SA-STUDENT

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QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Various options are provided as possible answers to the following questions. Each question has only ONE correct answer. Choose the answer and write only the letter (A–D) next to the question numbers (1.1 to 1.10) in the ANSWER BOOK, e.g. 1.11 E.

1.1 Which ONE of the following quantities is the tendency of an object to resist a change to its state of motion?

A Inertia

B Impulse

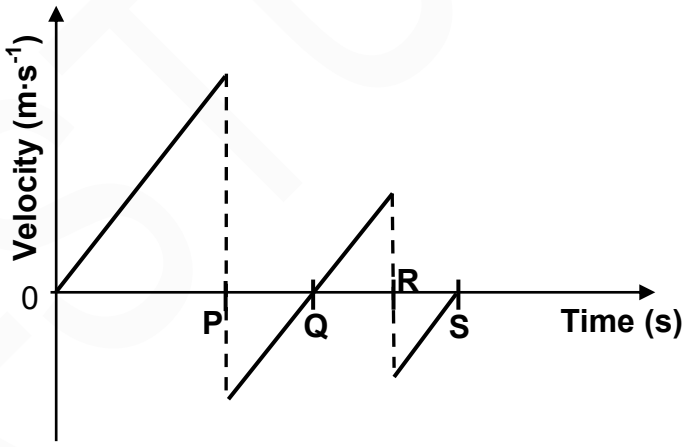
C Momentum

D Acceleration (2)

1.2 A ball is dropped from rest at a height above a concrete floor. The ball strikes the floor and bounces vertically up and down on the same spot on the floor.

The velocity-time graph for the bouncing ball is shown below, with points **P**, **Q**, **R** and **S** representing different times during the motion.

Ignore the effects of air resistance.



At which time does the ball reach its maximum height after the first upward bounce?

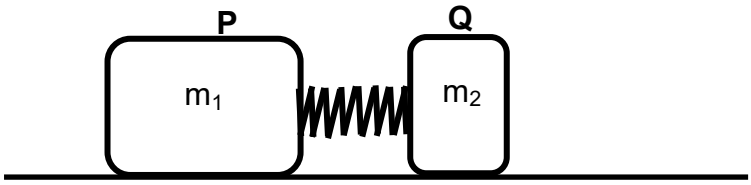
A **P**

B **Q**

C **R**

D **S** (2)

1.3 Two blocks, **P** and **Q**, of masses m_1 and m_2 respectively, are held at rest on a frictionless horizontal floor with a compressed spring between them, as shown below.



When the blocks are released and the spring drops to the floor, block **Q** moves to the right with velocity **v**.

Which ONE of the following represents the momentum of block **P** after the blocks are released?

A m_1**v** to the right

B m_2**v** to the right

C m_1**v** to the left

D m_2**v** to the left (2)

1.4 The magnitude of the gravitational force that spheres **X** and **Y** exert on each other is **F**.

The mass of sphere **X** is now doubled while the mass of sphere **Y** and the distance between the centres of the spheres remain the same.

Which ONE of the following combinations is CORRECT for the magnitude of the forces that the spheres now exert on each other?

	FORCE THAT X EXERTS ON Y	FORCE THAT Y EXERTS ON X
A	**F**	**F**
B	**F**	2**F**
C	2**F**	**F**
D	2**F**	2**F**

(2)

1.5 A hot-air balloon is moving vertically downwards at a CONSTANT SPEED. Assume that the mass of the hot-air balloon remains constant.

Which ONE of the following physical quantities associated with the hot-air balloon changes during the motion?

A Weight

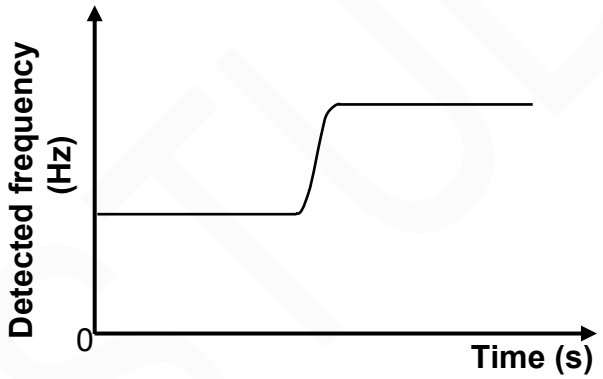
B Momentum

C Kinetic energy

D Potential energy (2)

1.6 A learner standing at a roadside records the frequency of sound waves produced by the siren of an ambulance. The ambulance is moving at constant velocity along a straight horizontal road.

The frequency-time graph for the detected sound is shown below.



Which ONE of the following statements concerning the motion of the ambulance is CORRECT?

The ambulance …

A approaches the learner and then passes the learner.

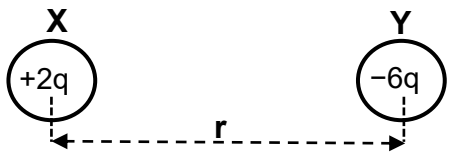
B moves away from the learner, then turns and approaches the learner.

C approaches the learner, then turns and moves away from the learner.

D moves away from the learner and then stops. (2)

1.7 Two identically charged spheres, **X** and **Y**, carry charges of +2q and −6q respectively.

Sphere **X** experiences an electrostatic force **F** to the right when the distance between their centres is **r**.



The spheres are brought into contact and are then returned to their original positions.

Which ONE of the following represents the magnitude of the electrostatic force that sphere **X** experiences now?

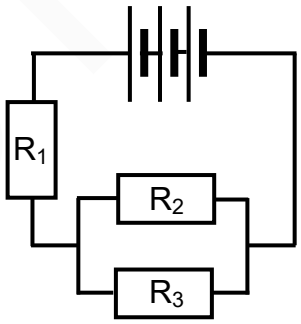
A $-\mathbf{F}$

B $-\mathbf{F}$

C $4\,\mathbf{F}$

D $12\,\mathbf{F}$ (2)

1.8 In the circuit diagram below, R_1, R_2 and R_3 are identical resistors. The battery has negligible internal resistance.



The power dissipated by R_1 is **P**.

Which ONE of the following is the power dissipated by R_2?

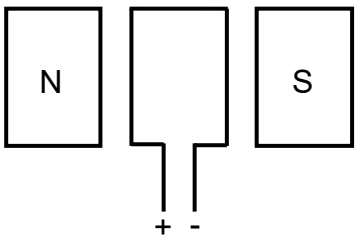
A $-\mathbf{P}$

B $-\frac{\mathbf{P}}{2}$

C $2\,\mathbf{P}$

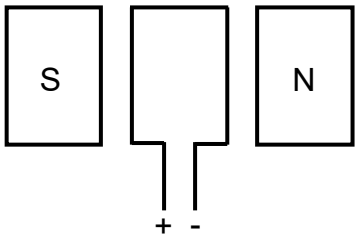
D $4\,\mathbf{P}$ (2)

1.9 The simplified diagram below represents a DC motor.

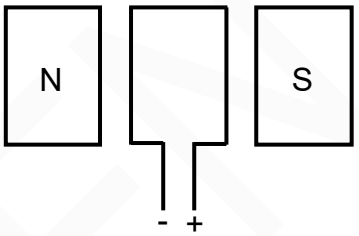


The diagrams below indicate some changes made to the above motor.

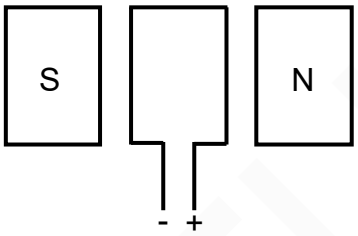
(i)



(ii)



(iii)



Which of the changes to the motor above will change the original direction of rotation of the coil?

A (i) and (ii) only

B (i) and (iii) only

C (ii) and (iii) only

D (iii) only (2)

1.10 An atom has a ground state energy of **x**. When the atom moves to a higher energy state **y**, a line spectrum is observed.

Which ONE of the following combinations is CORRECT for the ENERGY CHANGE of the atom and the TYPE OF LINE SPECTRUM observed during the transition?

	ENERGY CHANGE	TYPE OF LINE SPECTRUM
A	**y – x**	Emission
B	**x – y**	Emission
C	**x – y**	Absorption
D	**y – x**	Absorption

(2)
[20]

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1.1 Which ONE of the following combinations consists of only SCALAR quantities?

A Velocity, speed and time

B Time, distance and speed

C Acceleration, speed and distance

D Displacement, velocity and acceleration (2)

1.2 The acceleration due to gravity on Earth is g.

Which ONE of the following represents the acceleration due to gravity on a planet that has TWICE the mass and HALF the radius of the Earth?

A $-g$

B $2g$

C $4g$

D $8g$ (2)

1.3 A ball is projected vertically upwards from the ground and reaches its maximum height after a while.

Ignore the effects of air friction.

How will the ACCELERATION and TOTAL MECHANICAL ENERGY of the ball at its maximum height compare to that immediately after it was projected?

	ACCELERATION	TOTAL MECHANICAL ENERGY
A	Equal to	Equal to
B	Greater than	Smaller than
C	Equal to	Greater than
D	Smaller than	Equal to

(2)

1.4 A car travels at CONSTANT VELOCITY along a horizontal road. A constant frictional force acts on the car during its motion.

Which ONE of the following statements about the power dissipated by the engine of the car during the motion is CORRECT?

The power …

A is zero.

B increases.

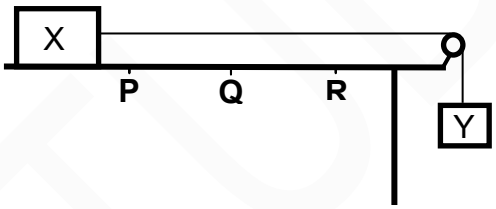
C decreases.

D remains constant. (2)

1.5 Block X is placed on a horizontal table and is connected to block Y by a light inextensible string passing over a frictionless pulley, as shown below.

A constant frictional force acts on block X while it moves to the right.

P, **Q** and **R** are points on the table such that the distance from **P** to **Q** is equal to that from **Q** to **R**.



When block X reaches point **Q**, the string is cut and block X continues to move towards point **R**. Ignore the effect of air friction.

Consider the following statements:

(i) The work done by the frictional force acting on block X is greater when the block moves from point **P** to point **Q** than when the block moves from point **Q** to point **R**.

(ii) Both the momentum and kinetic energy of block X decrease when the block moves from point **Q** to point **R**.

(iii) The total mechanical energy of block X remains constant when the block moves from point **Q** to point **R**.

Which of the statements above is/are CORRECT as block X moves from point **Q** to point **R**?

A (i) only

B (ii) only

C (i) and (ii) only

D (ii) and (iii) only (2)

1.6 Light emitted from a distant star contains a spectral line X of frequency *f*. The spectral lines of this star when observed on Earth are red shifted.

Which ONE of the following combinations of the OBSERVED FREQUENCY of spectral line X and the MOTION OF THE STAR is CORRECT?

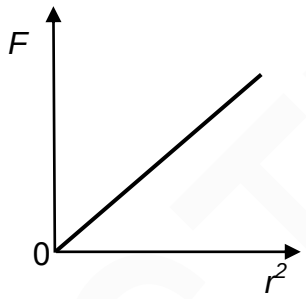
	OBSERVED FREQUENCY	**MOTION OF THE STAR**
A	Greater than *f*	Away from Earth
B	Greater than *f*	Towards Earth
C	Smaller than *f*	Away from Earth
D	Smaller than *f*	Towards Earth

(2)

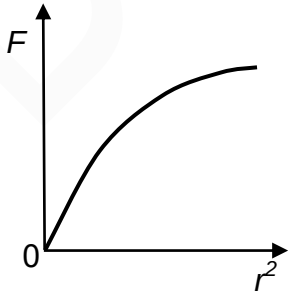
1.7 A proton and an electron are a distance *r* apart. The magnitude of the electrostatic force that they exert on each other is *F*.

Which ONE of the following graphs shows the relationship between *F* and r^2 as the proton and the electron approach each other?

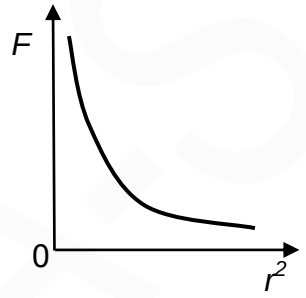
A



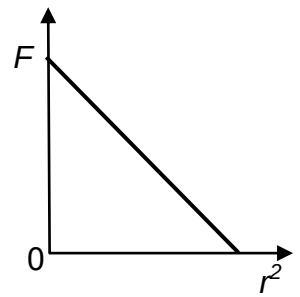
B



C

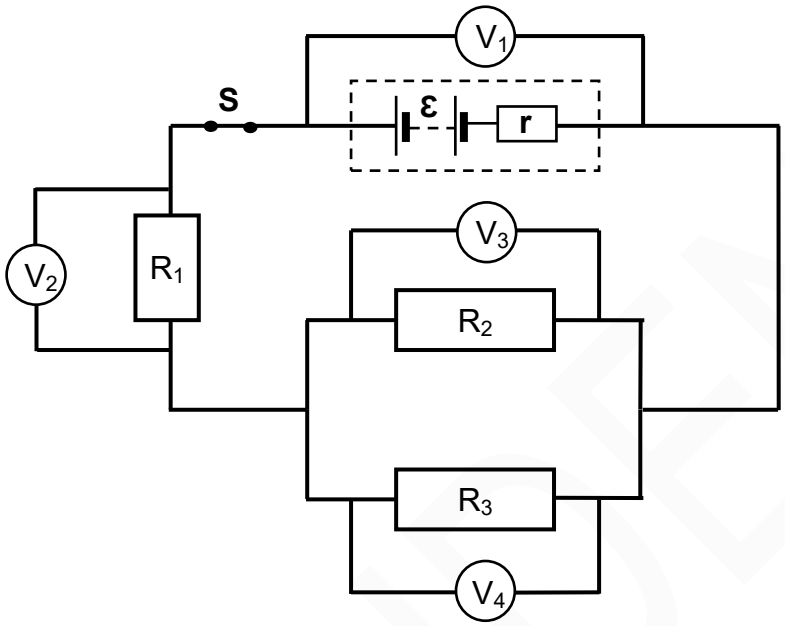


D



(2)

1.8 The emf of a battery is **ε** and its internal resistance is **r**. The battery is connected to three resistors and four voltmeters, as shown below. The resistance of the conducting wires is negligible, while the voltmeters have very high resistances.



Which ONE of the following equations represents the reading on voltmeter V_1 in terms of the readings on the other voltmeters?

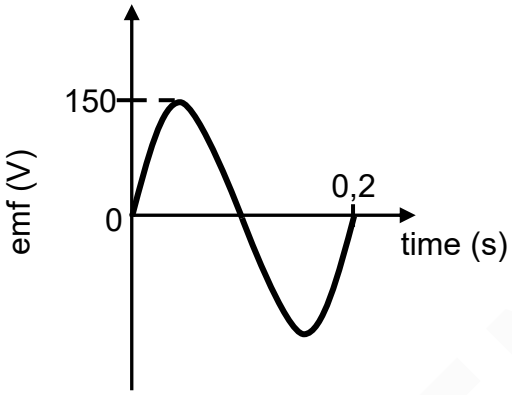
A $V_1 = V_2 + V_3$

B $V_1 = V_2 + -V_3$

C $V_1 = V_2 + V_3 + V_4$

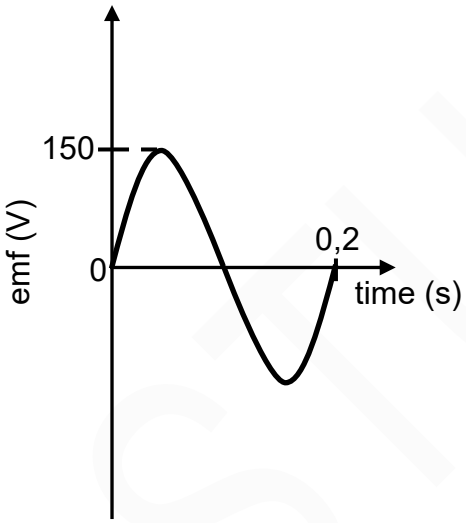
D $V_1 = V_2 + 2V_3$ (2)

1.9 An AC generator consists of a coil which is rotated in a magnetic field. The emf time graph for one complete rotation of the coil is shown below.

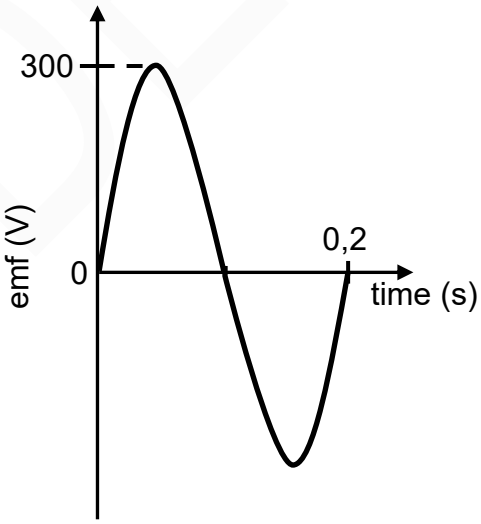


If the speed of rotation of the coil is now DOUBLED, which ONE of the following graphs is CORRECT for one complete rotation of the coil?

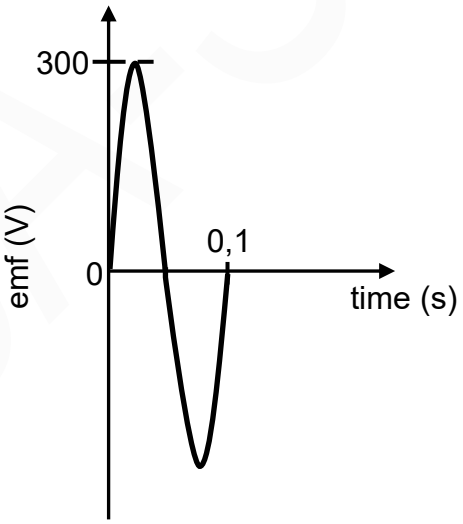
A



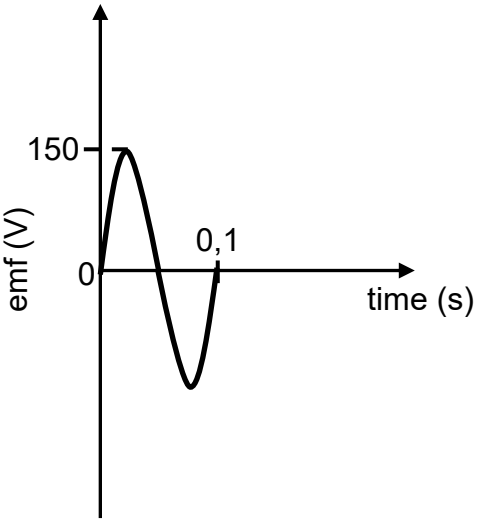
B



C

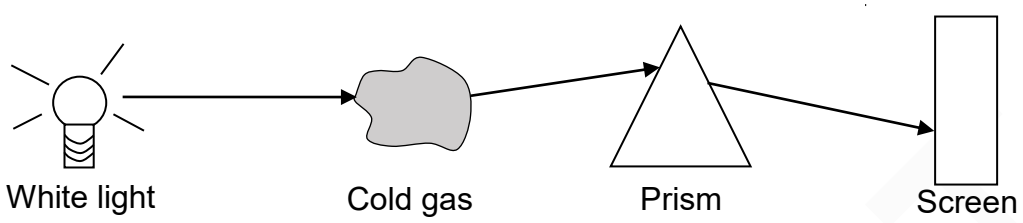


D



(2)

1.10 White light is passed through a cold gas and then through a prism, as shown below. A line spectrum is observed on the screen.



Which ONE of the following correctly describes the ENERGY TRANSITION of the atoms of the gas and the TYPE OF LINE SPECTRUM observed on the screen?

	ENERGY TRANSITION	TYPE OF LINE SPECTRUM
A	Higher to lower energy level	Emission
B	Lower to higher energy level	Emission
C	Higher to lower energy level	Absorption
D	Lower to higher energy level	Absorption

(2)
[20]

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1.1 A bucket is at rest on a table.

Which ONE of the following is the reaction force to the weight of the bucket, as described by Newton's Third Law?

A Force of the table on Earth

B Force of the bucket on Earth

C Force of the bucket on the table

D Force of the table on the bucket (2)

1.2 A ball is dropped from a small height above the ground.

Ignore air resistance.

The following pairs show physical quantities associated with the ball while it is falling to the ground.

In which ONE of these pairs will BOTH quantities change while the ball is falling?

A Mechanical energy and weight

B Kinetic energy and momentum

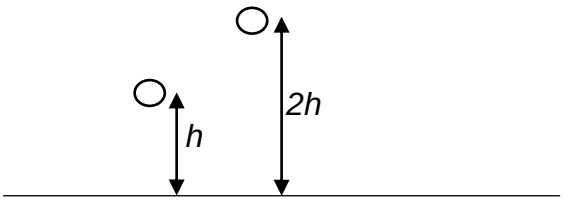
C Gravitational acceleration and kinetic energy

D Gravitational potential energy and gravitational force (2)

1.3 A ball is dropped from height *h* and strikes the floor with momentum **p**.

Ignore air resistance.

The ball is NOW dropped from height *2h*.



Which ONE of the following represents the momentum with which the ball NOW strikes the floor?

A **p**

B $\sqrt{2}\,\mathbf{p}$

C $2\sqrt{\mathbf{p}}$

D 2**p** (2)

1.4 Object X exerts a gravitational force **F** on object Y when the distance between the centres of the objects is **r**.

The distance **r** is now DOUBLED.

Which ONE of the following represents the gravitational force that X now exerts on Y?

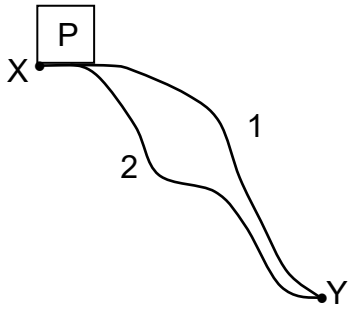
A $\frac{1}{4}\mathbf{F}$

B $\frac{1}{2}\mathbf{F}$

C 2**F**

D 4**F** (2)

1.5 A force **F** moves an object P from point X to point Y along two different paths, 1 and 2, as shown below.



The work done by **F** in moving the object is the same for both paths. Which ONE of the following can be used to describe force **F**?

A Normal force

B Tension force

C Frictional force

D Gravitational force (2)

1.6 Which ONE of the following can be explained by the Doppler effect?

A A stethoscope is used to listen to a person's heartbeat.

B An echo is heard when sound waves are reflected off a cliff.

C The spectrum of light from an approaching star is shifted towards shorter wavelengths.

D Sound intensity decreases when the sound source moves away from a stationary listener. (2)

1.7 Two oppositely charged point charges move towards each other.

Which ONE of the following is CORRECT?

The point charges move at …

A constant velocity.

B decreasing velocity.

C constant acceleration.

D increasing acceleration. (2)

1.8 Which ONE of the following phrases describes the emf of a battery?

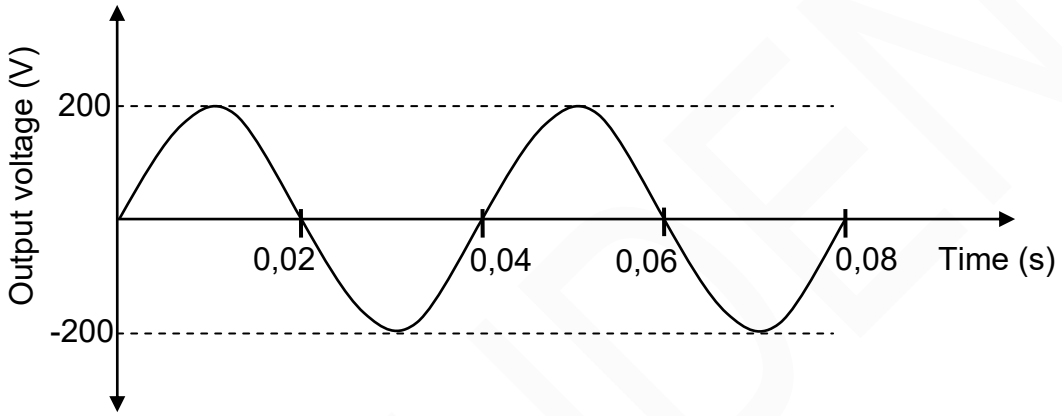
A Energy supplied per unit time

B Charge transferred per unit time

C Current supplied per unit charge

D Maximum energy supplied per unit charge (2)

1.9 The graph below represents the output voltage versus time for an AC generator.



The speed of rotation of the generator's coil is now DOUBLED.

Which ONE of the combinations below shows the CORRECT new peak output voltage and the time for ONE rotation?

	PEAK OUTPUT VOLTAGE (V)	TIME FOR ONE ROTATION (S)
A	400	0,02
B	200	0,02
C	200	0,04
D	100	0,04

(2)

1.10 A photon of light of energy $2X$ joules is shone onto a metal surface with work function X joules.

Which ONE of the following represents the maximum kinetic energy (in joules) of the electron ejected from the metal by this photon?

A Zero

B $\frac{1}{2}X$

C X

D $2X$ (2)

[20]

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1.1 Consider the statement below.

The perpendicular force exerted by a surface on an object in contact with the surface.

Which ONE of the following forces is defined by the statement above?

A Normal force

B Resultant force

C Frictional force

D Gravitational force (2)

1.2 Two balls of masses m and 2m are dropped simultaneously from the same height above the ground. Ignore air resistance.

When the balls strike the ground, which ONE of the following physical quantities will be the same for both balls?

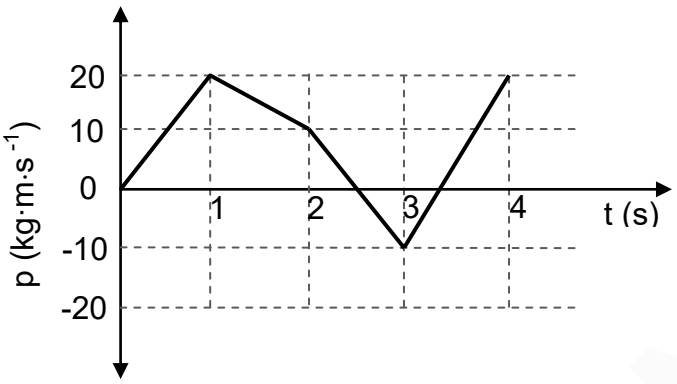
A Weight

B Velocity

C Momentum

D Kinetic energy (2)

1.3 The graph below shows how the momentum (p) of an object changes with time (t).



During which ONE of the following time intervals, measured in seconds, is the magnitude of the net force acting on the object the greatest?

A 0 to 1

B 1 to 2

C 2 to 3

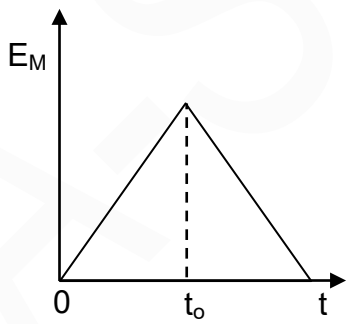
D 3 to 4 (2)

1.4 A ball is dropped from a height above a floor. The ball makes an elastic collision with the floor at time t_o and bounces vertically upwards.

