SA-STUDENT

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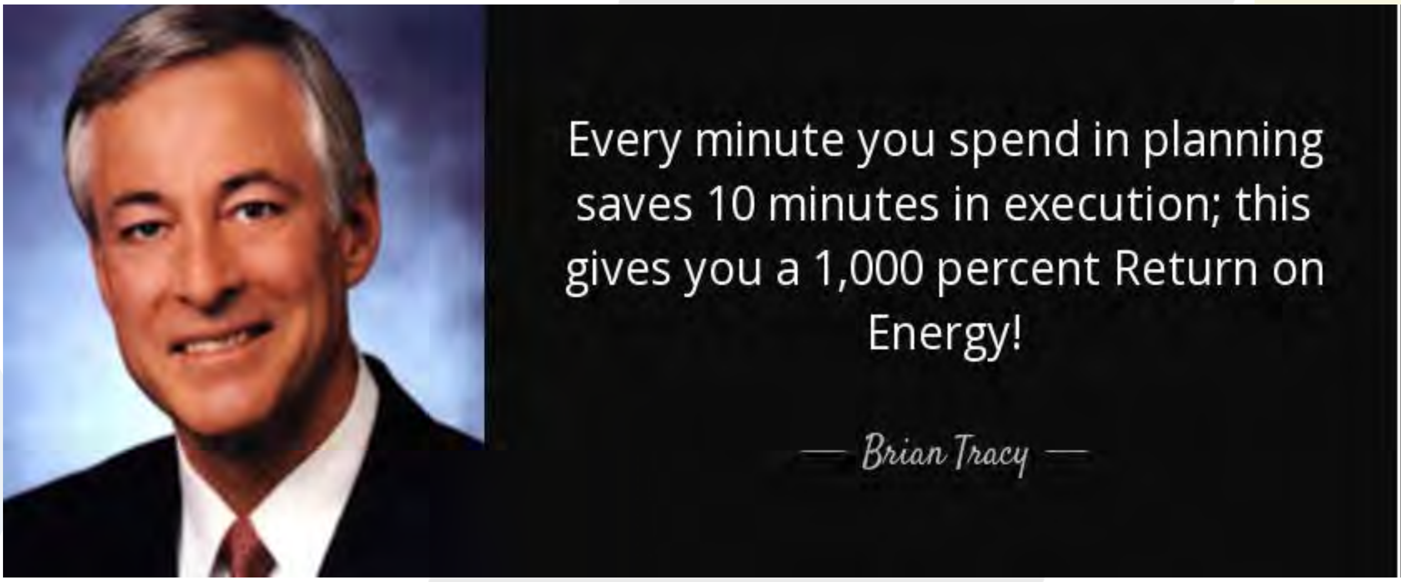


QUESTION 7/*VRAAG* 7

7.1	$f(x)=-2x^2-1$ $f'(x)=\lim_{h\to 0}\frac{f(x+h)-f(x)}{h}$ $f'(x)=\lim_{h\to 0}\frac{-2(x+h)^2-1-(-2x^2-1)}{h}$ $f'(x)=\lim_{h\to 0}\frac{-2x^2-4xh-2h^2-1+2x^2+1}{h}$ $=\lim_{h\to 0}\frac{-4xh-2h^2}{h}$ $=\lim_{h\to 0}\frac{h(-4x-2h)}{h}$ $=-4x$	✓substitution into the correct formula ✓ $-2x^2-4xh-2h^2-1$ ✓ $-4xh-2h^2$ ✓common factor ✓answer (5)
	OR/*OF* $f(x+h)=-2(x+h)^2-1$ $f(x+h)=-2x^2-4xh-2h^2-1$ $f(x+h)-f(x)=-2x^2-4xh-2h^2-1+2x^2+1$ $f(x+h)-f(x)=-4xh-2h^2$ $f'(x)=\lim_{h\to 0}\frac{f(x+h)-f(x)}{h}$ $=\lim_{h\to 0}\frac{-4xh-2h^2}{h}$ $=\lim_{h\to 0}\frac{h(-4x-2h)}{h}$ $=-4x$	**OR/*OF*** ✓ $-2x^2-4xh-2h^2-1$ ✓ $-4xh-2h^2$ ✓substitution into the correct formula ✓common factor ✓answer (5)
7.2.1	$f(x)=-2x^3+3x^2$ $f'(x)=-6x^2+6x$	✓ $-6x^2$ ✓ $+6x$ (2)
7.2.2	$y=2x+\frac{1}{\sqrt{4x}}$ $y=2x+\frac{1}{2}x^{-\frac{1}{2}}$ $\frac{dy}{dx}=2-\frac{1}{4}x^{-\frac{3}{2}}$	✓ $\frac{1}{2}$ ✓ $x^{-\frac{1}{2}}$ ✓ 2 ✓ $-\frac{1}{4}x^{-\frac{3}{2}}$ (4)
7.3	$x<1$	✓✓ answer (2)
		[13]

QUESTION 7/*VRAAG 7*

7.1	$f(x)=x^2+x$ $f^{/}(x)=\lim_{h\to 0}\frac{f(x+h)-f(x)}{h}$ $f^{/}(x)=\lim_{h\to 0}\frac{(x+h)^2+(x+h)-(x^2+x)}{h}$ $f^{/}(x)=\lim_{h\to 0}\frac{x^2+2xh+h^2+x+h-x^2-x}{h}$ $=\lim_{h\to 0}\frac{2xh+h^2+h}{h}$ $=\lim_{h\to 0}\frac{h(2x+h+1)}{h}$ $\therefore f^{/}(x)=2x+1$ **OR/*OF*** $f(x)=x^2+x$ $f(x+h)=(x+h)^2+(x+h)=x^2+2xh+h^2+x+h$ $f(x+h)-f(x)=x^2+2xh+h^2+x+h-x^2-x$ $=2xh+h^2+h$ $f^{/}(x)=\lim_{h\to 0}\frac{f(x+h)-f(x)}{h}$ $=\lim_{h\to 0}\frac{2xh+h^2+h}{h}$ $=\lim_{h\to 0}\frac{h(2x+h+1)}{h}$ $\therefore f^{/}(x)=2x+1$	✓substitution into the formula ✓ $x^2+2xh+h^2+x+h$ ✓ $2xh+h^2+h$ ✓common factor ✓answer (5) **OR/*OF*** ✓ $x^2+2xh+h^2+x+h$ ✓ $2xh+h^2+h$ ✓substitution into the formula ✓common factor ✓answer (5)
7.2	$f(x)=2x^5-3x^4+8x$ $f^{/}(x)=10x^4-12x^3+8$	✓ $10x^4$ ✓ $-12x^3$ ✓ 8 (3)

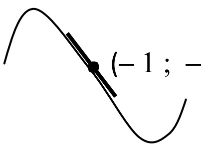
7.3	$g(x)=ax^3+3x^2+bx+c$
	$g^{/}(x)=3ax^2+6x+b$
	$g^{//}(x)=6ax+6$
	$g^{//}(-1)=6a(-1)+6=0$
	$\therefore a=1$
	For concave up $g^{//}(x)>0$
	$6x+6>0$
	$x>-1$
		✓ $g^{/}(x)=3ax^2+6x+b$
		✓
		$g^{//}(-1)=6a(-1)+6=0$
		✓ $a=1$
		✓ $x>-1$ (4)

OR/OF

Min gradient at (– 1 ; – 7) implies:
at $x = -1$ - point of inflection
and g will be positive cubic
hence $a > 0$

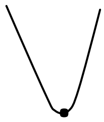
Since g is concave up
$x > -1$

OR/OF



(– 1 ; – 7)

Since g is concave up
$x > -1$



(– 1 ; y)

Since g is concave up
$x > -1$

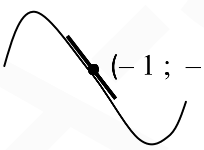
Answer only: $\frac{1}{4}$

OR/OF

Min gradient at (– 1 ; – 7) implies:
at $x = -1$ - point of inflection
and g will be positive cubic
hence $a > 0$

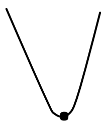
Since g is concave up
$x > -1$

OR/OF



(– 1 ; – 7)

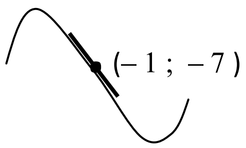
Since g is concave up
$x > -1$



(– 1 ; y)

Since g is concave up
$x > -1$

Answer only: $\frac{1}{4}$

	OR/OF Min gradient at (– 1 ; – 7) implies: at $x = -1$ - point of inflection and g will be positive cubic hence $a > 0$ Since g is concave up $x > -1$ **OR/OF**  Since g is concave up $x > -1$  (– 1 ; y) Since g is concave up $x > -1$ Answer only: $\frac{1}{4}$	**OR/OF** ✓ point of inflection ✓✓ $a > 0$ ✓ $x > -1$ (4) **OR/OF** ✓✓pos graph ✓point of inflection ✓ $x > -1$ (4)
		[12]

QUESTION/*VRAAG* 8

8.1	$f(x)=-x^2$ $f^{/}(x)=\lim\limits_{h\to 0}\dfrac{f(x+h)-f(x)}{h}$ $f^{/}(x)=\lim\limits_{h\to 0}\dfrac{-(x+h)^2+x^2}{h}$ $f^{/}(x)=\lim\limits_{h\to 0}\dfrac{-x^2-2xh-h^2+x^2}{h}$ $=\lim\limits_{h\to 0}\dfrac{-2xh-h^2}{h}$ $=\lim\limits_{h\to 0}\dfrac{h(-2x-h)}{h}$ $=\lim\limits_{h\to 0}(-2x-h)$ $\therefore f^{/}(x)=-2x$ **OR/*OF*** $f(x)=-x^2$ $f(x+h)=-(x+h)^2=-x^2-2xh-h^2$ $f(x+h)-f(x)=-x^2-2xh-h^2-(-x^2)=-2xh-h^2$ $f^{/}(x)=\lim\limits_{h\to 0}\dfrac{f(x+h)-f(x)}{h}$ $=\lim\limits_{h\to 0}\dfrac{-2xh-h^2}{h}$ $=\lim\limits_{h\to 0}\dfrac{h(-2x-h)}{h}$ $=\lim\limits_{h\to 0}(-2x-h)$ $\therefore f^{/}(x)=-2x$	✓ substitution into formula ✓ $-(x^2+2xh+h^2)$ ✓ $-2xh-h^2$ ✓ $-2x-h$ ✓ answer (5) **OR/*OF*** ✓ $-x^2-2xh-h^2$ ✓ $-2xh-h^2$ ✓ substitution into the formula ✓ $-2x-h$ ✓ answer (5)
8.2.1	$f(x)=4x^3-5x^2$ $f^{/}(x)=12x^2-10x$	✓ $12x^2$ (A) ✓ $-10x$ (A) (2)
8.2.2	$D_x\left[\dfrac{-6\sqrt[3]{x}+2}{x^4}\right]$ $=D_x\left[\dfrac{-6(x)^{\frac{1}{3}}}{x^4}+\dfrac{2}{x^4}\right]$ $=D_x\left[-6x^{-\frac{11}{3}}+2x^{-4}\right]$ $=22x^{-\frac{14}{3}}-8x^{-5}$	✓ $x^{\frac{1}{3}}$ ✓ $-6x^{-\frac{11}{3}}+2x^{-4}$ ✓ $22x^{-\frac{14}{3}}$ ✓ $-8x^{-5}$ (4)
		[11]

