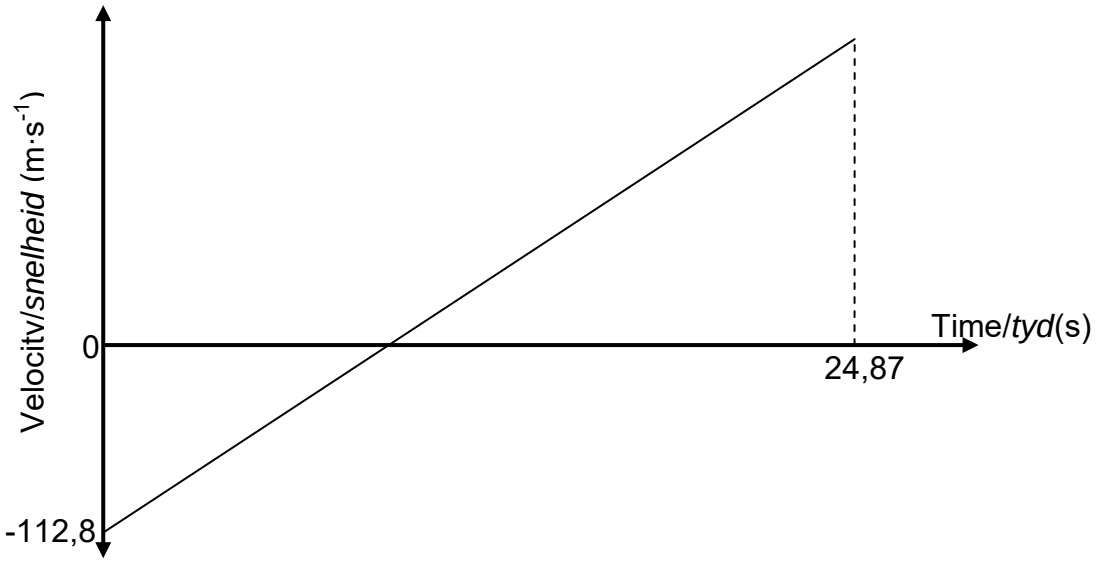
Notes/*Aantekeninge:*

If wrong labels/*Indien verkeerde byskrifte*: Max./*Maks.* $\frac{3}{4}$

OPTION 2/*OPSIE 2*

If upwards taken as negative: Max $\frac{4}{5}$/

Indien opwaarts as negatief geneem: Maks. $\frac{4}{5}$



Criteria for graph/*Kriteria vir grafiek:*	**Marks/ *Punte***
Graph starts at (0; -112,8)./ *Grafiek begin by (0; -112,8).*	✓
Graph is a straight line with a gradient. /*Grafiek is 'n reguitlyn met 'n gradiënt.*	✓
Graph has a positive gradient./*Grafiek het 'n positiewe gradiënt.*	✓
POSITIVE MARKING FROM QUESTION 3.3./*POSITIEWE NASIEN VANAF VRAAG 3.3.* Graph extends above x-axis until t = 24,87 s. *Grafiek verleng bo x-as tot t = 24,87s.*	✓
Graph extends above the x-axis to a magnitude of the velocity greater than (112,8 m·s^{-1}). / *Tweede deel van grafiek verleng bo die x-as tot 'n grootte van die snelheid groter as (112.8 m·s^{-1}).*	✓

Notes/*Aantekeninge:*

If wrong labels/*Indien verkeerde byskrifte*: Max./*Maks.* $\frac{3}{4}$

(5)
[15]

QUESTION 3/*VRAAG 3*

3.1 0,5 m ✓ (1)

3.2 **OPTION 1/*OPSIE 1***

Upwards positive/*Opwaarts positief*:

$v_f^2 = v_i^2 + 2a\Delta y$
$v_f^2 = (-2)^2 + 2(-9,8)(-1,8)$ ✓
$v_f = -6,27\ m\cdot s^{-1}$ ✓

$v_f = v_i + a\Delta t$
$-6,27 = -2 + (-9,8)\Delta t$ ✓
$\Delta t = 0,44\ s$ ✓

✓Both equations/*Beide vergelykings*

Downwards positive/*Afwaarts positief:*

$v_f^2 = v_i^2 + 2a\Delta y$ ✓
$v_f^2 = (2)^2 + 2(9,8)(1,89)$ ✓
$v_f = 6,27\ m\cdot s^{-1}$ ✓

$v_f = v_i + a\Delta t$
$6,27 = 2 + (9,8)\Delta t$ ✓
$\Delta t = 0,44\ s$ ✓

✓Both equations/*Beide vergelykings*

OPTION 2/*OPSIE 2*

Upwards positive/*Opwaarts positief:*

$\Delta y = v_i\Delta t + \frac{1}{2} a\Delta t^2$ ✓
$-1,8$ ✓$= (-2)\Delta t$ ✓ $+ \frac{1}{2}(-9,8)\Delta t^2$ ✓

$$\Delta t = \frac{-2 \pm \sqrt{(2)^2 - 4(4,9)(-1,8)}}{2(4,9)}$$

$= 0,44\ s$ ✓

Downwards positive/*Afwaarts positief:*

$\Delta y = v_i\Delta t + \frac{1}{2} a\Delta t^2$ ✓
$1,8$ ✓ $= (2)\Delta t$ ✓ $+ \frac{1}{2}(9,8)\Delta t^2$ ✓

$$\Delta t = \frac{-2 \pm \sqrt{(-2)^2 - 4(4,9)(-1,8)}}{2(4,9)} = 0,44\ s$$ ✓

(5)

3.3 **Upwards positive/*Opwaarts positief:***

$v_f^2 = v_i^2 + 2a\Delta y$ ✓
$0^2 = v_i^2 + 2(-9,8)(0,9)$ ✓
$v_i = 4,2\ m\cdot s^{-1}$ ✓ upwards/*opwaarts* ✓

Downwards positive/*Afwaarts positief:*

$v_f^2 = v_i^2 + 2a\Delta y$ ✓
$0^2 = v_i^2 + 2(9,8)(0,9)$ ✓
$v_i = 4,2\ m\cdot s^{-1}$ ✓ upwards/*opwaarts* ✓ (4)

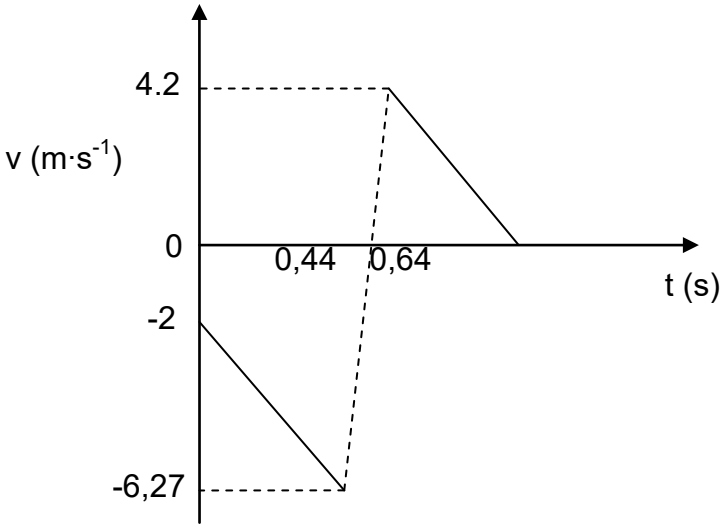
3.4 **Upwards positive/*Opwaarts positief:***

$F_{net}\Delta t = m\Delta v$ ✓
F_{net} (0,2) ✓= (0,5)[(4,2 – (-6,27)] ✓
F_{net} = 26,175 N ✓

