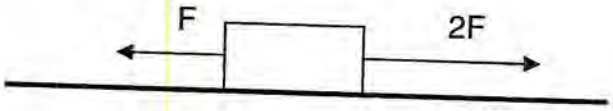
QUESTION 1: MULTIPLE-CHOICE QUESTIONS

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.

1.1 A block is placed on a surface with negligible friction. Forces **F** and **2F** are applied on the block as shown below.



Which ONE of the following correctly describes the motion of the block?

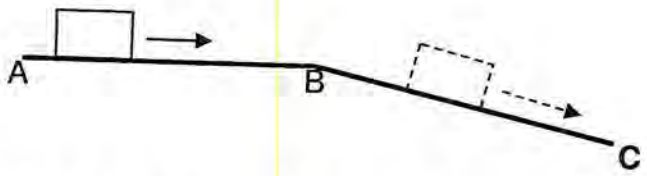
A The block moves at constant velocity to the right.

B The block moves with increasing acceleration to the right.

C The block moves with constant acceleration to the right.

D The block moves with constant acceleration to the left. (2)

1.2 A block moves at velocity **v** across a horizontal surface **AB.** It then moves down slope **BC**. The coefficient of kinetic friction is the same along **ABC.**



Which one of the following statements about the frictional force experienced by the block is TRUE?

A $f_k(\text{slope}) > f_k(\text{horizontal})$

B $\mu_k N(\text{slope}) = \mu_k N(\text{horizontal})$

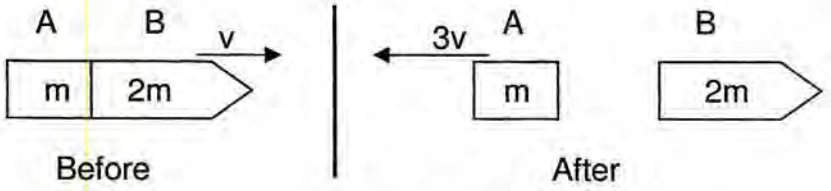
C $f_k(\text{slope}) < f_k(\text{horizontal})$

D $f_k(\text{slope}) = f_k(\text{horizontal})$ (2)

1.3 A ball is dropped from rest at a height above the ground and reaches a velocity **v** after it has travelled a distance 2**y.** What will the magnitude of the velocity of the object be after it has travelled a distance 8**y**?
(Ignore all effects of friction.)

A ½ v
B $\sqrt{2}$ v
C 2v
D 4v (2)

1.4 A spacecraft, consisting of two parts **A** and **B**, with mass **m** and **2m** respectively, is moving with a velocity **v** in an easterly direction. After an explosion, part **A** breaks away from part **B** with a velocity of **3v** in a westerly direction as shown below.



The magnitude of the velocity of part **B** after collision is ...

A **v**
B 2v
C 3v
D 6v (2)

1.5 An object, with mass **m**, is accelerated vertically upwards by an applied force **F** acting on it. (Ignore all effects of friction.)

Which ONE of the following is true for the work done by the applied force **F** and the net force $\mathbf{F}_{net}$ respectively?

	WORK DONE BY F	WORK DONE BY F_{net}
A	$\Delta U + \Delta K$	$\frac{1}{2}mv^2$
B	$\Delta U - \Delta K$	$\frac{1}{2}mv^2$
C	$\Delta U + \Delta K$	ΔK
D	$mgh + \frac{1}{2}mv^2$	ΔK

(2)

1.6 A ball is dropped from rest, in the absence of air friction, from a height **h** with mechanical energy equals to **E**. When the ball reaches a height **⅓h**, the kinetic energy of the ball will be ...

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

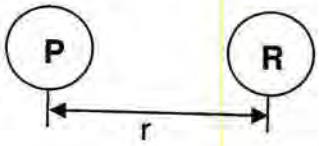
B $\frac{2}{3}E$

C E

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

(2)

1.7 The electric field experienced by point charge **P** due to the presence of point charge **R** at a distance **r** from **P**, is equal to **E.**



If the distance between **P** and **R** is increased to **2r**, the electric field experienced by **P** will be ...