QUESTION/VRAAG 9

9.1	$f^{/}(x)=\lim\limits_{h\to 0}\dfrac{f(x+h)-f(x)}{h}$ $f^{/}(x)=\lim\limits_{h\to 0}\dfrac{2(x+h)^2-3(x+h)-(2x^2-3x)}{h}$ $f^{/}(x)=\lim\limits_{h\to 0}\dfrac{2x^2+4xh+2h^2-3x-3h-2x^2+3x}{h}$ $=\lim\limits_{h\to 0}\dfrac{4xh+2h^2-3h}{h}$ $=\lim\limits_{h\to 0}\dfrac{h(4x+2h-3)}{h}$ $=\lim\limits_{h\to 0}(4x+2h-3)$ $\therefore f^{/}(x)=4x-3$ **OR/OF** $f(x)=2x^2-3x$ $f(x+h)=2(x+h)^2-3(x+h)$ $f(x+h)=2x^2+4xh+2h^2-3x-3h$ $f(x+h)-f(x)=4xh+2h^2-3h$ $f^{/}(x)=\lim\limits_{h\to 0}\dfrac{f(x+h)-f(x)}{h}$ $=\lim\limits_{h\to 0}\dfrac{4xh+2h^2-3h}{h}$ $=\lim\limits_{h\to 0}\dfrac{h(4x+2h-3)}{h}$ $=\lim\limits_{h\to 0}(4x+2h-3)$ $\therefore f^{/}(x)=4x-3$	✓substitution ✓ $2x^2+4xh+2h^2-3x-3h$ ✓ $4xh+2h^2-3h$ ✓factorisation ✓answer (5) **OR/OF** ✓substitution ✓ $2x^2+4xh+2h^2-3x-3h$ ✓ $4xh+2h^2-3h$ ✓factorisation ✓answer (5)
9.2.1	$y=4x^5-6x^4+3x$ $\dfrac{dy}{dx}=20x^4-24x^3+3$	✓ $20x^4$ ✓ $-24x^3$ ✓3 (3)

9.2.2	$D_x\left[\dfrac{-\sqrt[3]{x}}{2}+\left(\dfrac{1}{3x}\right)^2\right]$ $D_x\left[\dfrac{-x^{\frac{1}{3}}}{2}+\dfrac{x^{-2}}{9}\right]$ $D_x\left[-\dfrac{1}{2}x^{\frac{1}{3}}+\dfrac{1}{9}x^{-2}\right]$ $=-\dfrac{1}{6}x^{-\frac{2}{3}}-\dfrac{2x^{-3}}{9}$ $=-\dfrac{1}{6x^{\frac{2}{3}}}-\dfrac{2}{9x^3}$	✓ $\dfrac{-x^{\frac{1}{3}}}{2}$ ✓ $\dfrac{x^{-2}}{9}$ ✓ $-\dfrac{1}{6}x^{-\frac{2}{3}}$ ✓ $-\dfrac{2x^{-3}}{9}$ (4)
		[12]

	OR/OF Interest over 5 years = 652 743,95 – 9 000 × 60 = 112 743,95 $\therefore$ interest on n years = 190 214,14 – 112 743, 95 = 77 470,19 $652\ 743{,}95 + 77\ 470{,}19 = 652\ 743{,}95\left(1+\frac{0{,}075}{12}\right)^n$ $1{,}1186.... = (1{,}00625)^n$ $n = \log_{1{,}00625}(1{,}1186)$ $\therefore n = 18$ months	**OR/OF** ✓ 60 × 9 000 ✓ answer ✓equating ✓simplification ✓use of logs ✓ 18 months (6)
		[13]

QUESTION/*VRAAG* 8

8.1	$f(x) = 3x^2$ $f^{/}(x) = \lim_{h\to 0}\frac{f(x+h)-f(x)}{h}$ $f^{/}(x) = \lim_{h\to 0}\frac{3(x+h)^2-3x^2}{h}$ $f^{/}(x) = \lim_{h\to 0}\frac{3x^2+6xh+3h^2-3x^2}{h}$ $= \lim_{h\to 0}\frac{6xh+3h^2}{h}$ $= \lim_{h\to 0}\frac{h(6x+3h)}{h}$ $= 6x$	 ✓ substitution ✓ expansion ✓ simplification ✓ $\lim_{h\to 0}\frac{h(6x+3h)}{h}$ ✓$6x$ (5)
8.2.1	$f(x) = x^2 - 3 + 9x^{-2}$ $f^{/}(x) = 2x - 18x^{-3}$	✓$9x^{-2}$ ✓$2x$ ✓ $-18x^{-3}$ (3)

8.2.2	$g(x)=(\sqrt{x}+3)(\sqrt{x}-1)$ $g(x)=x+2x^{\frac{1}{2}}-3$ $g^{/}(x)=1+x^{-\frac{1}{2}}$	✓ x ✓ $2x^{\frac{1}{2}}$ ✓1 ✓ $x^{-\frac{1}{2}}$ (4)
		[12]

QUESTION/*VRAAG* 9

9.1	$f^{/}(x)=6x^2+6x-12$ $6x^2+6x-12=0$ $x^2+x-2=0$ $(x+2)(x-1)=0$ $x=-2$ or $x=1$ $y=20$ or $y=-7$ $\therefore$ A(–2 ; 20) and B(1 ; –7)	✓ $6x^2+6x-12$ ✓ $=0$ ✓factors ✓ x -values ✓ y -values (5)
9.2	$f^{//}(x)=12x+6$ $12x+6>0$ $12x>-6$ $x>-\frac{1}{2}$ **OR/OF** $x=\frac{-2+1}{2}=-\frac{1}{2}$ $\therefore x>-\frac{1}{2}$	✓ $12x+6$ ✓ $f^{//}(x)>0$ ✓ $x>-\frac{1}{2}$ (3) **OR/OF** ✓ $x=-\frac{1}{2}$ ✓✓ $x>-\frac{1}{2}$ (3)
9.3	$f^{/}(2)=24$ Equation of the tangent: $y-4=24(x-2)$ $y=24x-44$	✓ $f^{/}(2)$ ✓ 24 ✓ equation (3)
		[11]

QUESTION/*VRAAG* 7
Penalty of – 1 for notation only in 7.1

7.1	$f(x)=2x^2-1$ $f(x+h)=2(x+h)^2-1$ $=2(x^2+2xh+h^2)^2-1$ $=2x^2+4xh+2h^2-1$ $f(x+h)-f(x)=2x^2+4xh+2h^2-1-(2x^2-1)$ $=2x^2+4xh+2h^2-1-2x^2+1$ $=4xh+2h^2$ $f'(x)=\lim\limits_{h\to 0}\dfrac{f(x+h)-f(x)}{h}$ $=\lim\limits_{h\to 0}\dfrac{4xh+2h^2}{h}$ $=\lim\limits_{h\to 0}\dfrac{h(4x+2h)}{h}$ $=\lim\limits_{h\to 0}(4x+2h)$ $=4x$	✓ $2x^2+4xh+2h^2-1$ ✓ $4xh+2h^2$ ✓ substitution ✓ simplification ✓ answer (5)
7.2.1	$\dfrac{d}{dx}\left(\sqrt[5]{x^2}+x^3\right)$ $=\dfrac{d}{dx}\left(x^{\frac{2}{5}}+x^3\right)$ $\dfrac{dy}{dx}=\dfrac{2}{5}x^{-\frac{3}{5}}+3x^2$	✓ $x^{\frac{2}{5}}$ ✓ $\dfrac{2}{5}x^{-\frac{3}{5}}$ ✓ $3x^2$ (3)
7.2.2	$f(x)=\dfrac{4x^2-9}{4x+6}$ $=\dfrac{(2x-3)(2x+3)}{2(2x+3)}$ $=\dfrac{2x-3}{2}$ $=x-\dfrac{3}{2}$ $f'(x)=1$	✓ $(2x-3)(2x+3)$ ✓ $2(2x+3)$ ✓ simplification to two separate terms ✓ answer (4)
		[12]

QUESTION/*VRAAG* 7

7.1	$f(x)=4-7x$ $f'(x)=\lim\limits_{h\to 0}\dfrac{f(x+h)-f(x)}{h}$ $=\lim\limits_{h\to 0}\dfrac{4-7(x+h)-(4-7x)}{h}$ $=\lim\limits_{h\to 0}\dfrac{h(-7)}{h}$ $=-7$	✓ $4-7(x+h)$ ✓substitution ✓simplification ✓answer (4)
7.2	$y=4x^8+\sqrt{x^3}$ $=4x^8+x^{\frac{3}{2}}$ $\dfrac{dy}{dx}=32x^7+\dfrac{3}{2}x^{\frac{1}{2}}$	✓ $x^{\frac{3}{2}}$ ✓ $32x^7$ ✓ $\dfrac{3}{2}x^{\frac{1}{2}}$ (3)
7.3.1	$y=ax^2+a$ $\dfrac{dy}{dx}=2ax+0$ $\dfrac{dy}{dx}=2ax$	✓ $2ax$ (1)
7.3.2	$y=ax^2+a$ $\dfrac{dy}{da}=x^2+1$	✓ ✓ answer (2)

7.4	Substitute (2 ; b) in $y = x + \frac{12}{x}$ $b = 2 + \frac{12}{2}$ $b = 8$ $m_{\text{tangent}} = \frac{dy}{dx}$ $\frac{dy}{dx} = 1 - \frac{12}{x^2}$ $m_{\text{tangent}} = 1 - \frac{12}{2^2} = -2$ $m_{\text{perp}} = \frac{1}{2}$ Equation of perpendicular line: $y - y_1 = m(x - x_1)$ OR $y = mx + c$ $y - 8 = \frac{1}{2}(x-2)$ $8 = \frac{1}{2}(2) + c$ $y = \frac{1}{2}x + 7$ $c = 7$ $y = \frac{1}{2}x + 7$	✓ value of b ✓ $\frac{dy}{dx} = 1 - \frac{12}{x^2}$ ✓gradient of perpendicular line ✓ equation (4)
		[14]

QUESTION/*VRAAG* 8

8.1	36cm	✓answer (1)
8.2	$\therefore t = 6$ $(-2t^2 + 3t - 6)$ have no real roots Insect reaches the floor only once.	✓✓✓ only once (3)
8.3	$h(t) = -2t^3 + 15t^2 - 24t + 36$ $h'(t) = -6t^2 + 30t - 24$ $-6t^2 + 30t - 24 = 0$ $t^2 - 5t + 4 = 0$ $(t-4)(t-1) = 0$ $t = 4$ or $t = 1$ Only $t = 4$ because maximum value required $h = -2(4)^3 + 15(4)^2 - 24(4) + 36 = 52\ cm$	✓ expansion ✓ $-6t^2 + 30t - 24 = 0$ ✓both values ✓answer (4)
		[8]

6.2.2	$A = P(1+i)^n$ $= 793749{,}25\left(1+\frac{0{,}1025}{12}\right)^3$ $=$ R814 263,3052 New instalment/*Nuwe paaiement*: $P = \frac{x\left[1-(1+i)^{-n}\right]}{i}$ $814\,263{,}3052 = \frac{x\left[1-\left(1+\frac{0{,}1025}{12}\right)^{-231}\right]}{\frac{0{,}1025}{12}}$ $x =$ R8 089,20	✓ $793749{,}25\left(1+\frac{0{,}1025}{12}\right)^3$ ✓ $n = 231$ ✓ substitution of new P ✓ substitution of n and i into formula ✓ answer (5) **[15]**

QUESTION/*VRAAG* 7

7.1	$f(x) = x^2 + 2$ $f(x+h) = (x+h)^2 + 2$ $= x^2 + 2xh + h^2 + 2$ $f(x+h) - f(x) = x^2 + 2xh + h^2 + 2 - (x^2 + 2)$ $= 2xh + h^2$ $f^{/}(x) = \lim_{h\to 0}\frac{f(x+h)-f(x)}{h}$ $= \lim_{h\to 0}\frac{2xh+h^2}{h}$ $= \lim_{h\to 0}\frac{h(2x+h)}{h}$ $= \lim_{h\to 0}(2x+h)$ $= 2x$ **OR/*OF*** $f^{/}(x) = \lim_{h\to 0}\frac{f(x+h)-f(x)}{h}$ $= \lim_{h\to 0}\frac{x^2+2xh+h^2+2-(x^2+2)}{h}$ $= \lim_{h\to 0}\frac{2xh+h^2}{h}$ $= \lim_{h\to 0}\frac{h(2x+h)}{h}$ $= \lim_{h\to 0}(2x+h)$ $= 2x$	✓ $x^2 + 2xh + h^2 + 2$ ✓ $\lim_{h\to 0}\frac{2xh+h^2}{h}$ ✓ $\lim_{h\to 0}\frac{h(2x+h)}{h}$ ✓ answer (4) **OR/*OF*** ✓ $x^2 + 2xh + h^2 + 2$ ✓ $\lim_{h\to 0}\frac{2xh+h^2}{h}$ ✓ $\lim_{h\to 0}\frac{h(2x+h)}{h}$ ✓ answer (4)