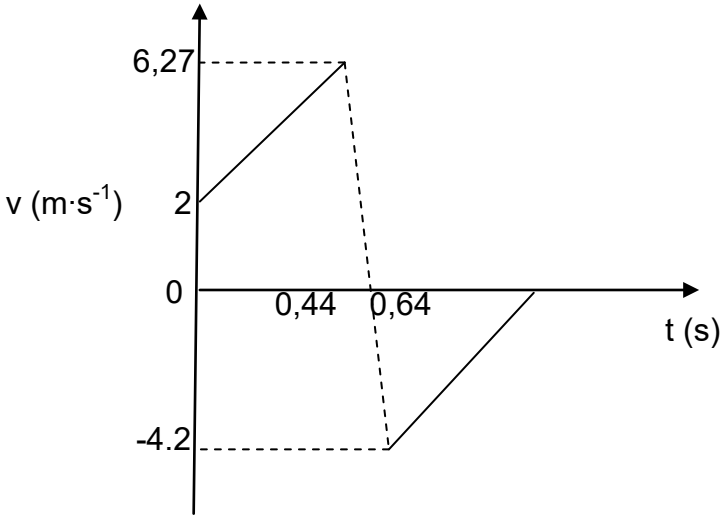
Downwards positive/*Afwaarts positief:*

$F_{net}\Delta t = m\Delta v$ ✓
F_{net} (0,2) ✓ = (0,5)[(-4,2 – (6,27)] ✓
F_{net} = -26,175 N
F_{net} = 26,175 N ✓ (4)

3.5 **Upwards positive/*Opwaarts positief:***



Downwards positive/*Afwaarts positief:*



(3)

Criteria for graph/*Kriteria vir grafiek:*	**Marks/ *Punte***
First part of the graph starts at v = 2 m·s^{-1} at t = 0 s and extends until v = 6,27 m·s^{-1} at t = 0,44 s. *Eerste deel van die grafiek begin by v = 2 m·s^{-1} by t = 0 s en verleng tot* v = 6,27 m·s^{-1} by *t = 0,44 s.*	✓
Graph is discontinuous and object changes direction at 0,64 s. *Grafiek is nie kontinu nie en voorwerp verander van rigting by 0,64 s.*	✓
Second part of graph starts at v = 4,2 m·s^{-1} at t = 0,64 s until v = 0 m·s^{-1}. *Tweede deel van grafiek begin by v = 4,2 m·s^{-1} by t = 0,64 s tot* v = 0 m·s^{-1}*.*	✓

[17]

QUESTION 4/*VRAAG 4*

4.1 The total linear momentum in a closed system ✓ remains constant. / is conserved. ✓
Die totale lineêre momentum in 'n geslote sisteem bly konstant / bly behoue.

OR/*OF*
In a closed system ✓ the total linear momentum before collision is equal to the total linear momentum after collision. ✓
In 'n geslote sisteem is die totale lineêre momentum voor botsing gelyk aan die totale lineêre momentum na botsing. (2)

4.2 $\sum p_i = \sum p_f$
$(m_1 + m_2)v_i = m_1v_{1f} + m_2v_{2f}$ } ✓ Any one/*Enige een*
$(2m + 4m)(0)$ ✓ $= 2m(2) + 4m(v_{2f})$ ✓
$-4m = 4mv_f$
$\therefore v_f = -1$ m·s^{-1}
$\therefore v_f = 1$ m·s^{-1} ✓ in the opposite direction to that of the boys ✓
in die teenoorgestelde rigting as dié van die seuns (5)

4.3 Greater than / *Groter as* ✓ (1)
[8]

SECTION B/*AFDELING B*

QUESTION 3/*VRAAG 3*

3.1 $15\ m\cdot s^{-1}$ ✓ (1)

3.2

OPTION 1/*OPSIE 1*

Inelastic ✓

The speed/velocity at which the ball leaves the floor is less / different than that at which it strikes the floor. OR The speed/velocity of the ball changes during the collision. ✓

Therefore the kinetic energy changes/is not conserved. ✓

Onelasties

Die spoed/snelheid waarteen die bal die vloer verlaat is kleiner / verskillend as dit waarteen dit die vloer tref. OF Die spoed / snelheid van die bal verander gedurende die botsing.

Die kinetiese energie verander/bly nie behoue nie.

OPTION 2/*OPSIE 2*

Collision is inelastic. ✓

Botsing is onelasties

$\Delta K = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$

$= \frac{1}{2}(0,15)(15)^2 - \frac{1}{2}(0,15)(20)^2$ ✓

$= -13,13\ J$

$K_i \neq K_f$ / $\Delta K \neq 0$ ✓

.

OPTION 3/*OPSIE 3*

Collision is inelastic.

Botsing is onelasties. ✓

$K_f = \frac{1}{2}mv_f^2$

$= \frac{1}{2}(0,15)(15)^2$

$= 16,88\ J$

$K_i = \frac{1}{2}mv_i^2$

$= \frac{1}{2}(0,15)(20)^2$ ✓

$= 30\ J$

$K_f \neq K_1$ / $\Delta K \neq 0$ ✓ (3)

3.3

OPTION 1/*OPSIE 1*

$v_f^2 = v_i^2 + 2a\Delta y$ ✓

$(20)^2$ ✓ $= (10)^2 + 2(9,8)\Delta y$ ✓

$\therefore \Delta y = 15,31\ m$ ✓

OPTION 2/*OPSIE 2*

$W_{net} = \Delta K$ ✓

$F_{net}\Delta y\cos\theta = \frac{1}{2}m(v_f^2 - v_i^2)$

$m(9,8)\Delta y\cos 0°$ ✓ $= \frac{1}{2}m(20^2 - 10^2)$ ✓

$\Delta y = 15,31\ m$ ✓

OPTION 3/*OPSIE 3*

$(E_p + E_k)_{top} = (E_p + E_k)_{bottom}$

$(mgh + \frac{1}{2}mv^2)_{top} = (mgh + \frac{1}{2}mv^2)_{bottom}$ } ✓any one/*enige een*

$m(9,8)h + \frac{1}{2}m(10)^2$ ✓ $= m(9,8)(0) + \frac{1}{2}m(20)^2$ ✓

$h = 15,31\ m$ ✓

OPTION 4/*OPSIE 4*

$v_f = v_i + a\Delta t$

$20 = 10 + (9,8)(\Delta t)$ ✓

$\therefore \Delta t = 1,02\ s$

$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$

$= (10)(1,02)$ ✓ $+ \frac{1}{2}(9,8)(1,02)^2$ ✓

$\therefore \Delta y = 15,3\ m$ ✓

OPTION 5/*OPSIE 5*

$v_f = v_i + a\Delta t$

$20 = 10 + (9,8)(\Delta t)$

$\therefore \Delta t = 1,02$ s

$\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$ ✓

$\Delta y = \left(\frac{10+20}{2}\right)$ ✓(1,02) ✓

$\therefore \Delta y = 15,3$ m ✓

OPTION 6/*OPSIE 6*

$v_f = v_i + a\Delta t$

$20 = 10 + (9,8)(\Delta t)$

$\therefore \Delta t = 1,02$ s ✓

Height = area between graph & *t* axis

Hoogte = opperv. tussen grafiek & t-as

= ½(sum ‖ sides)$h_{\perp}$

= ½(10 + 20) ✓1,02 ✓

= 15,3 m✓

= 15,3 m ✓

OPTION 7/*OPSIE 7*

$v_f = v_i + a\Delta t$

$20 = 10 + (9,8)(\Delta t)$

$\therefore \Delta t = 1,02$ s ✓

Height = area between graph & *t* axis

Hoogte = opperv. tussen grafiek & t-as

= lb + ½bh = ½(10 + 20)1,02

= (1,02)(10) ✓ + ½(1,02)(10) ✓

= 15,3 m ✓

OPTION 8/*OPSIE 8*

$F_{net} = ma$

$mg = m\left(\frac{v_f^2 - v_i^2}{2\Delta x}\right)$ ✓

(0,15)(9,8) ✓ =(0,15) $\left(\frac{20^2 - 10^2}{2\Delta x}\right)$ ✓

$\Delta x = 15,31$ m✓ (4)