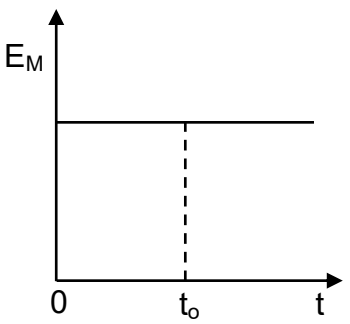
Ignore air resistance.

Which ONE of the following graphs shows how the total mechanical energy (E_M) of the ball changes with time?

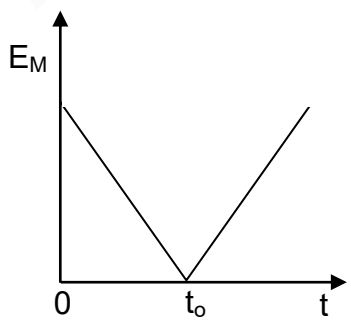
A



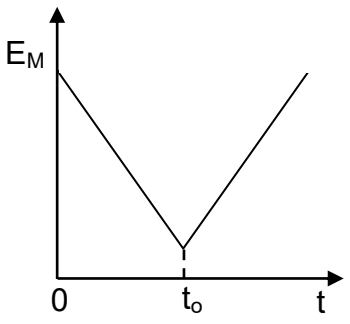
B



C



D



(2)

1.5 Consider the two spectrum diagrams below.

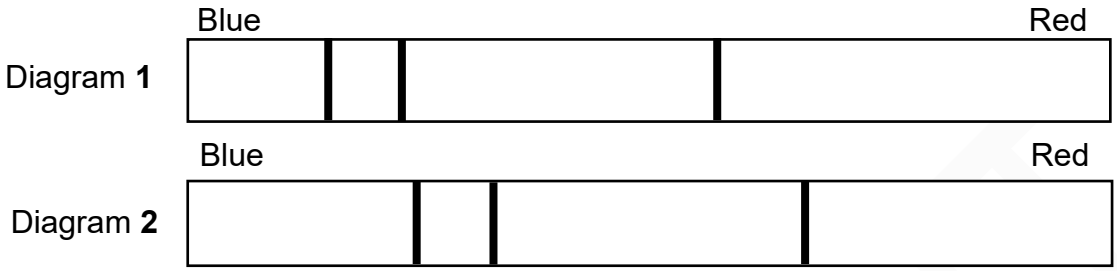


Diagram **1** represents the spectrum of an element in a laboratory on Earth.

Diagram **2** represents the spectrum of the same element from a distant star as observed from Earth.

Which ONE of the following can be deduced from the spectra above?

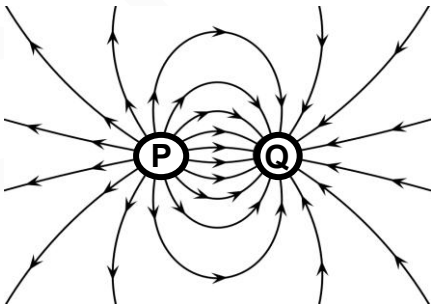
A The star is moving towards Earth.

B The star is at rest relative to Earth.

C The star is moving away from Earth.

D Both the star and Earth are moving towards each other. (2)

1.6 The diagram below shows the field lines for the combined electric field due to two small charged spheres **P** and **Q**.



Which ONE of the combinations below correctly shows the polarity of spheres **P** and **Q**?

	SPHERE P	**SPHERE Q**
A	Negative	Positive
B	Negative	Negative
C	Positive	Positive
D	Positive	Negative

(2)

1.7 Two identical spheres, **P** and **Q**, carry charges of +q and –2q respectively. Sphere **P** exerts an electrostatic force of magnitude F on sphere **Q**.

Which ONE of the following represents the magnitude of the electrostatic force exerted on sphere **P** by sphere **Q**?

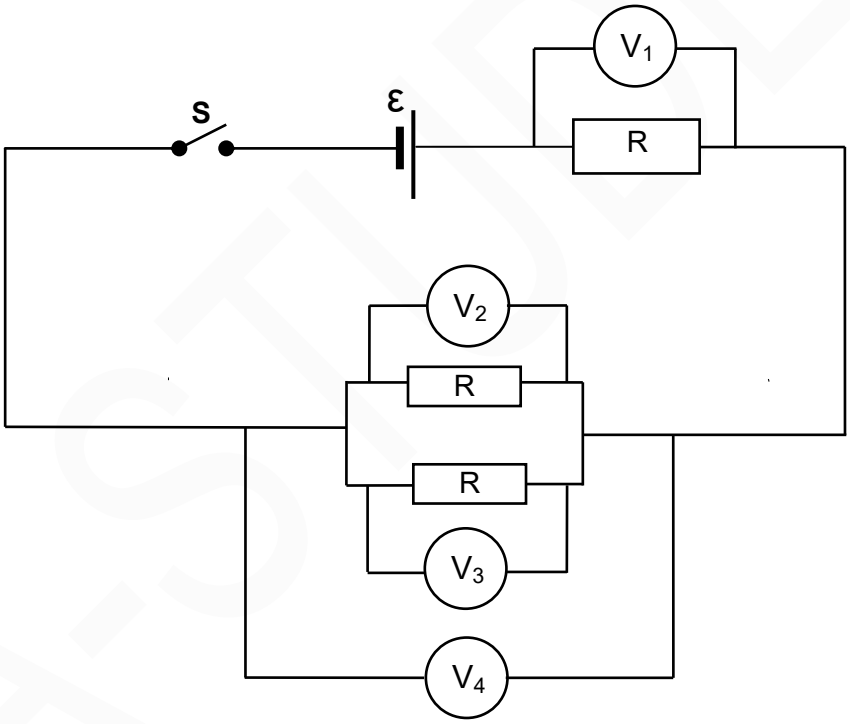
A $\frac{1}{2}F$

B F

C 2F

D 4F (2)

1.8 In the circuit diagram shown below all the resistors are IDENTICAL. Ignore the internal resistance of the cell.



Which voltmeter will have the HIGHEST reading when switch **S** is closed?

A V_1

B V_2

C V_3

D V_4 (2)

1.9 In which ONE of the following electrical machines is electrical energy converted to mechanical energy?

A AC generator

B DC generator

C AC dynamo

D DC motor (2)

1.10 Which ONE of the following combinations correctly links an emission spectrum and an absorption spectrum to the energy transitions of an electron in an atom?

	EMISSION SPECTRUM	ABSORPTION SPECTRUM
A	From low to high energy levels	From high to low energy levels
B	From low to high energy levels	From low to high energy levels
C	From high to low energy levels	From high to low energy levels
D	From high to low energy levels	From low to high energy levels

(2)
[20]

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Various options are provided as possible answers to the following questions. Choose the answer and write only the letter (A–D) next to the question numbers (1.1 to 1.10) in the ANSWER BOOK, e.g. 1.11 E.

1.1 A constant net force acts on an object moving in a straight line. Which ONE of the following quantities associated with the object will remain constant during the motion?

A Velocity

B Momentum

C Acceleration

D Kinetic energy (2)

1.2 The weight of an object on the surface of the Earth is **w**. What will be the weight of the object on the surface of another planet of the SAME mass as that of the Earth, but TWICE the radius of the Earth?

A $\frac{1}{4}\mathbf{w}$

B $\frac{1}{2}\mathbf{w}$

C $2\mathbf{w}$

D $4\mathbf{w}$ (2)

1.3 The diagram below shows a cricket player moving his hands downwards from position **1** to **2** to **3** while catching a ball.

Which ONE of the following statements CORRECTLY explains why the cricket player moves his hands downwards?

A The impulse on the ball is decreased.

B The change in momentum of the ball is increased.

C The change in momentum of the ball is decreased.

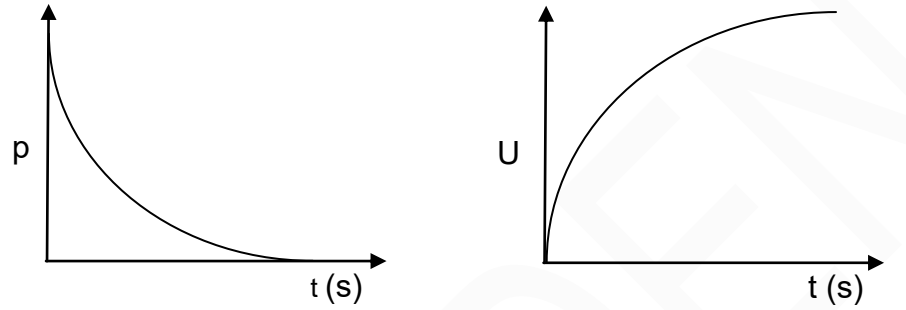
D The time it takes to change the momentum of the ball is increased. (2)

1.4 Consider the motion of a small stone thrown vertically upwards until it reaches its maximum height.

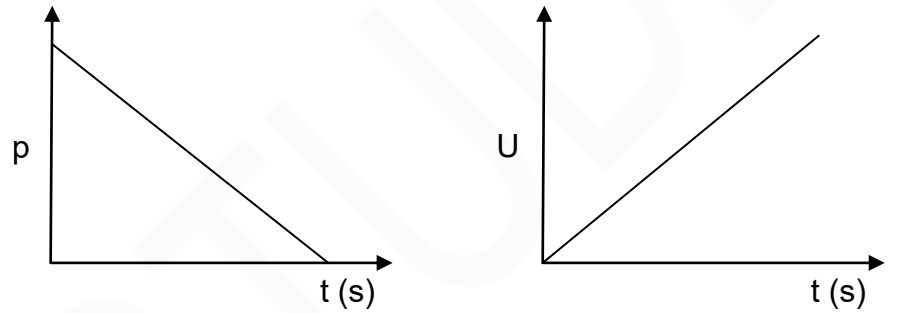
Ignore the effects of friction.

Which ONE of the following combinations of graphs CORRECTLY shows how the momentum **p** and the gravitational potential energy **U** of the stone change with time?

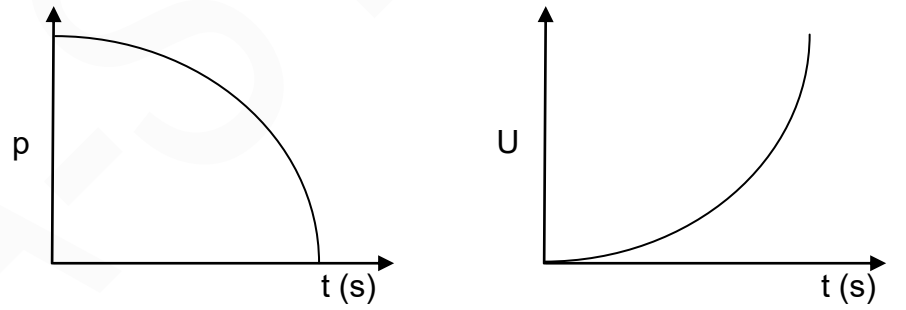
A



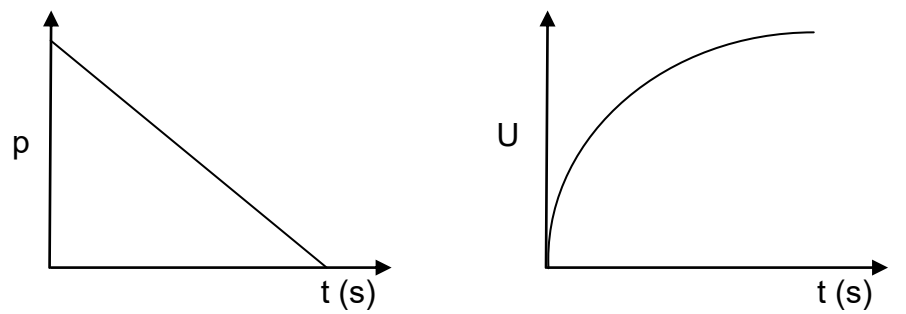
B



C



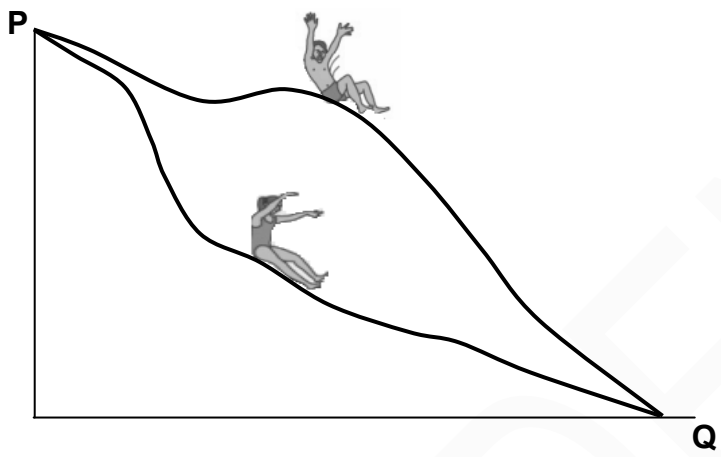
D



(2)

1.5 A boy and a girl, having DIFFERENT masses, are initially at rest at point **P**. They slide down different paths of a water slide, as shown in the diagram below.

Ignore the effects of friction.



Consider the statements below regarding the boy and the girl:

I Only conservative forces act on both the boy and the girl while they are sliding downwards.

II The boy and the girl each have the same gravitational potential energy at point **P**.

III On reaching point **Q**, the speed of the girl is equal to that of the boy.

Which of the above statements is/are CORRECT?

A I only

B I and III only

C II and III only

D I, II and III (2)

1.6 An astronomer observes that the light spectrum of a star has been blue shifted.

How have the observed frequency of light from the star and the distance between the star and Earth changed?

	OBSERVED FREQUENCY OF LIGHT	DISTANCE BETWEEN THE STAR AND EARTH
A	Increased	Increased
B	Increased	Decreased
C	Decreased	Increased
D	Decreased	Decreased

(2)

1.7 A small negative point charge (q) is situated halfway between two identical spheres, **P** and **Q**, carrying IDENTICAL charges, as shown below.

Sphere **P** exerts an electrostatic force of magnitude **F** on sphere **Q**. What is the magnitude of the net electrostatic force experienced by the point charge?

A Zero

B $\frac{1}{2}F$

C F

D 2 F

(2)

1.8 Consider the statements below regarding AC power and DC power:

I AC voltage can be changed during AC power transmission.

II DC power transmission requires transformers.

III AC power transmission is more energy efficient.

Which of the above statement(s) is/are CORRECT?

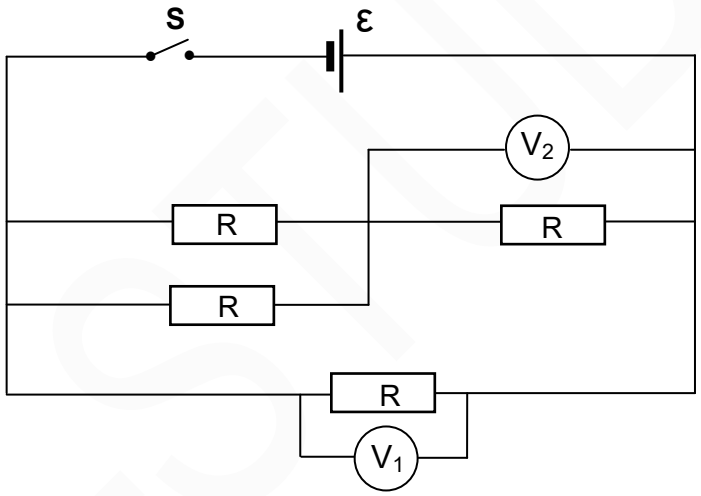
A I only

B II only

C I and III only

D II and III only (2)

1.9 In the circuit diagram below, all resistors are IDENTICAL. Ignore the internal resistance of the cell and the resistance of the connecting wires.



When switch **S** is CLOSED, the reading on voltmeter V_1 is 3 V.

What will be the reading on voltmeter V_2?

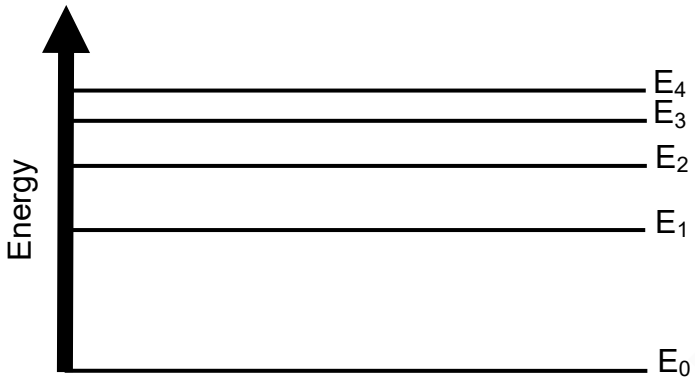
A 1 V

B 1,5 V

C 2 V

D 3 V (2)

1.10 Some of the energy levels of an atom are represented in the diagram below.



E_0 represents the ground state energy.

Which ONE of the energy transitions below represents the absorption of light of the lowest frequency by the atom?

A E_0 to E_4

B E_1 to E_3

C E_3 to E_4

D E_0 to E_3 (2)

[20]

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Various options are provided as possible answers to the following questions. Choose the answer and write only the letter (A–D) next to the question numbers (1.1 to 1.10) in the ANSWER BOOK, e.g. 1.11 E.

1.1 The rate of change of momentum of an object is equal to the …

A impulse on the object.

B net force acting on the object.

C product of the object's mass and its change in velocity.

D product of the net force acting on the object and its acceleration. (2)

1.2 The gravitational acceleration on the surface of planet **X** with mass M and radius r is g.

The gravitational acceleration on the surface of planet **Y** with mass 2M and radius $\frac{1}{2}r$ is …

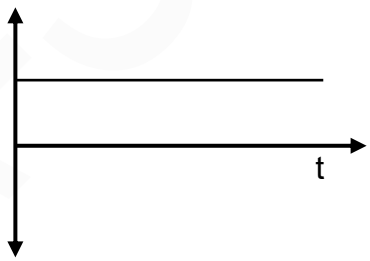
A $\frac{1}{2}g$

B g

C $4g$

D $8g$ (2)

1.3 The graph below shows how one of the physical quantities associated with an object in free fall changes with time t. The label on the y-axis is omitted. Ignore air friction.



Which ONE of the following physical quantities can be the label on the y-axis?

A Velocity

B Position

C Weight

D Momentum (2)

1.4 A ball of mass *m*, falling vertically downwards, hits the floor at a speed *v* and bounces vertically upwards at a speed 0,75*v*.

Which ONE of the following combinations regarding the change in momentum of the ball during the collision is CORRECT?

	MAGNITUDE	DIRECTION
A	0,25*mv*	Upwards
B	0,25*mv*	Downwards
C	1,75*mv*	Upwards
D	1,75*mv*	Downwards

(2)

1.5 The base SI unit of the physical quantity 'work' is …

A $kg \cdot m \cdot s^{-1}$

B $kg \cdot m^2 \cdot s^2$

C $kg \cdot m^2 \cdot s^{-2}$

D $kg \cdot m \cdot s^{-2}$ (2)

1.6 The siren of a police car, moving in front of a truck, emits sound waves of frequency *f*. Both vehicles are travelling at the same constant velocity.

The frequency of the sound heard by the driver of the truck is …

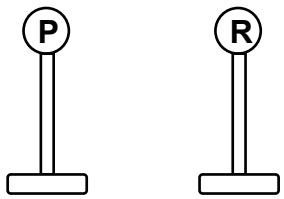
A *f*.

B zero.

C greater than *f*.

D smaller than *f.* (2)

1.7 Two identical metal spheres, **P** and **R**, on insulated stands, carry different charges. The spheres are brought into contact and then separated again.



If the charge on sphere **R** AFTER the separation is *q*, the charge on sphere **P** after the separation is …

A *q.*

B zero.

C less than *q.*

D greater than *q.* (2)

1.8 An AC generator generates a current with a frequency of 50 Hz.

The number of times that the maximum (peak) current is produced in one second is …

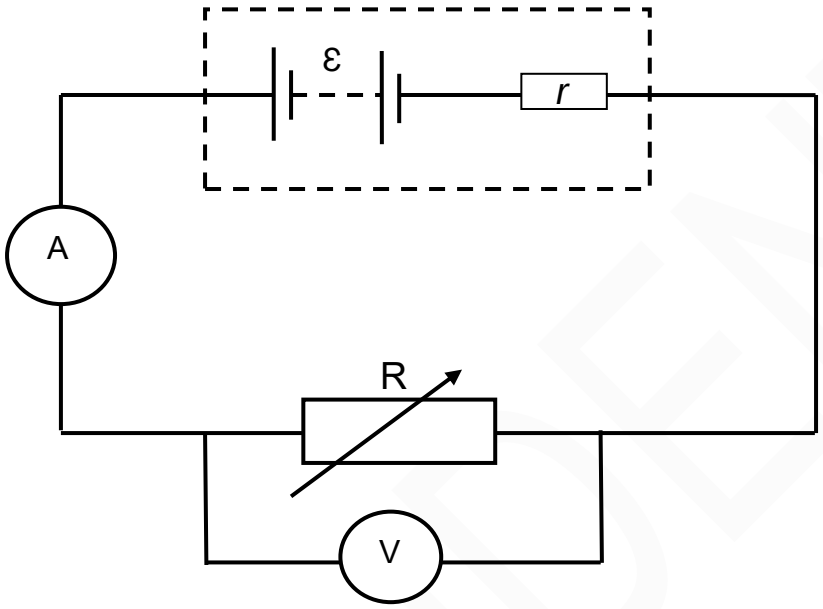
A 25.

B 50.

C 75.

D 100. (2)

1.9 In the circuit below, the battery has an internal resistance *r* and an emf ε. A variable resistor R is connected in the circuit and the ammeter and voltmeter register readings.



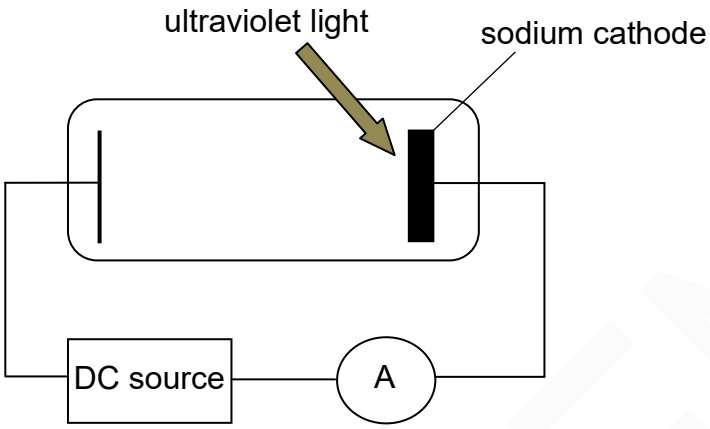
The resistance of the variable resistor R is INCREASED now.

Which ONE of the following combinations is the CORRECT representation of the change in the readings on the ammeter and voltmeter as the resistance of R is increased?

	AMMETER READING	VOLTMETER READING
A	Decreases	Increases
B	Increases	Increases
C	Increases	Decreases
D	Decreases	Decreases

(2)

1.10 The sodium cathode of a photocell is irradiated with ultraviolet light as shown in the diagram below. The ammeter registers a current.



Which ONE of the following changes will INCREASE the ammeter reading?

A Use a thinner sodium cathode.

B Increase the intensity of the ultraviolet light.

C Increase the frequency of the ultraviolet light.

D Replace the sodium cathode with a cathode of lower work function. (2)

[20]

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Various options are provided as possible answers to the following questions. Choose the answer and write only the letter (A–D) next to the question numbers (1.1 to 1.10) in the ANSWER BOOK, e.g. 1.11 E. Each question has only ONE correct answer.

1.1 Which physical quantity is equal to the rate of change of momentum?

A Mass

B Impulse

C Net force

D Acceleration (2)

1.2 The gravitational acceleration on the surface of a planet of radius R is g.

The gravitational acceleration at a height of $2R$ above the surface of the same planet is …

A $\frac{g}{9}$

B $\frac{g}{4}$

C $4g$

D $9g$ (2)

1.3 A ball falls from the edge of a table. Ignore the effects of air friction.

Which ONE of the physical quantities associated with the ball during the fall remains constant?

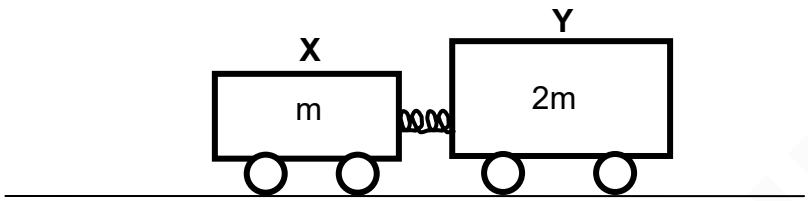
A Weight

B Momentum

C Kinetic energy

D Gravitational potential energy (2)

1.4 Two trolleys, **X** and **Y**, of masses m and 2m respectively, are held together by a compressed spring between them. Initially they are stationary on a horizontal floor, as shown below. Ignore the effects of friction.



The spring is now released and falls to the floor while the trolleys move apart.

The magnitude of the MOMENTUM of trolley **X** while it moves away is …

A zero.

B half the magnitude of the momentum of trolley **Y**.

C twice the magnitude of the momentum of trolley **Y**.

D the same as the magnitude of the momentum of trolley **Y**. (2)

1.5 An object is dropped from rest and after falling a distance x, its momentum is p. Ignore the effects of air friction.

The momentum of the object, after it has fallen a distance $2x$, is …

A p

B $\sqrt{2}p$

C $\frac{p}{2}$

D $2p$ (2)

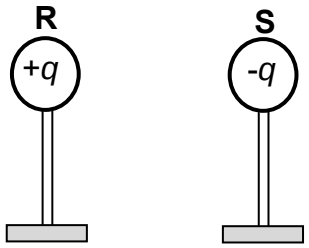
1.6 A police car, with its siren on, is travelling at a constant speed TOWARDS a stationary sound detector. The siren emits sound waves of frequency f and speed v.

Which ONE of the following combinations best describes the frequency and speed of the detected sound waves?

	FREQUENCY	**SPEED**
A	Less than f	v
B	Less than f	Less than v
C	Greater than f	Less than v
D	Greater than f	v

(2)

1.7 Two identical spheres, **R** and **S**, on insulated stands, carrying charges of $+q$ and $-q$ respectively, are placed a distance apart. Sphere **R** exerts an electrostatic force of magnitude F on sphere **S**.



The two spheres are now brought into contact and returned to their original positions.

The magnitude of the electrostatic force that sphere **R** exerts on sphere **S** is now …

A zero

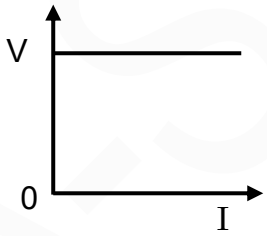
B $\frac{F}{2}$

C F

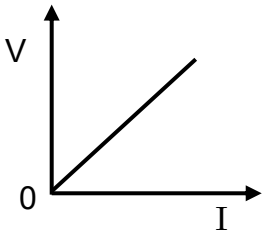
D $2F$ (2)

1.8 Which ONE of the graphs below best represents the relationship between potential difference (V) and current (I) for an ohmic conductor?