7.2.1	$y = 4x^3 + 2x^{-1}$ $\frac{dy}{dx} = 12x^2 - 2x^{-2}$	✓ $+2x^{-1}$ ✓ $12x^2$ ✓ $-2x^{-2}$ (3)
7.2.2	$y = 4\sqrt[3]{x} + (3x^3)^2$ $= 4x^{\frac{1}{3}} + 9x^6$ $\frac{dy}{dx} = \frac{4}{3}x^{-\frac{2}{3}} + 54x^5$	✓ $4x^{\frac{1}{3}}$ ✓ $9x^6$ ✓ $\frac{4}{3}x^{-\frac{2}{3}}$ ✓ $54x^5$ (4)
7.3	Point of contact: (1 ; 5) $m = 2$ $y - y_1 = m(x - x_1)$ or $y = 2x + c$ $y - 5 = 2(x - 1)$ $5 = 2 + c$ $c = 3$ $y = 2x + 3$ $y = 2x + 3$	✓ $m = 2$ ✓ substitution of (1 ; 5) ✓ answer (3) **[14]**

QUESTION/*VRAAG* 8

8.1	$h(x) = -2(x + \frac{3}{2})(x - 1)(x + 3)$ $h(x) = -(2x + 3)(x^2 + 2x - 3)$ $h(x) = -2x^3 - 7x^2 + 9$ **OR/*OF*** $h(x) = -(2x + 3)(x - 1)(x + 3)$ $h(x) = -(2x + 3)(x^2 + 2x - 3)$ $h(x) = -2x^3 - 7x^2 + 9$	✓✓ $-2(x + \frac{3}{2})(x - 1)(x + 3)$ ✓correct simplification (3) **OR/*OF*** ✓✓ $-(2x + 3)(x - 1)(x + 3)$ ✓ correct simplification (3)
8.2	$h'(x) = -6x^2 - 14x$ $-6x^2 - 14x = 0$ $-2x(3x + 7) = 0$ $x = 0$ or $x = -\frac{7}{3}$	✓ first derivative ✓ = 0 ✓ both answers (3)
8.3	$x < -\frac{7}{3}$ or $x > 0$ **OR/*OF*** $x \in \left(-\infty ; -\frac{7}{3}\right) \cup (0 ; \infty)$	✓✓ answer (2) **OR/*OF*** ✓✓ answer (2)

QUESTION/*VRAAG* 8

8.1	$f'(x)=\lim_{h\to 0}\frac{f(x+h)-f(x)}{h}$ $=\lim_{h\to 0}\frac{x^2+2xh+h^2-5-x^2+5}{h}$ $=\lim_{h\to 0}\frac{h(2x+h)}{h}$ $=\lim_{h\to 0}(2x+h)$ $=2x$	✓ $x^2+2xh+h^2-5$ ✓simplification ✓factorisation ✓ $\lim_{h\to 0}(2x+h)$ ✓ $2x$ (5)
	OR/OF $f(x+h)=(x+h)^2-5$ $=x^2+2xh+h^2-5$ $f(x+h)-f(x)=x^2+2xh+h^2-5-(x^2-5)$ $=2xh+h^2$ $f'(x)=\lim_{h\to 0}\frac{f(x+h)-f(x)}{h}$ $=\lim_{h\to 0}\frac{2xh+h^2}{h}$ $=\lim_{h\to 0}\frac{h(2x+h)}{h}$ $=\lim_{h\to 0}(2x+h)$ $=2x$	**OR/OF** ✓ $x^2+2xh+h^2-5$ ✓simplification ✓factorisation ✓ $\lim_{h\to 0}(2x+h)$ ✓ $2x$ (5)
8.2.1	$y=3x^3+6x^2+x-4$ $\frac{dy}{dx}=9x^2+12x+1$	✓ $9x^2$ ✓ $12x$ ✓ 1 (3)
8.2.2	$y(x-1)=2x(x-1)$ $y=\frac{2x(x-1)}{x-1}$ if $x\neq 1$ $y=2x$ $\frac{dy}{dx}=2$	✓ $y(x-1)$ ✓ $2x(x-1)$ ✓ $y=2x$ ✓answer (4)
		[12]

QUESTION/*VRAAG* 8

8.1	$f(x+h)= 4x^2$ $f(x+h)-f(x)=4(x+h)^2-4x^2$ $=4(x^2+2xh+h^2)-4x^2$ $=4x^2+8xh+4h^2-4x^2$ $=8xh+4h^2$ $f'(x)=\lim_{h\to 0}\frac{f(x+h)-f(x)}{h}$ $=\lim_{h\to 0}\left[\frac{8xh+4h^2}{h}\right]$ $=\lim_{h\to 0}\left[\frac{h(8x+4h)}{h}\right]$ $=8x$ **OR/OF** $f'(x)=\lim_{h\to 0}\frac{f(x+h)-f(x)}{h}$ $=\lim_{h\to 0}\left[\frac{4(x+h)^2-4x^2}{h}\right]$ $=\lim_{h\to 0}\left[\frac{4x^2 8xh+4h^2-4x^2}{h}\right]$ $=\lim_{h\to 0}\left[\frac{8xh+4h^2}{h}\right]$ $=\lim_{h\to 0}\left[\frac{h(8x+4h)}{h}\right]$ $=8x$	✓ $4(x+h)^2$ ✓ $8xh+4h^2$ ✓ $\frac{f(x+h)-f(x)}{h}$ ✓ $\frac{h(8x+4h)}{h}$ ✓ $8x$ **OR/OF** ✓ $\frac{f(x+h)-f(x)}{h}$ ✓ $4(x+h)^2$ ✓ $8xh+4h^2$ ✓ $\frac{h(8x+4h)}{h}$ ✓ $8x$ (5)
8.2.1	$D_x\left[\frac{x^2-2x-3}{x-1}\right]$ $= D_x\left[\frac{(x-3)(x+1)}{x+1}\right]$ $=D_x(x-3)$ $=1$	✓ $\frac{(x-3)(x+1)}{x+1}$ ✓ $(x-3)$ ✓ 1 (3)
8.2.2	$f(x)=\sqrt{x}=x^{\frac{1}{2}}$ $f'(x)=\frac{1}{2}x^{-\frac{1}{2}}$ $f''(x)=-\frac{1}{4}x^{-\frac{3}{2}}$	✓ $x^{\frac{1}{2}}$ ✓ $\frac{1}{2}x^{-\frac{1}{2}}$ ✓ $-\frac{1}{4}x^{-\frac{3}{2}}$ (3) **[11]**

QUESTION/*VRAAG* 7

Penalize 1 mark for incorrect notation in the whole question.

7.1	$f(x+h)=2-3(x+h)^2$ $=2-3(x^2+2xh+h^2)$ $=2-3x^2-6xh-3h^2$ $f(x+h)-f(x)=2-3x^2-6xh-3h^2-\left(2-3x^2\right)$ $=-6xh-3h^2$ $f'(x)=\lim\limits_{h\to 0}\dfrac{f(x+h)-f(x)}{h}$ $=\lim\limits_{h\to 0}\dfrac{-6xh-3h^2}{h}$ $=\lim\limits_{h\to 0}\dfrac{h(-6x-3h)}{h}$ $=\lim\limits_{h\to 0}\left(-6x-3h\right)$ $=-6x$	✓$2-3x^2-6xh-3h^2$ ✓ $-6xh-3h^2$ ✓subst. into formula ✓factorisation ✓answer (5)
	OR/*OF*	**OR/*OF***
	$f'(x)=\lim\limits_{h\to 0}\dfrac{f(x+h)-f(x)}{h}$ $=\lim\limits_{h\to 0}\dfrac{2-3(x+h)^2-(2-3x^2)}{h}$ $=\lim\limits_{h\to 0}\dfrac{2-3x^2-6xh-3h^2-\left(2-3x^2\right)}{h}$ $=\lim\limits_{h\to 0}\dfrac{-6xh-3h^2}{h}$ $=\lim\limits_{h\to 0}\dfrac{h(-6x-3h)}{h}$ $=\lim\limits_{h\to 0}\left(-6x-3h\right)$ $=-6x$	✓subst. into formula ✓simplification ✓ $-6xh-3h^2$ ✓common factor ✓ answer (5)

7.2.1	$D_x\left[(4x+5)^2\right]$ $= D_x\left(16x^2+40x+25\right)$ $= 32x+40$	✓ $16x^2+40x+25$ ✓ $32x$ ✓ $+40$ (3)
7.2.2	$y=\sqrt[4]{x}+\dfrac{x^2-8}{x^2}$ $y = x^{\frac{1}{4}}+1-8x^{-2}$ $\dfrac{dy}{dx}=\dfrac{1}{4}x^{-\frac{3}{4}}+16x^{-3}$	✓ $x^{\frac{1}{4}}$ ✓ $1-8x^{-2}$ ✓ $\dfrac{1}{4}x^{-\frac{3}{4}}$ ✓ $16x^{-3}$ (4) **[12]**

QUESTION/*VRAAG* 8

8.1	$f(x+h)= 4x^2$ $f(x+h)-f(x)=4(x+h)^2-4x^2$ $=4(x^2+2xh+h^2)-4x^2$ $=4x^2+8xh+4h^2-4x^2$ $=8xh+4h^2$ $f'(x)=\lim_{h\to 0}\frac{f(x+h)-f(x)}{h}$ $=\lim_{h\to 0}\left[\frac{8xh+4h^2}{h}\right]$ $=\lim_{h\to 0}\left[\frac{h(8x+4h)}{h}\right]$ $=8x$ **OR/OF** $f'(x)=\lim_{h\to 0}\frac{f(x+h)-f(x)}{h}$ $=\lim_{h\to 0}\left[\frac{4(x+h)^2-4x^2}{h}\right]$ $=\lim_{h\to 0}\left[\frac{4x^2 8xh+4h^2-4x^2}{h}\right]$ $=\lim_{h\to 0}\left[\frac{8xh+4h^2}{h}\right]$ $=\lim_{h\to 0}\left[\frac{h(8x+4h)}{h}\right]$ $=8x$	✓ $4(x+h)^2$ ✓ $8xh+4h^2$ ✓ $\frac{f(x+h)-f(x)}{h}$ ✓ $\frac{h(8x+4h)}{h}$ ✓ $8x$ **OR/OF** ✓ $\frac{f(x+h)-f(x)}{h}$ ✓ $4(x+h)^2$ ✓ $8xh+4h^2$ ✓ $\frac{h(8x+4h)}{h}$ ✓ $8x$ (5)
8.2.1	$D_x\left[\frac{x^2-2x-3}{x-1}\right]$ $= D_x\left[\frac{(x-3)(x+1)}{x+1}\right]$ $=D_x(x-3)$ $=1$	✓ $\frac{(x-3)(x+1)}{x+1}$ ✓ $(x-3)$ ✓ 1 (3)
8.2.2	$f(x)=\sqrt{x}=x^{\frac{1}{2}}$ $f'(x)=\frac{1}{2}x^{-\frac{1}{2}}$ $f''(x)=-\frac{1}{4}x^{-\frac{3}{2}}$	✓ $x^{\frac{1}{2}}$ ✓ $\frac{1}{2}x^{-\frac{1}{2}}$ ✓ $-\frac{1}{4}x^{-\frac{3}{2}}$ (3) **[11]**