3.3.2 $F_{net}\Delta t = \Delta p$

$F_{net}\Delta t = mv_f - mv_i$ ✓Any one/*Enige een*

$\Delta p = mv_f - mv_i$

= 0,15(-15 – 20) ✓

= - 5,25 N·s (or - 5,25 kg·m·s^{-1})

Magnitude/*Grootte* = 5,25 N·s or 5,25 kg·m·s^{-1}✓ (3)

3.3.3

OPTION 1 / *OPSIE 1*

Displacement from floor to max. height/ *Verplasing van vloer na maks. hoogte*:

$v_f^2 = v_i^2 + 2a\Delta y$ ✓

$(0)^2 = (-15)^2 + 2(9,8)\Delta y$ ✓

$\therefore \Delta y = -11,48$ m

Total displacement / *Totale verplasing*

$= -11,48 + 15,3$ ✓

$= 3,82$ m ✓ / 3,83 m

OPTION 2 / *OPSIE 2*

$v_f = v_i + a\Delta t$

$0 = -15 + (9,8)\Delta t$

$\Delta t = 1,53$ s ✓

$\Delta y = v_i\Delta t + ½ a\Delta t^2$

$= (-15)(1,53) + ½ (9,8)(1,53)^2$ ✓

$= -11,48$ m

Total displacement / *Totale verplasing*

$= -11,48 + 15,3$ ✓

$= 3,82$ m ✓

OPTION 3 / *OPSIE 3*

$v_f = v_i + a\Delta t$

$0 = -15 + (9,8)\Delta t$

$\Delta t = 1,53$ s ✓

$\Delta y = \left(\frac{v_f + v_i}{2}\right)\Delta t$

$= \left(\frac{0 + (-15)}{2}\right)(1,53)$ ✓

$= -11,48$ m

Total displacement / *Totale verplasing*

$= -11,48 + 15,3$ ✓

$= 3,82$ m ✓

OPTION 4 / *OPSIE 4*

$v_f = v_i + a\Delta t$

$0 = -15 + (9,8)\Delta t$

$\Delta t = 1,53$ s ✓

Area = ½ bh

$= ½ (1,53)(-15)$ ✓

$= -11,48$ m

Total displacement / *Totale verplasing*

$= -11,48 + 15,3$ ✓

$= 3,82$ m ✓

OPTION 5 / *OPSIE 5*

$E_{M(initial)} = E_{M(final)}$
$(E_p + E_k)_{initial} = (E_p + E_k)_{final}$
$(mgh + ½ mv^2)_{initial} = (mgh + ½ mv^2)_{final}$
✓Any one /*Enige een*

$(0,15)(9,8)(0) + ½ (0,15)(15)^2 = (0,15)(9,8)h + ½ (0,15)(0)^2$ ✓
h = 11,48 m

Total displacement / *Totale verplasing*
= 15,31 - 11,48 ✓ = 3,83 m ✓

OPTION 6/*OPSIE 6*

$W_{net} = \Delta K$ ✓
$F_{net}\Delta y\cos\theta = ½ m(v_f^2 - v_i^2)$
$m(9,8)\Delta y\cos 180° = ½ m(0^2 - 15^2)$ ✓
Δy = 11,48 m

Total displacement / *Totale verplasing*
= 15,31 - 11,48 ✓
= 3,83 m ✓

OPTION 7/*OPSIE 7*

$F_{net} = ma$

$mg = m\left(\frac{v_f^2 - v_i^2}{2\Delta x}\right)$ ✓

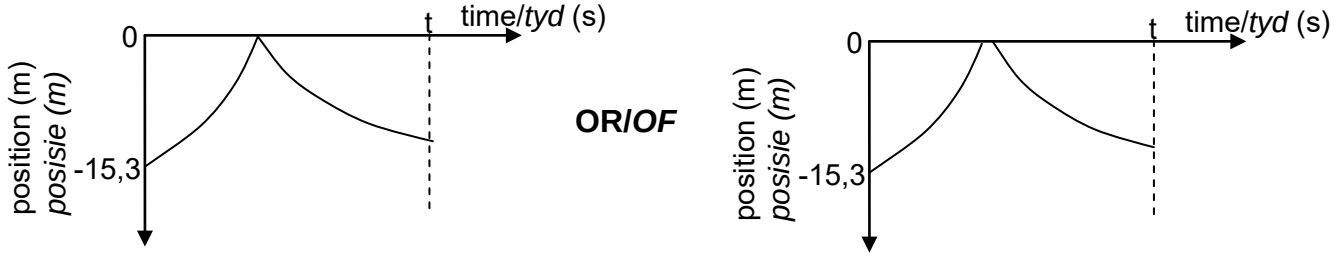
$(0,15)(9,8) = (0,15)\left(\frac{0^2 - (-15)^2}{2\Delta x}\right)$ ✓

Δx = -11,48 m

Total displacement / *Totale verplasing*
= 15,31 - 11,48 ✓
= 3,83 m ✓

(4)

3.4



Marking criteria for graph:/*Nasienriglyne vir grafiek:*	
Correct shape as shown for first part./*Korrekte vorm soos aangetoon vir eerste deel.*	✓
Correct shape as shown for the second part up to t / 2,55 s. *Korrekte vorm soos aangetoon vir tweede deel t / 2,55 s.*	✓
Graph starts at -15,3 m at t = 0 s./*Grafiek begin by -15,3 m by t = 0 s.*	✓
Maximum height after bounce at time *t* / 2,55 s./*Maksimum hoogte na bons by tyd t./ 2,55 s.* Maximum height after bounce less than 15,3 m./*Maksimum hoogte na bons kleiner as 15,3 m.*	✓

(4)
[19]

SECTION B/*AFDELING B*

QUESTION 3/*VRAAG 3*

3.1 50 N ✓downwards/*afwaarts*✓ (2)

3.2

3.2.1

OPTION 1/*OPSIE 1*	**Notes/*Aantekeninge***
Downward positive: ***Afwaarts positief:*** $v_f^2 = v_i^2 + 2a\Delta y$ ✓ $\therefore v_f^2 = 0^2 + \underline{2(9,8)(0,8)}$ ✓ $\therefore v_f = 3,96\ m\cdot s^{-1}$ ✓ downward /*afwaarts*✓ **Downward negative:** ***Afwaarts negatief:*** $v_f^2 = v_i^2 + 2a\Delta y$ ✓ $\therefore v_f^2 = 0^2 + \underline{2(-9,8)(-0,8)}$ ✓ $\therefore v_f = -3,96\ m\cdot s^{-1}$ $\therefore v_f = 3,96\ m\cdot s^{-1}$ ✓ downward /*afwaarts*✓	Accept/*Aanvaar:* g or/*of* a Accept/*Aanvaar*: $v_f^2 = v_i^2 + 2a\Delta x$ $v^2 = u^2 + 2as$
OPTION 2/*OPSIE 2*	**Notes/*Aantekeninge***
$(E_p + E_k)_{top/bo} = (E_p + Ek)_{bottom/onder}$✓ $mgh + 0 = 0 + ½mv^2$ (9,8)(0,8) ✓= ½ v^2 $v = 3,96\ m\cdot s^{-1}$ ✓ downward/*afwaarts*✓	Accept/*Aanvaar*: $(U + K)_{top/bo} = (U + K)_{bottom/onder}$

(4)