A 4E.

B 2E.

C ½E.

D ¼E.

(2)

1.8 A lamp connected to an AC supply lights up with the same brightness as it does when connected to a **X** volt DC source. The power dissipated by the lamp, is equal to ...

A ½(X)(I_{max}).

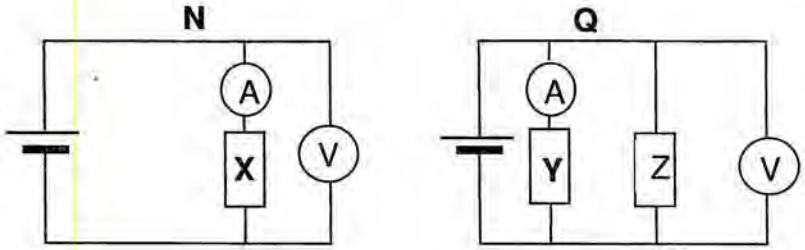
B (X) $\frac{I_{max}}{\sqrt{2}}$

C $\frac{X}{\sqrt{2}}I_{rms}$

D (X)(I_{max}).

(2)

1.9 In circuits **N** and **Q** shown below all resistors and cells are **identical.**

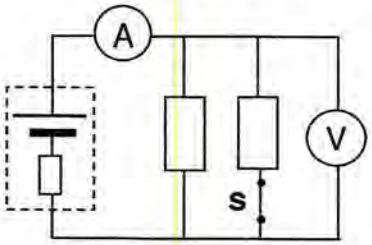


Which ONE of the following gives the correct comparison between the ammeter reading and the voltmeter reading across resistor **X** and **Y** respectively?

	AMMETER READING	VOLTMETER READING
A	$I_X = I_Y$	$V_X = V_Y$
B	$I_X > I_Y$	$V_X > V_Y$
C	$I_X < I_Y$	$V_X < V_Y$
D	$I_X = I_Y$	$V_X > V_Y$

(2)

1.10 A circuit with two parallel resistors is shown below.



How will the ammeter and voltmeter readings be affected if switch **S** is opened?

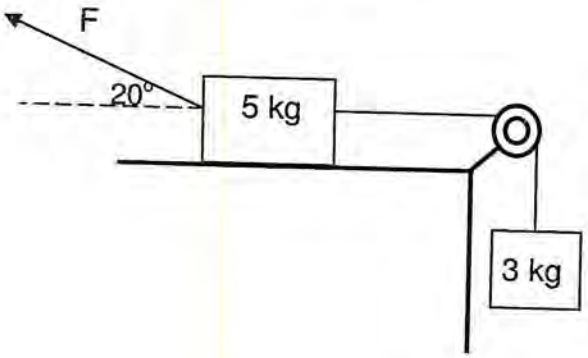
	AMMETER READING	VOLTMETER READING
A	Increase	Decrease
B	Decrease	Increase
C	Stays the same	Stays the same
D	Decrease	Decrease

(2)
[20]

QUESTION 2 (Begin on a new page.)

A 5 kg block, resting on a rough horizontal surface, is connected by a light inextensible string passing over a light frictionless pulley to a second block of mass 3 kg hanging vertically.

An applied force **F** is acting on the 5 kg block as shown in the diagram below and the coefficient of kinetic friction between the 5 kg block and the surface is 0,2.
The 5 kg block accelerates to the left.



2.1 Define the term *frictional force.* (2)

2.2 Calculate the magnitude of the:

2.2.1 Vertical component of **F** if the magnitude of the horizontal component of **F** equals 38 N (2)

2.2.2 Normal force acting on the 5 kg block (3)

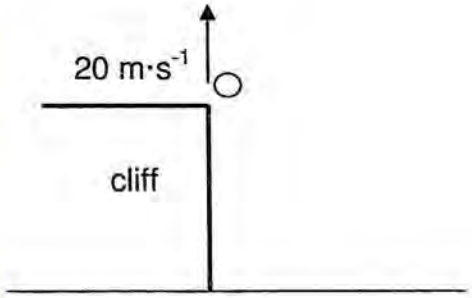
2.3 State *Newton's Second Law of motion.* (2)

2.4 Draw a labelled free-body diagram to indicate all the forces acting on the 3 kg block. (2)

2.5 Calculate the magnitude of the tension in the string connecting the two blocks. (6)
[17]

QUESTION 3 (Begin on a new page.)