QUESTION/*VRAAG* 7

7.1	$f(x+h) = 2(x+h)^2 - (x+h)$ $= 2(x^2+2xh+h^2) - x - h$ $= 2x^2+4xh+2h^2-x-h$ $f(x+h)-f(x) = 2x^2+4xh+2h^2-x-h-2x^2+x$ $= 4xh+2h^2-h$ $f'(x) = \lim_{h\to 0}\frac{f(x+h)-f(x)}{h}$ $= \lim_{h\to 0}\frac{4xh+2h^2-h}{h}$ $= \lim_{h\to 0}\frac{h(4x+2h-1)}{h}$ $= \lim_{h\to 0}(4x+2h-1)$ $= 4x-1$ **OR/*OF*** $f'(x) = \lim_{h\to 0}\frac{f(x+h)-f(x)}{h}$ $= \lim_{h\to 0}\frac{2(x+h)^2-(x+h)-(2x^2-x)}{h}$ $= \lim_{h\to 0}\frac{2x^2+4xh+2h^2-x-h-2x^2+x}{h}$ $= \lim_{h\to 0}\frac{4xh+2h^2-h}{h}$ $= \lim_{h\to 0}\frac{h(4x+2h-1)}{h}$ $= \lim_{h\to 0}(4x+2h-1)$ $= 4x-1$	✓ $2x^2+4xh+2h^2-x-h$ ✓ $4xh+2h^2-h$ ✓ $f'(x) = \lim_{h\to 0}\frac{f(x+h)-f(x)}{h}$ ✓subst. into formula ✓ $\lim_{h\to 0}(4x+2h-1)$ ✓ $4x-1$ **OR/*OF*** ✓ $f'(x) = \lim_{h\to 0}\frac{f(x+h)-f(x)}{h}$ ✓subst. into formula ✓ $2x^2+4xh+2h^2-x-h$ ✓ $4xh+2h^2-h$ ✓ $\lim_{h\to 0}(4x+2h-1)$ ✓ $4x-1$ (6)
7.2.1	$D_x[(x+1)(3x-7)]$ $= D_x(3x^2-4x-7)$ $= 6x-4$	✓ $3x^2-4x-7$ ✓ $6x-4$ (2)
7.2.2	$y = \sqrt{x^3} - \frac{5}{x} + \frac{1}{2}\pi$ $y = x^{\frac{3}{2}} - 5x^{-1} + \frac{1}{2}\pi$ $\frac{dy}{dx} = \frac{3}{2}x^{\frac{1}{2}} + 5x^{-2}$	✓ $x^{\frac{3}{2}} - 5x^{-1}$ ✓ $\frac{3}{2}x^{\frac{1}{2}}$ ✓ $+5x^{-2}$ ✓ derivative of $\frac{1}{2}\pi$ is 0 (4) **[12]**

QUESTION/*VRAAG* 8

8.1	$f(x+h)=3-2(x+h)^2$ $=3-2x^2-4xh-2h^2$ $f(x+h)-f(x)=3-2x^2-4xh-2h^2-3+2x^2$ $=-4xh-2h^2$ $f'(x)=\lim_{h\to 0}\frac{f(x+h)-f(x)}{h}$ $=\lim_{h\to 0}\frac{-4xh-2h^2}{h}$ $=\lim_{h\to 0}\frac{h(-4x-2h)}{h}$ $=\lim_{h\to 0}(-4x-2h)$ $=-4x$	✓ $3-2x^2-4xh-2h^2$ ✓ $-4xh-2h^2$ ✓ $f'(x)=\lim_{h\to 0}\frac{f(x+h)-f(x)}{h}$ ✓ $\lim_{h\to 0}(-4x-2h)$ ✓ $-4x$ (5)
	OR/*OF* $f'(x)=\lim_{h\to 0}\frac{f(x+h)-f(x)}{h}$ $=\lim_{h\to 0}\frac{3-2(x+h)^2-(3-2x^2)}{h}$ $=\lim_{h\to 0}\frac{3-2x^2-4xh-2h^2-3+2x^2}{h}$ $=\lim_{h\to 0}\frac{-4xh-2h^2}{h}$ $=\lim_{h\to 0}\frac{h(-4x-2h)}{h}$ $=\lim_{h\to 0}(-4x-2h)$ $=-4x$	✓ $f'(x)=\lim_{h\to 0}\frac{f(x+h)-f(x)}{h}$ ✓ $3-2x^2-4xh-2h^2$ ✓ $-4xh-2h^2$ ✓ $\lim_{h\to 0}(-4x-2h)$ ✓ $-4x$ (5)
8.2	$y=\frac{12x^2+2x+1}{6x}$ $=2x+\frac{1}{3}+\frac{1}{6x}$ $=2x+\frac{1}{3}+\frac{1}{6}x^{-1}$ $\frac{dy}{dx}=2-\frac{1}{6}x^{-2}$ $=2-\frac{1}{6x^2}$	✓ $\frac{12x^2}{6x}+\frac{2x}{6x}+\frac{1}{6x}$ ✓ $\frac{1}{6}x^{-1}$ ✓ 2 ✓ $-\frac{1}{6}x^{-2}$ (4)

8.3	$y = x^3 + bx^2 + cx - 4$ $y' = 3x^2 + 2bx + c$ $y'' = 6x + 2b$ At point of inflection: $y'' = 6x + 2b = 0$ Substitute $x = 2$: $6(2) + 2b = 0$ $2b = -12$ $b = -6$ $y = x^3 - 6x^2 + cx - 4$ Substitute $(2; 4)$: $4 = 2^3 - 6(2)^2 + c(2) - 4$ $2c = 24$ $c = 12$ $y = x^3 - 6x^2 + 12x - 4$	✓ $y' = 3x^2 + 2bx + c$ ✓ $y'' = 6x + 2b$ ✓ $y'' = 0$ ✓ sub $x = 2$ into $y'' = 0$ ✓ value of b ✓ substitute $(2; 4)$ ✓ value of c (7) **[16]**

QUESTION/*VRAAG* 9

9.1	(0 ; 1)	✓ answer (1)
9.2	$f(x) = x^3 - x^2 - x + 1$ $f(x) = x^2(x-1) - (x-1)$ $f(x) = (x-1)(x^2-1)$ $f(x) = (x-1)(x-1)(x+1)$ $f(x) = 0$ $(x-1)(x-1)(x+1) = 0$ x-intercepts: (–1; 0); (1; 0) **OR** $f(x) = x^3 - x^2 - x + 1$ $f(x) = (x-1)(x^2-1)$ $f(x) = (x-1)(x-1)(x+1)$ $f(x) = 0$ $(x-1)(x-1)(x+1) = 0$ x-intercepts: (–1; 0); (1; 0) **OR**	✓ $(x - 1)$ ✓ $(x^2 - 1)$ ✓ $(x-1)(x-1)(x+1)$ ✓(–1; 0) ✓(1; 0) (5) ✓ $(x - 1)$ ✓ $(x^2 - 1)$ ✓ $(x-1)(x-1)(x+1)$ ✓(–1; 0) ✓(1; 0) (5)

QUESTION/*VRAAG* 8

Penalise candidates a maximum of one mark (overall) for notation error in 8.1 and 8.2

8.1	$\underbrace{f'(x)=\lim_{h\to 0}}_{\text{Notation}}\underbrace{\frac{f(x+h)-f(x)}{h}}_{\text{formula}}$ Formula can be implied
8.2	• If function and derivative is mixed but splitting of fractions is evident max ¾ • If they start with differentiation – breakdown 0/4
8.3	$y^{//}=0$ can be implied

QUESTION/*VRAAG* 9

9.2	No working is shown(calculator used) • If the cubic becomes a quadratic 2/5 • If three brackets 5/5
9.3	$f^{/}(x)=0$ cannot be implied $f^{/}(x)=3x^2-2x-1$ $x=-\left(\frac{-2}{2(3)}\right)$ **BE CAREFUL** 1/6 for derivative $=\frac{1}{3}$
9.4	If dots only indicated on the graph 1/3 – x and y-intercepts
9.5	Only CA from a cubic graph Each answer gets evaluated independently

QUESTION/*VRAAG* 10

10.2	Derivative equal to zero is an independent mark $A^{/}(r)=0$ can be implied if working is correct

QUESTION/*VRAAG* 11

If percentages are used – penalize once per question

11.1	Answer only 2/2 2 or 0 marks
11.3.2	Do not penalize rounding
11.3.3	Do not penalize rounding

QUESTION/*VRAAG* 7

PENALISE ONLY ONCE for incorrect notation in this question.

7.1	$f(x+h)=(x+h)^2-5=(x^2+2xh+h^2)-5$ $=x^2+2xh+h^2-5$ $f(x+h)-f(x)=x^2+2xh+h^2-5-(x^2-5)$ $=2xh+h^2$ $f'(x)=\lim\limits_{h\to 0}\dfrac{f(x+h)-f(x)}{h}$ $=\lim\limits_{h\to 0}\dfrac{2xh+h^2}{h}$ $=\lim\limits_{h\to 0}\dfrac{h(2x+h)}{h}$ $=\lim\limits_{h\to 0}(2x+h)$ $=2x$	✓simplifying ✓formula ✓subst. into formula ✓factorisation ✓answer (5)
	OR/OF $f'(x)=\lim\limits_{h\to 0}\dfrac{f(x+h)-f(x)}{h}$ $=\lim\limits_{h\to 0}\dfrac{x^2+2xh+h^2-5-(x^2-5)}{h}$ $=\lim\limits_{h\to 0}\dfrac{2xh+h^2}{h}$ $=\lim\limits_{h\to 0}\dfrac{h(2x+h)}{h}$ $=\lim\limits_{h\to 0}(2x+h)$ $=2x$	✓formula ✓subst. into formula ✓simplifying ✓factorisation ✓answer (5)
7.2	$g(x)=5x^2-\dfrac{2x}{x^3}$ $=5x^2-2x^{-2}$ $g'(x)=10x+4x^{-3}$ $=10x+\dfrac{4}{x^3}$	✓ $5x^2-2x^{-2}$ ✓ $10x$ ✓ $4x^{-3}$ or $\dfrac{4}{x^3}$ (3)

7.3	$h(x) = ax^2,\ x > 0$ $h^{-1}:\ x = ay^2 \quad y > 0$ $y = \sqrt{\frac{x}{a}}$ $h^{-1}(8) = \sqrt{\frac{8}{a}}$ $h^{/}(x) = 2ax$ $h^{/}(4) = 2a(4)$ $= 8a$ $\sqrt{\frac{8}{a}} = 8a$ $64a^2 = \frac{8}{a}$ $a^3 = \frac{1}{8}$ $a = \frac{1}{2}$	✓ $y = \sqrt{\frac{x}{a}}$ ✓ $\sqrt{\frac{8}{a}}$ ✓ $h^{/}(4) = 8a$ ✓ $\sqrt{\frac{8}{a}} = 8a$ ✓ $a^3 = \frac{1}{8}$ ✓ $a = \frac{1}{2}$ (6)
		[14]

QUESTION/*VRAAG* 8

8.1	$f^{/}(x) = 0$ $6x^2 - 10x + 4 = 0$ $3x^2 - 5x + 2 = 0$ $(3x-2)(x-1) = 0$ $x = \frac{2}{3}$ or $x = 1$ $y = 2\left(\frac{2}{3}\right)^3 - 5\left(\frac{2}{3}\right)^2 + 4\left(\frac{2}{3}\right)$ $\quad y = 2(1)^3 - 5(1)^2 + 4(1)$ $y = \frac{28}{27}$ or $y = 1$ Turning points are $\left(\frac{2}{3}\,;\frac{28}{27}\right)$ and $(1\,;1)$	✓ derivative ✓ derivative $= 0$ ✓ factors ✓ x-values ✓ y-values (5)

	$\text{Balance} = 256289{,}06\left(1+\frac{0{,}15}{12}\right)^{36} - \frac{9000\left(\left(1+\frac{0{,}15}{12}\right)^{36}-1\right)}{\frac{0{,}15}{12}}$ $= \text{R } -5\ 217{,}86$ $\text{Final payment} = 9\ 000 - 5217{,}86$ $= \text{R } 3\ 782{,}14$	✓ $256289{,}06\left(1+\frac{0{,}15}{12}\right)^{36}$ ✓ $\frac{9000\left(\left(1+\frac{0{,}15}{12}\right)^{36}-1\right)}{\frac{0{,}15}{12}}$ ✓ $9\ 000 - 5217{,}86$ ✓ answer (4) **[15]**