3.2.2

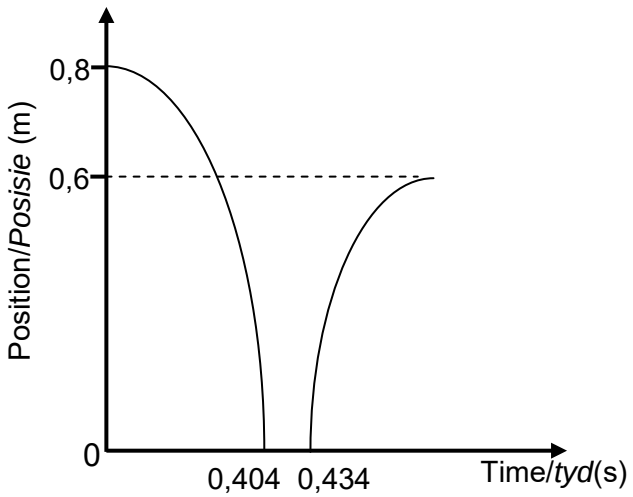
POSITIVE MARKING FROM QUESTION 3.2.1 ***POSITIEWE NASIEN VAN VRAAG 3.2.1*** **OPTION 1/*OPSIE 1*** **Downward positive/*Afwaarts positief:*** $F_{net}\Delta t = \Delta p$ OR $F_{net}\Delta t = m(v_f - v_i)$ ✓ $(F_{app} + mg)\Delta t = \Delta p$ $(-50 + (0,2)(9,8)\Delta t$ ✓ $= 0,2(-3,43 - 3,96)$ ✓ $\therefore \Delta t = 0,03$ s ✓ $(3 \times 10^{-2}$ s) **Downward negative/*Afwaarts negatief:*** $F_{net}\Delta t = \Delta p$ OR $F_{net}\Delta t = m(v_f - v_i)$ ✓ $(F_{app} + mg)\Delta t = \Delta p$ $(50 - (0,2)(9,8)\Delta t$✓ $= 0,2[3,43 - (-3,96)]$ ✓ $\therefore \Delta t = 0,03$ s ✓ $(3 \times 10^{-2}$ s)	**Notes/*Aantekeninge:*** Substitution: F_{app} and v_f must have the same sign. *Substitusie: F_{app} en v_f moet dieselfde tekens hê.*
OPTION 2/*OPSIE 2* **Downward positive/*Afwaarts positief:*** $F_{net} = ma$ $F_{app} + mg = ma$ $(-50 + (0,2)(9,8) = 0,2a$ ✓ $\therefore a = -240,2$ m·s^{-2} $v_f = v_i + a\Delta t$ $-3,43 = 3,96 + (-240,2)\Delta t$ ✓ $\therefore \Delta t = 0,03$ s ✓ $(3 \times 10^{-2}$ s) ✓both formulae *beide formules* **Downward negative/*Afwaarts negatief:*** $F_{net} = ma$ $F_{app} + mg = ma$ $(50 - (0,2)(9,8) = 0,2a$ ✓ $\therefore a = 240,2$ m·s^{-2} $v_f = v_i + a\Delta t$ $3,43 = -3,96 + (240,2)\Delta t$ ✓ $\therefore \Delta t = 0,03$ s ✓ $(3 \times 10^{-2}$ s) ✓both formulae *beide formules*	**Notes/*Aantekeninge*** Accept/*Aanvaar*: $v = u + at$ $v_f = v_i + a\Delta t$

(4)

3.3 **POSITIVE MARKING FROM QUESTION 3.2.**
POSITIEWE NASIEN VAN VRAAG 3.2.

OPTION/*OPSIE 1*
Ground as zero reference and downward negative:
Grond as nulverwysing en afwaarts negatief:

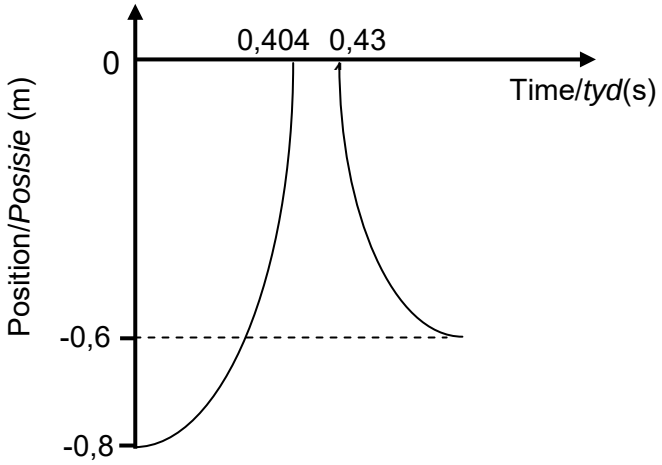
Criteria for graph/*Kriteria vir grafiek:*	Marks/ *Punte*
Correct shape (both curves) *Korrekte vorm (beide krommes)*	✓
Graph starts at y = 0,8 m at t = 0 s *Grafiek begin by y* = 0,8 m at t = 0 s	✓
Second maximum height at y = 0,6 m *Tweede maksimum by y = 0,6 m s*	✓
Contact time shown as space on x axis between two curves. *Kontaktyd aangetoon as spasie op x-as tussen twee krommes.*	✓
Time at which ball leaves the floor shown as t = 0,434 s. *Tyd wanneer die bal die vloer verlaat getoon as t = 0,434 s.*	✓



OPTION/*OPSIE 2*

Ground as zero reference and downward positive:
Grond as nulverwysing en afwaarts positief:

Criteria for graph/*Kriteria vir grafiek:*	Marks/ *Punte*
Correct shape (both curves) *Korrekte vorm (beide krommes)*	✓
Graph starts at y = -0,8 m at t = 0 s *Grafiek begin by y* = -0,8 m at t = 0 s	✓
Second maximum height at y = -0,6 m *Tweede maksimum by y = -0,6 m s*	✓
Contact time shown as space on x axis between two curves. *Kontaktyd aangetoon as spasie op x-as tussen twee krommes.*	✓
Time at which ball leaves the floor shown as t = 0,434 s. *Tyd wanneer die bal die vloer verlaat getoon as t = 0,434 s.*	✓



(5)
[15]

SECTION B/*AFDELING B*

QUESTION 3/*VRAAG 3*

3.1 Downward/*afwaarts* ✓ (1)

3.2

3.2.1 **Upwards positive/*Opwaarts positief:***

$v_f = v_i + a\Delta t$ ✓
$= 8$ ✓$+ (-9,8)(4)$ ✓
$= -31,2\ m\cdot s^{-1}$
$\therefore v_f = 31,2\ m\cdot s^{-1}$ ✓

Downwards positive/*Afwaarts positief:*

$v_f = v_i + a\Delta t$✓
$= -8$ ✓$+ (9,8)(4)$ ✓
$\therefore v_f = 31,2\ m\cdot s^{-1}$ ✓ (4)

3.2.2

OPTION 1/*OPSIE 1*

Upwards positive/*Opwaarts positief*:

$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$✓
$= (8)(4)$ ✓ $+ \frac{1}{2}(-9,8)(4)^2$ ✓
$= -46,4$ m

Height of balcony/*Hoogte van balkon:*
60 – 46,4 ✓= 13,6 m ✓

Downwards positive/*Afwaarts positief:*

$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$✓
$= (-8)(4)$ ✓ $+ \frac{1}{2}(9,8)(4)^2$ ✓
$= 46,4$ m

Height of balcony/*Hoogte van balkon:*
60 – 46,4 ✓= 13,6 m ✓

OPTION 2/*OPSIE 2*

Upwards positive/*Opwaarts positief:*

$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$✓
$= (27,13)$ ✓ (6) ✓$+ \frac{1}{2}(-9,8)(6)^2$✓
$= -13,62$ m