A boy, standing on the edge of a cliff, projects a ball vertically upwards at a speed of 20 $m \cdot s^{-1}$. On its return the ball passes the boy and reaches the ground at the bottom of the cliff 6 s after it was projected. Ignore all effects of air friction.



3.1 Define the term *free fall.* (1)

3.2 Give the magnitude and direction of the acceleration of the ball the moment it reaches its maximum height. (1)

3.3 Calculate the time taken by the ball to pass the boy on its way downward. (4)

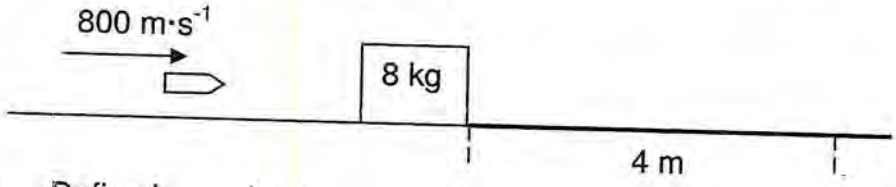
3.4 Calculate the height of the ball above the ground 2,8 s after it is released. (5)

On reaching the ground, the ball bounces inelastically from the ground.

3.5 Sketch a position-time graph for the motion of the ball from the time it is projected till it reaches its maximum height after the first bounce. Use the top of the cliff as zero position. Clearly indicate the time of 6 s on the graph. (3)
[14]

QUESTION 4 (Begin on a new page.)

The diagram below shows a bullet, of mass 40 g, that is travelling horizontally at a speed of 800 m·s^{-1}. The bullet strikes a stationary block of mass 8 kg and becomes embedded in it. The bullet and the block together travel on a rough horizontal surface for 4 m before coming to a stop.



4.1 Define in words the term *impulse*. (2)

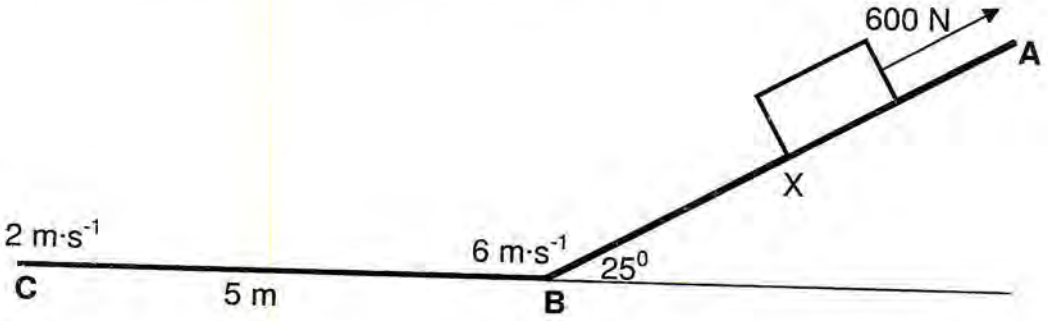
4.2 Calculate the change in momentum of the block caused by the impact of the bullet. (5)

4.3 Use energy principles to calculate the magnitude of the frictional force acting on the block after impact with the bullet. (4)

[11]

QUESTION 5 (Begin on a new page.)

A crate is allowed to move down a frictionless slope **AB** at constant velocity by applying a force of 600 N as shown in the diagram below.



5.1 Define the term *normal force*. (2)

5.2 Calculate the mass of the crate. (5)

The crate is then brought to rest at point **X** (by applying a larger force) when the cable suddenly snaps causing the crate to accelerate down the slope reaching point **B** with a speed of 6 m·s^{-1}. It then moves along a rough horizontal portion **BC** and reaches a speed of 2 m·s^{-1} at point **C**.

5.3 State in words the principle of conservation of mechanical energy. (2)

5.4 Calculate the:

5.4.1 Height at point **X** (4)

5.4.2 Coefficient of kinetic friction from **B** to **C** (5)
[18]

QUESTION 6 (Begin on a new page.)