QUESTION/*VRAAG* 8

8.1	$f(x+h) = 3(x+h)^2$ $= 3(x^2+2xh+h^2)$ $= 3x^2+6xh+3h^2$ $f(x+h)-f(x) = 3x^2+6xh+3h^2-3x^2$ $= 6xh+3h^2$ $f'(x) = \lim\limits_{h\to0}\frac{f(x+h)-f(x)}{h}$ $= \lim\limits_{h\to0}\frac{6xh+3h^2}{h}$ $= \lim\limits_{h\to0}\frac{h(6x+3h)}{h}$ $= \lim\limits_{h\to0}(6x+3h)$ $= 6x$ **OR/OF** $f'(x) = \lim\limits_{h\to0}\frac{f(x+h)-f(x)}{h}$ $= \lim\limits_{h\to0}\frac{3(x+h)^2-3x^2}{h}$ $= \lim\limits_{h\to0}\frac{3x^2+6xh+3h^2-3x^2}{h}$ $= \lim\limits_{h\to0}\frac{6xh+3h^2}{h}$ $= \lim\limits_{h\to0}\frac{h(6x+3h)}{h}$ $= \lim\limits_{h\to0}(6x+3h)$ $= 6x$	✓ $3(x+h)^2$ ✓ $6xh+3h^2$ ✓ $f'(x) = \lim\limits_{h\to0}\frac{f(x+h)-f(x)}{h}$ ✓ $\lim\limits_{h\to0}(6x+3h)$ ✓ $6x$ (5) ✓ $f'(x) = \lim\limits_{h\to0}\frac{f(x+h)-f(x)}{h}$ ✓ $3(x+h)^2-3x^2$ ✓ $6xh+3h^2$ ✓ $\lim\limits_{h\to0}(6x+3h)$ ✓ $6x$ (5)

8.2	$\lim_{h\to 0}\dfrac{\sqrt{4+h}-2}{h}$ $g(x)=\sqrt{x}$ $a=4$	✓ answer ✓ answer (2)
8.3	$y=\sqrt{x^3}-\dfrac{5}{x^3}$ $y=x^{\frac{3}{2}}-5x^{-3}$ $\dfrac{dy}{dx}=\dfrac{3}{2}x^{\frac{1}{2}}+15x^{-4}$	✓ $x^{\frac{3}{2}}$ ✓ $-5x^{-3}$ ✓ $\dfrac{3}{2}x^{\frac{1}{2}}$ ✓ $15x^{-4}$ (4)
8.4	$f(x)=x^3+ax^2+bx+18$ $f'(x)=3x^2+2ax+b$ At $x=1$, $m_{\tan}=-8$ $f'(1)=-8$ $3(1)^2+2a(1)+b=-8$ $3+2a+b=-8$ $2a+b=-11$ ....(1) $y=f(1)$ $=g(1)$ $=-8(1)+20$ $=12$ $1+a+b+18=12$ $a+b=-7$ ....(2) $a=-4$ $b=-3$	✓ $3x^2+2ax+b$ ✓ $f'(1)=-8$ or $3(1)^2+2a(1)+b=-8$ ✓ $1+a+b+18=12$ ✓ $a=-4$ ✓ $b=-3$ (5) **[16]**

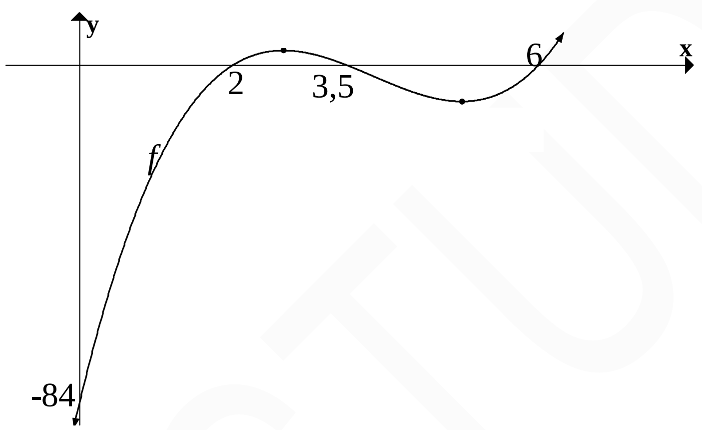
QUESTION/VRAAG 7

7.1	$f(x+h)=3(x+h)^2-5=3(x^2+2xh+h^2)-5$ $=3x^2+6xh+3h^2-5$ $f(x+h)-f(x)=3x^2+6xh+3h^2-5-3x^2+5$ $=6xh+3h^2$ $f'(x)=\lim\limits_{h\to 0}\dfrac{f(x+h)-f(x)}{h}$ $=\lim\limits_{h\to 0}\dfrac{6xh+3h^2}{h}$ $=\lim\limits_{h\to 0}\dfrac{h(6x+3h)}{h}$ $=\lim\limits_{h\to 0}(6x+3h)$ $=6x$	✓ $3x^2+6xh+3h^2-5$ ✓ $6xh+3h^2$ ✓ $\dfrac{f(x+h)-f(x)}{h}$ ✓ common factor/ $(6x+3h)$ ✓ answer (5)
	OR/OF $f'(x)=\lim\limits_{h\to 0}\dfrac{f(x+h)-f(x)}{h}$ $=\lim\limits_{h\to 0}\dfrac{3(x+h)^2-5-(3x^2-5)}{h}$ $=\lim\limits_{h\to 0}\dfrac{3x^2+6xh+3h^2-5-3x^2+5}{h}$ $=\lim\limits_{h\to 0}\dfrac{6xh+3h^2}{h}$ $=\lim\limits_{h\to 0}\dfrac{h(6x+3h)}{h}$ $=\lim\limits_{h\to 0}(6x+3h)$ $=6x$	✓ $\dfrac{f(x+h)-f(x)}{h}$ ✓ $3x^2+6xh+3h^2-5$ ✓ $6xh+3h^2$ ✓ common factor/ $(6x+3h)$ ✓ answer (5)
7.2.1	$y=2x^5+\dfrac{4}{x^3}$ $y=2x^5+4x^{-3}$ $\dfrac{dy}{dx}=10x^4-12x^{-4}$	✓ $2x^5+4x^{-3}$ ✓ $10x^4$ ✓ $-12x^{-4}$ (3)

7.2.2	$y=\left(\sqrt{x}-x^{2}\right)^{2}$ $y=\left(x^{\frac{1}{2}}-x^{2}\right)^{2}$ $=x-2x^{\frac{5}{2}}+x^{4}$ $\frac{dy}{dx}=1-5x^{\frac{3}{2}}+4x^{3}$	✓ $x-2x^{\frac{5}{2}}+x^{4}$ ✓ 1 ✓ $-5x^{\frac{3}{2}}$ ✓ $4x^{3}$ (4) **[12]**

QUESTION/*VRAAG* 8

8.1	$f(x+h) = -(x+h)^2 + 4 = -(x^2 + 2xh + h^2) + 4$ $= -x^2 - 2xh - h^2 + 4$ $f(x+h) - f(x) = -2xh - h^2$ $f'(x) = \lim_{h\to 0} \frac{f(x+h) - f(x)}{h}$ $= \lim_{h\to 0} \frac{-2xh - h^2}{h}$ $= \lim_{h\to 0} \frac{h(-2x-h)}{h}$ $= \lim_{h\to 0}(-2x-h)$ $= -2x$ **OR/*OF*** $f'(x) = \lim_{h\to 0} \frac{f(x+h) - f(x)}{h}$ $= \lim_{h\to 0} \frac{-(x+h)^2 + 4 - (-x^2+4)}{h}$ $= \lim_{h\to 0} \frac{-x^2 - 2xh - h^2 + 4 + x^2 - 4}{h}$ $= \lim_{h\to 0} \frac{-2xh - h^2}{h}$ $= \lim_{h\to 0} \frac{h(-2x-h))}{h}$ $= \lim_{h\to 0}(-2x-h)$ $= -2x$	✓ finding $f(x+h)$ ✓ $-2xh - h^2$ ✓formula ✓factorisation ✓answer (5) ✓formula ✓ finding $f(x+h)$ ✓ $-2xh - h^2$ ✓factorisation ✓answer (5)
8.2.1	$y = 3x^2 + 10x$ $\frac{dy}{dx} = 6x + 10$	✓ $6x$ ✓ 10 (2)
8.2.2	$f(x) = \left(x - \frac{3}{x}\right)^2$ $= x^2 - 6 + \frac{9}{x^2}$ $= x^2 - 6 + 9x^{-2}$ $f'(x) = 2x - 18x^{-3}$	✓ $x^2 - 6 + \frac{9}{x^2}$ ✓ $9x^{-2}$ ✓ $2x - 18x^{-3}$ (3)

8.3.1	$f(2)=2(2)^3-23(2)^2+80(2)-84$ $=0$ $\therefore (x-2)$ is a factor	✓substitution of 2 into f ✓value of 0 (2)
8.3.2	$f(x)=2x^3-23x^2+80x-84$ $=(x-2)(2x^2-19x+42)$ $=(x-2)(2x-7)(x-6)$	✓ $2x^2-19x+42$ ✓ $(x-2)(2x-7)(x-6)$ (2)
8.3.3	$f'(x)=6x^2-46x+80$ $6x^2-46x+80=0$ $3x^2-23x+40=0$ $(3x-8)(x-5)=0$ $x=\frac{8}{3}$ or $x=5$	✓ $f'(x)=6x^2-46x+80$ ✓ $f'(x)=0$ ✓factors ✓x-values (4)
8.3.4		✓x-intercepts ✓y-intercept ✓shape (3)
8.3.5	$6x^2-46x+80=40$ $6x^2-46x+40=0$ $3x^2-23x+20=0$ $(3x-20)(x-1)=0$ $x=\frac{20}{3}$ or $x=1$ But x must be an integer, so $x=1$ at the point where tangent touches f /*x moet heelgetal wees so x = 1 by punt waar die raaklyn f raak:* $y=f(1)=2(1)^3-23(1)^2+80(1)-84=-25$ $y=mx+c$ $-25=40(1)+c$ $-65=c$ $(0;-65)$	✓ $6x^2-46x+80=40$ ✓factors ✓$x=1$ ✓ y-value ✓ $-25=40(1)+c$ ✓answer (6) **[27]**

QUESTION/*VRAAG* 8

8.1	$f(x+h) = (x+h)^2 - 3(x+h)$ $= x^2 + 2xh + h^2 - 3x - 3h$ $f(x+h) - f(x) = x^2 + 2xh + h^2 - 3x - 3h - (x^2 - 3x)$ $= 2xh + h^2 - 3h$ $f'(x) = \lim_{h \to 0} \frac{f(x+h) - f(x)}{h}$ $= \lim_{h \to 0} \frac{2xh + h^2 - 3h}{h}$ $= \lim_{h \to 0} \frac{h(2x + h - 3)}{h}$ $= \lim_{h \to 0} (2x + h - 3)$ $= 2x - 3$	✓finding $f(x+h)$ ✓ $2xh + h^2 - 3h$ ✓formula ✓factorisation ✓answer (5)
	OR/*OF*	
	$f'(x) = \lim_{h \to 0} \frac{f(x+h) - f(x)}{h}$ $= \lim_{h \to 0} \frac{(x+h)^2 - 3(x+h) - (x^2 - 3x)}{h}$ $= \lim_{h \to 0} \frac{x^2 + 2xh + h^2 - 3x - 3h - x^2 + 3x}{h}$ $= \lim_{h \to 0} \frac{2xh + h^2 - 3h}{h}$ $= \lim_{h \to 0} \frac{h(2x + h - 3)}{h}$ $= \lim_{h \to 0} (2x + h - 3)$ $= 2x - 3$	✓formula ✓finding $f(x+h)$ ✓ $2xh + h^2 - 3h$ ✓factorisation ✓answer (5)
8.2.1	$y = \left(x^2 - \frac{1}{x^2} \right)^2$ $y = x^4 - 2 + \frac{1}{x^4}$ $= x^4 - 2 + x^{-4}$ $\frac{dy}{dx} = 4x^3 - 4x^{-5}$	✓ $x^4 - 2 + \frac{1}{x^4}$ ✓ $4x^3$ ✓ $-4x^{-5}$ (3)
	OR/*OF*	