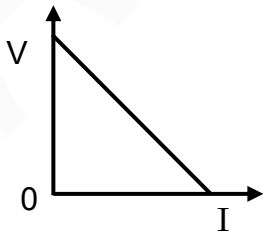
A



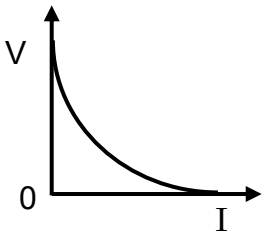
B



C



D



(2)

1.9 Which ONE of the following combinations regarding the energy conversions in electric motors and electric generators is CORRECT?

	ENERGY CONVERSION IN MOTORS	ENERGY CONVERSION IN GENERATORS
A	Mechanical to electrical	Electrical to mechanical
B	Mechanical to electrical	Mechanical to electrical
C	Electrical to mechanical	Electrical to mechanical
D	Electrical to mechanical	Mechanical to electrical

(2)

1.10 Consider the statements below regarding the photoelectric effect.

The photoelectric effect proves that …

(i) light energy is quantised.

(ii) light has a particle nature.

(iii) light has a wave nature.

Which of the statements above is/are CORRECT?

A (i) only

B (ii) only

C (i) and (ii) only

D (i) and (iii) only (2)

[20]

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Various options are provided as possible answers to the following questions. Choose the answer and write only the letter (A–D) next to the question numbers (1.1 to 1.10) in the ANSWER BOOK, e.g. 1.11 D.

1.1 A car is moving at a **constant velocity**.

Which ONE of the following statements about the forces acting on the car is CORRECT?

A The net force acting on the car is zero.

B There are no forces acting on the car.

C The weight of the car is equal to the normal force acting on the car.

D There is a non-zero net force acting on the car. (2)

1.2 A ball is projected vertically upwards. Ignore air resistance.

Which ONE of the following statements about the acceleration of the ball at its maximum height is CORRECT?

The acceleration is equal to …

A zero.

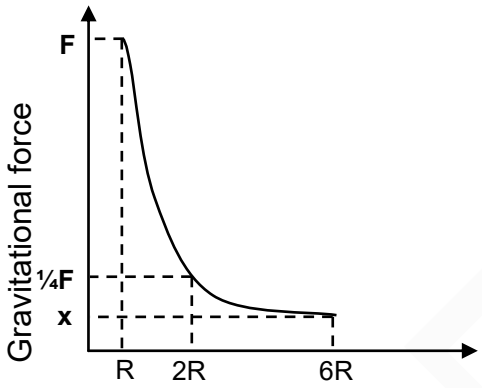
B *g* and is directed downwards.

C *g* and is directed upwards.

D *g* and is directed horizontally. (2)

1.3 The graph below, not drawn to scale, shows the relationship between the gravitational force on a given mass and its distance from the centre of Earth.

The magnitude of the force on the mass at a distance R from the centre of Earth is **F**.



Which ONE of the following is the CORRECT representation of the magnitude of force **x** shown on the graph?

A $6\mathbf{F}$

B $12\mathbf{F}$

C $\frac{1}{6}\mathbf{F}$

D $\frac{1}{36}\mathbf{F}$ (2)

1.4 Ball M, moving at speed ***v*** to the right, collides with a stationary ball N on a smooth horizontal surface. Immediately after the collision, ball M comes to rest and ball N moves to the right with speed ***v***.

Which ONE of the following statements about the collision of the balls is CORRECT?

A Total momentum is conserved and the masses of the balls are unequal.

B Total kinetic energy is conserved and the masses of the balls are unequal

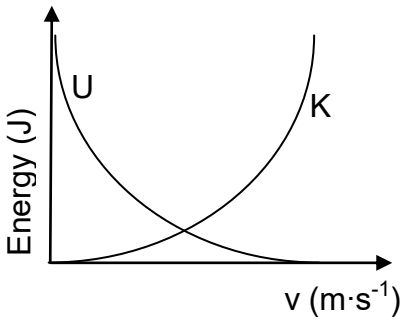
C Total momentum and total kinetic energy are conserved and the masses of the balls are equal.

D Total momentum is conserved but total kinetic energy is not conserved and the masses of the balls are equal. (2)

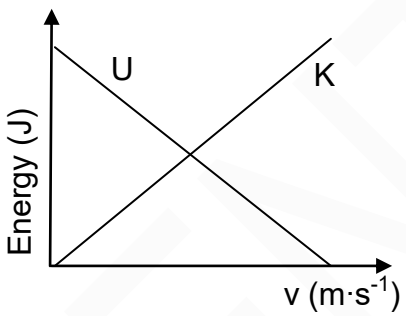
1.5 A small stone is dropped from rest and undergoes free fall.

Which ONE of the graphs below shows the CORRECT relationship between the gravitational potential energy (U) and speed *v* and the kinetic energy (K) and speed *v*, respectively, for the stone? The graphs are NOT drawn to scale.

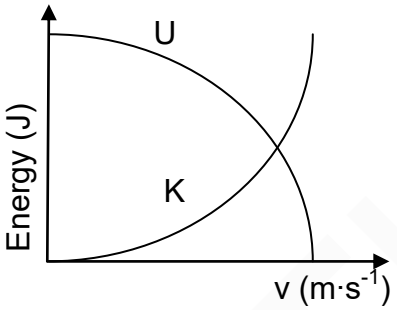
A



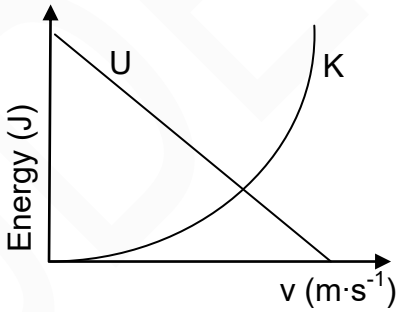
B



C



D



(2)

1.6 A stationary passenger at a railway station listens to a train approaching at constant speed.

Which ONE of the following is CORRECT for the sound of the approaching train heard by the stationary passenger?

A Lower pitch, lower frequency

B Higher pitch, lower frequency

C Higher pitch, higher frequency

D Lower pitch, higher frequency (2)

1.7 Particle P has charge Q and particle R has charge 2Q. They are separated by a small distance, *r*.

Which ONE of the statements below about the electrostatic forces, F_{PR}, which P exerts on R and F_{RP}, which R exert on P, is CORRECT?

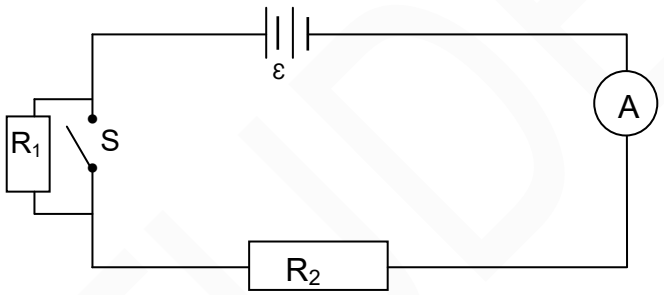
A $F_{PR} = ½F_{RP}$

B $F_{PR} = F_{RP}$

C $F_{PR} = 2F_{RP}$

D $F_{PR} = -F_{RP}$ (2)

1.8 A battery of emf ε and negligible internal resistance is connected in a circuit, as shown below. The resistances of R_1 and R_2 are high.



Which ONE of the following combinations about the ammeter readings will be CORRECT when switch S is open and when switch S is closed?

	SWITCH OPEN	SWITCH CLOSED
A	Ammeter reads only the current in R_1	Ammeter reads only the current in R_2
B	Ammeter reads only the current in R_2	Ammeter reads the current in both R_1 and R_2
C	Ammeter reads the current in both R_1 and R_2	Ammeter reads the current in both R_1 and R_2
D	Ammeter reads the current in both R_1 and R_2	Ammeter reads the current in R_2 only

(2)

1.9 The direction of the induced current in the coil of a generator depends on the …

A length of the coil.

B speed of rotation of the coil.

C direction of the magnetic field.

D strength of the magnetic field. (2)

1.10 The work function of zinc is greater than that of magnesium.

Which ONE of the following statements about the threshold frequencies of the metals is CORRECT?

A The threshold frequency of zinc is greater than that of magnesium.

B The threshold frequency of zinc is smaller than that of magnesium.

C Both zinc and magnesium have the same threshold frequency.

D The threshold frequencies of zinc and magnesium are independent of their work functions. (2)

[20]

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Various options are provided as possible answers to the following questions. Choose the answer and write only the letter (A–D) next to the question numbers (1.1 to 1.10) in the ANSWER BOOK, e.g. 1.11 D.

1.1 Inertia is the tendency of an object to …

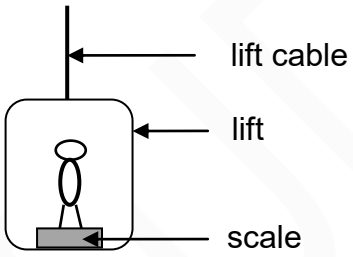
A maintain its mass.

B continue in a state of non-uniform motion.

C remain at rest or in the state of uniform motion.

D maintain its velocity when a non-zero net force is acting on it. (2)

1.2 A person stands on a bathroom scale that is fixed to the floor of a lift, as shown in the diagram below.



The reading on the scale is largest when the lift moves …

A upwards at a constant speed.

B downwards at a constant speed.

C upwards at a increasing speed.

D downwards at a increasing speed. (2)

1.3 An object is projected vertically upwards. Ignore air resistance.

As the object rises, its velocity …

A and acceleration are both directed upwards.

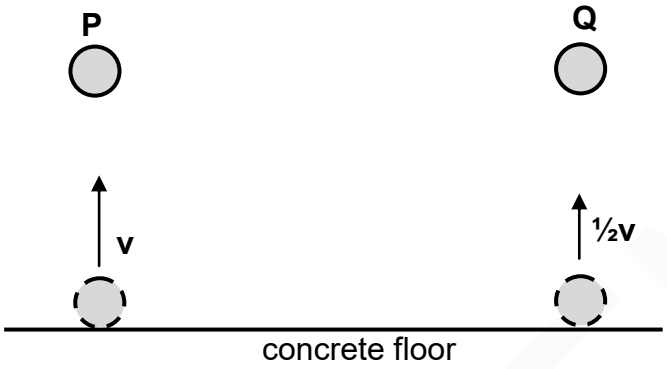
B and acceleration are both directed downwards.

C is directed upwards, but its acceleration is directed downwards.

D is directed downwards, but its acceleration is directed upwards. (2)

1.4 Ball **P** and ball **Q**, of the same mass, are dropped onto a concrete floor. Both balls hit the concrete floor at the same speed, **v**. Ball **P** rebounds with the same vertical speed, **v**, *but ball **Q** rebounds with speed ½**v***.

Refer to the diagram below. Ignore air resistance.



Which ONE of the following statements regarding the collision of EACH ball with the concrete floor is CORRECT?

A Kinetic energy is conserved for both balls **P** and **Q**.

B The change in momentum of ball **P** is greater than that of ball **Q**.

C The contact time with the floor is the same for both balls **P** and **Q**.

D Momentum is conserved for the collision of ball **P**, but not for that of ball **Q**. (2)

1.5 If the net work done on a moving object is POSITIVE, then we can conclude that the kinetic energy of the object …

A is zero.

B has increased.

C has decreased.

D has not changed. (2)

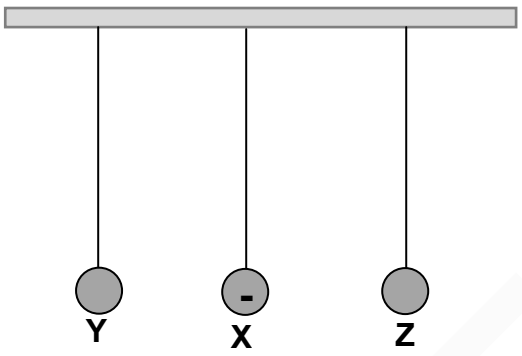
1.6 The spectrum produced by a moving asteroid, as observed from Earth, indicates that the light has shifted towards the blue end of the spectrum.

Which ONE of the following frequency combinations of the observed light and the distance between the asteroid and Earth is CORRECT?

	FREQUENCY OF OBSERVED LIGHT	**DISTANCE BETWEEN ASTEROID AND EARTH**
A	Increased	Decreases
B	Increased	Increases
C	Decreased	Decreases
D	Decreased	Increases

(2)

1.7 Three charged spheres **X**, **Y** and **Z**, supported by insulating threads of equal length, hang from a beam, as shown in the diagram below.
Sphere **X** is negatively charged.
Sphere **X** attracts sphere **Y**, but repels sphere **Z**.



Which ONE of the following conclusions is CORRECT?

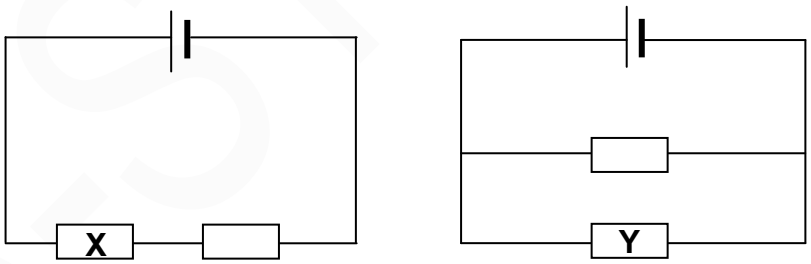
A Sphere **Y** is positively charged and sphere **Z** is negatively charged.

B Sphere **Y** is positively charged and sphere **Z** is positively charged.

C Sphere **Y** is negatively charged and sphere **Z** is negatively charged.

D Sphere **Y** is negatively charged and sphere **Z** is positively charged. (2)

1.8 In the circuit diagrams below, the cells and resistors are identical. The cells have negligible internal resistances.



The power dissipated in resistor **X** is **P**. The power dissipated in resistor **Y** is …

A ¼**P**.

B ½**P**.

C 2**P**.

D 4**P**. (2)

1.9 Which ONE of the following actions will NOT cause an **increase** in the induced emf in a coil if the coil is rotated in a uniform magnetic field?

A Rotating the coil faster

B Increasing the strength of the magnetic field

C Increasing the number of turns of the coil

D Replacing the coil with a coil of lower resistance (2)

1.10 A learner writes the following statements about the emission spectrum of light in a notebook:

(i) An emission spectrum is formed when certain frequencies of electromagnetic radiation pass through a cold gas.

(ii) The lines in the emission spectrum of an atom have the same frequency as the corresponding lines in the atom's absorption spectrum.

(iii) An emission spectrum is formed when the atom makes transitions from a high-energy state to a lower energy state.

Which ONE of the following combinations of the statements above is CORRECT?

A (i) only

B (ii) only

C (ii) and (iii) only

D (i) and (iii) only (2)

[20]

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Various options are provided as possible answers to the following questions. Choose the answer and write only the letter (A–D) next to the question number (1.1–1.10) in the ANSWER BOOK, for example 1.11 D.

1.1 A constant horizontal force **F** is applied to a box resting on a horizontal, frictionless surface.

Which ONE of the following statements regarding force **F** is CORRECT?

Force **F** will cause the box to move with …

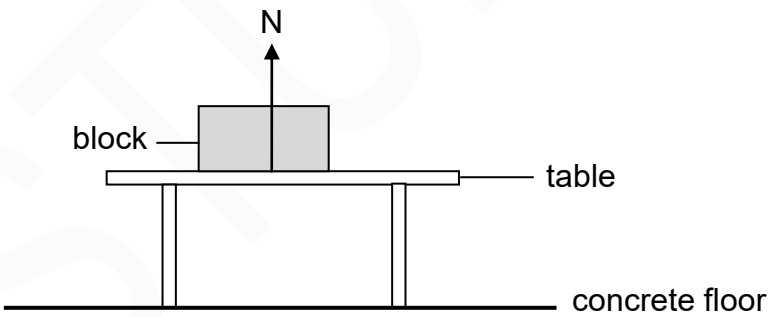
A constant acceleration.

B constant velocity.

C constant kinetic energy.

D constant momentum. (2)

1.2 A block rests on a table. The table stands on a concrete floor. The normal force is represented by N, as shown in the diagram below.



Which ONE of the following forces will form an action-reaction pair with the normal force (N)?

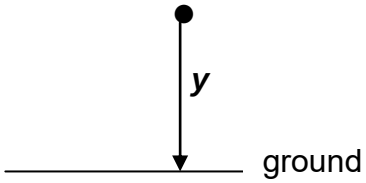
A Force of the block on the Earth

B Force of the block on the table

C Force of the table surface on the block

D Force of the block on the concrete floor (2)

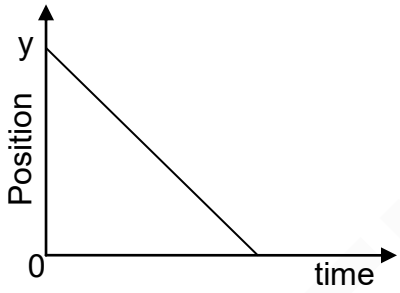
1.3 A small stone is dropped from a height ***y*** above the ground. It strikes the ground after time t, as shown in the diagram below.



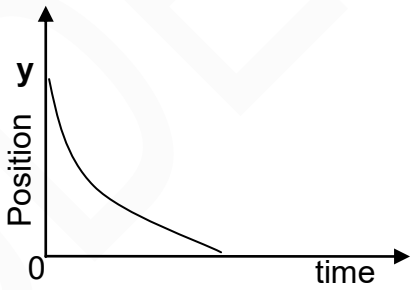
Take upwards as the positive direction and the ground as zero reference. Ignore the effects of air resistance.

Which ONE of the following diagrams shows a correct position-time graph for the motion of the stone?

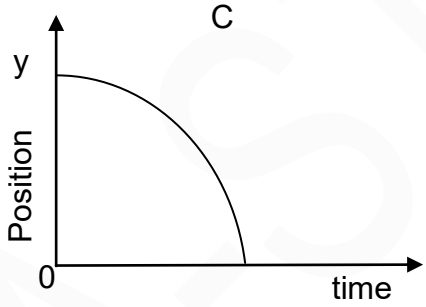
A



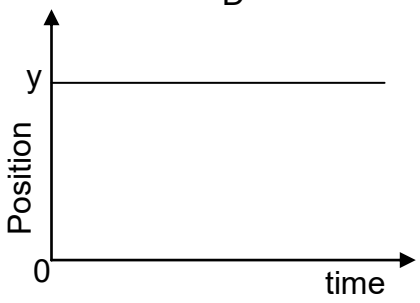
B



C

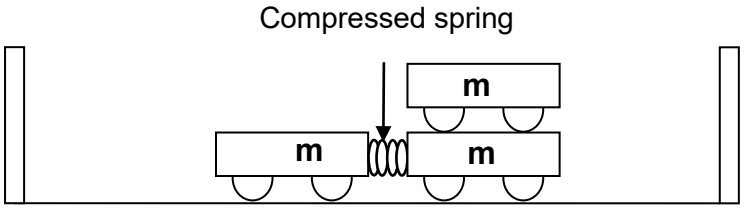


D



(2)

1.4 Learners perform an experiment using identical trolleys, each of mass **m**. The trolleys are arranged, as shown in the diagram below. They are initially at rest on a frictionless surface and are connected with a compressed, massless spring.



When the spring is released it falls vertically down and the single trolley moves with momentum **p** to the left.
The magnitude of the momentum of the two trolleys moving to the right will be:

A 2**p**

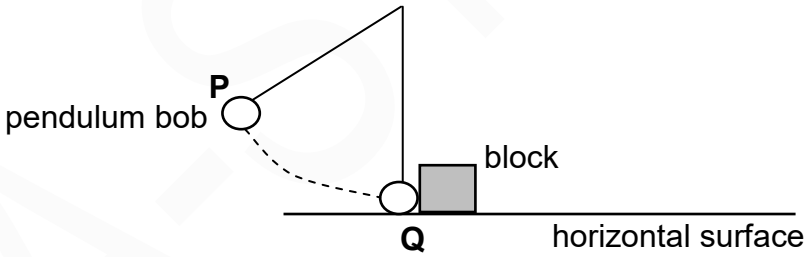
B **p**

C $\frac{1}{2}$**p**

D $\frac{1}{4}$**p**

(2)

1.5 A pendulum bob is released from point **P** above a horizontal surface. At the lowest point, **Q**, of its swing, it collides with a stationary block situated on a frictionless horizontal surface, as shown below. Ignore air friction.



Which ONE of the following combinations of **conservation laws** can be used to calculate the speed of the bob at **Q** immediately before and after colliding with the block?

	SPEED AT Q	SPEED AFTER COLLISION
A	Conservation of mechanical energy	Conservation of linear momentum
B	Conservation of linear momentum	Conservation of mechanical energy
C	Conservation of mechanical energy	Conservation of mechanical energy
D	Conservation of linear momentum	Conservation of linear momentum

(2)

1.6 Which ONE of the statements below about the Doppler effect is CORRECT?

A The Doppler effect is only applicable to sound waves.

B The Doppler effect can be used to explain the expanding universe.

C Electrons are ejected from a metal surface by means of the Doppler effect.

D A stationary listener hears a lower pitch of the sound from a siren of an approaching vehicle because of the Doppler effect. (2)

1.7 The magnitude of the electrostatic force on a charge $\mathbf{Q_1}$ due to another charge $\mathbf{Q_2}$ is **F**. Both charges are now doubled without changing the distance between them.

The magnitude of the new electrostatic force on $\mathbf{Q_1}$ will be:

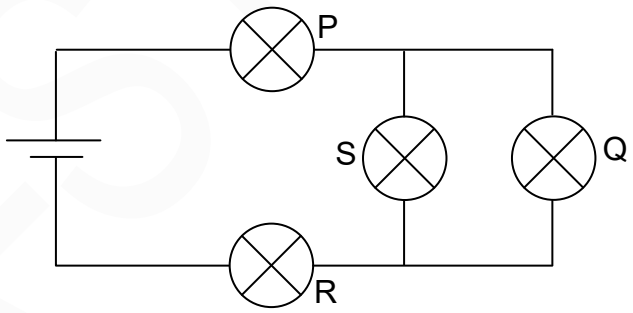
A $\frac{\mathbf{F}}{2}$

B 2**F**

C 4**F**

D 6**F** (2)

1.8 Four identical bulbs, **P**, **Q**, **R** and **S**, are connected to a cell in a circuit, as shown below. The cell has negligible internal resistance.



Which ONE of the following statements about the brightness of bulbs **P**, **Q**, **R** and **S** is CORRECT?

A **P** burns brighter than **R**.

B **S** and **Q** burn brighter than **P** and **R**.

C **P** and **R** burn brighter than **S** and **Q**.

D ALL the bulbs burn with the same brightness. (2)

1.9 Which ONE of the energy conversions below takes place when a **DC** motor is in operation?

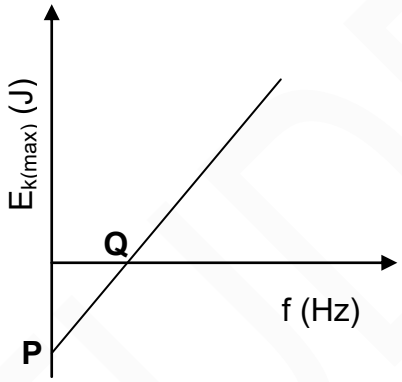
A Kinetic to electrical

B Heat to mechanical

C Mechanical to electrical

D Electrical to mechanical (2)

1.10 In an investigation on the photoelectric effect, the graph of maximum kinetic energy ($E_{k(max)}$) versus frequency (f) was obtained for a certain metal, as shown below.



The intercepts, **P** and **Q** respectively, represent …

A Planck's constant and threshold frequency.

B work function and threshold frequency.

C threshold frequency and work function.

D threshold frequency and Planck's constant. (2)
[20]

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Various options are provided as possible answers to the following questions. Choose the answer and write down only the letter (A–D) next to the question numbers (1.1 to 1.10) in the ANSWER BOOK, e.g. 1.11 D.

1.1 The net (resultant) force acting on an object is equal to the ... of the object in the direction of the net force.

A change in momentum

B change in kinetic energy

C rate of change of momentum

D rate of change of kinetic energy (2)

1.2 A physical quantity that is described as a measure of the resistance of a body to a change in motion is called …

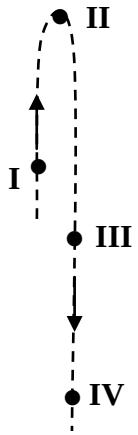
A inertia.

B force.

C acceleration.

D weight. (2)

1.3 The diagram below shows a section of the path of a stone projected vertically upwards.



At which ONE of the positions indicated on the diagram will the magnitude of the momentum of the stone be the GREATEST? Ignore air resistance.

A **I**

B **II**

C **III**

D **IV** (2)

1.4 Two cars, P and Q, moving in a straight line, have the same momentum. The kinetic energy of Q is greater than the kinetic energy of P.

Which ONE of the following statements regarding the cars is CORRECT?

A Q has a smaller mass than P.

B Q has the same mass as P.

C Q is moving slower than P.

D Q is moving at the same speed as P. (2)

1.5 The net work done on an object to increase its speed from rest to **v** is **W**. How much net work must be done on the same object to increase its speed from **v** to 2**v**?

A **W**

B 2**W**

C 3**W**

D 4**W** (2)

1.6 Which ONE of the following is NOT an application of the Doppler effect?

A A light meter

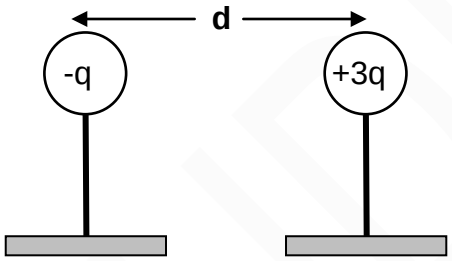
B A blood flow meter

C Detecting the heartbeat of a foetus using ultrasound

D Measuring the speed of an approaching car using radar (2)

1.7 Two small identical metal spheres, on insulated stands, carry charges -q and +3q respectively.

When the centres of the spheres are a distance **d** apart, the spheres exert an electrostatic force of magnitude ***F*** on each other.



The spheres are now made to touch and are brought back to the **same positions** as before.

The magnitude of the electrostatic force which the spheres now exert on each other, in terms of ***F***, is:

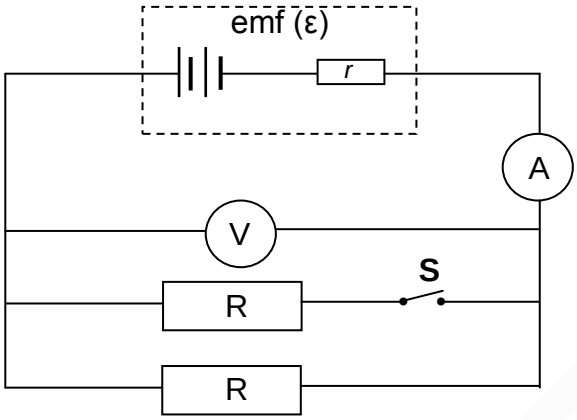
A $\frac{4}{3}F$

B $\frac{1}{3}F$

C $\frac{1}{2}F$

D $3F$ (2)

1.8 In the circuit below the battery has an emf (ε) and internal resistance *r*. With switch **S** open, readings are registered on the ammeter and voltmeter.



Switch **S** is now closed. How do the readings on the ammeter and voltmeter change?

	AMMETER READING	VOLTMETER READING
A	Increases	Remains the same
B	Increases	Decreases
C	Decreases	Remains the same
D	Decreases	Decreases

(2)

1.9 A learner lists the following as factors that affect the magnitude of the current induced in an AC generator:

(i) The number of turns (windings) of the coil
(ii) The strength of the magnetic field
(iii) The speed of rotation of the coil

Which ONE of the combinations below is CORRECT?