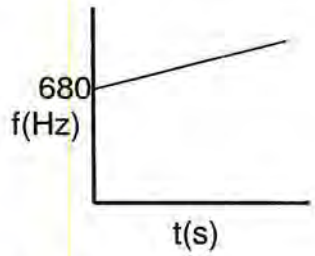
6.1 The siren of a stationary police car emits sound at a frequency of 650 Hz. An observer travelling in a car at constant velocity measures the frequency of the detected sound from the siren for two different situations. The results obtained are presented in graphs **A** and **B** below.

6.1.1 Define the *Doppler effect.* (2)

6.1.2 Which graph demonstrates the results obtained when the observer was travelling towards the siren. Give a reason for your answer. (2)

6.1.3 Calculate the speed of the observer using the data from graph **A**. (Take the speed of sound in air as 340 $m \cdot s^{-1}$) (5)

The observer now conducts a new investigation and from the results obtained draws the graph shown below.



6.1.4 Explain the change in the shape of the graph when compared to graph **B**. (2)

6.2 State ONE use of the Doppler effect in medicine. (1)
[12]

QUESTION 7 (Begin on a new page.)

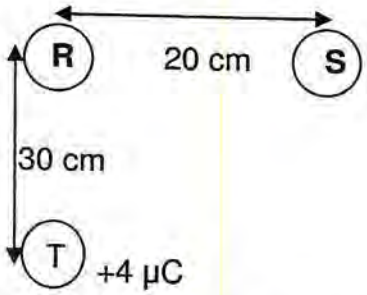
The diagram below shows two identical spheres **R** an **S** carrying charges of -6 μC and +2 μC respectively placed a distance apart in vacuum.

7.1 State *Coulomb's Law* in words. (2)

Spheres **R** and **S** are brought into contact for a while and then separated by a distance of 20 cm.

7.2 Calculate the charge on each sphere. (1)

After **R** and **S** has touched, a third sphere **T**, of charge +4 μC, is placed at a position as shown in the diagram below.