	By using the chain rule (which is not part of CAPS): $y = \left(x^2 - x^{-2}\right)^2$ $\frac{dy}{dx} = 2\left(x^2 - x^{-2}\right)\left(2x + 2x^{-3}\right)$ $= 2\left(2x^3 + 2x^{-1} - 2x^{-1} - 2x^{-5}\right)$ $= 2\left(2x^3 - 2x^{-5}\right)$ $= 4x^3 - 4x^{-5}$	✓✓✓ $2\left(x^2 - x^{-2}\right)\left(2x + 2x^{-3}\right)$ (3)
8.2.2	$D_x\left[\frac{(x-1)(x^2+x+1)}{x-1}\right]$ $= D_x\left[x^2 + x + 1\right]$ $= 2x + 1$ **OR/*OF*** By using the quotient rule (with is not part of CAPS): $D_x\left[\frac{x^3-1}{x-1}\right]$ $= \frac{3x^2(x-1) - (x^3-1)}{(x-1)^2}$	✓factorisation ✓ $x^2 + x + 1$ ✓ $2x + 1$ (3) ✓✓✓ $\frac{3x^2(x-1) - (x^3-1)}{(x-1)^2}$ (3) **[11]**

QUESTION/*VRAAG* 8

8.1	$f(x+h)=2(x+h)^2+4$ $=2x^2+4xh+2h^2+4$ $f(x+h)-f(x)=2x^2+4xh+2h^2+4-2x^2-4$ $=4xh+2h^2$ $f^{/}(x)=\lim_{h\to 0}\frac{4xh+2h^2}{h}$ $=\lim_{h\to 0}\frac{h(4x+2h)}{h}$ $=\lim_{h\to 0}(4x+2h)$ $=4x$	✓ $2x^2+4xh+2h^2+4$ ✓ $4xh+2h^2$ ✓ $\lim_{h\to 0}\frac{h(4x+2h)}{h}$ ✓ $4x$ (4)
8.2.1	$f(x)=-3x^2+5\sqrt{x}$ $f(x)=-3x^2+5x^{\frac{1}{2}}$ $f^{/}(x)=-6x+\frac{5}{2}x^{-\frac{1}{2}}$	✓ $5x^{\frac{1}{2}}$ ✓ $-6x$ ✓ $\frac{5}{2}x^{-\frac{1}{2}}$ (3)
8.2.2	$p(x)=\left(\frac{1}{x^3}+4x\right)^2$ $=\frac{1}{x^6}+\frac{8}{x^2}+16x^2$ $=x^{-6}+8x^{-2}+16x^2$ $p^{/}(x)=-6x^{-7}-16x^{-3}+32x$ **OR/*OF*** $p(x)=(x^{-3}+4x)^2$ by making use of the chain rule: $p^{/}(x)=2(x^{-3}+4x)(-3x^{-4}+4)$ $p^{/}(x)=-6x^{-7}-16x^{-3}+32x$	✓ $\frac{1}{x^6}+\frac{8}{x^2}+16x^2$ ✓ $x^{-6}+8x^{-2}+16x^2$ ✓✓ answer/*antwoord* (4) ✓✓ $2(x^{-3}+4x)$ ✓✓ $(-3x^{-4}+4)$ (4)
8.3.1	$h^{/}(x)=3x^2-14x+14$	✓ finding/*kry* $h^{/}(x)$ (1)
8.3.2	At/*By* B: $h^{/}(x)=0$ $3x^2-14x+14=0$ $x=\frac{14\pm\sqrt{(-14)^2-4(3)(14)}}{2(3)}$ $=1{,}45$ or $3{,}22$ n/a	✓ derivative equal to/ *afgeleide gelyk aan* 0 ✓ substitution into correct formula/*substitusie in korrekte formule* ✓x-value of/*x-waarde van* 1,45 (3)

8.3.3	$x^3-7x^2+14x-8=(x-1)(x^2-6x+8)$ $=(x-1)(x-2)(x-4)$ $C(4;0)$ **OR/*OF*** $x_c>3{,}22$ $h(4)=(4)^3-7(4)^2+14(4)-8=0$ $\therefore x_c=4$	✓ $(x-1)$ ✓ x^2-6x+8 ✓ $(x-2)(x-4)$ ✓coordinates of/*koördinate van* C (4) ✓ $x_c>3{,}22$ ✓substitution of/ *substitusie van* 4 ✓ $h(4)=0$ ✓ x_c (4)
8.3.4	$h'(x)=3x^2-14x+14$ $h''(x)=6x-14$ $6x-14<0$ $6x<14$ $\therefore x<\frac{7}{3}$ $\therefore k=\frac{7}{3}$	✓ $h''(x)=6x-14$ ✓ $6x-14<0$ ✓ $k=\frac{7}{3}$ (3) **[22]**

QUESTION/*VRAAG* 8

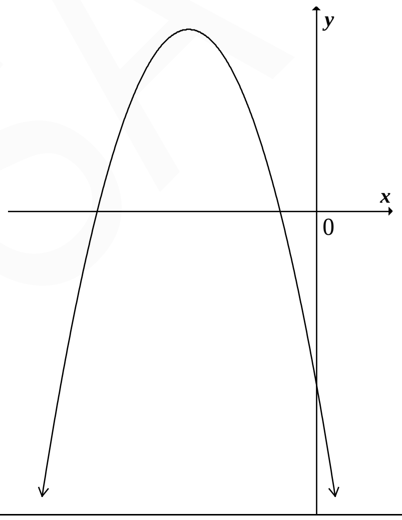
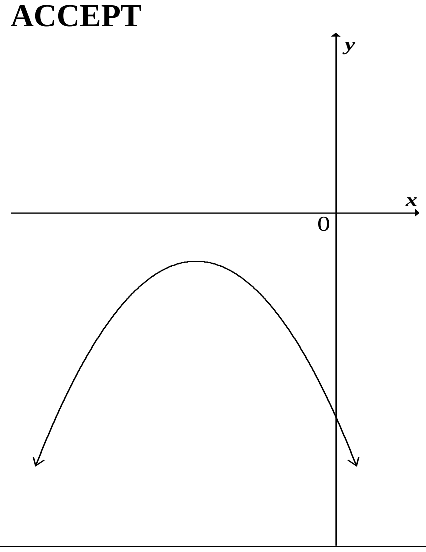
8.1	$f(x+h)=(x+h)^3=(x^2+2xh+h^2)(x+h)$ $=x^3+x^2h+2x^2h+2xh^2+h^2x+h^3$ $=x^3+3x^2h+3xh^2+h^3$ $f(x+h)-f(x)=x^3+3x^2h+3xh^2+h^3-x^3$ $=3x^2h+3xh^2+h^3$ $f'(x)=\lim\limits_{h\to 0}\dfrac{f(x+h)-f(x)}{h}$ $=\lim\limits_{h\to 0}\dfrac{3x^2h+3xh^2+h^3}{h}$ $=\lim\limits_{h\to 0}\dfrac{h(3x^2+3xh+h^2)}{h}$ $=\lim\limits_{h\to 0}\left(3x^2+3xh+h^2\right)$ $=3x^2$	✓simplifying/*vereenvouding* ✓formula/*formule* ✓subst. into formula/*subst. in formule* ✓factorization/*faktorisering* ✓answer/*antwoord* (5)
	OR/OF $f'(x)=\lim\limits_{h\to 0}\dfrac{f(x+h)-f(x)}{h}$ $=\lim\limits_{h\to 0}\dfrac{(x+h)^3-x^3}{h}$ $=\lim\limits_{h\to 0}\dfrac{(x+h)(x+h)^2-x^3}{h}$ $=\lim\limits_{h\to 0}\dfrac{(x+h)(x^2+2xh+h^2)-x^3}{h}$ $=\lim\limits_{h\to 0}\dfrac{x^3+3x^2h+3xh^2+h^3-x^3}{h}$ $=\lim\limits_{h\to 0}\dfrac{h(3x^2+3xh+h^2)}{h}$ $=\lim\limits_{h\to 0}\left(3x^2+3xh+h^2\right)$ $=3x^2$ **OR**	✓formula/*formule* ✓subst. into formula/*subst. in formule* ✓simplifying/*vereenvoudiging* ✓factorization/*faktorisering* ✓answer/*antwoord* (5)

	$f'(x) = \lim_{h\to 0}\frac{f(x+h)-f(x)}{h}$ $= \lim_{h\to 0}\frac{(x+h)^3 - x^3}{h}$ $= \lim_{h\to 0}\frac{(x+h-x)(x^2+2xh+h^2+x^2+xh+x^2)}{h}$ $= \lim_{h\to 0}\frac{h(3x^2+3xh+h^2)}{h}$ $= \lim_{h\to 0}\left(3x^2+3xh+h^2\right)$ $= 3x^2$	✓formula/*formule* ✓subst. into formula/*subst. in formule* ✓factorization/*faktorisering* ✓simplifying/*vereenvoudiging* ✓answer/*antwoord* (5)

8.2	$f'(x) = 4x + 2x^3$	✓$4x$ ✓ $2x^3$ (2)
8.3	$y = x^{12} - 2x^6 + 1$ $\frac{dy}{dx} = 12x^{11} - 12x^5$ $= 12x^5\left(x^6 - 1\right)$ $= 12x^5\sqrt{y}$	✓simplification/*vereenvoudiging* ✓derivative/*afgeleide* ✓factors/*faktore* (3)
8.4	$f(x) = 2x^3 - 2x^2 + 4x - 1$ $f'(x) = 6x^2 - 4x + 4$ $f''(x) = 12x - 4$ f is concave up when/*is konkaaf op as* $f''(x) > 0$ $\therefore 12x - 4 > 0$ $12x > 4$ $x > \frac{1}{3}$	✓first derivative/*eerste afgeleide* ✓ second derivative/*tweede afgeleide* ✓ $f''(x) > 0$ ✓ $x > \frac{1}{3}$ (4) **[14]**

QUESTION/*VRAAG* 10

10.1.1	$f(x) = -\dfrac{2}{x}$ $f(x+h) = -\dfrac{2}{(x+h)}$ $f(x+h) - f(x) = -\dfrac{2}{(x+h)} - \left(-\dfrac{2}{x}\right)$ $= \dfrac{-2x + 2(x+h)}{x(x+h)}$ $= \dfrac{-2x + 2x + 2h}{x(x+h)}$ $= \dfrac{2h}{x(x+h)}$ $f'(x) = \lim\limits_{h \to 0} \dfrac{\frac{2h}{x(x+h)}}{h}$ $= \lim\limits_{h \to 0} \left(\dfrac{2}{x^2 + xh}\right)$ $= \dfrac{2}{x^2}$	✓ substitution ✓ simplification ✓ formula ✓ common factor ✓ answer (5)
	OR $f'(x) = \lim\limits_{h \to 0} \dfrac{f(x+h) - f(x)}{h}$ $= \lim\limits_{h \to 0} \dfrac{\left[-\frac{2}{(x+h)}\right] - \left(-\frac{2}{x}\right)}{h}$ $= \lim\limits_{h \to 0} \dfrac{\frac{-2x + 2(x+h)}{x(x+h)}}{h}$ $= \lim\limits_{h \to 0} \dfrac{\frac{-2x + 2x + 2h}{x(x+h)}}{h}$ $= \lim\limits_{h \to 0} \dfrac{\frac{2h}{x(x+h)}}{h}$ $= \lim\limits_{h \to 0} \left(\dfrac{2}{x^2 + xh}\right)$ $= \dfrac{2}{x^2}$	✓ formula ✓ substitution ✓ simplification ✓ common factor ✓ answer (5)