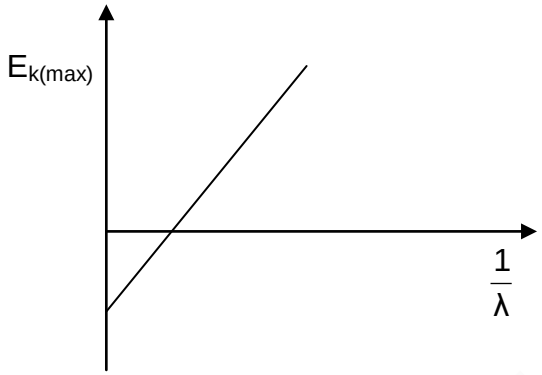
A (i) and (ii) only

B (i) and (iii) only

C (ii) and (iii) only

D (i), (ii) and (iii) (2)

1.10 The graph below is obtained from an experiment on the photoelectric effect.



Which ONE of the following represents the gradient of the graph?

A hc

B h

C $\frac{E_{k(max)}}{\lambda}$

D W_0

(2)
[20]

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Various options are provided as possible answers to the following questions. Choose the answer and write only the letter (A–D) next to the question number (1.1–1.10) in the ANSWER BOOK, for example 1.11 D.

1.1 The acceleration due to gravity on Earth is greater than that on the moon.

Which ONE of the following statements is CORRECT?

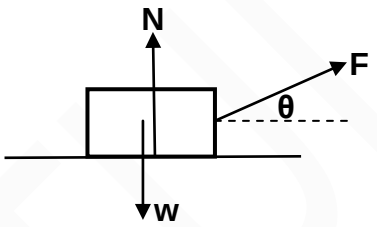
A The weight of an object on Earth is the same as that on the moon.

B The mass of an object on Earth is the same as that on the moon.

C The mass of an object on Earth is greater than that on the moon.

D The weight of an object on Earth is less than that on the moon. (2)

1.2 The force diagram below shows the forces acting on a box.



Which ONE of the following equations for the magnitude of the normal force (N) is CORRECT?

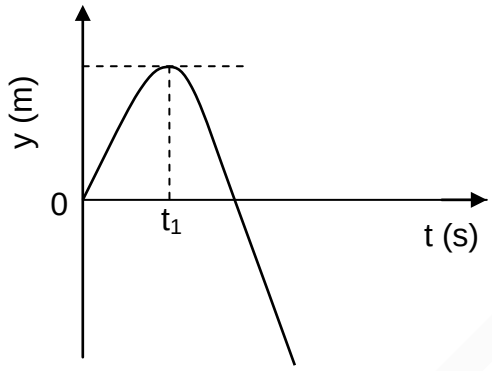
A $N = w + F\cos\theta$

B $N = w + F\sin\theta$

C $N = w - F\cos\theta$

D $N = w - F\sin\theta$ (2)

1.3 A stone is projected vertically upwards from the top of a building at a speed of v m·s^{-1}. The position-time graph below represents the motion of the stone. Ignore the effects of air resistance.

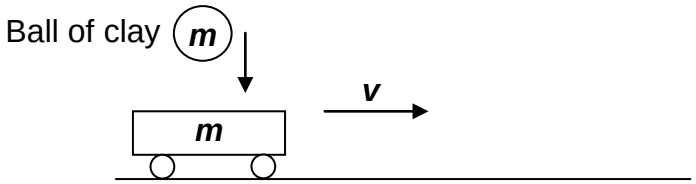


Which ONE of the combinations below regarding the magnitudes of the stone's velocity and acceleration, at time t_1, is CORRECT?

	MAGNITUDE OF VELOCITY (m·s^{-1})	**MAGNITUDE OF ACCELERATION (m·s^{-2})**
A	0	9,8
B	0	0
C	*v*	0
D	*v*	9,8

(2)

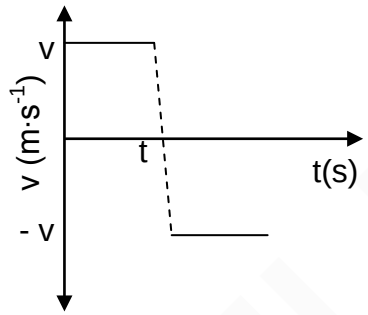
1.4 A trolley of mass ***m*** is moving at constant velocity ***v*** to the right on a frictionless horizontal surface. A ball of clay, also of mass ***m***, dropped vertically, falls onto the trolley at time t, as shown in the diagram below.



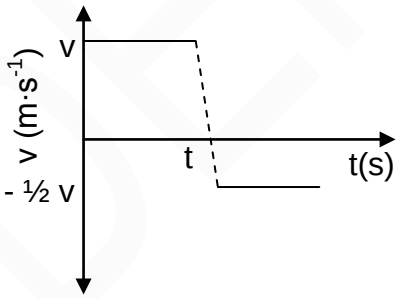
The ball of clay sticks to the trolley.

Which ONE of the velocity-time graphs below CORRECTLY represents the velocity of the trolley *before* and *after* time t?

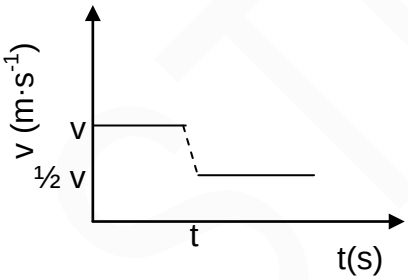
A



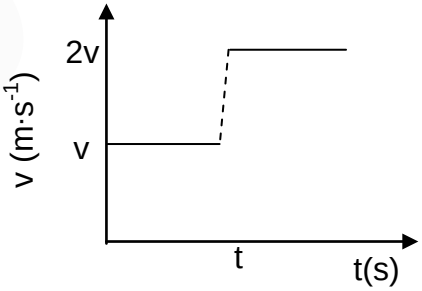
B



C



D



(2)

1.5 A person lifts a crate vertically upwards at constant velocity through a distance *h.* The person does work *x* on the crate in time *t*.

The person now lifts the same crate vertically upwards at constant velocity through the same distance, but in time 2*t*.

The work done by the person on the crate will now be …

A ½*x*

B *x*

C 2*x*

D 4*x* (2)

1.6 The wavelengths of light emitted by a distant star appear shorter when observed from Earth. From this we can conclude that the star is …

A moving towards Earth and the light is blue shifted.

B moving towards Earth and the light is red shifted.

C moving away from Earth and the light is red shifted.

D moving away from Earth and the light is blue shifted. (2)

1.7 Two identical light graphite-coated spheres, P_1 and P_2, are suspended using identical thin insulated threads. P_1 is charged, but P_2 is neutral. The spheres are then brought into contact with each other, as shown in diagram **I**. Thereafter the spheres assume the positions, as shown in diagram **II**.

Diagram **I**

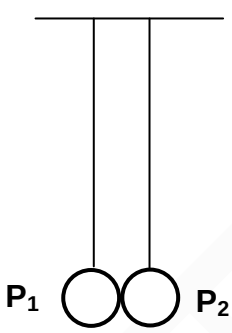
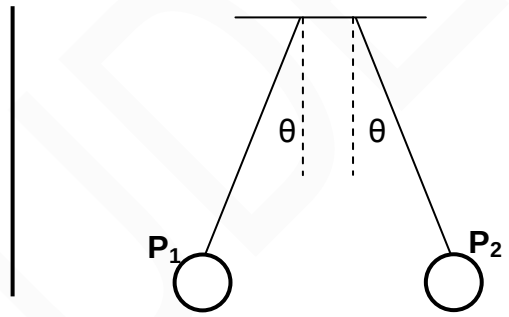


Diagram **II**



Which ONE of the following statements concerning the charges on the spheres possibly explains why the spheres move apart after touching, as shown in diagram **II**?

	SIGN OF CHARGE ON P_1	SIGN OF CHARGE ON P_2	MAGNITUDE OF CHARGES ON P_1 AND P_2
A	+	+	Unequal
B	-	-	Unequal
C	+	-	Equal
D	+	+	Equal

(2)

1.8 When a resistor of resistance R is connected to a battery of emf Ɛ and negligible internal resistance, the power dissipated in the resistor is P.

If the resistor is replaced with a resistor of resistance 2R, without changing the battery, the power dissipated will be …

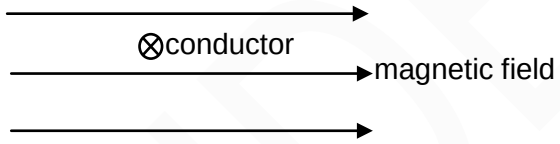
A ¼P

B ½P

C 2P

D 4P (2)

1.9 The diagram below shows a current-carrying conductor lying in a uniform magnetic field directed to the right. The current flows into the page.



Which ONE of the following arrows shows the direction of the force experienced by the conductor due to the magnetic field?

A B C D

(2)

1.10 Light of a certain frequency is shone onto a metal **M** and electrons are ejected from the surface. The same source of light is shone onto another metal **N**.

The electrons ejected from the surface of metal **N** have a much higher kinetic energy than that from metal **M**.

This means that …

A metal **N** has the same work function as metal **M**.

B metal **N** has a larger work function than metal **M**.

C the threshold frequency of metal **N** is higher than that of metal **M**.

D the threshold frequency of metal **N** is lower than that of metal **M**. (2)

[20]

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Various options are provided as possible answers to the following questions. Write down the question number (1.1–1.10), choose the answer and make a cross (X) over the letter (A–D) of your choice in the ANSWER BOOK.

EXAMPLE:

1.11	**A**	**B**	**C**	~~**D**~~

1.1 A constant net force acts on a trolley.

According to Newton's Second Law, the acceleration of the trolley is … the mass of the trolley.

A equal to

B independent of

C directly proportional to

D inversely proportional to (2)

1.2 The weight of a man on the surface of the Earth is **w**. Planet **X** has the *same* radius as the Earth, but *half* the mass of the Earth.

If the same man goes to Planet **X**, his weight on the surface will be …

A ¼ **w**

B ½ **w**

C **w**

D 2 **w** (2)

1.3 An object falls freely in a vacuum near the surface of the Earth.

Which ONE of the following statements regarding the motion of the object is CORRECT?

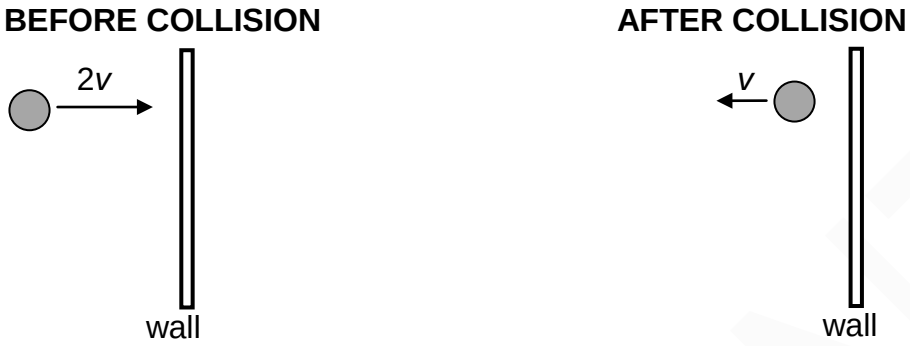
A The velocity of the object will remain constant.

B The velocity of the object will decrease uniformly.

C The rate of change of velocity of the object will increase uniformly.

D The rate of change of velocity of the object will remain constant. (2)

1.4 A ball, moving horizontally, hits a wall with a speed 2*v*. The ball then bounces back horizontally with a speed *v*, as shown in the diagram below.

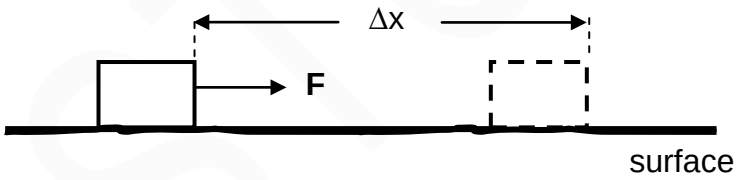


Which ONE of the following combinations regarding the linear momentum and the total kinetic energy of the ball for the collision above is CORRECT? Assume that the ball-wall system is isolated.

	LINEAR MOMENTUM	TOTAL KINETIC ENERGY
A	Conserved	Not conserved
B	Conserved	Conserved
C	Not conserved	Not conserved
D	Not conserved	Conserved

(2)

1.5 A constant horizontal force **F** displaces a box by Δx over a rough horizontal surface. Study the diagram below.



The normal force acting on the box does NO work on the box during the motion, because it is …

A equal to the applied force.

B perpendicular to the applied force.

C equal and opposite to the weight of the box.

D perpendicular to the displacement of the box. (2)

1.6 A car travels at a constant velocity towards a stationary listener. The car's hooter emits a sound of constant frequency as it approaches the listener.

Which ONE of the following statements regarding the frequency and wavelength of the sound of the hooter is CORRECT as observed by the listener?

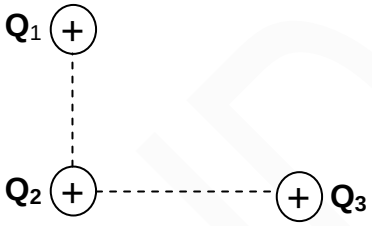
A Both the frequency and wavelength have decreased.

B The frequency has increased while the wavelength has decreased.

C The frequency has decreased while the wavelength has increased.

D Both the frequency and wavelength have increased. (2)

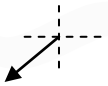
1.7 Three identical positive point charges, $\mathbf{Q_1}$, $\mathbf{Q_2}$ and $\mathbf{Q}_3$, are initially situated on a smooth flat table at the corners of a right-angled triangle. The diagram below shows the charges as viewed from above.

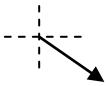


Which ONE of the following diagrams shows the direction in which $\mathbf{Q}_2$ will move as a result of the electrostatic forces exerted by $\mathbf{Q}_1$ and $\mathbf{Q}_3$ on it?

A 

B 

C 

D 

(2)

1.8 A certain conductor obeys Ohm's law.

Which ONE of the statements below regarding the resistance of the conductor is CORRECT?

The resistance of this conductor …

A changes as the potential difference across it changes at constant temperature.

B changes as the current passing through it changes at constant temperature.

C remains unchanged, even if the potential difference across it or current in it changes at constant temperature.

D remains unchanged, even if its temperature changes. (2)

1.9 Which ONE of the following energy conversions takes place when an AC generator is in operation?

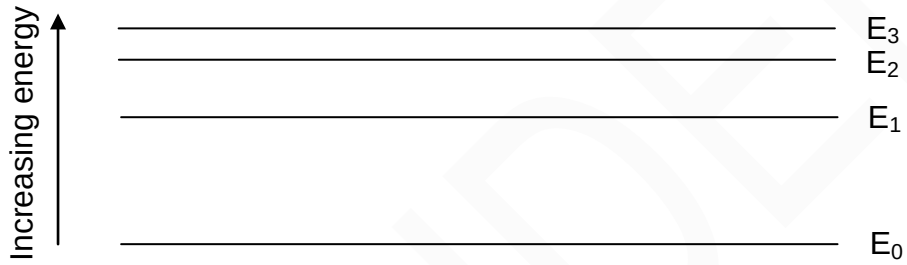
A Electrical to mechanical

B Mechanical to electrical

C Heat to mechanical

D Electrical to potential (2)

1.10 The diagram below shows four energy levels of an atom. The transition of the atom from higher energy levels to lower energy levels results in the emission of a photon.



Which ONE of the following transitions will lead to the emission of a photon with the shortest wavelength?

A From energy level E_2 to energy level E_1

B From energy level E_3 to energy level E_0

C From energy level E_3 to energy level E_2

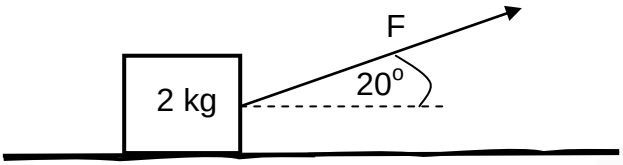
D From energy level E_1 to energy level E_0 (2)

[20]

QUESTION 2 (Start on a new page.)

2.1 A crate of mass 2 kg is being pulled to the right across a *rough* horizontal surface by a constant force F.

The force F is applied at an angle of 20^o to the horizontal, as shown in the diagram below.



2.1.1 Draw a labelled free-body diagram showing ALL the forces acting on the crate. (4)

A constant frictional force of 3 N acts between the surface and the crate. The coefficient of kinetic friction between the crate and the surface is 0,2.

Calculate the magnitude of the:

2.1.2 Normal force acting on the crate (3)

2.1.3 Force F (4)

2.1.4 Acceleration of the crate (3)

2.2 A massive rock from outer space is moving towards the Earth.

2.2.1 State Newton's Law of Universal Gravitation in words. (2)

2.2.2 How does the magnitude of the gravitational force exerted by the Earth on the rock change as the distance between the rock and the Earth becomes smaller?

Choose from INCREASES, DECREASES or REMAINS THE SAME.

Give a reason for the answer. (2)
[18]

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Various options are provided as possible answers to the following questions. Write down the question number (1.1–1.10), choose the answer and make a cross (X) over the letter (A–D) of your choice in the ANSWER BOOK.

EXAMPLE:

1.11	**A**	**B**	**C**	~~**D**~~

1.1 According to Newton's Second Law of Motion, the acceleration of an object is …

A independent of its mass.

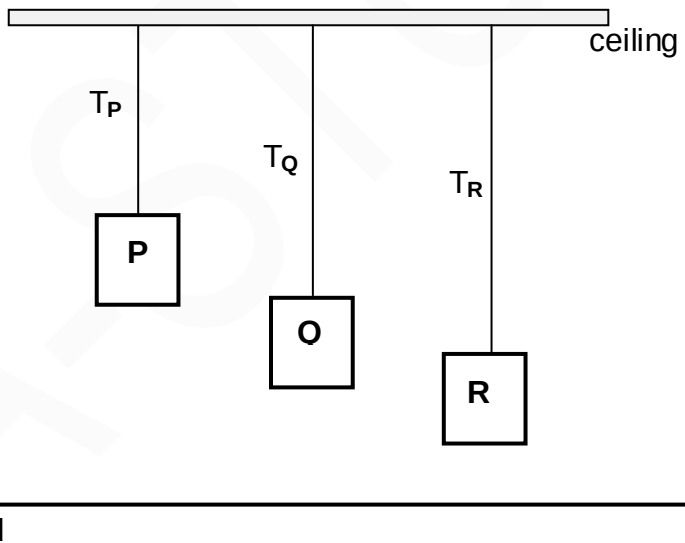
B always equal to its mass.

C directly proportional to its mass.

D inversely proportional to its mass. (2)

1.2 The diagram below shows three blocks, **P**, **Q** and **R**, suspended from a ceiling. The blocks are *identical*, *stationary* and have the *same mass* but are at different heights above the ground.

The connecting strings are massless and inextensible. The tensions in the strings attached to blocks **P**, **Q** and **R** are T_P, T_Q and T_R respectively.



Which ONE of the following statements about the tensions is CORRECT?

A $T_P > T_Q > T_R$

B $T_P < T_Q < T_R$

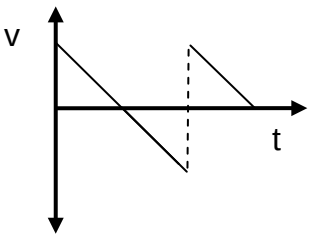
C $T_P = T_Q = T_R$

D $T_P > T_Q$ and $T_Q < T_R$ (2)

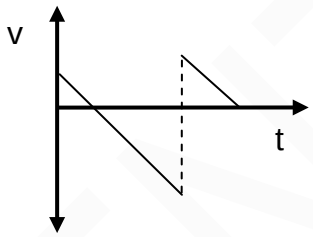
1.3 A ball is projected vertically upwards from the ground. It returns to the ground, makes an elastic collision with the ground and then bounces to a maximum height. Ignore air resistance.

Which ONE of the following velocity-time graphs CORRECTLY describes the motion of the ball?

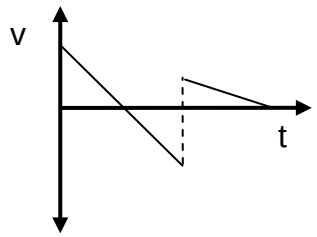
A



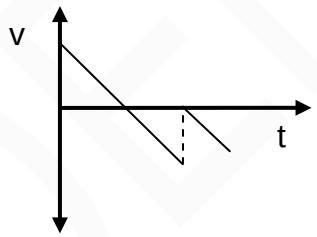
B



C



D



(2)

1.4 When the velocity of a moving object is *doubled*, the …

A net work done by the object is doubled.

B kinetic energy of the object is doubled.

C potential energy of the object is doubled.

D linear momentum of the object is doubled. (2)

1.5 The net work required to stop a moving object is equal to the …

A inertia of the object.

B change in kinetic energy of the object.

C change in momentum of the object.

D change in impulse of the object. (2)

1.6 A stationary observer is listening to the sound coming from a sound source. The listener hears a sound of a lower pitch when compared to that produced by the source.

What can you conclude about the source from this observation?

A The source is at rest.

B The source is moving towards the listener.

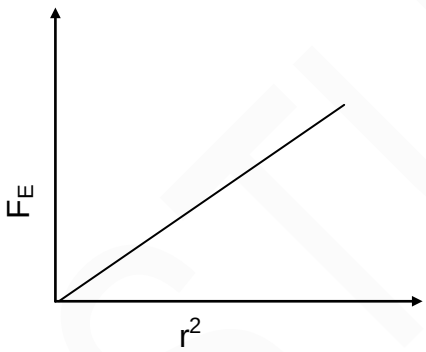
C The source is moving away from the listener.

D There is an obstacle between the source and the listener. (2)

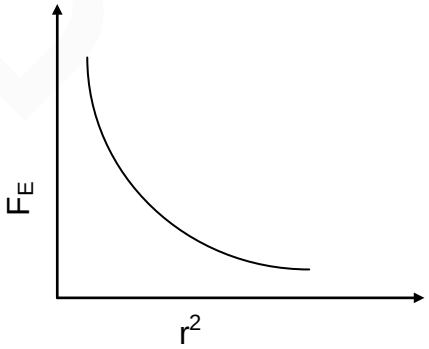
1.7 Two charged particles are placed a distance, r, apart. The electrostatic force exerted by one charged particle on the other is F_E

Which ONE of the graphs below CORRECTLY represents the relationship between the electrostatic force, F_E, and the square of the distance, r^2, between the two charges?

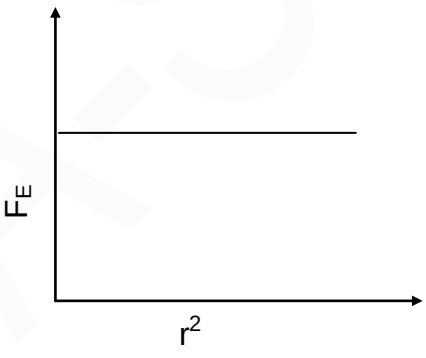
A



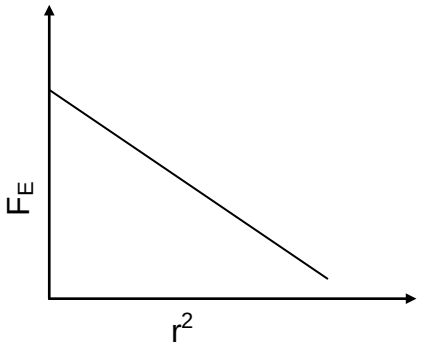
B



C



D

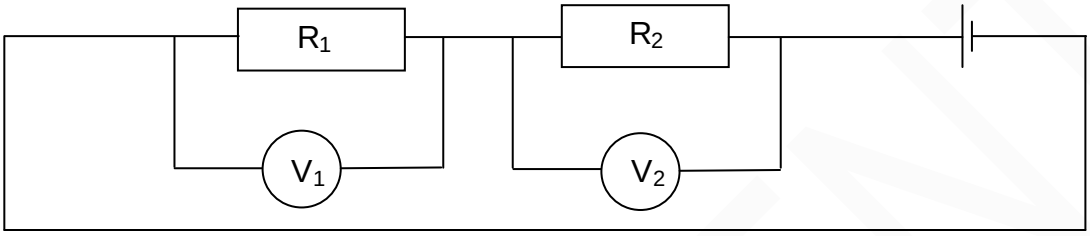


(2)

1.8 In the circuit diagram below, the resistance of resistor R_1 is TWICE the resistance of resistor R_2.

The two resistors are connected in series and identical high-resistance voltmeters are connected across each resistor.

The readings on the voltmeters are V_1 and V_2 respectively.



Which ONE of the following statements concerning the voltmeter readings is CORRECT?

A $V_1 = 2V_2$

B $V_1 = ½V_2$

C $V_1 = ¼V_2$

D $2V_1 = V_2$ (2)

1.9 In a DC generator the current to the external circuit is delivered through the …

A coils.

B battery.

C slip rings.

D split rings (commutators). (2)

1.10 In an experiment on the photoelectric effect, the frequency of the incident light is high enough to cause the removal of electrons from the surface of the metal.

The number of electrons ejected from the metal surface is proportional to the …

A kinetic energy of the electrons.

B number of incident photons.

C work function of the metal.

D frequency of the incident light. (2)

[20]

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Various options are provided as possible answers to the following questions. Write down the question number (1.1–1.10), choose the answer and make a cross (X) over the letter (A–D) of your choice in the ANSWER BOOK.

EXAMPLE:

1.11 | A | B | C | ~~D~~ |

1.1 The tendency of an object to remain at rest or to continue in its uniform motion in a straight line is known as …

A inertia.

B acceleration.

C Newton's Third Law.

D Newton's Second Law. (2)

1.2 The mass of an astronaut on Earth is M. At a height equal to twice the radius of the Earth, the **mass** of the astronaut will be …

A $\frac{1}{4}$M

B $\frac{1}{9}$M

C M

D 2M (2)

1.3 An object is thrown vertically upwards from the ground.

Which ONE of the following is CORRECT regarding the direction of the acceleration of the object as it moves upwards and then downwards? Ignore the effects of air resistance.

	OBJECT MOVING UPWARDS	OBJECT MOVING DOWNWARDS
A	Downwards	Upwards
B	Upwards	Downwards
C	Downwards	Downwards
D	Upwards	Upwards

(2)

1.4 A person drops a glass bottle onto a concrete floor from a certain height and the bottle breaks. The person then drops a second, identical glass bottle from the same height onto a thick, woollen carpet, but the bottle does not break.

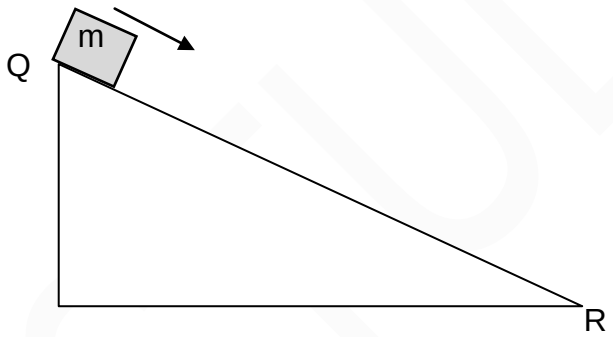
Which ONE of the following is CORRECT for the second bottle compared to the first bottle for the same momentum change?