Height of balcony/*Hoogte van balkon:*
= 13,62 m ✓

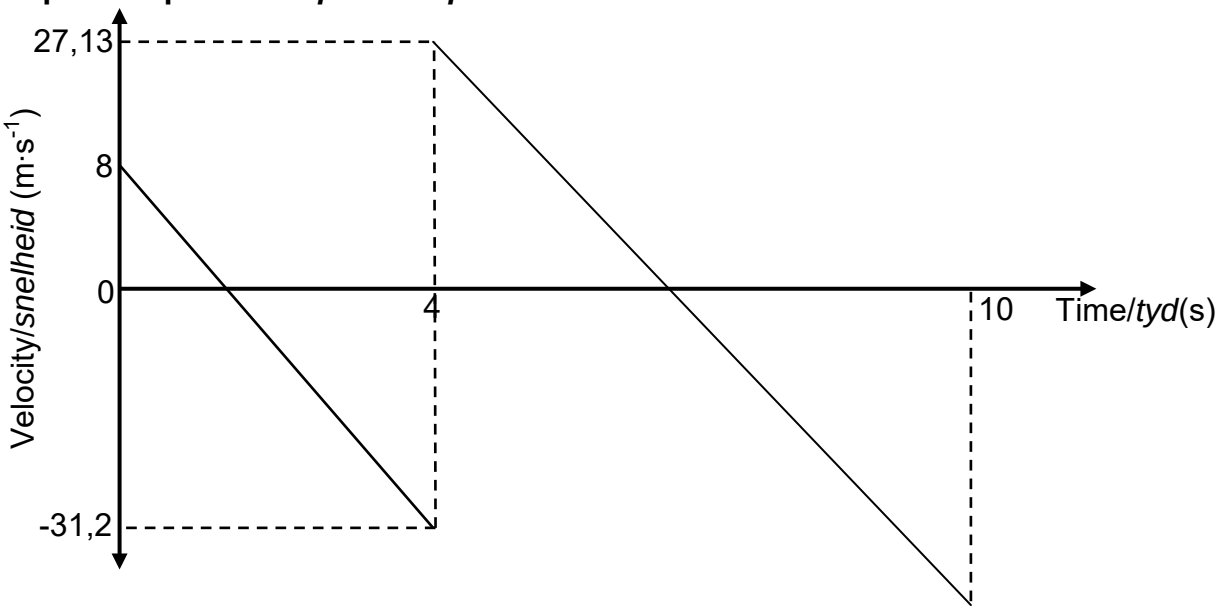
Downwards positive/*Afwaarts positief:*

$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$✓
$= (-27,13)$ ✓ (6) ✓$+ \frac{1}{2}(9,8)(6)^2$✓
$= 13,62$ m

Height of balcony/*Hoogte van balkon:*
= 13,62 m ✓ (5)

3.3 **OPTION 1/*OPSIE 1***

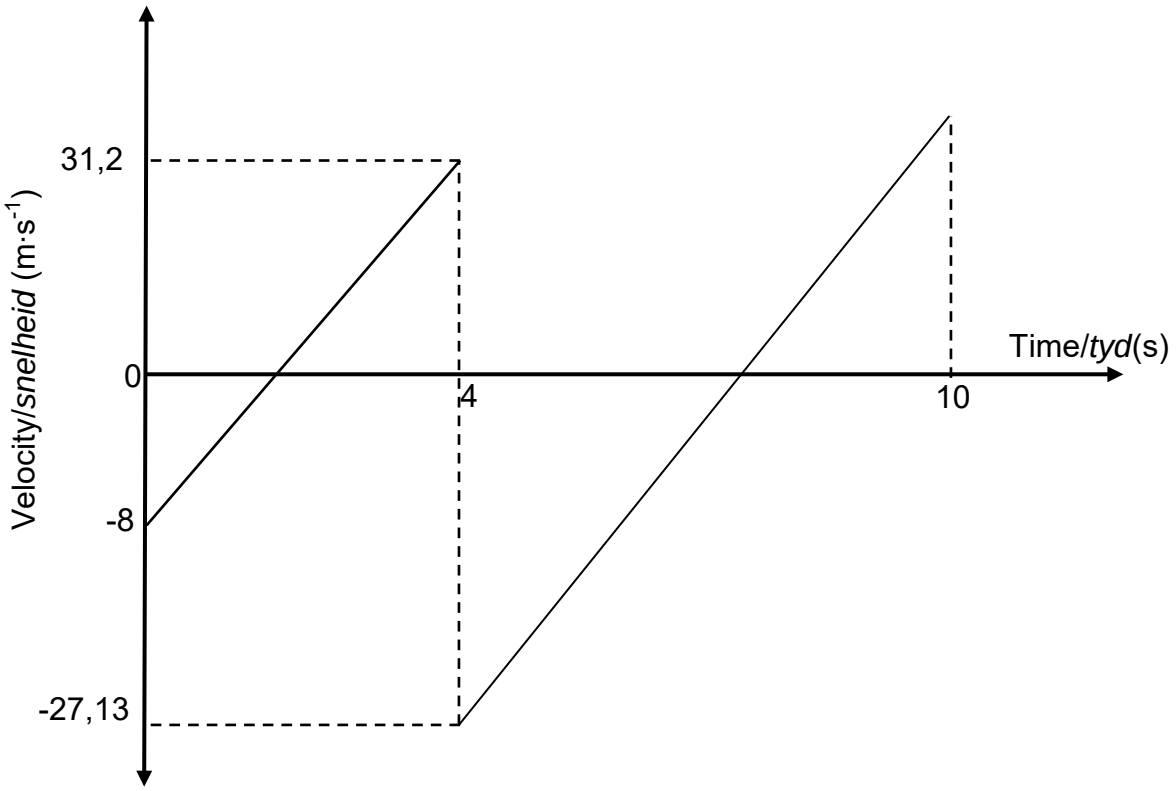
Upwards positive/*Opwaarts positief:*



Criteria for graph/*Kriteria vir grafiek:*	**Marks/ *Punte***
Shape has two parallel lines with a gradient. *Vorm het twee ewewydige lyne met gradient.*	✓
First part of graph starts at v = 8 m·s^{-1} at t = 0 s *Eerste deel van grafiek begin by v = 8 m·s^{-1} by t = 0 s.*	✓
Positive marking from QUESTION 3.2.1: ***Positiewe nasien vanaf VRAAG 3.2.1:*** First part of the graph extends below the x axis until v = -31,2 m·s^{-1} at t = 4 s. *Eerste deel van die grafiek verleng onder x-as tot* v = -31,2 m·s^{-1} by *t = 4 s.*	✓
Graph is discontinuous and object changes direction at 4 s. *Grafiek is nie kontinu nie en voorwerp verander van rigting by 4 s.*	✓
Second part of graph starts at v = 27,13 m·s^{-1} at t = 4 s. *Tweede deel van grafiek begin by v = 27,13 m·s^{-1} by t = 4 s.*	✓
Second part of graph extends below the x axis until t = 10 s. *Tweede deel van grafiek verleng onder x-as tot t =10 s.*	✓

OPTION 2/*OPSIE 2*

Upwards negative/*Opwaarts negatief:*



Criteria for graph/*Kriteria vir grafiek:*	**Marks** ***Punte***
Correct shape as shown (two parallel lines). *Korrekte vorm soos aangetoon (twee ewewydige lyne).*	✓
First part of graph starts at v = -8 m·s^{-1} at t = 0 s *Eerste deel van grafiek begin by v = -8 m·s^{-1} by t = 0 s*	✓
Positive marking from QUESTION 3.2.1. ***Positiewe nasien vanaf VRAAG 3.2.1.*** First part of the graph extends above the x axis until v = 31,2 m·s^{-1} at t = 4 s. *Eerste deel van die grafiek verleng bokant x-as tot* v = 31,2 m·s^{-1} by *t = 4 s.*	✓
Graph is discontinuous and object changes direction at 4 s. *Grafiek is nie kontinu en voorwerp verander van rigting by 4 s.*	✓
Second part of graph starts at v = -27,13 m·s^{-1} at t = 4 s. *Tweede deel van grafiek begin by v = -27,13 m·s^{-1} by t = 4 s.*	✓
Second part of graph extends above the x axis until t = 10 s. *Tweede deel van grafiek verleng bokant x-as tot t = 10 s.*	✓