10.1.2	$f'(x)=\dfrac{2}{x^2}$ $x^2 \geq 0$ for $x \in R$ $f'(x)>0$ for $x \in R;\ x \neq 0$	✓ $x^2 \geq 0$ or $\dfrac{2}{x^2} \geq 0$ for $x \in R$ ✓ $f'(x)>0$ for $x \in R;\ x \neq 0$ (2)
10.2	$y=\dfrac{1}{4}x^2-2x$ $\dfrac{dy}{dx}=\dfrac{1}{2}x-2$	✓ $\dfrac{1}{2}x$ ✓ -2 (2)
10.3	$y=4\left(\sqrt[3]{x^2}\right)$ $y=4x^{\frac{2}{3}}$ and $x=w^{-3}$ $y=4(w^{-3})^{\frac{2}{3}}$ $=4w^{-2}$ $\dfrac{dy}{dw}=-8w^{-3}$ $=-\dfrac{8}{w^3}$	✓ $y=4x^{\frac{2}{3}}$ ✓ subs: $4(w^{-3})^{\frac{2}{3}}$ ✓simplification ✓ answer (4)
10.4	$f'(x)=3ax^2+2bx+c$ $a<0$ shape (max TP) $c<0$ y - intercept is negative $b<0$ axis of symmetry on LHS of y - axis **ACCEPT** 	✓ $f'(x)=3ax^2+2$ ✓ shape (max TP) ✓ axis of symmetry on LHS if y-axis ✓y – intercept is below x-axis (4) **[17]**

QUESTION/VRAAG 8

8.1	$f(x) = 3x^2 - 2$ $f(x+h) = 3(x+h)^2 - 2$ $= 3x^2 + 6xh + 3h^2 - 2$ $f(x+h) - f(x) = 6xh + 3h^2$ $f'(x) = \lim_{h \to 0} \frac{6xh + 3h^2}{h}$ $= \lim_{h \to 0} \frac{h(6x+3h)}{h}$ $= \lim_{h \to 0}(6x+3h)$ $= 6x$	✓ substitution of of $x + h$ ✓ simplification to $6xh + 3h^2$ ✓ formula ✓taking out common factor ✓ answer (5)
	OR $f'(x) = \lim_{h \to 0} \frac{f(x+h) - f(x)}{h}$ $= \lim_{h \to 0} \frac{\left[3(x+h)^2 - 2\right] - \left(3x^2 - 2\right)}{h}$ $= \lim_{h \to 0} \frac{\left[3\left(x^2 + 2xh + h^2\right) - 2\right] - 3x^2 + 2}{h}$ $= \lim_{h \to 0} \frac{[3x^2 + 6xh + 3h^2 - 2] - 3x^2 + 2}{h}$ $= \lim_{h \to 0} \frac{6xh + 3h^2}{h}$ $= \lim_{h \to 0} \frac{h(6x+3h)}{h}$ $= \lim_{h \to 0}(6x+3h)$ $= 6x$	✓ formula ✓ substitution of $x + h$ ✓ simplification to $\frac{6xh + 3h^2}{h}$ ✓ taking out common factor ✓ answer (5)
8.2	$y = 2x^{-4} - \frac{x}{5}$ $\frac{dy}{dx} = -8x^{-5} - \frac{1}{5}$	✓ $-8x^{-5}$ ✓ $-\frac{1}{5}$ (2) **[7]**

QUESTION/*VRAAG* 8

8.1.1	$f'(x)=\lim_{h\to 0}\frac{f(x+h)-f(x)}{h}$ $=\lim_{h\to 0}\frac{3(x+h)^2-4-(3x^2-4)}{h}$ $=\lim_{h\to 0}\frac{3x^2+6xh+3h^2-4-3x^2+4}{h}$ $=\lim_{h\to 0}\frac{6xh+3h^2}{h}$ $=\lim_{h\to 0}\frac{h(6x+3h)}{h}$; $h\neq 0$ $=\lim_{h\to 0}(6x+3h)$ $=6x$ **NOTE:** • Incorrect notation: max 4/5 marks (Leaving out limit / incorrect use of limit, leaving out $f'(x)$, = in the wrong place constitute incorrect notation) • If $\lim_{h\to 0}\frac{3x^2+6xh+3h^2-3x^2-8}{h}$, take out common factor, then correct to the final answer: max 3/5 marks. **OR** $f(x)=3x^2-4$ $f(x+h)=3(x+h)^2-4$ $=3x^2+6xh+3h^2-4$ $f(x+h)-f(x)=6xh+3h^2$ **NOTE:** If candidate uses differentiation rules: 0/5 marks $f'(x)=\lim_{h\to 0}\frac{f(x+h)-f(x)}{h}$ $=\lim_{h\to 0}\frac{6xh+3h^2}{h}$ $=\lim_{h\to 0}\frac{h(6x+3h)}{h}$ $=\lim_{h\to 0}(6x+3h)$ $=6x$	✓ formula ✓ substitution of of $x+h$ ✓ simplification to $\frac{6xh+3h^2}{h}$ ✓ $\lim_{h\to 0}(6x+3h)$ ✓ answer (5) ✓ substitution of of $x+h$ ✓ simplification to $6xh+3h^2$ ✓ formula ✓ $\lim_{h\to 0}(6x+3h)$ ✓ answer (5)
8.1.2	$f(x)=3x^2-4$ average gradient of f between $A(-2\ ;\ y)$ and $B(x\ ;\ 23)$ $y=3(-2)^2-4=8$ $23=3x^2-4$ $27=3x^2$ $9=x^2$ $x=3$	✓ $y=8$ ✓ $23=3x^2-4$ ✓ $x=3$

	Average gradient $= \frac{23-y}{x-(-2)}$ $= \frac{23-8}{3+2}$ $= 3$	✓ $\frac{23-y}{x-(-2)}$ ✓answer (5)
8.2	**NOTE:** There is a maximum penalty of 1 mark for incorrect notation in question 8. $y = \frac{x+5}{x^{\frac{1}{2}}}$ $= \frac{x}{x^{\frac{1}{2}}} + \frac{5}{x^{\frac{1}{2}}}$ $= x^{\frac{1}{2}} + 5x^{-\frac{1}{2}}$ $\frac{dy}{dx} = \frac{1}{2}x^{-\frac{1}{2}} - \frac{5}{2}x^{-\frac{3}{2}}$	✓ $x^{\frac{1}{2}} + 5x^{-\frac{1}{2}}$ ✓ $\frac{1}{2}x^{-\frac{1}{2}}$ or $\frac{1}{2\sqrt{x}}$ ✓ $-\frac{5}{2}x^{-\frac{3}{2}}$ or $\frac{-5}{2\sqrt{x^3}}$ (3)
	OR $y = \frac{x+5}{x^{\frac{1}{2}}}$ By the quotient rule $\frac{dy}{dx} = \frac{1.x^{\frac{1}{2}} - \frac{1}{2}x^{-\frac{1}{2}}(x+5)}{\left(x^{\frac{1}{2}}\right)^2}$ $= \frac{x^{\frac{1}{2}} - \frac{1}{2}x^{\frac{1}{2}} - \frac{5}{2}x^{-\frac{1}{2}}}{x}$ $= \frac{1}{2x^{\frac{1}{2}}} - \frac{5}{2x^{\frac{3}{2}}}$	✓✓ $\frac{1.x^{\frac{1}{2}} - \frac{1}{2}x^{-\frac{1}{2}}(x+5)}{\left(x^{\frac{1}{2}}\right)^2}$ ✓ $\frac{1}{2}x^{-\frac{1}{2}}$ or $\frac{1}{2\sqrt{x}}$ or $-\frac{5}{2}x^{-\frac{3}{2}}$ or $\frac{-5}{2\sqrt{x^3}}$ (3)
8.3	$f(x) = -3x^3 - 4x + 5$ $f'(x) = -9x^2 - 4$ $m_{\tan} = -9(-1)^2 - 4$ $= -13$	✓ $-9x^2$ ✓ -4 ✓ substitution of $x = -1$ ✓ answer (4) **[17]**

QUESTION 9

9.1	$f(x)=2x^3$ $f(x+h)=2(x+h)^3$ $=2(x^3+3x^2h+3xh^2+h^3)$ $=2x^3+6x^2h+6xh^2+2h^3$ $f(x+h)-f(x)=2x^3+6x^2h+6xh^2+2h^3-2x^3$ $=6x^2h+6xh^2+2h^3$ $f'(x)=\lim_{h\to 0}\frac{6x^2h+6xh^2+2h^3}{h}$ $=\lim_{h\to 0}\frac{h(6x^2+6xh+2h^2)}{h}$ $=\lim_{h\to 0}(6x^2+6xh+2h^2)$ $f'(x)=6x^2$	✓ substitution ✓ expansion ✓ formula ✓ $6x^2+6xh+2h^2$ ✓ answer (5)
	OR	
	$f'(x)=\lim_{h\to 0}\frac{f(x+h)-f(x)}{h}$ $=\lim_{h\to 0}\frac{2(x+h)^3-2x^3}{h}$ $=\lim_{h\to 0}\frac{2(x^3+3x^2h+3xh^2+h^3)-2x^3}{h}$ $=\lim_{h\to 0}\frac{6x^2h+6xh^2+2h^3}{h}$ $=\lim_{h\to 0}\frac{h(6x^2+6xh+2h^2)}{h}$ $=\lim_{h\to 0}(6x^2+6xh+2h^2)$ $f'(x)=6x^2$	✓ formula ✓ substitution ✓ expansion ✓ $6x^2+6xh+2h^2$ ✓ answer (5)
9.2	$y=\frac{2\sqrt{x}+1}{x^2}$ $=2x^{-\frac{3}{2}}+x^{-2}$ $\frac{dy}{dx}=-3x^{-\frac{5}{2}}-2x^{-3}$	✓ $2x^{-\frac{3}{2}}$ ✓ x^{-2} ✓ $-3x^{-\frac{5}{2}}$ ✓ $-2x^{-3}$ (4)

9.3	$f'(-1) = -7$ $f'(x) = 2ax + b$ $-7 = -2a + b$ $f(-1) = -7(-1) + 3$ $= 10$ $\therefore\ a - b + 5 = 10$ $a - b = 5$............[1] $-2a + b = -7$.........[2] $-a = -2$.........[1] + [2] $a = 2$ $b = -3$	✓ $f'(x) = 2ax + b$ ✓ substitution of $x = -1$ ✓ $-7 = -2a + b$ ✓ $f(-1) = 10$ ✓ $a = 2$ ✓ $b = -3$ (6) **[15]**

	OR $A = F_v$ $P(1+i)^n = \frac{x\left[(1+i)^n - 1\right]}{i}$ $900000\left(1+\frac{0,105}{12}\right)^n = \frac{18000\left[\left(1+\frac{0,105}{12}\right)^n - 1\right]}{\frac{0,105}{12}}$ $\frac{0,105}{12} \times 900\ 000\left(1+\frac{0,105}{12}\right)^n = 18000\left(1+\frac{0,105}{12}\right)^n - 18000$ $18000 = 18000\left(1+\frac{0,105}{12}\right)^n - \frac{0,105}{12} \times 900\ 000\left(1+\frac{0,105}{12}\right)^n$ $18000 = \left(1+\frac{0,105}{12}\right)^n \left(18000 - \frac{0,105}{12} \times 900\ 000\right)$ $18000 \div \left(18000 - \frac{0,105}{12} \times 900\ 000\right) = \left(1+\frac{0,105}{12}\right)^n$ $\frac{16}{9} = \left(1+\frac{0,105}{12}\right)^n$ $-n = \log_{\left(1+\frac{0,105}{12}\right)} \frac{9}{16}$ $n = 66,04$ months She will be able to maintain her current lifestyle for a little more than 66 months using her pension money.	✓ x = 18 000 ✓ $i = \frac{0,105}{12}$ in annuity formula ✓ subs into correct formula ✓ simplification ✓ use of logs ✓ answer in months (6) **[17]**