	AVERAGE FORCE ON SECOND BOTTLE	TIME OF CONTACT WITH CARPET
A	Larger	Smaller
B	Smaller	Smaller
C	Larger	Larger
D	Smaller	Larger

(2)

1.5 A block of mass m is released from rest from the top of a frictionless inclined plane **QR**, as shown below.

The total mechanical energy of the block is E_Q at point **Q** and E_R at point **R**. The kinetic energy of the block at points **Q** and **R** is K_Q and K_R respectively.

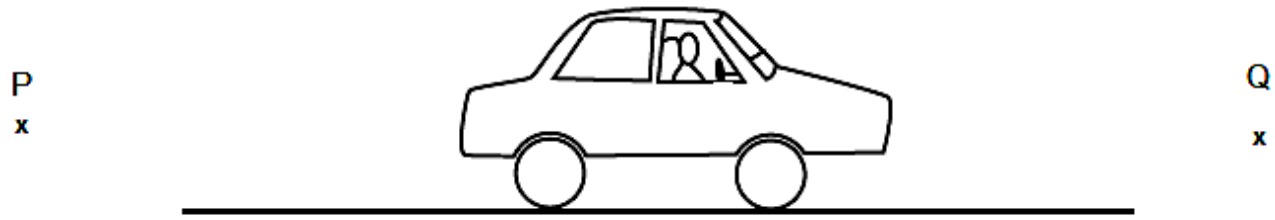


Which ONE of the statements regarding the total mechanical energy and the kinetic energy of the block at points **Q** and **R** respectively is CORRECT?

	TOTAL MECHANICAL ENERGY E	KINETIC ENERGY K
A	$E_Q > E_R$	$K_Q = K_R$
B	$E_Q = E_R$	$K_Q < K_R$
C	$E_Q = E_R$	$K_Q = K_R$
D	$E_Q < E_R$	$K_Q > K_R$

(2)

1.6 The diagram below shows the positions of two stationary listeners, **P** and **Q**, relative to a car moving at a constant velocity towards listener **Q**. The hooter on the car emits sound. Listeners **P** and **Q** and the driver all hear the sound of the hooter.

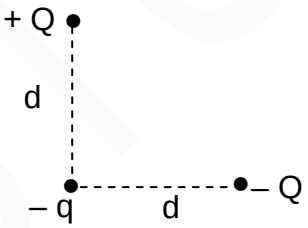


Which ONE of the following CORRECTLY describes the frequency of the sound heard by **P** and **Q**, *compared to that heard by the driver*?

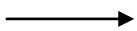
	FREQUENCY OF THE SOUND HEARD BY P	FREQUENCY OF THE SOUND HEARD BY Q
A	Lower	Higher
B	Higher	Higher
C	Lower	Lower
D	Higher	Lower

(2)

1.7 Two charges, + Q and – Q, are placed a distance d from a negative charge – q. The charges, + Q and – Q, are located along lines that are perpendicular to each other as shown in the diagram below.



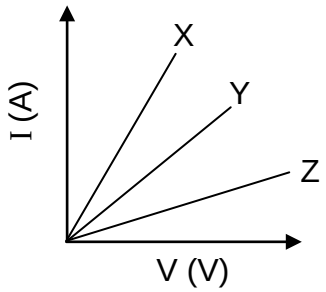
Which ONE of the following arrows CORRECTLY shows the direction of the net force acting on charge – q due to the presence of charges + Q and – Q?

A	
B	
C	
D	

(2)

1.8 Learners investigate the relationship between current (I) and potential difference (V) at a constant temperature for three different resistors, **X**, **Y** and **Z**.

They obtain the graphs shown below.



The resistances of **X**, **Y** and **Z** are R_X, R_Y and R_Z respectively.

Which ONE of the following conclusions regarding the resistances of the resistors is CORRECT?

A $R_z > R_Y > R_x$

B $R_X = R_Y = R_Z$

C $R_X > R_Y > R_Z$

D $R_X > R_Y$ and $R_Y < R_Z$ (2)

1.9 Which ONE of the following changes may lead to an increase in the emf of an AC generator without changing its frequency?

A Decrease the resistance of the coil.

B Increase the area of the coil.

C Increase the resistance of the coil.

D Decrease the speed of rotation. (2)

1.10 The wavelength of a monochromatic light source **P** is twice that of a monochromatic light source **Q**. The energy of a photon from source **P** will be … of a photon from source **Q**.

A a quarter of the energy

B half the energy

C equal to the energy

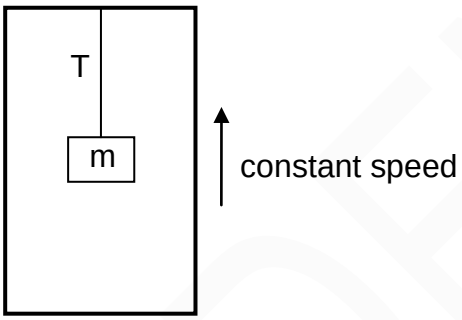
D twice the energy (2)

[20]

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Four options are provided as possible answers to the following questions. Each question has only ONE correct answer. Choose the answer and write only the letter (A–D) next to the question number (1.1–1.10) in the ANSWER BOOK, for example 1.11 E.

1.1 An object, of mass m, hangs at the end of a string from the ceiling of a lift cage. The lift is moving upward at CONSTANT SPEED. The acceleration due to gravity is *g*.



Which ONE of the following statements regarding the tension (T) in the string is CORRECT?

The tension T …

A will be equal to m*g*.

B will be less than m*g*.

C will be greater than m*g*.

D cannot be determined without knowing the speed of the lift cage. (2)

1.2 Two hypothetical planets, X and Y, have the same mass. The diameter of planet Y is twice that of planet X.

If the acceleration due to gravity on the surface of planet X is *g*, then the acceleration due to gravity on the surface of planet Y will be …

A $\frac{g}{16}$

B $\frac{g}{4}$

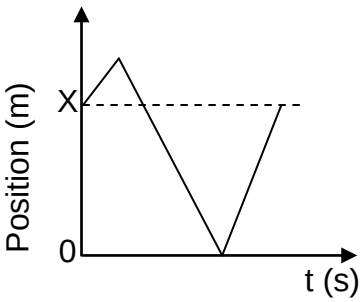
C $\frac{g}{2}$

D $2g$ (2)

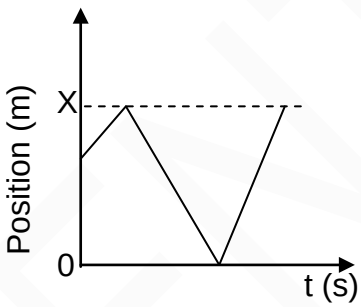
1.3 A ball is projected vertically upwards from a *height X above the ground*. After some time, the ball falls to the ground and bounces back to the same height from which it was projected. Ignore friction and assume that there is a negligible time lapse during the collision of the ball with the ground.

Which ONE of the following is the CORRECT position-time graph for the motion of the ball as described above?

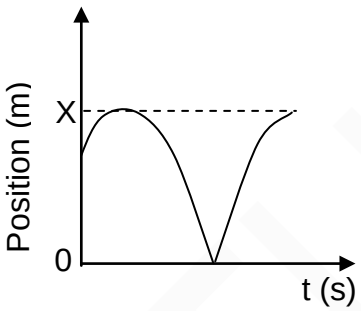
A



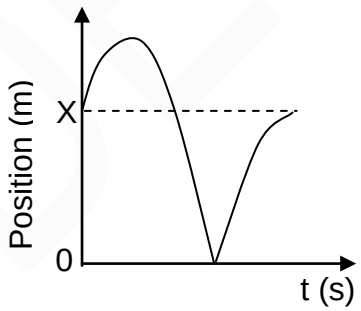
B



C



D



(2)

1.4 Which ONE of the following statements is always TRUE for *inelastic collisions* in an isolated system?

A Both momentum and kinetic energy are conserved.

B Both momentum and kinetic energy are not conserved.

C Momentum is conserved, but kinetic energy not.

D Kinetic energy is conserved, but momentum not. (2)

1.5 When the net work done on an object is positive (greater than zero), the …

A kinetic energy of the object is zero.

B kinetic energy of the object is increasing.

C kinetic energy of the object is decreasing.

D kinetic energy of the object remains unchanged. (2)

1.6 A police car with its siren wailing is moving away from a stationary observer at constant speed. The siren emits a sound of constant frequency.

Which of the following characteristics associated with the sound of the siren, as perceived by the observer, is/are CORRECT?

(i) The speed remains the same.
(ii) The frequency increases.
(iii) The wavelength increases.
(iv) The pitch decreases.

A (iii) only

B (i), (iii) and (iv)

C (i) and (iii) only

D (i) and (ii) only (2)

1.7 The magnitude of the electric field at a point P from a positive point charge q is x N·C^{-1}.

Which ONE of the statements below regarding this electric field is CORRECT?

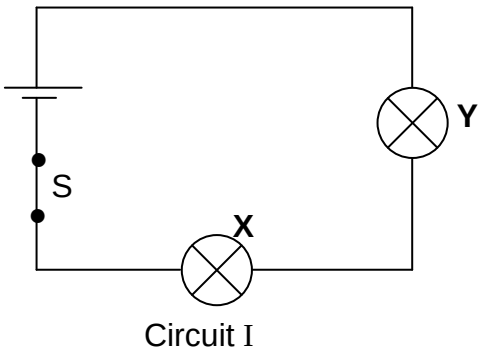
A A + 1 C charge placed at P will experience a force of magnitude x N directed away from q.

B The force on a + 2 C charge placed at P will have a magnitude ¼ x N directed away from q.

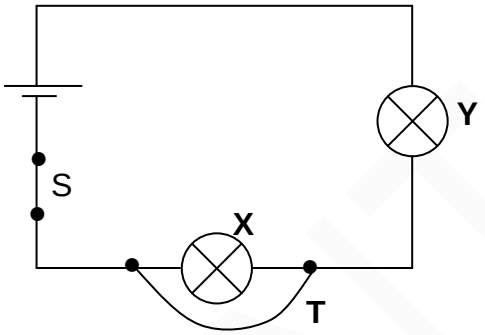
C A + 1 C charge placed at P will experience a force of magnitude x N directed towards q.

D The force on a + 2 C charge placed at P will have a magnitude ¼ x N directed towards q. (2)

1.8 Circuit I shows two identical lamps **X** and **Y** connected to a cell of negligible internal resistance. Switch S is closed.



Circuit I



Circuit II

A wire **T**, of negligible resistance, is now connected across **X** as shown in Circuit II.

Which ONE of the statements below best describes how the brightness of the lamps have changed after **T** had been connected?

	X	**Y**
A	Does not light up	Dimmer
B	Brighter	Dimmer
C	Brighter	Brighter
D	Does not light up	Brighter

(2)

1.9 Some learners decided to build a small electrical generator in the laboratory. They then used this generator to investigate how the magnitude of the induced emf would change as the magnetic field strength changed.

Which ONE of the following is CORRECT regarding the variables for the investigation?

	DEPENDENT VARIABLE	**INDEPENDENT VARIABLE**	**CONTROL VARIABLE**
A	Magnitude of induced emf	Number of turns of coil of generator	Magnetic field strength
B	Number of turns of coil of generator	Magnitude of induced emf	Magnetic field strength
C	Magnitude of induced emf	Magnetic field strength	Number of turns of coil of generator
D	Magnetic field strength	Number of turns of coil of generator	Magnitude of induced emf

(2)

1.10 In an experiment on the photoelectric effect, a scientist shines red light on a metal surface and observes that electrons are ejected from the metal surface. Later the scientist shines blue light, with the same intensity as the red light, on the same metal surface.

Which ONE of the statements below will be the CORRECT observation as a result of this change?

A The number of ejected electrons per second will increase.

B The number of ejected electrons per second will decrease.

C The speed of the ejected electrons will decrease.

D The maximum kinetic energy of the ejected electrons will increase. (2)

[20]

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Four options are provided as possible answers to the following questions. Each question has only ONE correct answer. Choose the answer and write only the letter (A–D) next to the question number (1.1–1.10) in the ANSWER BOOK, for example 1.11 E.

1.1 A net force **F** which acts on a body of mass *m* causes an acceleration *a*. If the same net force **F** is applied to a body of mass 2*m*, the acceleration of the body will be …

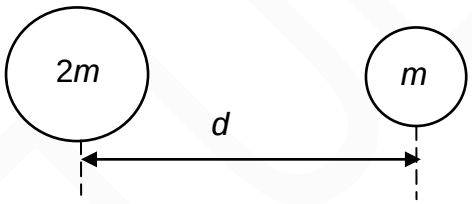
A ¼a

B ½a

C 2a

D 4a (2)

1.2 Two objects of masses 2*m* and *m* are arranged as shown in the diagram below.



Which ONE of the changes below will produce the GREATEST increase in the gravitational force exerted by the one mass on the other?

A Double the larger mass.

B Halve the smaller mass.

C Double the distance between the masses.

D Halve the distance between the masses. (2)

1.3 The statements below describe the motion of objects.

(i) A feather falls from a certain height inside a vacuum tube.

(ii) A box slides along a smooth horizontal surface at constant speed.

(iii) A steel ball falls through the air in the absence of air friction.

Which of the following describes UNIFORMLY ACCELERATED motion CORRECTLY?

A (i) and (ii) only

B (i) and (iii) only

C (ii) and (iii) only

D (i), (ii) and (iii) (2)

1.4 Airbags in modern cars provide more safety during an accident.

The statements below are made by a learner to explain how airbags can ensure better safety in a collision.

(i) The time of impact increases.

(ii) The impact force decreases.

(iii) The impulse increases.

Which of the statements above are CORRECT?

A (i) only

B (ii) only

C (ii) and (iii) only

D (i) and (ii) only (2)

1.5 The work done by a constant force F applied to an object to increase the object's speed from v to $2v$ is W.

The work done by the same force to increase the speed of the object from 0 to v will be ...

A ⅓W

B ½W

C 2W

D 3W (2)

1.6 Light reaching the Earth from a galaxy moving away is shifted towards …

A greater velocities.

B higher frequencies.

C longer wavelengths.

D shorter wavelengths. (2)

1.7 P, Q and R are three charged spheres. When P and Q are brought near each other, they experience an attractive force. When Q and R are brought near each other, they experience a repulsive force.

Which ONE of the following is TRUE?

A P and R have charges with the same sign.

B P and R have charges with opposite signs.

C P, Q and R have charges with the same sign.

D P, Q and R have equal charges. (2)

1.8 The minimum value of the resistance that can be obtained by connecting two 4 Ω resistors is ...

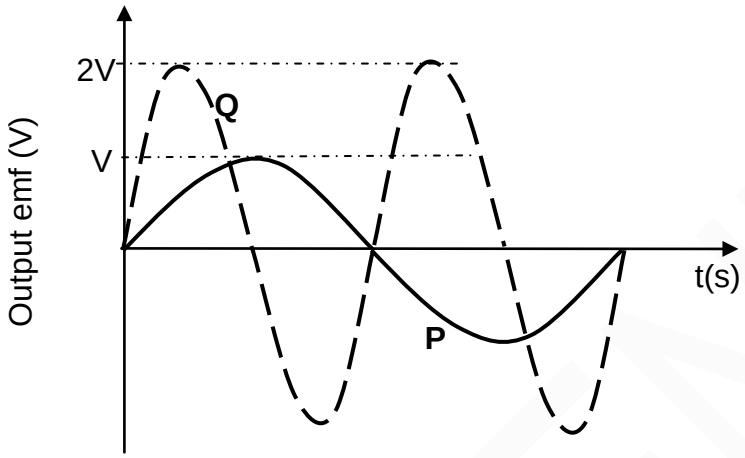
A 1 Ω.

B 2 Ω.

C 3 Ω.

D 8 Ω. (2)

1.9 Graph **P** represents the output emf of an AC generator. Graph **Q** is the output emf after a change has been made using the SAME generator.



Which ONE of the following changes has been made to the generator to produce graph **Q**?

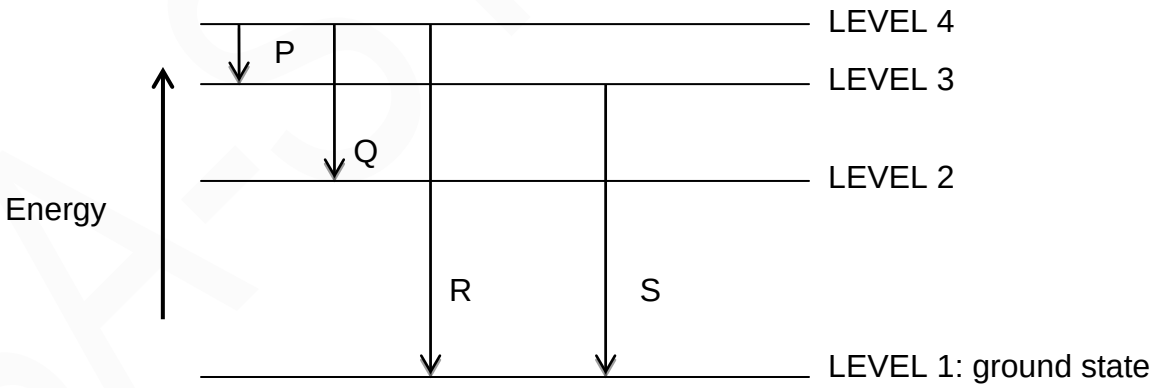
A The number of turns of the coil has been doubled.

B The surface area of the coil has been doubled.

C The speed of rotation has been doubled.

D The strength of the magnetic field has been doubled. (2)

1.10 The possible atomic transitions in an excited atom of an element are shown below.



Which transition will produce the spectral line with the longest wavelength?

A P

B Q

C R

D S (2)

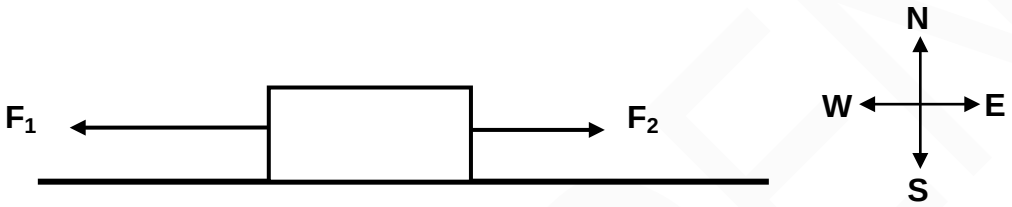
[20]

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Four options are provided as possible answers to the following questions. Each question has only ONE correct answer. Choose the answer and write only the letter (A–D) next to the question number (1.1–1.10) in the ANSWER BOOK, for example 1.11 E.

1.1 Two forces, $\mathbf{F_1}$ and $\mathbf{F_2}$, are applied on a crate lying on a frictionless, horizontal surface, as shown in the diagram below.

The magnitude of force $\mathbf{F_1}$ is greater than that of force $\mathbf{F_2}$.



The crate will …

A accelerate towards the east.

B accelerate towards the west.

C move at a constant speed towards the east.

D move at a constant speed towards the west. (2)

1.2 A person stands on a bathroom scale that is calibrated in newton, in a stationary elevator. The reading on the bathroom scale is W.

The elevator now moves with a constant upward acceleration of $\frac{1}{4}$g, where g is the gravitational acceleration.

What will the reading on the bathroom scale be now?

A $\frac{1}{4}$W

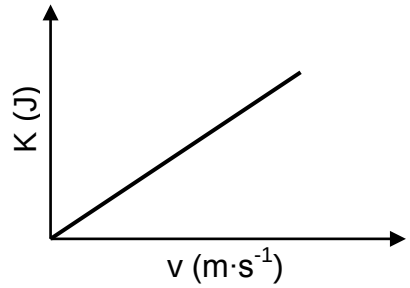
B $\frac{3}{4}$W

C W

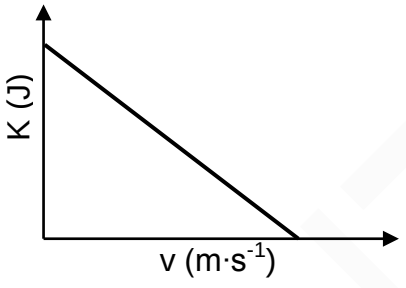
D $\frac{5}{4}$W (2)

1.3 Which ONE of the graphs below correctly represents the relationship between the kinetic energy (K) of a free-falling object and its speed (v)?

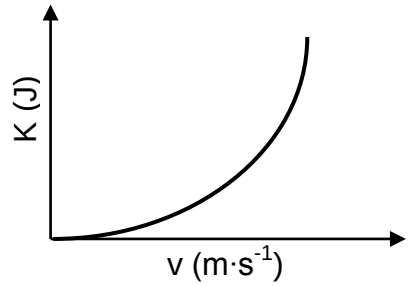
A



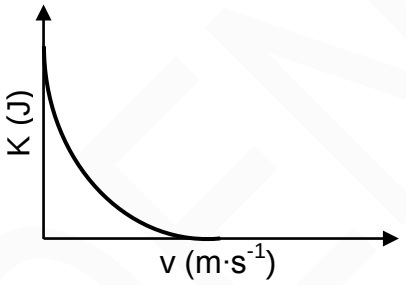
B



C

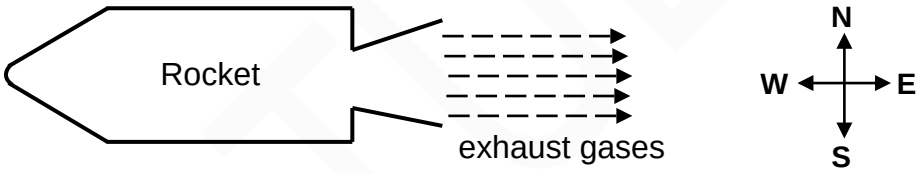


D



(2)

1.4 The simplified diagram below shows a rocket that has been fired horizontally, accelerating to the west.



Which ONE of the statements below best explains why the rocket accelerates?

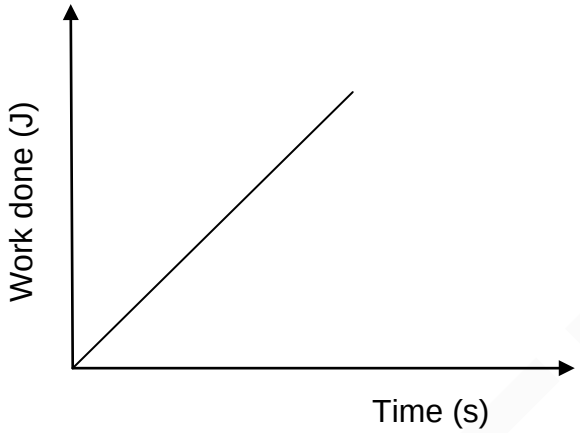
A The speed of the exhaust gases is smaller than the speed of the rocket.

B The pressure of the atmosphere at the back of the rocket is less than at the front.

C The air outside the rocket exerts a greater force on the back of the rocket than at the front.

D The rocket pushes the exhaust gases to the east and the exhaust gases push the rocket to the west. (2)

1.5 The graph below represents the relationship between the work done on an object and the time taken for this work to be done.



The gradient of the graph represents the …

A power.

B momentum.

C kinetic energy.

D potential energy. (2)

1.6 A line emission spectrum is formed when an excited atom moves from a ...

A higher to a lower energy level and releases energy.

B higher to a lower energy level and absorbs energy.

C lower to a higher energy level and releases energy.

D lower to a higher energy level and absorbs energy. (2)

1.7 Two charged spheres of magnitudes 2Q and Q respectively are placed a distance r apart on insulating stands.

If the sphere of charge Q experiences a force **F** to the east, then the sphere of charge 2Q will experience a force …

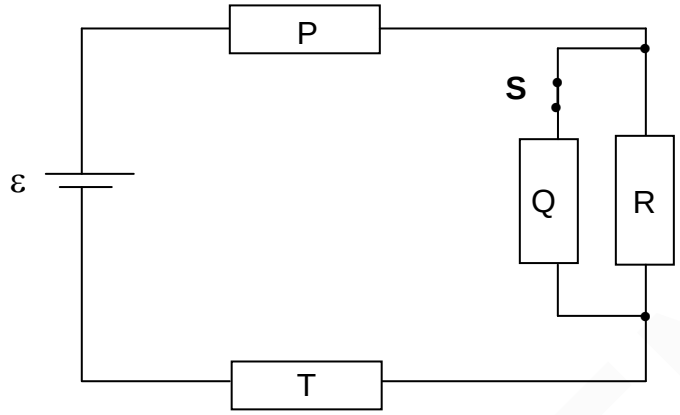
A **F** to the west.

B **F** to the east.

C 2**F** to the west.

D 2**F** to the east. (2)

1.8 The four resistors **P**, **Q**, **R** and **T** in the circuit below are identical. The cell has an emf ε and negligible internal resistance. The switch is initially CLOSED.

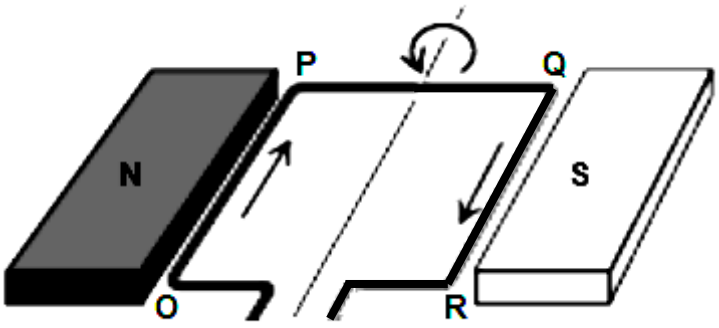


Switch **S** is now OPENED. Which ONE of the following combinations of changes will occur in **P**, **R** and **T**?

	CURRENT IN P	CURRENT IN R	CURRENT IN T
A	Decreases	Remains the same	Decreases
B	Increases	Remains the same	Increases
C	Increases	Increases	Increases
D	Decreases	Increases	Decreases

(2)

1.9 A DC current passes through a rectangular wire loop OPQR placed between two pole pieces of a magnet, as shown below.



Which TWO segments of the loop will experience an electromagnetic force when the loop is in the position above?

A OP and PQ

B QR and RO

C OP and QR

D RO and OP (2)

1.10 When light of a certain wavelength is incident on a metal surface, no electrons are ejected. Which ONE of the following changes may result in electrons being ejected from the metal surface?

A Increase the intensity of the light.

B Use light with a much shorter wavelength.

C Use metal with a larger work function.

D Increase the surface area of the metal. (2)

[20]

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Four options are provided as possible answers to the following questions. Each question has only ONE correct answer. Write only the letter (A–D) next to the question number (1.1–1.10) in the ANSWER BOOK, for example 1.11 D.

1.1 Which ONE of the following forces always acts perpendicular to the surface on which a body is placed?

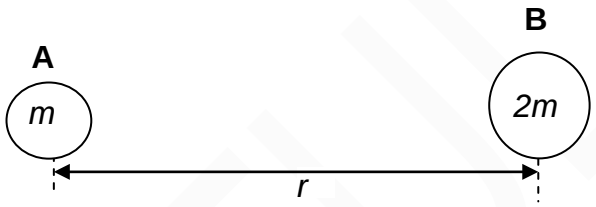
A Normal force

B Frictional force

C Gravitational force

D Tension force (2)

1.2 Two isolated bodies, **A** and **B**, having masses *m* and 2*m* respectively, are placed a distance *r* apart.



Consider the following statements regarding the gravitational force exerted by the bodies on each other.