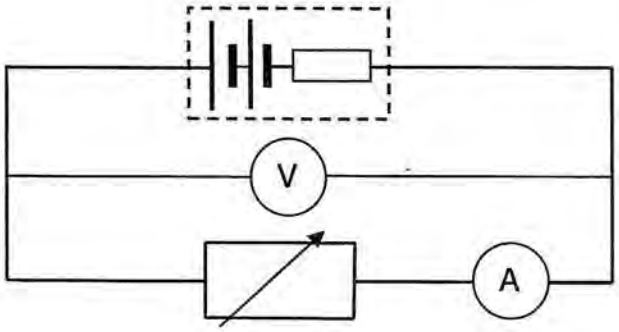


7.3 Calculate the net electrostatic force acting on **R** due to the presence of spheres **S** and **T**. (7)

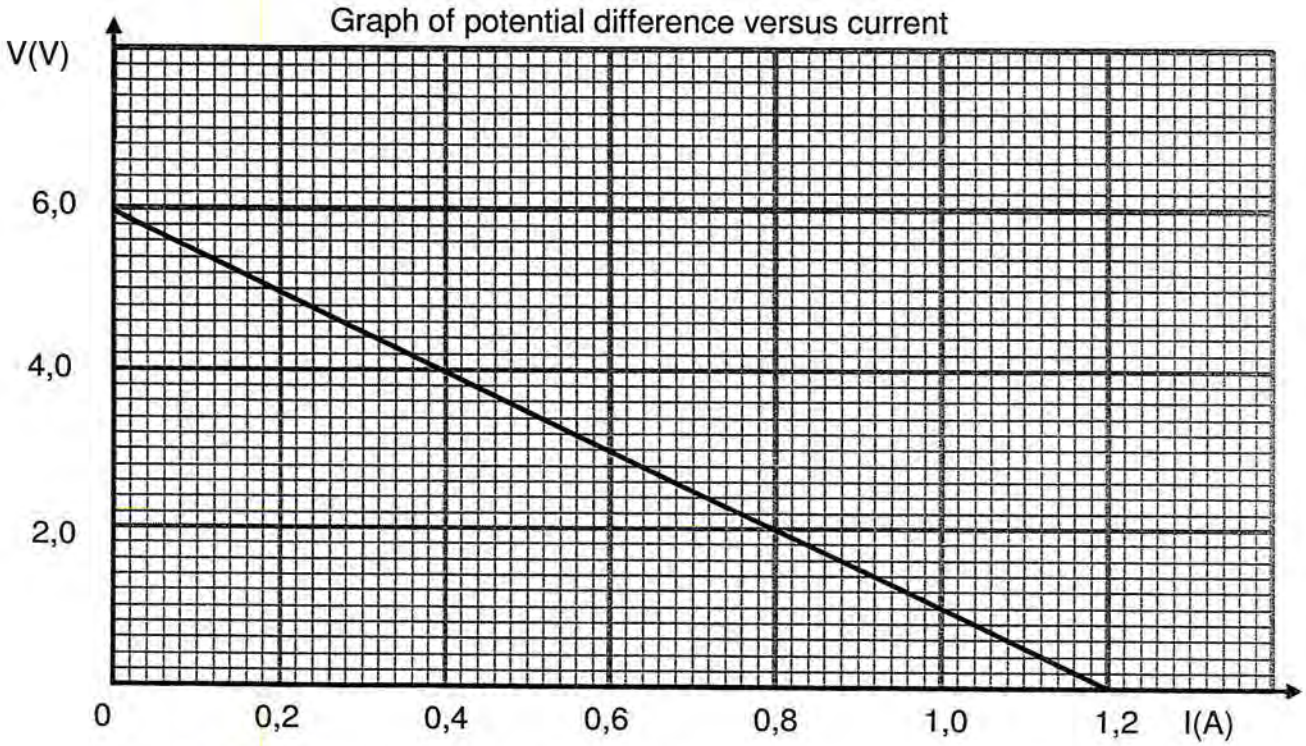
[10]

QUESTION 8 (Begin on a new page.)

8.1 A group of learners conducts an experiment to determine the internal resistance of a battery. They connect the battery to a rheostat, an ammeter and a voltmeter as shown in the diagram below.



The data obtained are shown in the graph below.



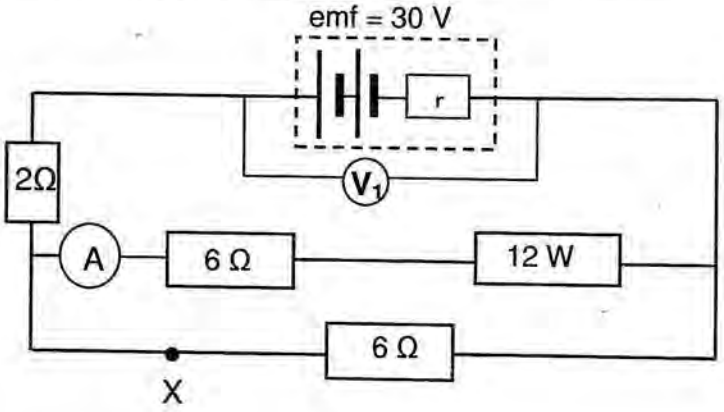
8.1.1 Explain the purpose of the rheostat. (2)

8.1.2 Name the independent variable in the experiment. (1)

8.1.3 What is the value of the emf of the battery? (1)

8.1.4 Calculate $V_{internal}$ if the current in the circuit is equal to 0,8 A. (2)

8.2 Three resistors and an electrical device are connected to a 30 V battery with internal resistance **r** as shown in the circuit diagram below. The ammeter has a reading of 2 A.