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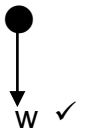
(6)
[16]

SECTION B/*AFDELING B*

QUESTION 3/*VRAAG 3*

3.1

Accepted Labels/*Aanvaarde benoemings*	
w	F_g / F_w / force of Earth on stone/weight/mg/gravitational force *F_g / F_w / krag van Aarde op klip/gewig/mg/gravitasiekrag*



(1)

3.2.1

Option 1/*Opsie 1*:

Upward positive/*Opwaarts positief*:

$v_f = v_i + a\Delta t$ ✓

$0 = 10$ ✓$+(-9,8)\Delta t$ ✓

$\therefore \Delta t = 1,02$ s ✓

Upward negative/*Opwaarts negatief*:

$v_f = v_i + a\Delta t$ ✓

$0 = -10$ ✓$+ 9,8\Delta t$ ✓

$\therefore \Delta t = 1,02$ s ✓

Option 2/*Opsie 2*:

Upward positive/*Opwaarts positief*:

$v_f^2 = v_i^2 + 2a\Delta y$

$0^2 = 10^2 + 2(-9,8)\Delta y$ ✓

$\therefore y = 5,1$ m

$\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$

$5,1 = (\frac{10+0}{2})\Delta t$ ✓

$\therefore \Delta t = 1,02$ s ✓

✓Both formulae/ *Beide formules*

Upward negative/*Opwaarts negatief*:

$v_f^2 = v_i^2 + 2a\Delta y$

$0^2 = (-10)^2 + 2(9,8)\Delta y$ ✓

$\therefore y = -5,1$ m

$\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$

$-5,1 = (\frac{-10+0}{2})\Delta t$ ✓

$\therefore \Delta t = 1,02$ s ✓

✓ Both formulae/ *Beide formules*

(4)

3.2.2 **POSITIVE MARKING FROM QUESTION 3.2.1 TO QUESTION 3.2.2**
POSITIEWE NASIEN VAN VRAAG 3.2.1 NA VRAAG 3.2.2

Option 1/*Opsie 1:*

Upward positive/*Opwaarts positief*:

$v_f^2 = v_i^2 + 2a\Delta y$ ✓

$0^2 = 10^2 + 2(-9,8)\Delta y$ ✓

$\therefore \Delta y = 5,1$ m

Height/*Hoogte* = 50 + ✓ 5,1
= 55,1 m ✓

Upward negative/*Opwaarts negatief*:

$v_f^2 = v_i^2 + 2a\Delta y$ ✓

$0^2 = (-10)^2 + 2(9,8)\Delta y$ ✓

$\therefore \Delta y = -5,1$ m

Height/*Hoogte* = 50 + ✓ 5,1
= 55,1 m ✓

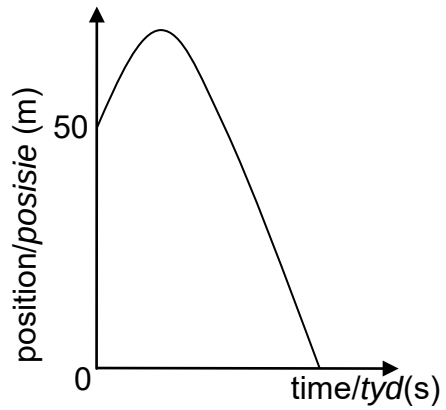
Option 2/*Opsie 2:*	**Option 3/*Opsie 3*:**
Upward positive/*Opwaarts positief*: $\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$ ✓ $\Delta y = (\frac{10+0}{2})1{,}02$ ✓ $\therefore$ = 5,1 m Height = 50 + ✓ 5,1 = 55,1 m ✓	**Consider downward motion/ *Beskou afwaartse beweging*:** $\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$ ✓ $\Delta y = (\frac{-10+0}{2})1{,}02$ ✓ $\therefore$ = -5,1 m Height = 50 + ✓ 5,1 = 55,1 m ✓
Upward negative/*Opwaarts negatief*: $\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$ ✓ $\Delta y = (\frac{-10+0}{2})1{,}02$ ✓ $\therefore$ $\therefore \Delta y$ = - 5,1 m Height/*Hoogte* = 50 + ✓ 5,1 = 55,1 m ✓	**Upward negative/*Opwaarts negatief*:** $\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$ ✓ $\Delta y = (\frac{-10+0}{2})1{,}02$ ✓ $\therefore$ = - 5,1 m Height/*Hoogte* = 50 +✓ 5,1 = 55,1 m✓

(4)

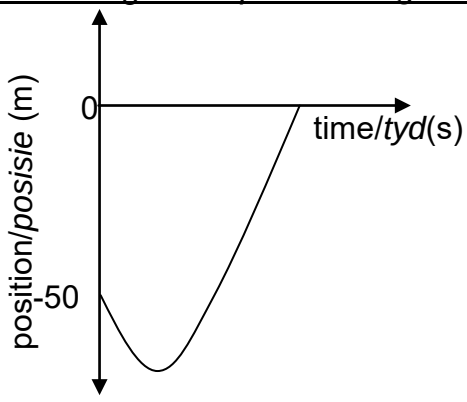
3.3

Criteria for graph/Kriteria vir grafiek	Marks/ *Punte*
Correct shape/*Korrekte vorm*	✓
Final position lower than initial position.	✓
Graph ends on x axis./*Grafiek eindig op x-as*.	✓

Upward positive/*Opwaarts positief*



Upward negative/*Opwaarts negatief*



3.4

Option 1/*Opsie 1*

$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2$ ✓

$1,5$ ✓ $= v_i(0,1) + \frac{1}{2}(9,8)(0,1)^2$ ✓

$\therefore v_i = 14,51 \text{ m·s}^{-1}$

From maximum height/*Van maksimum hoogte:*

$v_f^2 = v_i^2 + 2a\Delta y$ ✓

$14,51^2$ ✓ $= (0)^2 + 2(9,8)\Delta y$ ✓

$\therefore \Delta y = 10,74$ m

Height/*Hoogte* = 55,1 –10,74
= 44,36 m ✓

Option 2/*Opsie 2*

$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2$ ✓

$1,5$ ✓ $= v_i(0,1) + \frac{1}{2}(9,8)(0,1)^2$ ✓

$\therefore v_i = 14,51 \text{ m·s}^{-1}$

Downwards from top of tower to top of window:/*Afwaarts van bopunt van toring tot bopunt van venster*

$v_f^2 = v_i^2 + 2a\Delta y$ ✓

$14,51^2$ ✓ $= (10)^2 + 2(9,8)\Delta y$ ✓

$\therefore \Delta y = 5,64$ m

Height/*Hoogte* = 50 – 5,64
= 44,36 m ✓

Option 3/*Opsie 3*

$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2$ ✓

$1,5$ ✓ $= v_i(0,1) + \frac{1}{2}(9,8)(0,1)^2$ ✓

$\therefore v_i = 14,51 \text{ m·s}^{-1}$

From original point of projection:/*Van oorspronklike punt van projeksie*

$v_f^2 = v_i^2 + 2a\Delta y$ ✓

$14,51^2$ ✓ $= (-10)^2 + 2(9,8)\Delta y$ ✓

$\therefore \Delta y = 5,64$ m

Height/*Hoogte* = 50 – 5,64
= 44,36 m ✓

Option 4/*Opsie 4*

$\bar{v} = \frac{\Delta y}{\Delta t} = \frac{1,5}{0,1} = 15 \text{ m·s}^{-1}$

$\bar{v} = \frac{v_i + v_f}{2} = \frac{15}{}$

$\therefore v_i + v_f = 30 \text{ m·s}^{-1}$

$\therefore v_f = 30 - v_i$

$v_f = v_i + a\Delta t$ ✓

$30 - v_i$ ✓ $= v_i + 9,8(0,1)$ ✓

$\therefore v_i = 14,51 \text{ m·s}^{-1}$

$v_f^2 = v_i^2 + 2a\Delta y$ ✓

$14,51^2$ ✓ $= (0)^2 + 2(9,8)\Delta y$ ✓

$\therefore \Delta y = 10,74$ m

Height/*Hoogte* = 55,1 – 10,74
= 44,36 m ✓

(7)
[19]