(i) The force exerted by **B** on body **A** is half that exerted by **A** on body **B**.

(ii) The force exerted on the bodies is independent of the masses of the bodies.

(iii) The force exerted on body **A** by **B** is equal but opposite to that exerted on body **B** by **A**.

(iv) The forces will always be attractive.

Which of the statements above is/are TRUE?

A (i), (ii) and (iv) only

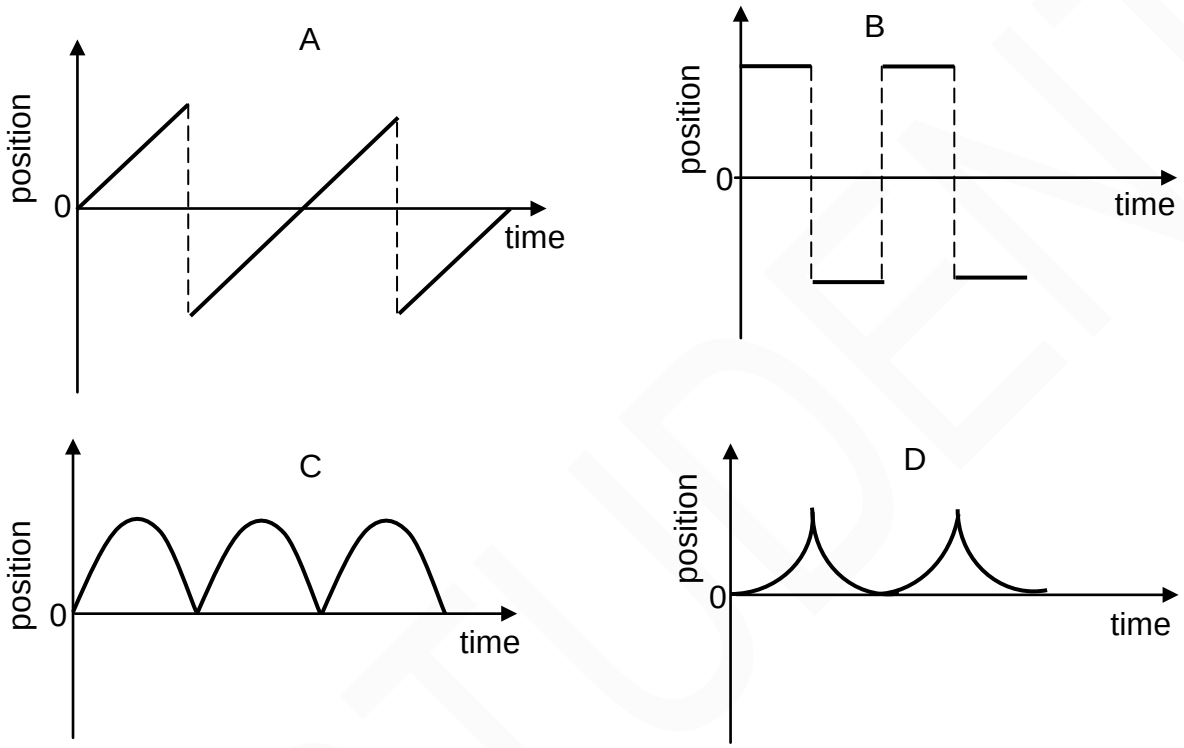
B (ii), (iii) and (iv) only

C (iii) and (iv) only

D (iv) only (2)

1.3 A ball is released from a height above the floor. The ball falls vertically and bounces off the floor a number of times. Ignore the effects of friction and assume that the collision of the ball with the floor is elastic. Take the point of release of the ball as the reference point and downward direction as positive.

Which ONE of the following is a CORRECT representation of the position-time graph for the motion of the ball?



(2)

1.4 Two bodies undergo an INELASTIC collision in the absence of friction. Which ONE of the following combinations of momentum and kinetic energy of the system is CORRECT?

	MOMENTUM	**KINETIC ENERGY**
A	Not conserved	Conserved
B	Conserved	Not conserved
C	Not conserved	Not conserved
D	Conserved	Conserved

(2)

1.5 The speed of a bicycle increases from 2 $m \cdot s^{-1}$ to 8 $m \cdot s^{-1}$. Its kinetic energy increases by a factor of …

A 4.

B 6.

C 8.

D 16. (2)

1.6 Which ONE of the following CANNOT be explained using the Doppler effect?

A Emission of electrons from a metal surface

B 'Flow meters' used in hospitals

C Red spectral lines from distant stars being shifted

D Observed frequency of light from moving bodies being higher than expected (2)

1.7 The magnitude of an electric field, a distance *r* from a point charge is ***E***. The magnitude of an electric field, a distance 2*r* from the same point charge will be …

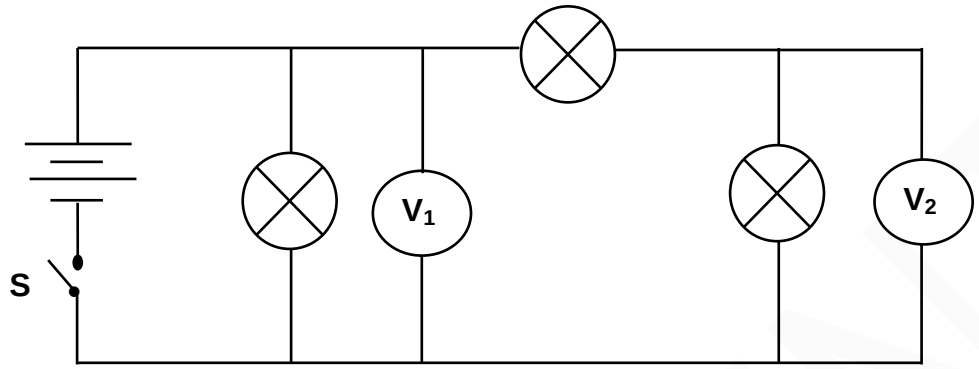
A $\frac{1}{4}\boldsymbol{E}$

B $\frac{1}{2}\boldsymbol{E}$

C 2***E***

D 4***E*** (2)

1.8 Three identical light bulbs are connected in a circuit as shown below. The resistances of the battery and connecting wires can be ignored.



Which ONE of the following statements is CORRECT when switch **S** is closed?

The reading on $\mathbf{V_1}$ is …

A half that on $\mathbf{V_2}$.

B equal to that on $\mathbf{V_2}$.

C twice that on $\mathbf{V_2}$.

D three times that on $\mathbf{V_2}$. (2)

1.9 The speed of rotation of the coils in an AC generator is increased. Which ONE of the following combinations of frequency and output voltage for the generator will occur as a result of the change?

	FREQUENCY	**OUTPUT VOLTAGE**
A	Increases	Increases
B	No change	Increases
C	Decreases	Decreases
D	Increases	No change

(2)

1.10 The spectrum of an element from a star shows some absorption lines. These lines are produced because …

A atoms absorb energy when moving from an excited state to a lower energy state.

B a cold gas absorbs certain frequencies of light passing through it.

C a hot gas absorbs certain frequencies of light passing through it.

D atoms release energy when moving from an excited state to a lower energy state. (2)

[20]

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Four options are provided as possible answers to the following questions. Each question has only ONE correct answer. Write only the letter (A–D) next to the question number (1.1–1.10) in the ANSWER BOOK, for example 1.11 D.

1.1 Which ONE of the following physical quantities is a measure of the inertia of a body?

A Mass

B Energy

C Velocity

D Acceleration (2)

1.2 The magnitude of the gravitational force exerted by one body on another body is ***F***. When the distance between the centres of the two bodies is doubled, the magnitude of the gravitational force, in terms of ***F***, will now be …

A $\frac{1}{4}\boldsymbol{F}$

B $\frac{1}{2}\boldsymbol{F}$

C $2\boldsymbol{F}$

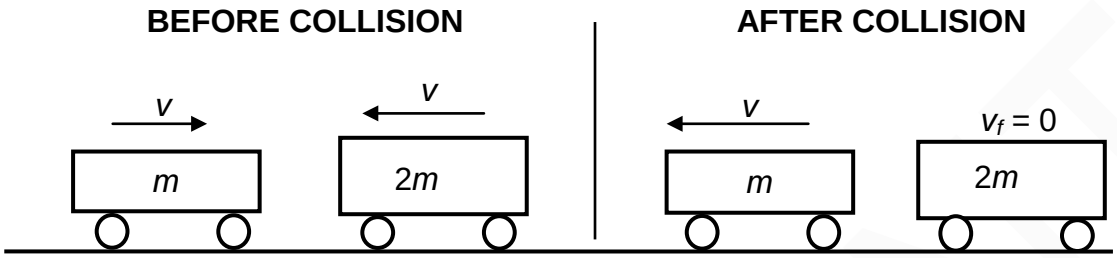
D $4\boldsymbol{F}$ (2)

1.3 An object is thrown vertically upwards. Which ONE of the following regarding the object's velocity and acceleration at the highest point of its motion is CORRECT? Ignore the effects of friction.

	VELOCITY	ACCELERATION
A	Zero	Zero
B	Zero	Upwards
C	Maximum	Zero
D	Zero	Downwards

(2)

1.4 An object of mass *m* moving at velocity *v* collides head-on with an object of mass 2*m* moving in the opposite direction at velocity *v*. Immediately after the collision the smaller mass moves at velocity *v* in the opposite direction and the larger mass is brought to rest. Refer to the diagram below.



Ignore the effects of friction.

Which ONE of the following is CORRECT?

	MOMENTUM	MECHANICAL ENERGY
A	Conserved	Conserved
B	Not conserved	Conserved
C	Conserved	Not conserved
D	Not conserved	Not conserved

(2)

1.5 Two balls, **P** and **Q**, are dropped simultaneously from the same height. Ball **P** has TWICE the mass of ball **Q**. Ignore the effects of air friction.

Just before the balls hit the ground, the kinetic energy of ball **P** is *x*. The kinetic energy of ball **Q**, in terms of *x*, will be …

A $\frac{1}{4}x$

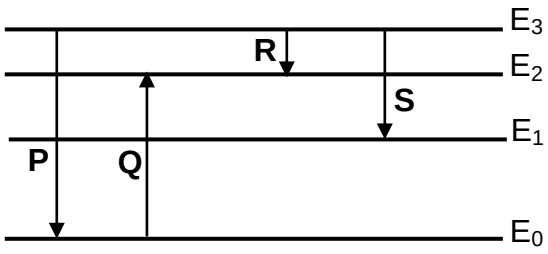
B $\frac{1}{2}x$

C x

D $2x$

(2)

1.6 The diagram below shows the electron transitions **P**, **Q**, **R** and **S** between different energy levels in an atom.



Which ONE of the transitions will result in an emission of a radiation with the longest wavelength?

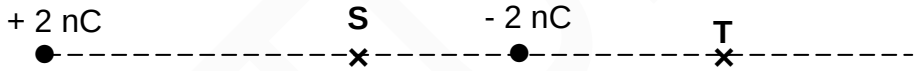
A **P**

B **Q**

C **R**

D **S** (2)

1.7 Two charges of + 2 nC and - 2 nC are located on a straight line. **S** and **T** are two points that lie on the same straight line as shown in the diagram below.



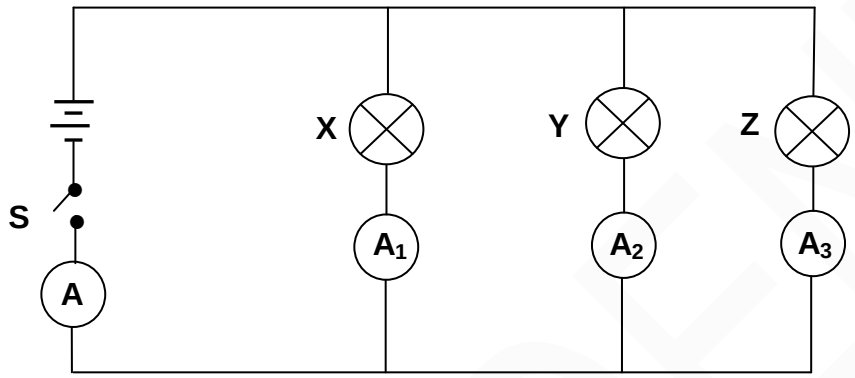
Which ONE of the following correctly represents the directions of the RESULTANT electric fields at **S** and at **T**?

	DIRECTION OF THE RESULTANT ELECTRIC FIELD AT POINT S	**DIRECTION OF THE RESULTANT ELECTRIC FIELD AT POINT T**
A	Right	Left
B	Left	Left
C	Right	Right
D	Left	Right

(2)

1.8 Three light bulbs, **X**, **Y** and **Z** with resistances *R*, 2*R* and *R* respectively, are connected in a circuit as shown below. The battery has negligible internal resistance.

When switch **S is closed**, all the bulbs light up. The reading on ammeter **A** is 2,5 A.

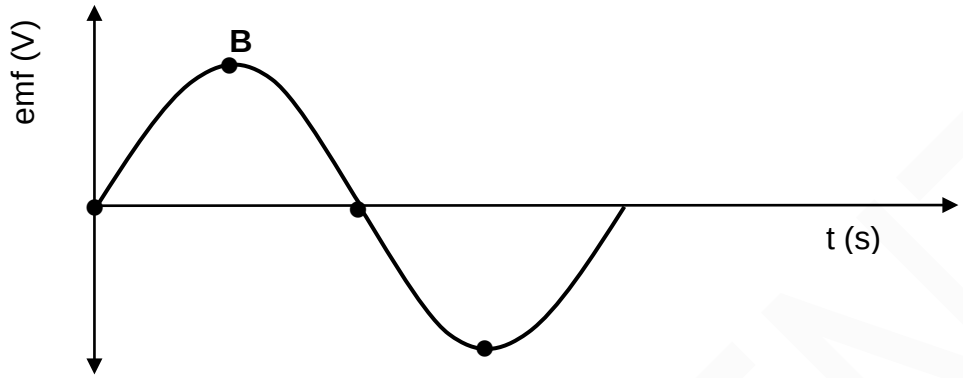


Which ONE of the following correctly describes the readings on the ammeters (in amperes) when bulb **Z** burns out?

	A_1	A_2	A_3	A
A	1,25	1,25	0	2,5
B	1,6	0,8	0,1	2,5
C	0,75	0,75	0	1,5
D	1	0,5	0	1,5

(2)

1.9 The coils of an AC generator make one complete rotation. The resulting graph for the output emf is shown below.



The position **B** on the graph is obtained when the plane of the coil is at an angle of … to the magnetic field.

A 0º

B 60º

C 90º

D 120º (2)

1.10 A learner makes the observations below after conducting an experiment using a photocell with frequencies of the incident light being above the threshold frequency (cut-off frequency).

(i) The photocurrent increases as the intensity of the incident light increases.

(ii) The ammeter in the circuit registers a current immediately after the incident light is radiated on the cathode.

(iii) The photocurrent increases as the frequency of the incident light increases.

Which of the observation(s) is/are CORRECT?

A (i) only

B (ii) only

C (i) and (ii) only

D (ii) and (iii) only (2)
[20]

SECTION A

QUESTION 1: ONE-WORD ITEMS

Give ONE word/term for each of the following descriptions. Write only the word/term next to the question number (1.1–1.5) in the ANSWER BOOK.

1.1 The sum of the kinetic energy and gravitational potential energy of an object (1)

1.2 The law of motion that can be used to explain why all persons in moving vehicles should wear safety belts (1)

1.3 The energy a charge possesses as a result of its position relative to other charges that it interacts with (1)

1.4 The bending of waves around corners or obstacles (1)

1.5 The minimum energy needed to remove an electron from the surface of a metal (1)
[5]

QUESTION 2: MULTIPLE-CHOICE QUESTIONS

Four options are given as possible answers to the following questions. Each question has only ONE correct answer. Write only the letter (A–D) next to the question number (2.1–2.10) in the ANSWER BOOK.

2.1 Net force is a measure of the …

A change in energy.
B rate of change in energy.
C change in momentum.
D rate of change in momentum. (2)

2.2 If air resistance is negligible, the total mechanical energy of a free-falling body …

A remains constant.
B becomes zero.
C increases.
D decreases. (2)

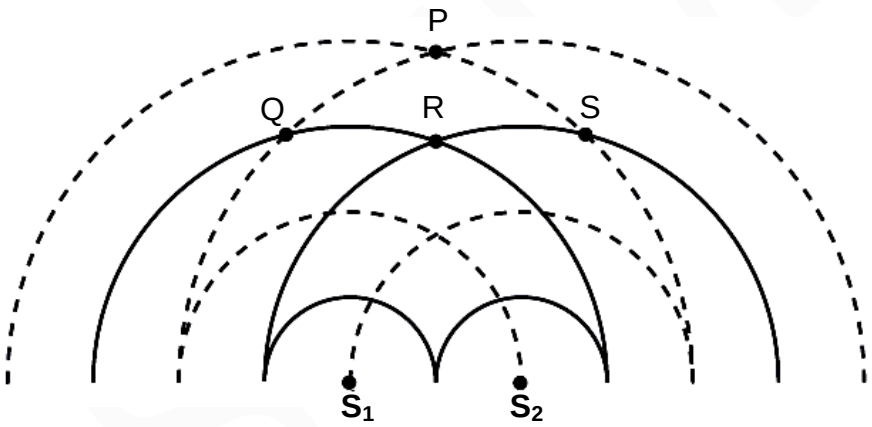
2.3 If the momentum of an object is doubled, then its kinetic energy is ...

A halved.
B doubled.
C three times greater.
D four times greater. (2)

2.4 The degree of diffraction depends on a wave's ...

A phase.
B velocity.
C amplitude.
D wavelength. (2)

2.5 The diagram below shows waves generated by two coherent sources, $\mathbf{S_1}$ and $\mathbf{S_2}$. The solid lines represent CRESTS and the broken (dashed) lines represent TROUGHS.



Destructive interference occurs at points ...

A Q and R.
B Q and P.
C Q and S.
D R and S. (2)

2.6 Two small identical metal spheres, each carrying equal charges Q, are brought into contact and then separated.

The charge on each sphere will now be …

A zero.

B $\frac{Q}{2}$.

C Q.

D $2Q$. (2)

2.7 Two resistors of equal resistance are connected in SERIES to a battery with negligible internal resistance. The current through the battery is I.

When the two resistors are connected in PARALLEL to the same battery, the current through the battery will be …

A $\frac{1}{2}I$.

B I.

C $2I$.

D $4I$. (2)

2.8 Which ONE of the following statements is INCORRECT?
Electromagnetic waves …

A can undergo reflection and refraction.

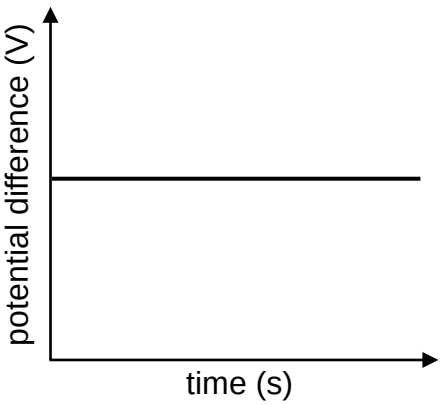
B are longitudinal waves.

C can travel through a vacuum.

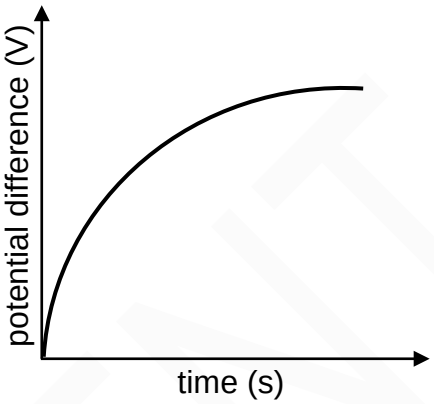
D can undergo diffraction and interference. (2)

2.9 Which ONE of the following graphs represents the change in potential difference across a capacitor as it charges?

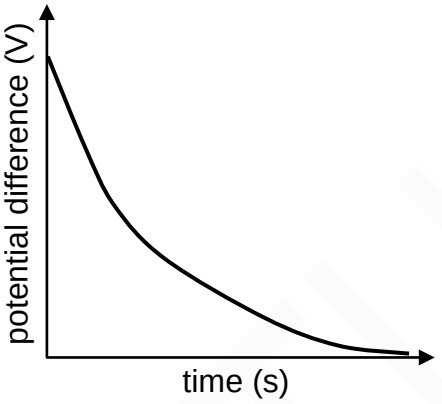
A



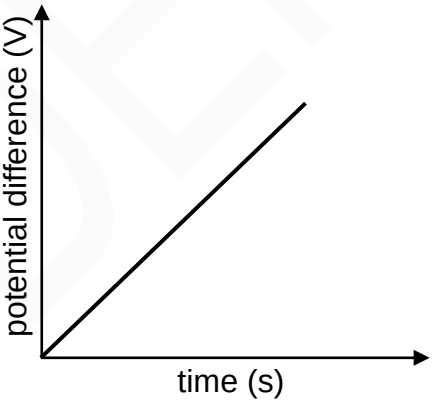
B



C

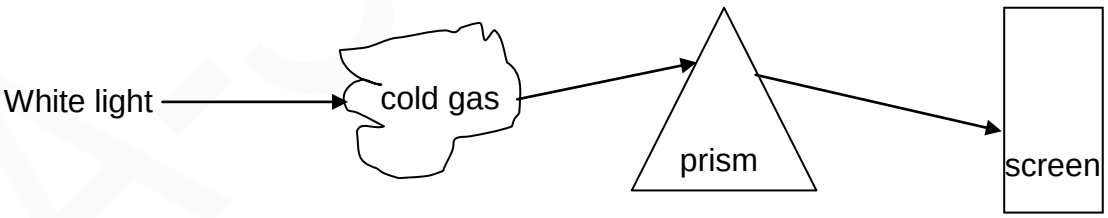


D



(2)

2.10 Light spectra help to identify elements. White light is passed through a cold gas and then through a prism as shown in the sketch below.



What type of spectrum is observed on the screen?

A Line absorption spectrum

B Line emission spectrum

C Continuous absorption spectrum

D Continuous emission spectrum (2)

[20]

TOTAL SECTION A: 25

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Four options are provided as possible answers to the following questions. Each question has only ONE correct answer. Write only the letter (A–D) next to the question number (1.1–1.10) in the ANSWER BOOK, for example 1.11 E.

1.1 The net force acting on an object is directly proportional to the ...

A mass of the object.

B acceleration of the object.

C change in momentum of the object.

D rate of change in momentum of the object. (2)

1.2 An astronomer, viewing light from distant galaxies, observes a shift of spectral lines toward the red end of the visible spectrum. This shift provides evidence that …

A the universe is expanding.

B the galaxies are moving closer towards Earth.

C Earth is moving towards the distant galaxies.

D the temperature of Earth's atmosphere is increasing. (2)

1.3 A ball is thrown vertically upwards. Which ONE of the following physical quantities has a non-zero value at the instant the ball changes direction?

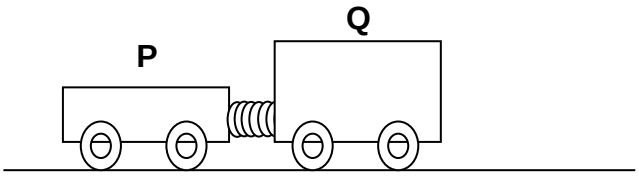
A Acceleration

B Kinetic energy

C Momentum

D Velocity (2)

1.4 Two trolleys, **P** and **Q**, of mass *m* and 2*m* respectively are at rest on a frictionless horizontal surface. The trolleys have a compressed spring between them.



The spring is released and the trolleys move apart. Which ONE of the following statements is TRUE?

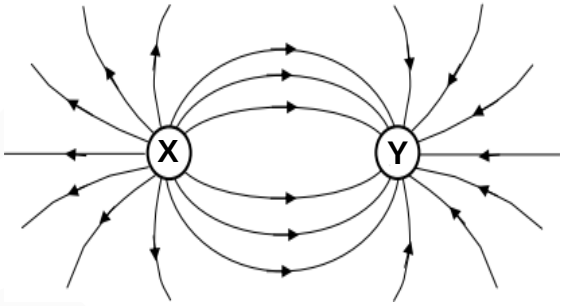
A **P** and **Q** have equal kinetic energies.

B The speed of **P** is less than the speed of **Q**.

C The sum of the final kinetic energies of **P** and **Q** is zero.

D The sum of the final momentum of **P** and **Q** is zero. (2)

1.5 The diagram below shows the electric field pattern due to two point charges **X** and **Y**.



Which ONE of the following represents the charge on **X** and **Y** respectively?

	POINT CHARGE X	POINT CHARGE Y
A	Negative	Negative
B	Positive	Positive
C	Positive	Negative
D	Negative	Positive

(2)

1.6 Two identical metal spheres, each of mass *m* and separated by a distance *r*, exert a gravitational force of magnitude *F* on each other. The distance between the spheres is now HALVED.

The magnitude of the force the spheres now exerts on each other is:

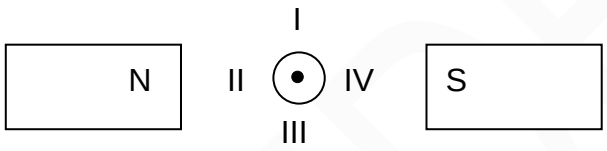
A ½*F*

B *F*

C 2*F*

D 4*F* (2)

1.7 In the diagram below, a conductor placed between two magnets is carrying current out of the page.



The direction of the force exerted on the conductor is towards:

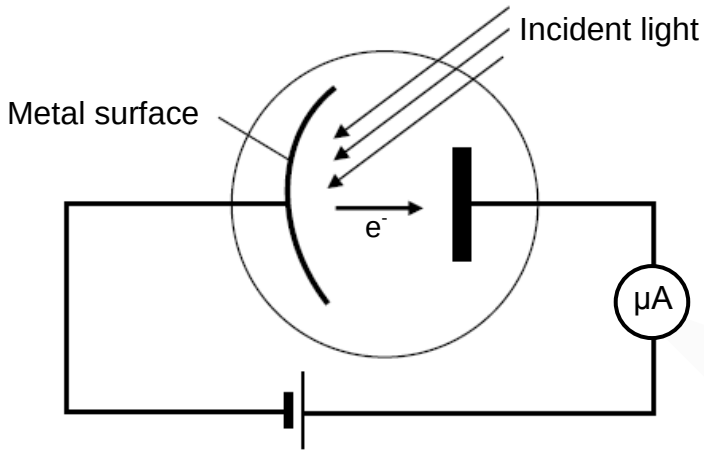
A I

B II

C III

D IV (2)

1.8 When light of a certain frequency is incident on the cathode of a photocell, the ammeter in the circuit registers a reading.

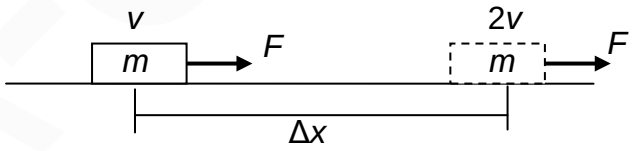


The frequency of the incident light is now increased while keeping the intensity constant. Which ONE of the following correctly describes the reading on the ammeter and the reason for this reading?

	AMMETER READING	REASON
A	Increases	More photoelectrons are emitted per second.
B	Increases	The speed of the photoelectrons increases.
C	Remains the same	The number of photoelectrons remains the same.
D	Remains the same	The speed of the photoelectrons remains the same.