QUESTION 8

8.1	$f(x) = 2x^2 - 5$ $f(x+h) = 2(x+h)^2 - 5$ $= 2x^2 + 4xh + 2h^2 - 5$ $f(x+h) - f(x) = 4xh + 2h^2$ $f'(x) = \lim_{h \to 0} \frac{4xh + 2h^2}{h}$ $= \lim_{h \to 0} \frac{h(4x+2h)}{h}$ $= \lim_{h \to 0} (4x + 2h)$ $= 4x$ **OR**	**Note:** If candidate makes a notation error Penalise 1 mark **Note:** If candidate uses differentiation rules Award 0/5 marks	✓ substitution of of $x + h$ ✓ simplification to $4xh + 2h^2$ ✓ formula ✓ $\lim_{h \to 0}(4x + 2h)$ ✓ answer (5)

	$f'(x)=\lim_{h\to 0}\frac{f(x+h)-f(x)}{h}$ $=\lim_{h\to 0}\frac{[2(x+h)^2-5]-(2x^2-5)}{h}$ $=\lim_{h\to 0}\frac{[2(x^2+2xh+h^2)-5]-2x^2+5}{h}$ $=\lim_{h\to 0}\frac{[2x^2+4xh+2h^2-5]-2x^2+5}{h}$ $=\lim_{h\to 0}\frac{4xh+2h^2}{h}$ $=\lim_{h\to 0}\frac{h(4x+2h)}{h}$ $=\lim_{h\to 0}(4x+2h)$ $=4x$	✓ formula ✓ substitution of $x+h$ ✓ simplification to $\frac{4xh+2h^2}{h}$ ✓ $\lim_{h\to 0}(4x+2h)$ ✓ answer (5)
8.2	$\frac{dy}{dx}=-4x^{-5}+6x^2-\frac{1}{5}$ $=\frac{-4}{x^5}+6x^2-\frac{1}{5}$ **Note:** notation error penalise 1 mark **Note:** candidates do NOT need to give their answer with positive exponents	✓ $-4x^{-5}$ ✓ $6x^2$ ✓ $-\frac{1}{5}$ (3)
8.3.1	$g(x)=\frac{x^2+x-2}{x-1}$ $=\frac{(x+2)(x-1)}{x-1}$ $=x+2 \quad (x\neq 1)$ $g'(x)=1 \quad (x\neq 1)$	✓ simplification ✓ answer (2)
8.3.2	The function is undefined at $x = 1$. **OR** Division by zero is undefined. **OR** The denominator cannot be zero. **OR** In the definition of the derivative , $g'(1)=\lim_{h\to 0}\frac{g(1+h)-g(1)}{h}$, but $g(1)$ does not exist.	✓ answer (1) **[11]**

QUESTION 8

8.1	$f(x) = 9 - x^2$ $f(x+h) = 9 - (x+h)^2$ $= 9 - x^2 - 2xh - h^2$ $f(x+h) - f(x) = -2xh - h^2$ $f'(x) = \lim_{h \to 0} \frac{-2xh - h^2}{h}$ $= \lim_{h \to 0} \frac{h(-2x - h)}{h}$ $= \lim_{h \to 0}(-2x - h)$ $= -2x$	✓ substitution ✓ simplification ✓ formula ✓ common factor ✓ answer (5)
	OR $f'(x) = \lim_{h \to 0} \frac{f(x+h) - f(x)}{h}$ $= \lim_{h \to 0} \frac{9 - (x+h)^2 - (9 - x^2)}{h}$ $= \lim_{h \to 0} \frac{9 - (x^2 + 2xh + h^2) - 9 + x^2}{h}$ $= \lim_{h \to 0} \frac{-2xh - h^2}{h}$ $= \lim_{h \to 0} \frac{h(-2x - h)}{h}$ $= \lim_{h \to 0}(-2x - h)$ $= -2x$	✓ formula ✓ substitution ✓ simplification ✓ common factor ✓ answer (5)
8.2.1	$D_x[1 + 6\sqrt{x}]$ $= D_x\left[1 + 6x^{\frac{1}{2}}\right]$ $= 3x^{-\frac{1}{2}}$	✓ $6x^{\frac{1}{2}}$ ✓ answer (2)
8.2.2	$y = \frac{8 - 3x^6}{8x^5}$ $= \frac{1}{x^5} - \frac{3}{8}x$ $= x^{-5} - \frac{3}{8}x$ $\frac{dy}{dx} = -5x^{-6} - \frac{3}{8}$	✓ x^{-5} ✓ $\frac{3}{8}x$ ✓ $-5x^{-6}$ ✓ $-\frac{3}{8}$ (4) **[11]**

	$f(x) = -4x^2$ $f(x+h) = -4(x+h)^2$ $= -4x^2 - 8xh - 4h^2$ $f(x+h) - f(x) = -8xh - 4h^2$ $f'(x) = \lim_{h\to 0} \frac{-8xh - 4h^2}{h}$ $= \lim_{h\to 0} \frac{h(-8x-4h)}{h}$ $= \lim_{h\to 0}(-8x-4h)$ $= -8x$	✓ substitution ✓ expansion ✓ formula ✓ $-8x-4h$ ✓ answer (5)
8.2.1	$y = \frac{3}{2x} - \frac{x^2}{2}$ $= \frac{3}{2}x^{-1} - \frac{1}{2}x^2$ $\frac{dy}{dx} = -\frac{3}{2}x^{-2} - x$ $= -\frac{3}{2x^2} - x$ **Note:** Incorrect notation in 8.2.1 and/or 8.2.2: Penalise 1 mark	✓ $\frac{3}{2}x^{-1}$ ✓ $-\frac{3}{2}x^{-2}$ ✓ $-x$ (3)
8.2.2	$f(x) = (7x+1)^2$ $= 49x^2 + 14x + 1$ $f'(x) = 98x + 14$ $f'(1) = 98(1) + 14$ $= 112$	✓multiplication ✓ $98x$ ✓14 ✓ answer (4)
	OR $f(x) = (7x+1)^2$ $f'(x) = 2(7x+1).(7)$ By the chain rule $f'(x) = 98x + 14$ $f'(1) = 98(1) + 14$ $= 112$	✓✓ chain rule ✓✓ answer (4) **[12]**

QUESTION 9

9.1

$f(x) = -2x^3 + ax^2 + bx + c$

$f'(x) = -6x^2 + 2ax + b$

$= -6(x-5)(x-2)$

$= -6(x^2 - 7x + 10)$

$= -6x^2 + 42x - 60$

$2a = 42$

$a = 21$

$b = -60$

> **Note:**
> A candidate who substitutes the values of a, b and c and then checks (by substitution) that $T(2;-9)$ and $S(5;18)$ lie on the curve:
> award max 2/7 marks

$f(5) = -2(5)^3 + 21(5)^2 - 60(5) + c$

$18 = -25 + c$

$c = 43$

OR

$f(2) = -2(2)^3 + 21(2)^2 - 60(2) + c$

$-9 = -52 + c$

$c = 43$

$a = 21$; $b = -60$; $c = 43$

Marks:
✓ $f'(x) = -6x^2 + 2ax + b$
✓✓ $-6(x-5)(x-2)$
✓ $b = -60$
✓ $2a = 42$
✓ subs (5 ; 18) or (2 ; -9)
✓ $c = 43$
(7)

> **Note:**
> A candidate who substitutes the values of a, b and c into the function i.e. gets $f(x) = -2x^3 - 21x^2 - 60x + 43$ and then shows by substitution that $T(2;-9)$ and $S(5;18)$ are on the curve **and** works out the derivative i.e. gets $f'(x) = -6x^2 - 42x - 60$ **and** shows (by substitution into the derivative) that the turning points are at $x = 2$ and $x = 5$ (assuming what s/he sets out to prove and proving what is given): **award max 4/7 marks** as follows:
> ✓ $x = 2$ from $f'(x) = 0$ OR subs $x = 2$ into the derivative and gets 0
> ✓ $x = 5$ from $f'(x) = 0$ OR subs $x = 5$ into the derivative and gets 0
> ✓substitution of $x = 2$ in f and gets -9
> ✓substitution of $x = 5$ in f and gets 18

OR

$f'(x) = -6x^2 + 2ax + b$

$f'(2) = -6(2)^2 + 2a(2) + b$

$0 = -24 + 4a + b$

$b = 24 - 4a$

$f'(5) = -6(5)^2 + 2a(5) + b$

$0 = -150 + 10a + b$

$0 = -150 + 10a + (24 - 4a)$

$0 = -126 + 6a$

$6a = 126$

$a = 21$

$b = -60$

> **Note:**
> If derivative equal to zero is not written: penalize once only

$f(5) = -2(5)^3 + 21(5)^2 - 60(5) + c$

$18 = -25 + c$

$c = 43$

OR

$f(2) = -2(2)^3 + 21(2)^2 - 60(2) + c$

$-9 = -52 + c$

$c = 43$

$a = 21$; $b = -60$; $c = 43$

Marks:
✓ $f'(x) = -6x^2 + 2ax + b$
✓ $f'(2) = 0$
✓ $f'(5) = 0$
✓ $6a = 126$
✓ $b = -60$
✓ subs (5 ; 18) or (2 ; -9)
✓ $c = 43$
(7)

QUESTION 9

9.1	$f'(x) = \lim_{h \to 0} \frac{f(x+h) - f(x)}{h}$ $= \lim_{h \to 0} \frac{1 - 3(x+h)^2 - (1 - 3x^2)}{h}$ $= \lim_{h \to 0} \frac{1 - 3x^2 - 6xh - 3h^2 - 1 + 3x^2}{h}$ $= \lim_{h \to 0} \frac{-6xh - 3h^2}{h}$ $= \lim_{h \to 0} \frac{h(-6x - 3h)}{h}$ $= \lim_{h \to 0} (-6x - 3h)$ $= -6x$	✓ substitution into formula ✓ $1 - 3x^2 - 6xh - 3h^2$ ✓ $h(-6x - 3h)$ ✓ answer (4)
9.2	$D_x\left[4 - \frac{4}{x^3} - \frac{1}{x^4}\right]$ $= D_x\left[4 - 4x^{-3} - x^{-4}\right]$ $= 12x^{-4} + 4x^{-5}$	✓ simplification ✓✓ answer (3)
9.3	$y = \left(1 + \sqrt{x}\right)^2$ $y = 1 + 2\sqrt{x} + x$ $y = 1 + 2x^{\frac{1}{2}} + x$ $\frac{dy}{dx} = x^{-\frac{1}{2}} + 1$	✓ expansion ✓ $x^{-\frac{1}{2}}$ ✓ 1 (3) **[10]**

- Consistent Accuracy will apply as a general rule.
- If a candidate does a question twice and does not delete either, mark the FIRST attempt.
- If a candidate does a question, crosses it out and does not re-do it, mark the deleted attempt.

QUESTION 10

10.1	$f'(x) = \lim_{h\to 0} \frac{f(x+h)-f(x)}{h}$ $= \lim_{h\to 0} \frac{-2(x+h)^2+3-(-2x^2+3)}{h}$ $= \lim_{h\to 0} \frac{-2x^2-4xh-2h^2+3+2x^2-3}{h}$ $= \lim_{h\to 0} \frac{h(-4x-2h)}{h}$ $= \lim_{h\to 0}(-4x-2h)$ $= -4x$ **NOTE:** Penalty 1 mark only for incorrect notation (lim missing or = in incorrect place) Answer only : 0 / 5 Cannot give mark for answer if the answer is incorrect according to the working out, even if the answer is given as – 4*x*.	✓ $\lim_{h\to 0} \frac{f(x+h)-f(x)}{h}$ ✓ $-2(x+h)^2+3$ ✓ simplification ✓ simplification ✓ answer (5)
10.2	$y = x^2 - \frac{1}{2x^3}$ $y = x^2 - \frac{1}{2}x^{-3}$ $\frac{dy}{dx} = 2x + \frac{3}{2}x^{-4}$ **OR** $\frac{dy}{dx} = 2x + \frac{3}{2x^4}$ **OR** $\frac{dy}{dx} = 2x - (-3)\frac{1}{2}x^{-4}$	✓ $2x$ ✓ $+\frac{3}{2}x^{-4}$ (2) **[7]**