SECTION B / *AFDELING B*

QUESTION 3 / *VRAAG 3*

3.1 The initial velocity / speed of the camera is the same ✓
(as that of the balloon).
Die beginsnelheid / spoed van die kamera is dieselfde ✓(as dié van die ballon). (1)

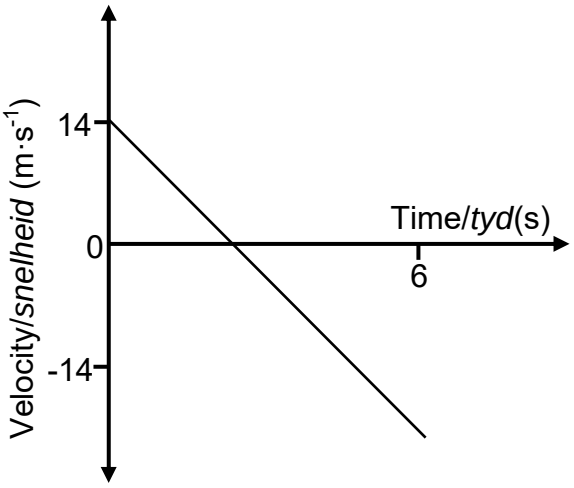
3.2 **Downward positive:**
Afwaarts positief:

$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2$ ✓
$\therefore 92,4$ ✓$= v_i(6) + ½(9,8)(6)^2$ ✓
$\therefore v_i = -14\ m \cdot s^{-1}$
$\therefore v_i = 14\ m \cdot s^{-1}$ ✓

Downward negative:
Afwaarts negatief:

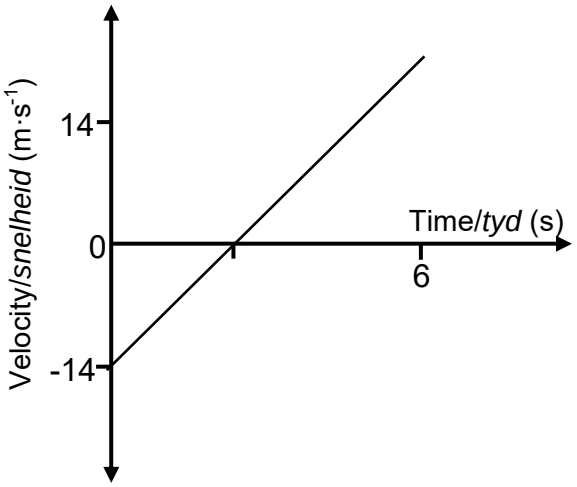
$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2$ ✓
$\therefore -92,4$ ✓$= v_i(6) + ½(-9,8)(6)^2$ ✓
$\therefore v_i = 14\ m \cdot s^{-1}$ ✓ (4)

3.3 Upward positive/*Opwaarts positief*:



Criteria for graph/*Kriteria vir grafiek:*	Marks/ *Punte*
Correct shape as shown.(straight line with gradient) Korrekte *vorm soos getoon.(reguitlyn met gradient)*	✓
Graph starts at v = 14 $m \cdot s^{-1}$ / v_i at t = 0 s. *Grafiek begin by v = 14 $m \cdot s^{-1}$ / v_i by t = 0 s.*	✓
Graph extends below t axis until t = 6 s. *Grafiek verleng onder t-as tot t = 6 s.*	✓
Section of graph below t axis longer than section above t axis. *Gedeelte van grafiek onderkant t-as langer as gedeelte bokant t-as.*	✓

Upward negative / *Opwaarts negatief:*



Criteria for graph/*Kriteria vir grafiek:*	Marks/ *Punte*
Correct shape as shown. Korrekte *vorm soos getoon.*	✓
Graph starts at v / v_i = -14 m·s^{-1} at t = 0 s. *Grafiek begin by v/v_i = -14 m·s^{-1} by t = 0 s.*	✓
Graph extends above t axis until t = 6 s. *Grafiek verleng bokant t-as tot t = 6 s.*	✓
Section of graph above t axis longer than section below t axis. *Gedeelte van grafiek bokant t-as langer as gedeelte onderkant t-as.*	✓

(4)

3.4

Option 1 / *Opsie 1*:

$\Delta x = v\Delta t$✓

$\therefore 10$ ✓$= (2)\Delta t$ ✓

$\therefore \Delta t = 5$ s ✓

Yes/ Will catch the camera, time is less than 6 s. ✓

Ja / Sal die kamera vang, tyd is kleiner as 6 s. ✓

Option 2/*Opsie 2*:

$\Delta x = v\Delta t$✓

$= (2)$✓(6) ✓

$= 12$ m ✓

Yes / Will catch the camera, distance covered is greater than 10 m. ✓

Ja / Sal die kamera vang , afstand afgelê is groter as 10 m. ✓

Option 3 / *Opsie 3*:

$\Delta x = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓

$\therefore 10$ ✓$= (2)\Delta t$ ✓$+ ½(0)\Delta t$

$\therefore \Delta t = 5$ s ✓

Yes/ will catch the camera, time is less than 6 s✓.

Ja / Sal die kamera vang, tyd is kleiner as 6 s. ✓

Option 4 / *Opsie 4*:

$\Delta x = (\frac{v_i + v_f}{2})\Delta t$ ✓ $\therefore 10$ ✓$= (\frac{2+2}{2})\Delta t$ ✓ $\therefore \Delta t = 5$ s ✓

Yes / Will catch the camera, time is less than 6 s.✓

Ja / Sal die kamera vang, tyd is kleiner as 6 s. ✓

Option 5 / *Opsie 5*:

$\Delta x = (\frac{v_i + v_f}{2})\Delta t$ ✓ $= (\frac{2+2}{2})$✓6 ✓ $= 12$ m·✓

Yes / Will catch the camera, distance covered is greater than 10 m. ✓

Ja / Sal die kamera vang , afstand afgelê is groter as 10 m. ✓

(5)
[14]

SECTION B/*AFDELING B*

QUESTION 4/*VRAAG 4*

4.1

Option 1/*Opsie 1*
Statements not correct (or no) / *Stellings nie reg nie (of nee*) ✓

The bricks will experience the same (gravitational) acceleration / free fall ✓ and thus reach the ground at the same time. ✓

Die bakstene ondervind dieselfde (gravitasie) versnelling /vryval ✓*en bereik dus die grond gelyktydig.* ✓

Option 2/*Opsie 2*
Pete is correct or Alex is wrong / *Pete is reg of Alex is verkeerd* ✓

The smaller brick experiences less air resistance, thus larger acceleration ✓
and reaches the ground first. ✓

Die kleiner baksteen ondervind minder lugweerstand, dus groter versnelling ✓
en tref die grond eerste. ✓

Option 3/*Opsie 3*
Alex is correct or Pete is wrong / *Alex is reg of Pete is verkeerd* ✓

In the presence of air resistance, the larger brick, with larger mass, experiences a larger net force downwards, thus largest acceleration ✓
and reaches the ground first ✓

In die aanwesigheid van lugweerstand, ondervind die groter baksteen met groter massa 'n groter netto afwaartse krag, dus grootste versnelling ✓
en *tref die grond eerste.* ✓