(2)

1.9 An applied force *F* accelerates an object of mass *m* on a horizontal frictionless surface from a velocity *v* to a velocity 2*v*.



The net work done on the object is equal to ...

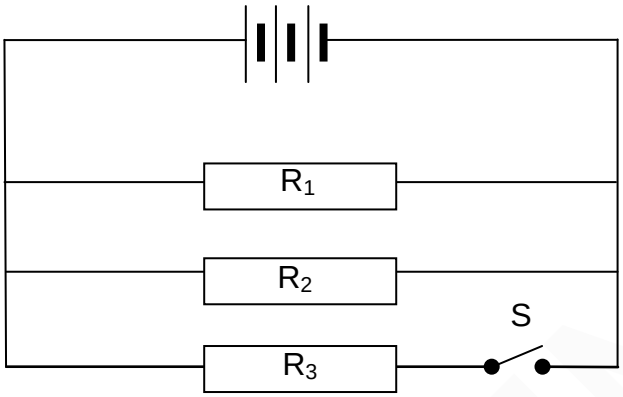
A $\frac{1}{2}mv^2$.

B mv^2.

C $\frac{3}{2}mv^2$.

D $2mv^2$. (2)

1.10 Consider the circuit diagram below.



Which ONE of the following correctly describes the change in total resistance and total current when switch **S** is closed?

	TOTAL RESISTANCE	TOTAL CURRENT
A	Decreases	Decreases
B	Increases	Increases
C	Decreases	Increases
D	Increases	Decreases

(2)
[20]

SECTION A

QUESTION 1: ONE-WORD ITEMS

Give ONE word/term for each of the following descriptions. Write only the word/term next to the question number (1.1–1.5) in the ANSWER BOOK.

1.1 The rate of change of velocity (1)

1.2 The distance between two consecutive points in phase on a wave (1)

1.3 A region of space in which an electric charge experiences an electrostatic force (1)

1.4 The type of electromagnetic wave with the shortest wavelength (1)

1.5 The minimum frequency of light needed to remove an electron from the surface of a metal (1)
[5]

QUESTION 2: MULTIPLE-CHOICE QUESTIONS

Four options are provided as possible answers to the following questions. Each question has only ONE correct answer. Write only the letter (A–D) next to the question number (2.1–2.10) in the ANSWER BOOK.

2.1 Which ONE of the following physical quantities is equal to the product of force and constant velocity?

A Work

B Power

C Energy

D Acceleration (2)

2.2 A 30 kg iron sphere and a 10 kg aluminium sphere with the same diameter fall freely from the roof of a tall building. Ignore the effects of friction.

When the spheres are 5 m above the ground, they have the same ...

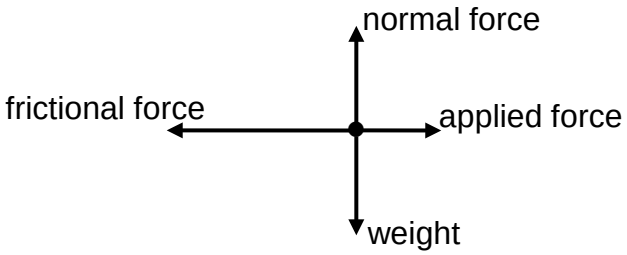
A momentum.

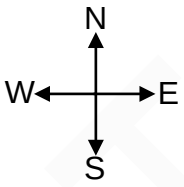
B acceleration.

C kinetic energy.

D potential energy. (2)

2.3 The free-body diagram below shows the relative magnitudes and directions of all the forces acting on an object moving horizontally in an easterly direction.





The kinetic energy of the object ...

A is zero.

B increases.

C decreases.

D remains constant. (2)

2.4 The hooter of a vehicle travelling at constant speed towards a stationary observer, produces sound waves of frequency 400 Hz. Ignore the effects of wind.

Which ONE of the following frequencies, in hertz, is most likely to be heard by the observer?

A 400

B 350

C 380

D 480 (2)

2.5 When two waves meet at a point, the amplitude of the resultant wave is the algebraic sum of the amplitudes of the individual waves.

This principle is known as …

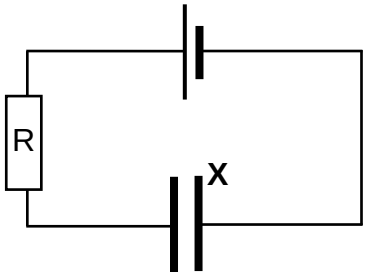
A dispersion.

B the Doppler effect.

C superposition.

D Huygens' principle. (2)

2.6 A parallel plate capacitor, **X**, with a vacuum between its plates is connected in a circuit as shown below. When fully charged, the charge stored on its plates is equal to Q.



Capacitor **X** is now replaced with a similar capacitor, **Y**, with the same dimensions but with paper between its plates. When fully charged, the charge stored on the plates of capacitor **Y** is …

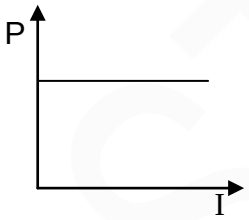
A zero.

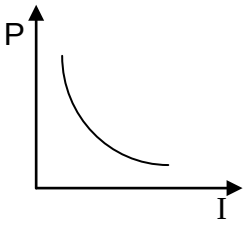
B equal to Q.

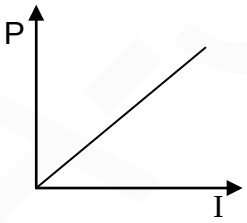
C larger than Q.

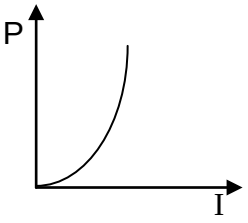
D smaller than Q. (2)

2.7 Which ONE of the following graphs best represents the relationship between the electrical power and the current in a given ohmic conductor?

A


B


C


D


(2)

2.8 In a vacuum, all electromagnetic waves have the same …

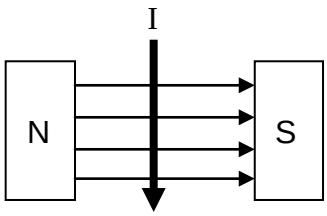
A energy.

B speed.

C frequency.

D wavelength. (2)

2.9 In the sketch below, a conductor carrying conventional current, I, is placed in a magnetic field.



Which ONE of the following best describes the direction of the magnetic force experienced by the conductor?

A Parallel to the direction of the magnetic field

B Opposite to the direction of the magnetic field

C Into the page perpendicular to the direction of the magnetic field

D Out of the page perpendicular to the direction of the magnetic field (2)

2.10 An atom in its ground state absorbs energy *E* and is excited to a higher energy state. When the atom returns to the ground state, a photon with energy ...

A *E* is absorbed.

B *E* is released.

C less than *E* is released.

D less than *E* is absorbed. (2)
[20]

TOTAL SECTION A: 25

SECTION A

QUESTION 1: ONE-WORD ITEMS

Give ONE word/term for each of the following descriptions. Write only the word/term next to the question number (1.1–1.5) in the ANSWER BOOK.

1.1 The type of electromagnetic radiation that is used to take pictures of the human skeleton (1)

1.2 The product of mass and velocity (1)

1.3 The principle which states that each point on a wave front acts as a source of secondary waves (1)

1.4 The unit of measurement equivalent to a coulomb per second (1)

1.5 The general term used to describe a system on which no external forces act (1)
[5]

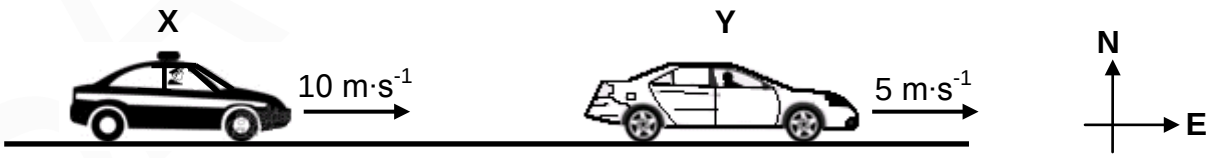
QUESTION 2: MULTIPLE-CHOICE QUESTIONS

Four options are provided as possible answers to the following questions. Each question has only ONE correct answer. Write only the letter (A–D) next to the question number (2.1–2.10) in the ANSWER BOOK.

2.1 Power is defined as the rate …

A of change of velocity.
B at which work is done.
C of change of momentum.
D of change of displacement. (2)

2.2 Two cars, **X** and **Y**, are travelling in an easterly direction along a straight level road as shown in the diagram below. The velocity of car **X** is 10 $m \cdot s^{-1}$ relative to the ground and the velocity of car **Y** is 5 $m \cdot s^{-1}$ relative to the ground.



The velocity of car **X** relative to car **Y** is …

A 5 $m \cdot s^{-1}$ east.
B 5 $m \cdot s^{-1}$ west.
C 15 $m \cdot s^{-1}$ east.
D 15 $m \cdot s^{-1}$ west. (2)

2.3 Which ONE of the following is an example of a contact force?

A Frictional force
B Magnetic force
C Electrostatic force
D Gravitational force (2)

2.4 A sound source approaches a stationary observer at constant velocity. Which ONE of the following describes how the observed frequency and wavelength differ from that of the sound source?

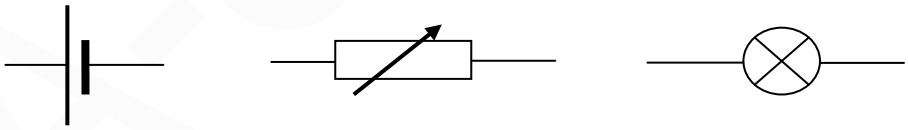
	Observed wavelength	Observed frequency
A	Greater than	Greater than
B	Less than	Less than
C	Greater than	Less than
D	Less than	Greater than

(2)

2.5 Two light sources of the same frequency maintain the same phase relationship with each other. This is an example of …

A coherence.
B Huygens' principle.
C destructive interference.
D constructive interference. (2)

2.6 Consider the three circuit components represented below.



Which ONE of the options below best represents the names of the components in the correct sequence, from left to right?

A Light bulb, resistor, cell
B Resistor, light bulb, cell
C Cell, light bulb, variable resistor
D Cell, variable resistor, light bulb (2)

2.7 A positively charged metal sphere **X** on an insulated stand is brought into contact with an identical neutral metal sphere **Y** on an insulated stand. The two spheres are then separated.

Which ONE of the following describes the charge on each sphere after they have been separated?

	Sphere X	Sphere Y
A	Positive	Neutral
B	Positive	Positive
C	Neutral	Positive
D	Neutral	Neutral

(2)

2.8 When the distance between the plates of a parallel plate capacitor is decreased, its capacitance …

A increases.

B decreases.

C becomes zero.

D remains unchanged. (2)

2.9 Consider the types of electromagnetic radiation below:

(i) Gamma rays
(ii) X-rays
(iii) Infrared rays

Which of the above radiations have wavelengths shorter than that of visible light?

A (i), (ii) and (iii)

B (i) and (ii) only

C (i) and (iii) only

D (ii) and (iii) only (2)

2.10 Which ONE of the following provides evidence that light behaves as particles?

A Light can be diffracted.

B Light is refracted by a triangular prism.

C Light ejects electrons from a metal surface.

D The speed of light decreases when it travels from air to glass. (2)

[20]

TOTAL SECTION A: 25

SECTION A

QUESTION 1: ONE-WORD ITEMS

Give ONE word/term for each of the following descriptions. Write only the word/term next to the question number (1.1–1.5) in the ANSWER BOOK.

1.1 The number of complete waves that pass a point in one second (1)

1.2 A circuit component which stores electric charge and releases it instantly (1)

1.3 The component in a generator needed to change it from an AC to a DC generator (1)

1.4 The tiny 'packets' (quanta) of energy that light consists of (1)

1.5 The vector difference of two velocities measured from the same frame of reference (1)
[5]

QUESTION 2: MULTIPLE-CHOICE QUESTIONS

Four options are provided as possible answers to the following questions. Each question has only ONE correct answer. Write only the letter (A–D) next to the question number (2.1–2.10) in the ANSWER BOOK.

2.1 The net force acting on an object is equal to the ...

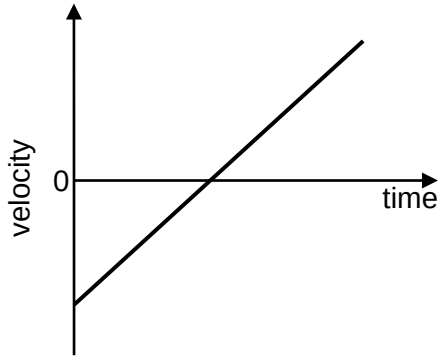
A mass of the object.

B acceleration of the object.

C change in momentum of the object.

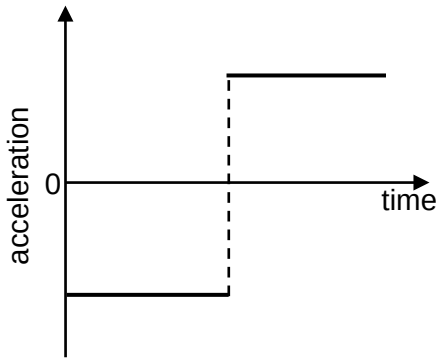
D rate of change in momentum of the object. (2)

2.2 The velocity-time graph below represents the motion of an object.

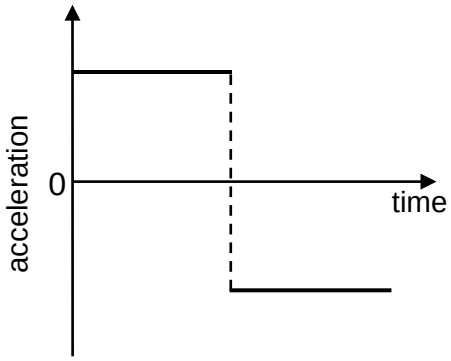


Which ONE of the following graphs represents the corresponding acceleration-time graph for the motion of this object?

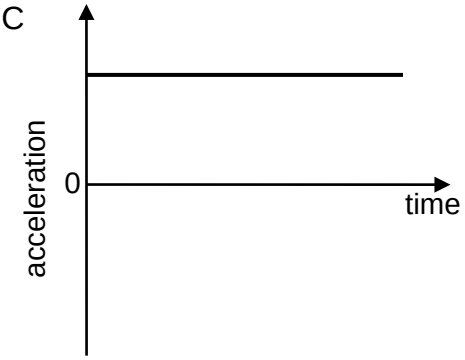
A



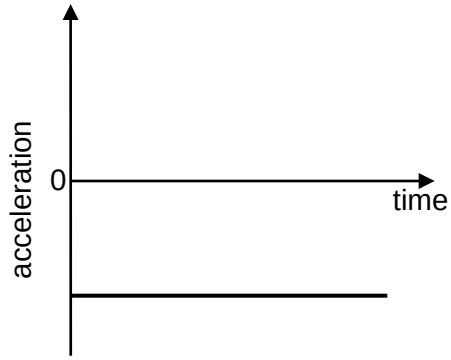
B



C



D



(2)

2.3 A car moves up a hill at CONSTANT speed. Which ONE of the following represents the work done by the weight of the car as it moves up the hill?

A ΔE_k

B ΔE_p

C $-\Delta E_k$

D $-\Delta E_p$ (2)

2.4 A central bright band is observed when light of wavelength λ passes through a single slit of width *a*.

Light of wavelength 2λ is now used. Which ONE of the following slit widths would produce a central bright band of the SAME broadness?

A $\frac{1}{4}a$

B $\frac{1}{2}a$

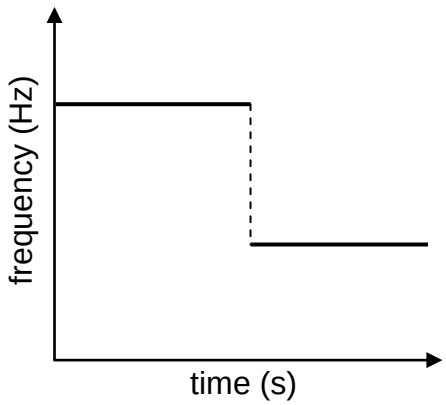
C a

D $2a$ (2)

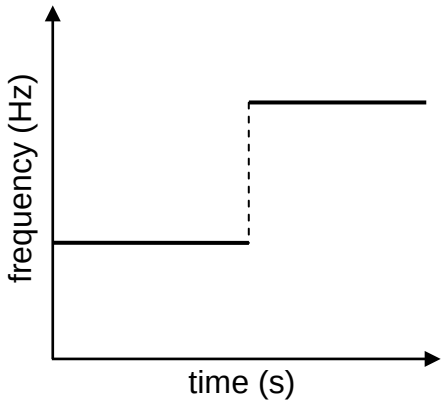
2.5 A source of sound approaches a stationary listener in a straight line at constant velocity. It passes the listener and moves away from him in the same straight line at the same constant velocity.

Which ONE of the following graphs best represents the change in observed frequency against time?

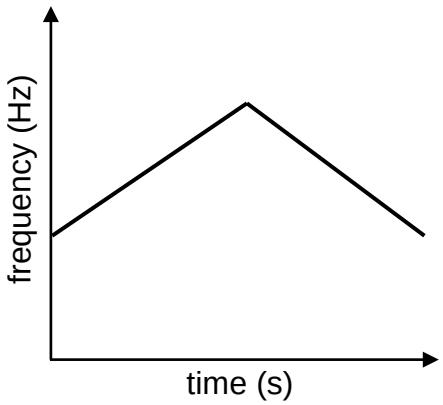
A



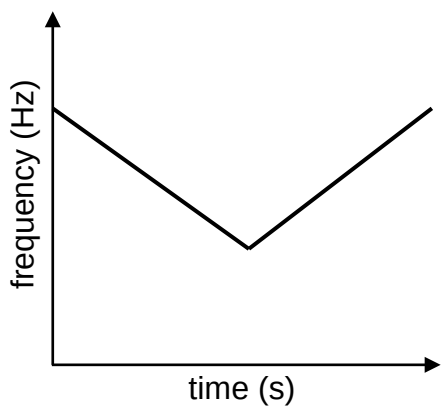
B



C



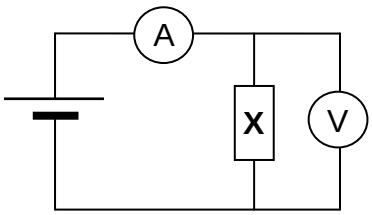
D



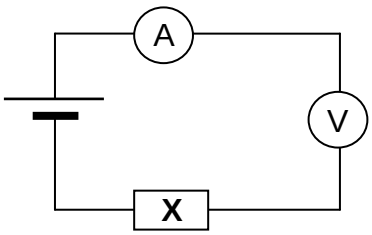
(2)

2.6 Which ONE of the circuits below can be used to measure the current in a conductor **X** and the potential difference across its ends?

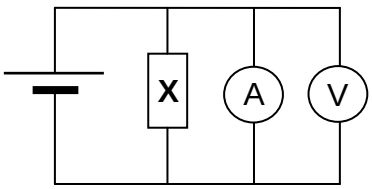
A



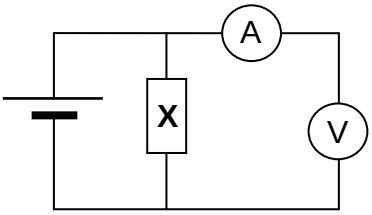
B



C

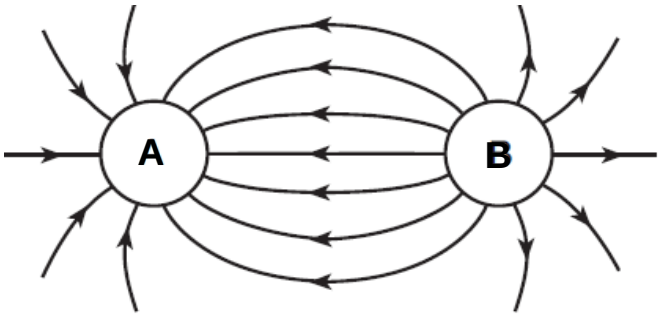


D



(2)

2.7 The electric field pattern between two charged spheres, **A** and **B**, is shown below.



Which ONE of the following statements regarding the charge on spheres **A** and **B** is CORRECT?

A Spheres **A** and **B** are both positively charged.

B Spheres **A** and **B** are both negatively charged.

C Sphere **A** is positively charged and sphere **B** is negatively charged.

D Sphere **A** is negatively charged and sphere **B** is positively charged. (2)

2.8 Which ONE of the following shows the different types of electromagnetic radiation in order of increasing frequency?

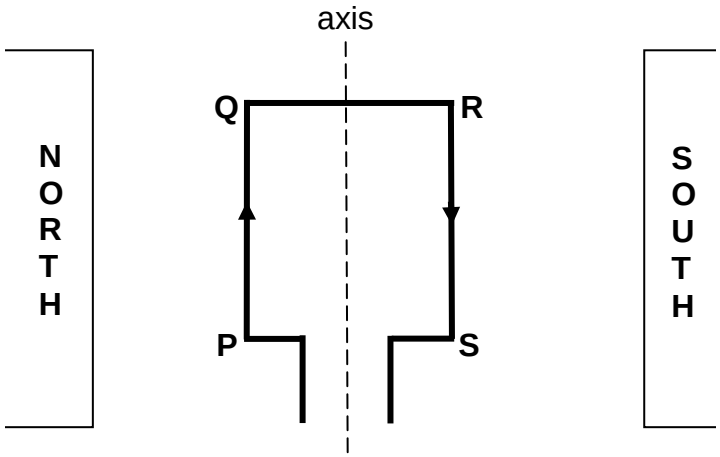
A X-rays; ultraviolet rays; infrared rays; visible light

B Infrared rays; X-rays; visible light; ultraviolet rays

C Infrared rays; visible light; ultraviolet rays; X-rays

D X-rays; ultraviolet rays; visible light; infrared rays (2)

2.9 A rectangular current-carrying coil, **PQRS**, is placed in a uniform magnetic field with its plane parallel to the field as shown below. The arrows indicate the direction of the conventional current.



The coil will ...

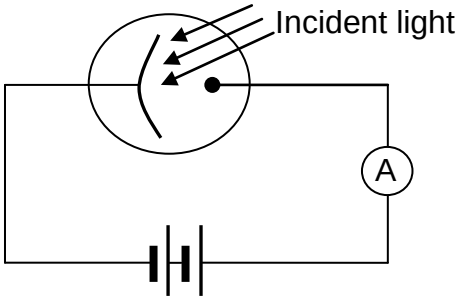
A rotate clockwise.

B remain stationary.

C rotate anticlockwise.

D rotate clockwise and then anticlockwise. (2)

2.10 The diagram below shows light incident on the cathode of a photocell. The ammeter registers a reading.



Which ONE of the following correctly describes the relationship between the intensity of the incident light and the ammeter reading?

	INTENSITY	**AMMETER READING**
A	Increases	Increases
B	Increases	Remains the same
C	Increases	Decreases
D	Decreases	Increases

(2)
[20]

TOTAL SECTION A: 25

SECTION A

QUESTION 1: ONE-WORD ITEMS

Give ONE word/term for each of the following descriptions. Write only the word/term next to the question number (1.1–1.5) in the ANSWER BOOK.

1.1 The type of energy an object has due to its motion (1)

1.2 The phenomenon which occurs when two light waves meet at a given point (1)

1.3 The unit of measurement of electrical resistance (1)

1.4 The basic principle on which electric generators function (1)

1.5 The type of line spectrum observed when electrons in an atom move from the excited state to the ground state (1)
[5]

QUESTION 2: MULTIPLE-CHOICE QUESTIONS

Four options are provided as possible answers to the following questions. Each question has only ONE correct answer. Write only the letter (A–D) next to the question number (2.1–2.10) in the ANSWER BOOK.

2.1 A car of mass m collides head-on with a truck of mass $2m$. If the car exerts a force of magnitude F on the truck during the collision, the magnitude of the force that the truck exerts on the car is …

A $\frac{1}{2}F$

B F

C $2F$

D $4F$ (2)

2.2 An object moves in a straight line on a ROUGH horizontal surface. If the net work done on the object is zero, then …

A the object has zero kinetic energy.

B the object moves at constant speed.

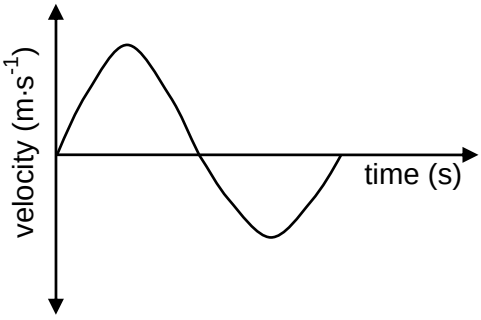
C the object moves at constant acceleration.

D there is no frictional force acting on the object. (2)

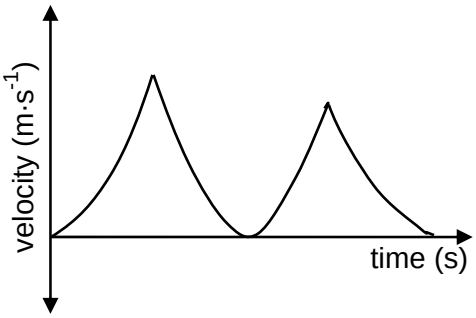
2.3 A ball is released from rest from a certain height above the floor and bounces off the floor a number of times. Ignore the effects of air resistance.

Which ONE of the following velocity-time graphs best represents the motion of the ball?

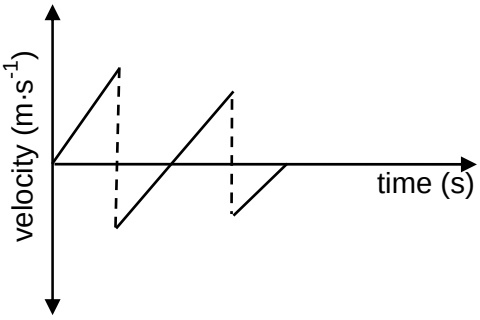
A



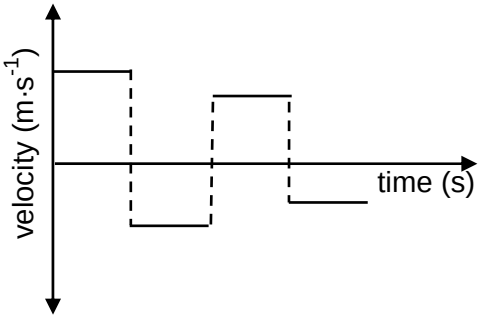
B



C

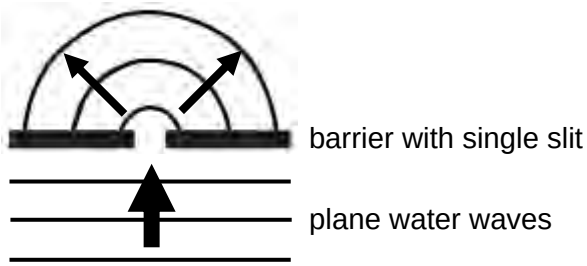


D



(2)

2.4 The diagram below shows plane water waves that spread out after passing through a single slit.



The wave phenomenon observed after the water waves pass through the slit is …

A reflection.