8.2.1 Define the term *emf* of a battery. (2)

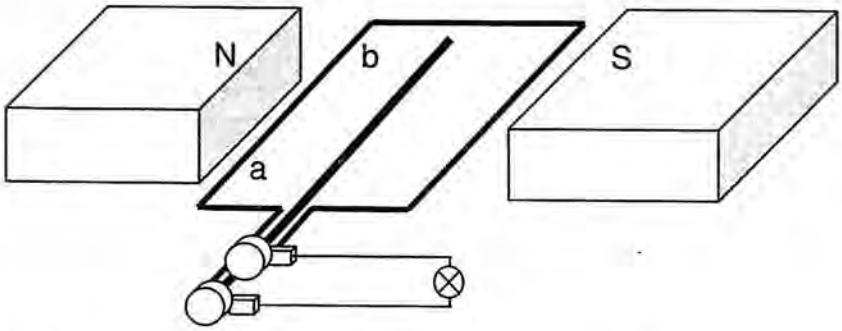
8.2.2 Calculate voltmeter reading V_1. (8)

8.2.3 Calculate the internal resistance of the battery. (3)

8.2.4 An additional resistor is connected at position **X** as indicated in the diagram. How will voltmeter reading V_1 be affected? Write down only INCREASE, DECREASE or STAYS THE SAME. Give an explanation for your answer. (4)
[23]

QUESTION 9 (Begin on a new page.)

9.1 A simplified diagram of an AC generator is shown below. The direction of the current in the coil is from **b** to **a**.



9.1.1 In which direction is the coil being rotated?
Write only CLOCKWISE or ANTICLOCKWISE. (1)

9.1.2 A maximum voltage is generated if the coil moves through the position indicated in the diagram above. Give an explanation for this observation. (2)

9.1.3 Starting from the position shown in the diagram above, sketch a graph of output voltage versus time for one complete cycle of the coil. (2)

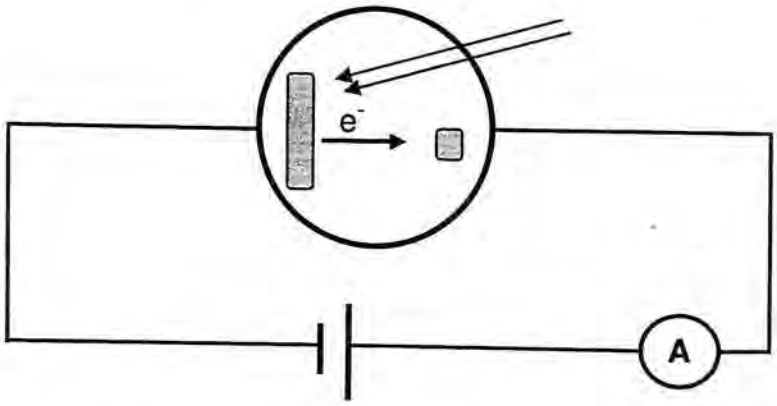
9.1.4 State ONE way in which the generator shown above can be used to produce a higher output voltage. (1)

9.1.5 Give ONE advantage for the use of alternating current. (1)

9.2 An electric fan with a power rating of 80 W is connected to an AC source which produces 7 A maximum current. Calculate the resistance of the fan. (5)
[12]

QUESTION 10 (Begin on a new page.)

A learner investigates the photoelectric effect with the use of a photocell. The photocell is irradiated by light of different wavelengths as shown below.



10.1 Define, in words, the *photoelectric effect.* (2)

10.2 The wavelengths of three sources of light are shown in the table below.

LIGHT	**WAVELENGTH** (nm)
Blue	4,92
Violet	4.48
Ultraviolet	4,30

The threshold frequency of the metal used in the photocell is 6.45×10^{14}. The average speed of the emitted photoelectrons are $2,78 \times 10^{5}$ m·s^{-1}. Identify the light used to irradiate the photocell. (5)

10.3 The intensity of the incident light is now increased. How will this influence the following:

10.3.1 The ammeter reading. Write down only INCREASE, DECREASE or STAYS THE SAME. (1)

10.3.2 The kinetic energy of the photoelectrons. Write down only INCREASE, DECREASE or STAYS THE SAME. (1)

10.3.3 Give an explanation to your answer in QUESTION 10.3.2. (2)

10.4 Light emitted by gas discharge tubes as used in fluorescent lights produces a line emission spectrum. Briefly explain how this type of spectrum is formed. (2)

[13]

GRAND TOTAL: 150