Option 4/*Opsie 4*
Both are correct / *Beide is reg* ✓

Pete correct: The smaller brick experiences less air resistance, thus larger acceleration and reaches the ground first. ✓
Die kleiner baksteen ondervind minder lugweerstand, dus groter versnelling en tref die grond eerste ✓

Alex correct: In the presence of air resistance, the larger brick, with larger mass, experiences a larger net force downwards, thus largest acceleration and reaches the ground first ✓
In die aanwesigheid van lugweerstand, ondervind die groter baksteen met groter massa, 'n groter netto afwaartse krag, dus grootste versnelling en tref grond eerste. ✓

[12.2.3] (3)

4.2.1 Any two / *Enige twee:*

- Ensure that both bricks are dropped from same height
  Maak seker dat beide bakstene vanaf dieselfde hoogte laat val word
- Ensure that both bricks are dropped at the same time
  Maak seker dat beide bakstene gelyktydig laat val word

  OR/*OF*
  Ensure that the stopwatch starts at instant that each brick is released and stopped at the instant that each brick reaches the ground
  Maak seker dat die stophorlosie begin die oomblik as elk van die bakstene gelos word, en gestop word die oomblik as elke baksteen die grond bereik
- Repeat the experiment several times and use the average of the results
  Herhaal die eksperiment verskeie kere en gebruik die gemiddelde van die resultate
- Make sure that $v_i = 0$ for both bricks
  Maak seker dat $v_i = 0$ vir beide bakstene
- Make sure that there is no strong wind
  Maak seker dat daar geen sterk wind is nie
- Use bricks made of the same material / of same density
  Gebruik bakstene gemaak van dieselfde materiaal / met dieselfde digtheid [12.1.1] (2)

4.2.2 External force(s) may be present e.g. friction/air resistance / strong wind blowing
Eksterne krag(te) kan teenwoordig wees bv. wrywing / lugweerstand / sterk wind wat waai [12.1.1] (1)

4.3

Option 1/*Opsie 1*:

Downward direction positive / *Afwaartse rigting positief:*

A:

$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓

8 ✓ $= (0)\Delta t + \frac{1}{2}(9,8)\Delta t^2$ ✓

$\therefore \Delta t = 1,28$ s

B:

$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$

8 ✓ $= v_{iB}(1,28 - 0,6)$ ✓ $+ \frac{1}{2}(9,8)(1,28 - 0,6)^2$ ✓

$\therefore v_{iB} = 8,43\ m\cdot s^{-1}$ ✓ (8,43 to/*tot* 8,48 $m\cdot s^{-1}$)

Downward motion negative / *Afwaartse beweging negatief:*

A:

$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓

-8 ✓ $= (0)\Delta t + \frac{1}{2}(-9,8)\Delta t^2$ ✓ $\therefore \Delta t = 1,28$ s

B:

$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$

-8 ✓ $= v_{iB}(1,28 - 0,6)$ ✓ $+ \frac{1}{2}(-9,8)(1,28 - 0,6)^2$ ✓

$\therefore v_{iB} = -8,43\ m\cdot s^{-1}$

$\therefore v_{iB} = 8,43\ m\cdot s^{-1}$ ✓ (8,43 to/*tot* 8,48 $m\cdot s^{-1}$)

Option 2/*Opsie 2*:

Downward direction positive / *Afwaartse rigting positief:*

A:

$v_f^2 = v_i^2 + 2a\Delta y$ ✓ $= 0^2 + 2(9,8)(8)$ ✓ $\therefore v_f = 12,52\ m\cdot s^{-1}$

$v_f = v_i + a\Delta t$ $\therefore 12,52 = 0 + (9,8)\Delta t$ ✓ $\therefore \Delta t = 1,28$ s

B:

$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$

8 ✓ $= v_{iB}(1,28 - 0,6)$ ✓ $+ \frac{1}{2}(9,8)(1,28 - 0,6)^2$ ✓

$\therefore v_{iB} = 8,43\ m\cdot s^{-1}$ ✓ (8,43 to/*tot* 8,48 $m\cdot s^{-1}$)

Downward direction negative / *Afwaartse rigting negatief:*

A:

$v_f^2 = v_i^2 + 2a\Delta y$ ✓ $= 0^2 + 2(-9,8)(-8)$ ✓ $\therefore v_f = -12,52\ m\cdot s^{-1}$

$v_f = v_i + a\Delta t$ $\therefore -12,52 = 0 + (-9,8)\Delta t$ ✓ $\therefore \Delta t = 1,28$ s

B:

$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$

-8 ✓ $= v_{iB}(1,28 - 0,6)$ ✓ $+ \frac{1}{2}(-9,8)(1,28 - 0,6)^2$ ✓

$\therefore v_{iB} = -8,43\ m\cdot s^{-1}$

$\therefore v_{iB} = 8,43\ m\cdot s^{-1}$ ✓ (8,43 to/*tot* 8,48 $m\cdot s^{-1}$)

Option 3/*Opsie 3*:

Downward direction positive / *Afwaartse rigting positief:*

A:

$v_f^2 = v_i^2 + 2a\Delta y$ ✓ = $0^2 + 2(9,8)(8)$ ✓ ∴ $v_f = 12,52\ m\cdot s^{-1}$

$\Delta y = \left(\frac{v_f + v_i}{2}\right)\Delta t$ ∴ $8 = \frac{(0+12,52)}{2}\Delta t$ ✓ ∴ $\Delta t = 1,28\ s$

B:

$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$

8 ✓ = $v_{iB}(1,28 - 0,6)$ ✓ + $\frac{1}{2}(9,8)(1,28 - 0,6)^2$ ✓

∴ $v_{iB} = 8,43\ m\cdot s^{-1}$ ✓ (8,43 to/*tot* 8,48 $m\cdot s^{-1}$)

Downward direction negative / *Afwaartse rigting negatief:*

A:

$v_f^2 = v_i^2 + 2a\Delta y$ ✓ = $0^2 + 2(-9,8)(-8)$ ✓ ∴ $v_f = -12,52\ m\cdot s^{-1}$

$\Delta y = \left(\frac{v_f + v_i}{2}\right)\Delta t$ ∴ $8 = \frac{(0-12,52)}{2}\Delta t$ ✓ ∴ $\Delta t = 1,28\ s$

B:

$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$

8 ✓ = $v_{iB}(1,28 - 0,6)$ ✓ + $\frac{1}{2}(-9,8)(1,28 - 0,6)^2$ ✓

∴ $v_{iB} = -8,43\ m\cdot s^{-1}$

∴ $v_{iB} = 8,43\ m\cdot s^{-1}$ ✓ (8,43 to/*tot* 8,48 $m\cdot s^{-1}$)

Option 4/*Opsie 4*:

A:

$W_{net} = \Delta K$

$mgh = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$

$m(9,8)(8) = \frac{1}{2}mv_f^2 - 0$ ✓

∴ $v_f = 12,52\ m\cdot s^{-1}$

A:

$(U + K)_i = (U + K)_f$

$mgh + 0 = 0 + \frac{1}{2}mv_f^2$

$m(9,8)(8) + 0 = 0 + \frac{1}{2}mv_f^2$ ✓

∴ $v_f = 12,52\ m\cdot s^{-1}$

$v_f = v_i + a\Delta t$ ∴ $12,52 = 0 + (9,8)\Delta t$ ✓

∴ $\Delta t = 1,28\ s$

B:

$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$

8 ✓ = $v_{iB}(1,28 - 0,6)$ ✓ + $\frac{1}{2}(9,8)(1,28 - 0,6)^2$ ✓

∴ $v_{iB} = 8,43\ m\cdot s^{-1}$ ✓ (8,43 to/*tot* 8,48 $m\cdot s^{-1}$)

[12.1.3] (7)

[13]