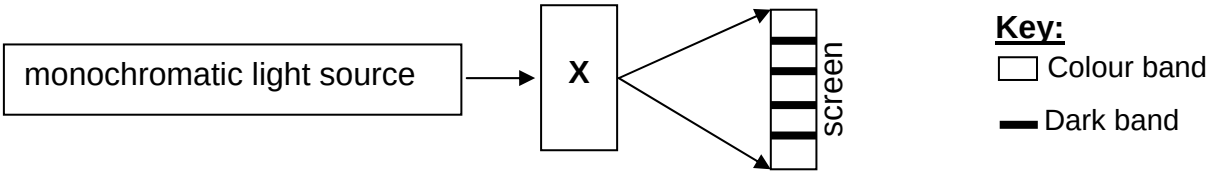
B diffraction.

C refraction.

D photoelectric effect. (2)

2.5 Monochromatic light from a point source passes through a device **X**.

A pattern is observed on a screen, as shown in the diagram below.



From the observation on the screen, it can be concluded that device **X** is a …

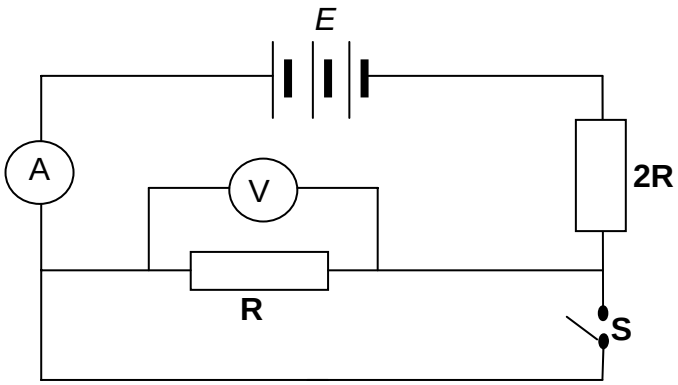
A prism.

B single slit.

C double slit.

D concave lens. (2)

2.6 In the circuit diagram below, the internal resistance of the battery and the resistance of the conducting wires are negligible. The emf of the battery is *E*.



When switch **S** is closed, the reading on voltmeter V, in volts, is ...

A 0

B $\frac{1}{3}E$

C $\frac{2}{3}E$

D E (2)

2.7 Two identical small metal spheres on insulated stands carry equal charges and are a distance *d* apart. Each sphere experiences an electrostatic force of magnitude *F*.

The spheres are now placed a distance $\frac{1}{2}d$ apart.

The magnitude of the electrostatic force each sphere now experiences is …

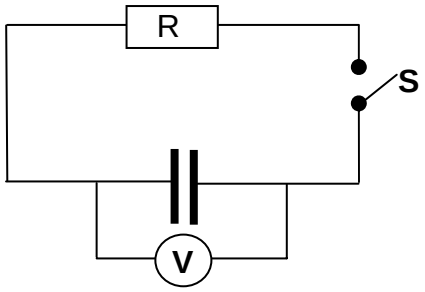
A $\frac{1}{2}F$

B F

C $2F$

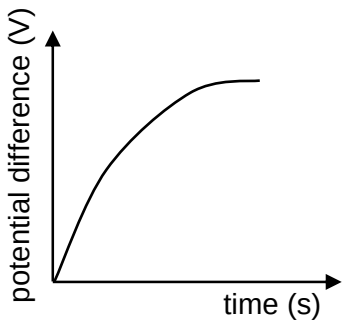
D $4F$ (2)

2.8 A fully charged capacitor is connected in a circuit, as shown below. The capacitor discharges when switch **S** is closed.

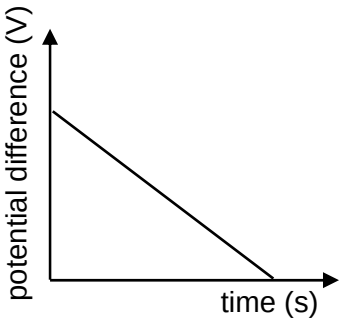


Which ONE of the following graphs correctly shows the change in the voltmeter reading with time when switch **S** is closed?

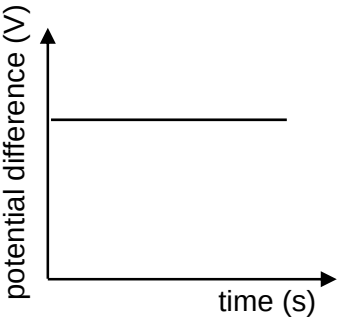
A



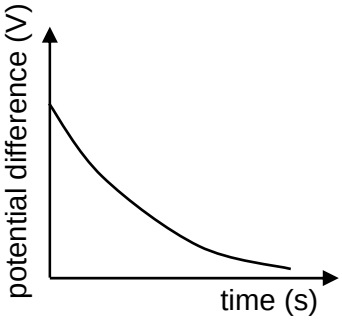
B



C

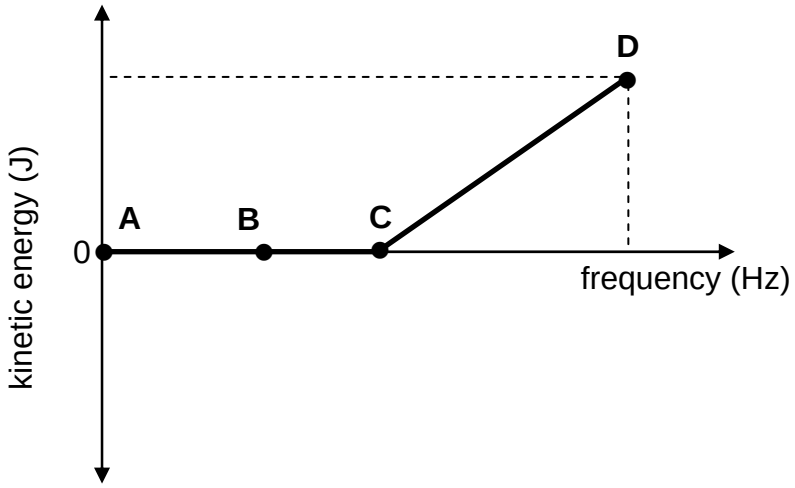


D



(2)

2.9 When light shines on a metal plate in a photocell, electrons are emitted. The graph below shows the relationship between the kinetic energy of the emitted photoelectrons and the frequency of the incoming light.



Which ONE of the points (**A**, **B**, **C** or **D**) on the graph represents the threshold frequency?

A A

B B

C C

D D (2)

2.10 Overexposure to sunlight causes damage to plants and crops.

Which ONE of the following types of electromagnetic radiation is responsible for this damage?

A Ultraviolet rays

B Radio waves

C Visible light

D X-rays (2)

[20]

TOTAL SECTION A: 25

SECTION A

QUESTION 1: ONE-WORD ITEMS

Give ONE word/term for each of the following descriptions. Write only the word/term next to the question number (1.1–1.5) in the ANSWER BOOK.

1.1 The rate at which work is done (1)

1.2 The term that describes two sources that produce waves that have a constant phase relationship to each other (1)

1.3 The general name given to the insulating material between the plates of capacitors (1)

1.4 The type of current produced by an electric generator which has slip rings (1)

1.5 The unit of measurement of electric field (1)
[5]

QUESTION 2: MULTIPLE-CHOICE QUESTIONS

Four options are provided as possible answers to the following questions. Each question has only ONE correct answer. Write only the letter (A–D) next to the question number (2.1–2.10) in the ANSWER BOOK.

2.1 Impulse is equal to the …

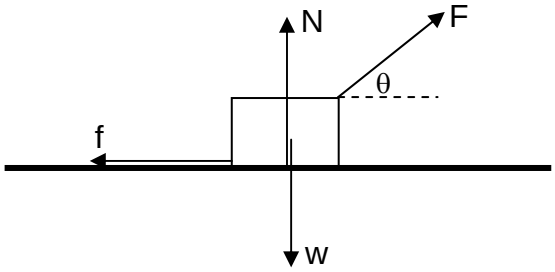
A initial momentum of a body.

B final momentum of a body.

C change in momentum of a body.

D rate of change in momentum of a body. (2)

2.2 An object is pulled along a straight horizontal road to the right without being lifted. The force diagram below shows all the forces acting on the object.



Which ONE of the above forces does POSITIVE WORK on the object?

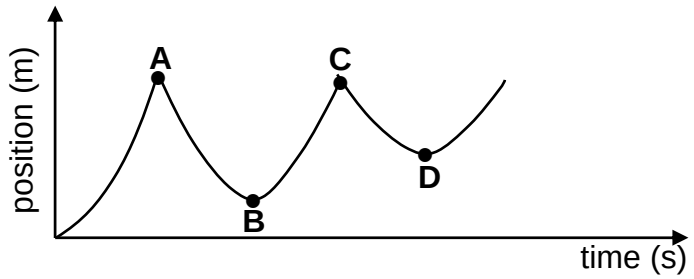
A w

B N

C f

D F (2)

2.3 A ball is released from rest from a certain height above the floor and bounces off the floor a number of times. The position-time graph below represents the motion of the bouncing ball from the instant it is released from rest.



Neglecting air resistance, which point (**A**, **B**, **C** or **D**) on the graph represents the position-time coordinates of the maximum height reached by the ball after the SECOND bounce?

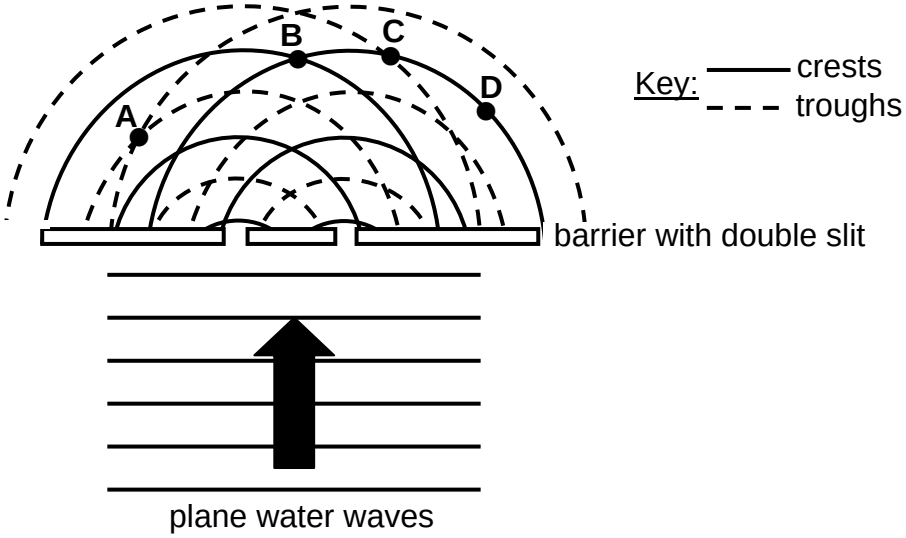
A A

B B

C C

D D (2)

2.4 Water waves pass through a double slit. The resulting circular wavefronts produced are shown as dotted and solid lines in the diagram below.



Which ONE of the points (**A**, **B**, **C** or **D**) lies on a nodal line?

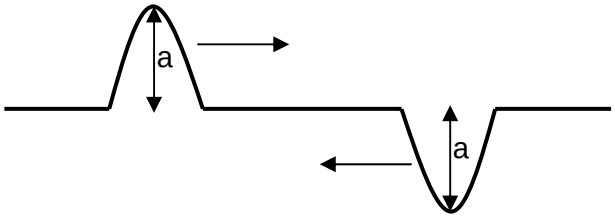
A A

B B

C C

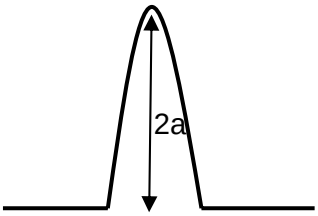
D D (2)

2.5 The diagram below represents two pulses, each of amplitude *a*, travelling in opposite directions along a slinky coil.



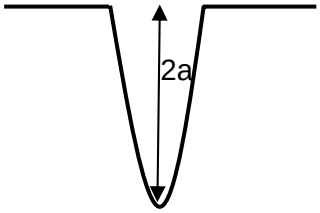
Which ONE of the following represents the resultant amplitude at the instant that these two pulses meet?

A

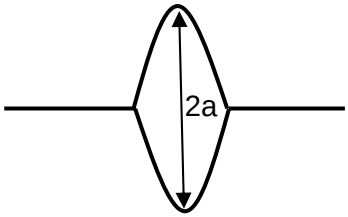


B

C



D

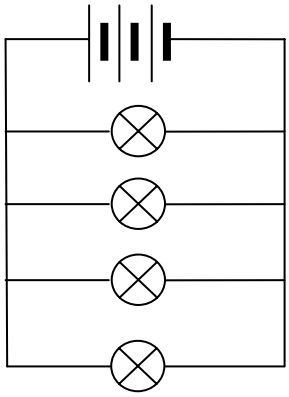


(2)

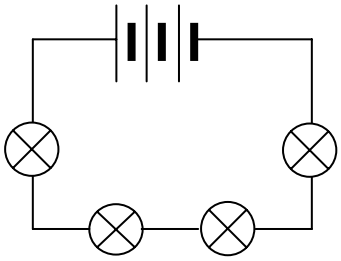
2.6 A set of identical light bulbs are connected as shown in the circuit diagrams below. The internal resistance of the battery is negligible.

In which ONE of these circuits will the light bulbs glow the brightest?

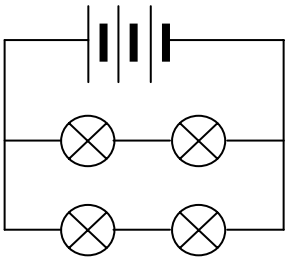
A



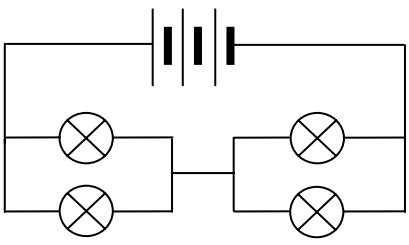
B



C



D



(2)

2.7 The unit of measurement of THE RATE OF FLOW OF CHARGE in a conductor is …

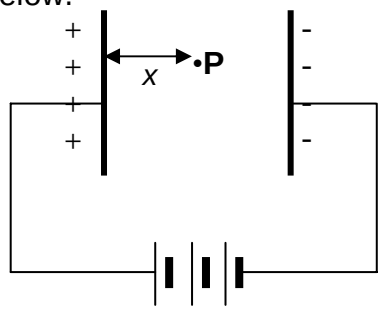
A watt.

B volt.

C ampere.

D coulomb. (2)

2.8 Point **P** is a distance *x* from the positive plate of a parallel-plate capacitor as shown in the diagram below.



The magnitude of the electric field at **P** is *E*. At a distance $\frac{1}{2}x$ from the positive plate, the magnitude of the electric field will be …

A $\frac{1}{4}E$

B $\frac{1}{2}E$

C E

D $2E$ (2)

2.9 Which ONE of the following descriptions best explains the formation of a line emission spectrum?

A line emission spectrum is formed when …

A white light passes through a cold gas.

B white light passes through a triangular prism.

C electrons in the ground state move to a higher energy level.

D electrons in the excited state move to a lower energy level. (2)

2.10 Which ONE of the following electromagnetic waves has the shortest wavelength?

A Radio waves

B Gamma rays

C Infrared rays

D Ultraviolet rays (2)

[20]

TOTAL SECTION A: 25

SECTION A

QUESTION 1: ONE-WORD ITEMS

Give ONE word/term for each of the following descriptions. Write only the word/term next to the question number (1.1 – 1.5) in the ANSWER BOOK.

1.1 The energy of a stationary object due to its position above the surface of the earth (1)

1.2 The unit of measurement equal to one joule per second (1)

1.3 The term used to describe two light sources that emit waves that maintain the same phase relationship with each other (1)

1.4 Electromagnetic waves with the highest penetrating ability (1)

1.5 The 'packets of energy' making up electromagnetic radiation (1)
[5]

QUESTION 2: FALSE ITEMS

Each of the five statements below is FALSE. Correct each statement so that it is TRUE. Write only the correct statement next to the question number (2.1 – 2.5) in the ANSWER BOOK.

NOTE: Correction by using the negative of the statement, for example "… IS NOT …", will not be accepted.

2.1 The magnitude of the acceleration of an object projected vertically upwards from the ground is zero at its maximum height. (2)

2.2 When a bullet is fired from a gun, the momentum of the bullet is the same as the momentum of the gun. (2)

2.3 Dispersion of white light by the parallel tracks on the surface of a CD is the result of refraction. (2)

2.4 Non-identical resistors connected in series have the same current in them and the same potential difference across each of them. (2)

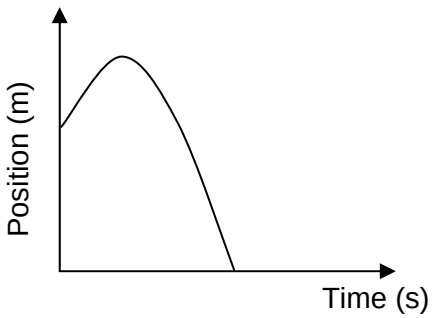
2.5 A line emission spectrum is formed when electrons in an atom move from lower to higher energy levels. (2)
[10]

QUESTION 3: MULTIPLE-CHOICE QUESTIONS

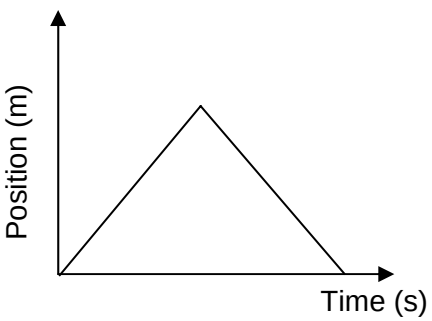
Four options are given as possible answers to the following questions. Each question has only ONE correct answer. Write only the letter (A – D) next to the question number (3.1 – 3.5) in the ANSWER BOOK.

3.1 A stone is thrown vertically upwards and returns to the thrower's hand after a while. Which ONE of the following position-versus-time graphs best represents the motion of the stone?

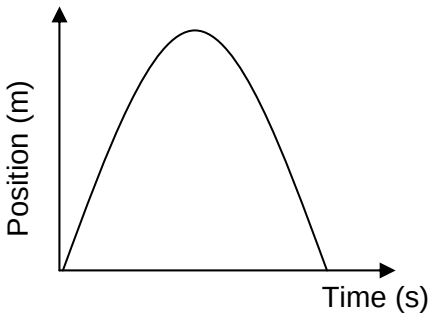
A



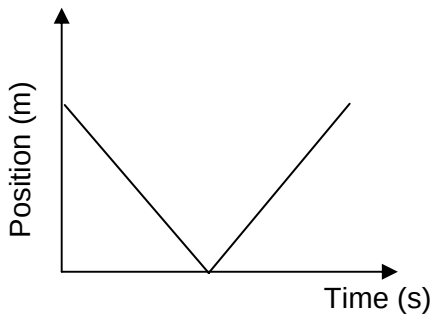
B



C



D



(2)

3.2 Car A moves west at speed *v*. Car B moves east at speed 2*v* along the same straight road. The velocity of Car A relative to Car B is:

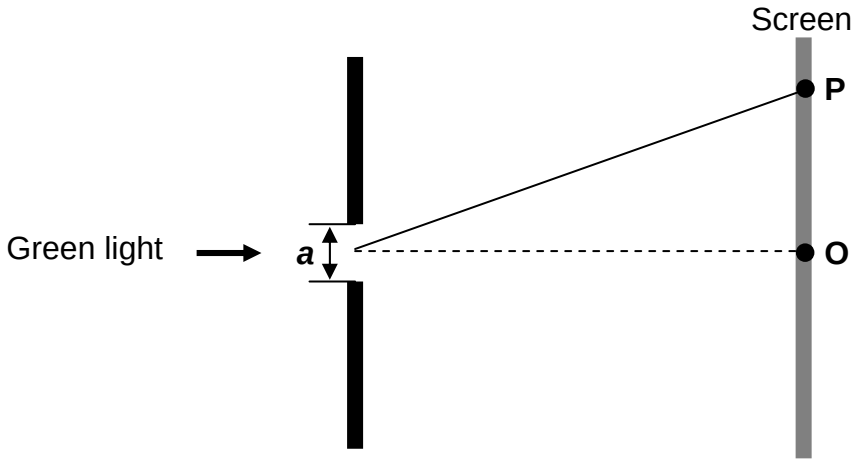
A 3*v* west

B 3*v* east

C *v* east

D *v* west (2)

3.3 Green light passes through a narrow slit of width *a*. The first minimum is observed at point P on a screen as shown in the diagram below.

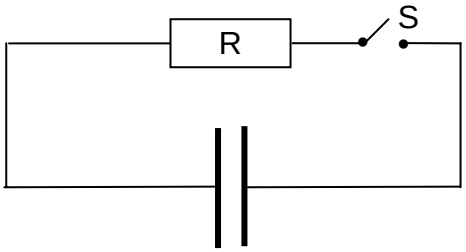


Which ONE of the following changes regarding the colour of the incident light and the width of the slit will cause the GREATEST increase in the distance OP?

	Colour of light	**Width of slit**
A	Red	2*a*
B	Red	½*a*
C	Blue	2*a*
D	Blue	½*a*

(2)

3.4 A fully charged capacitor is connected to a resistor *R* in a circuit, as shown below.

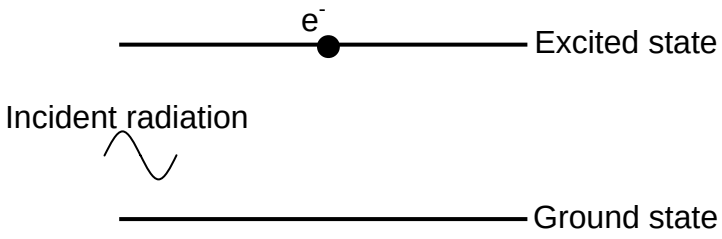


Which ONE of the following correctly describes the changes in the current, *I*, in the circuit and the potential difference, *V*, across the capacitor when the switch S is closed?

	I	***V***
A	Decreases	Increases
B	Increases	Decreases
C	Decreases	Decreases
D	Increases	Increases

(2)

3.5 The diagram below represents part of the process of stimulated emission in a laser. An electron in an atom of the lasing material is shown in the excited state, with radiation incident on the lasing material.



The radiation emitted by the electron when dropping to the ground state will be …

A in phase and in the same direction as the incident radiation.

B in phase and opposite in direction to the incident radiation.

C out of phase and in the same direction as the incident radiation.

D out of phase and opposite in direction to the incident radiation. (2)

[10]

TOTAL SECTION A: 25

SECTION A

Answer this section on the attached ANSWER SHEET.

QUESTION 1: ONE-WORD ITEMS

Give ONE word/term for EACH of the following descriptions. Write only the word/term next to the question number (1.1 – 1.5) on the attached ANSWER SHEET.

1.1 The product of force and velocity (1)

1.2 The type of collision in which kinetic energy is conserved (1)

1.3 The coloured bands produced when white light passes through a triangular prism (1)

1.4 A device used to store charge in an electric circuit (1)

1.5 A phenomenon that occurs in a LASER when there are more electrons in a high-energy state than in a lower energy state (1)

[5]

QUESTION 2: MATCHING ITEMS

Choose an item from COLUMN B that matches a description in COLUMN A. Write only the letter (A – J) next to the question number (2.1 – 2.5) on the attached ANSWER SHEET.

COLUMN A		COLUMN B	
2.1	A unit of measure equal to $kg \cdot m^2 \cdot s^{-2}$	A	opaque
2.2	The rate of change of momentum	B	electric field
2.3	Objects that absorb some light while reflecting others	C	net force
2.4	Electric potential energy per unit charge	D	joule
2.5	A source of monochromatic light	E	light bulb
		F	newton
		G	laser
		H	electric potential
		I	transparent
		J	impulse

[5]

QUESTION 3: TRUE/FALSE ITEMS

Indicate whether the following statements are TRUE or FALSE. Write only 'true' or 'false' next to the question number (3.1 – 3.5) on the attached ANSWER SHEET. Correct the statement if it is FALSE.

3.1 When work is done by a net force on an object moving along a horizontal plane, the kinetic energy of the object is constant. (2)

3.2 When car A, travelling at 20 $m \cdot s^{-1}$, approaches car B, travelling at 18 $m \cdot s^{-1}$ in the opposite direction, its speed relative to car B is 38 $m \cdot s^{-1}$. (2)

3.3 The degree of diffraction of a wave is directly proportional to its frequency. (2)

3.4 In a parallel plate capacitor, a dielectric increases capacitance by increasing the net electric field between the plates. (2)

3.5 In a laser, an incident photon leads to the creation of an identical photon travelling in the same direction as the incident photon. (2)

[10]

QUESTION 4: MULTIPLE-CHOICE QUESTIONS

Four options are provided as possible answers to the following questions. Each question has only ONE correct answer. Choose the answer and make a cross (X) in the block (A – D) next to the question number (4.1 – 4.5) on the attached ANSWER SHEET.

4.1 A car of mass *m* moves along a straight line with a velocity of magnitude *v*. The driver sees an obstruction and immediately applies the brakes. The car stops uniformly in *t* seconds from the moment that the brakes are applied. The car does not hit the obstruction.

Which ONE of the following represents the MAGNITUDE of the average force exerted on the car during the braking period of *t* seconds?

A $\frac{v}{t}$

B mv

C $\frac{mv}{t}$

D mvt (3)

4.2 Consider the statements below:

I Work is done on an object when a force displaces the object in the direction of the force.

II Mechanical energy of a system is conserved when an external force does no work on the system.

III The work done on an object by a net force is equal to the kinetic energy of the object.

Which of the above statements is/are TRUE?

A Only I

B I and II only

C II and III only

D I, II and III (3)

4.3 Which ONE of the statements is CORRECT for the pigment cyan?

Cyan absorbs …

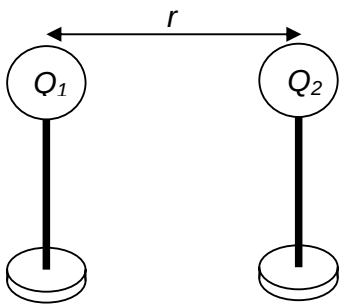
A red light while reflecting green and blue light.

B green light while reflecting red and blue light.

C blue light while reflecting green and red light.

D yellow light while reflecting green and blue light. (3)

4.4 The centres of two identical spheres are a distance *r* apart. They carry charges of Q_1 and Q_2 respectively as shown in the diagram below. Each sphere exerts an electrostatic force of magnitude *F* on the other.



The distance between the charges is now **halved** and the charge on Q_1 is **doubled.** The magnitude of the new force between the charges is …

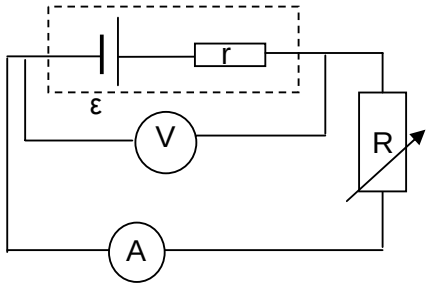
A *F*

B 2*F*

C 4*F*

D 8*F* (3)

4.5 In the circuit represented below, the resistance of the variable resistor is decreased.



How would this decrease affect the readings on the voltmeter and ammeter?

	Voltmeter reading	Ammeter reading
A	unchanged	unchanged
B	decreases	increases
C	decreases	unchanged
D	increases	increases

(3)
[15]

TOTAL SECTION A: 35