ALEXANDER ROAD HIGH SCHOOL

November 2021	**PHYSICAL SCIENCES ASSESSMENT PAPER 1**	180 MINUTES
CO, JA, MH	**GRADE 11**	TOTAL = 150

Instructions:

- The question paper consists of 8 questions.
- Answer all the questions.
- Start each question on a **new side** of a page.
- Answer section A on the answer sheet provided AND section B on folio sheets.
- A non-programmable calculator may be used.
- Number the answers correctly according to the numbering system.
- Round off to two (2) decimal places where necessary.
- A formula sheet has been provided at the end of the question paper.

SECTION A

(answer on the answer sheet)

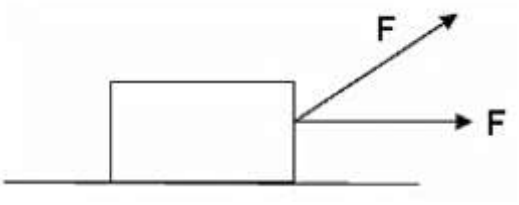
QUESTION 1:

Four possible options are provided as answers to the following questions. Each question has only one correct answer. Choose the correct answer and write the letter (A – D) next to the relevant question number (1.1 – 1.10) on the answer sheet.

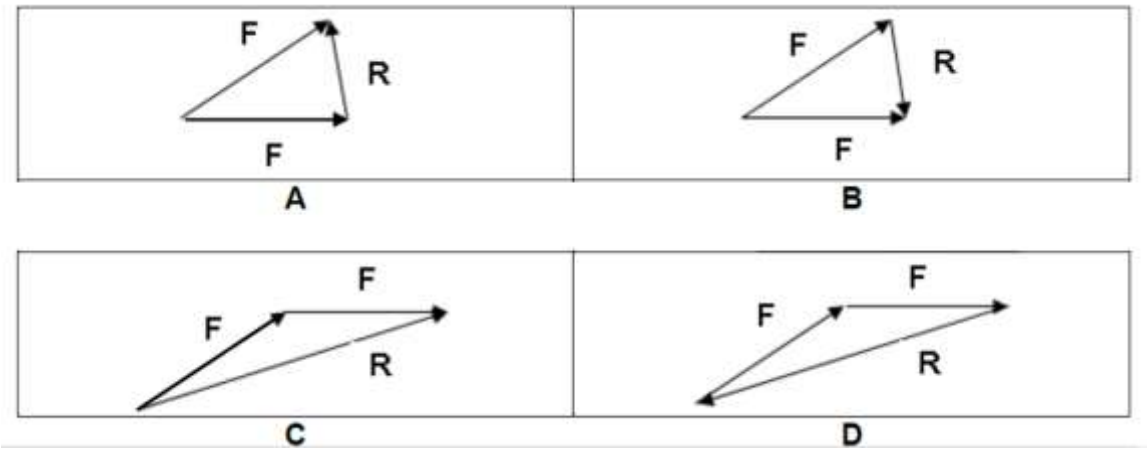
1.1 A bus stops suddenly. The standing passengers tumble forward as a result of their…

A. …velocity.
B. …inertia.
C. …acceleration.
D. …weight.

1.2 A crate is pulled along a smooth frictionless surface by two forces, each with a magnitude F, as shown in the diagram below.



Which vector diagram correctly shows how the resultant force R on the crate can be determined?



1.3 Hlumelo is much bigger and stronger than Themba. They lean on each other and both are stationary. Which ONE of the following statements is CORRECT?

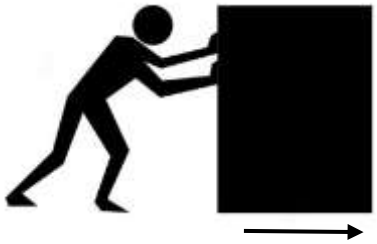
A. Hlumelo exerts a bigger force on Themba because he is stronger than Themba.

B. Themba must exert the bigger force because he has to stop heavier Hlumelo from falling on top of him.

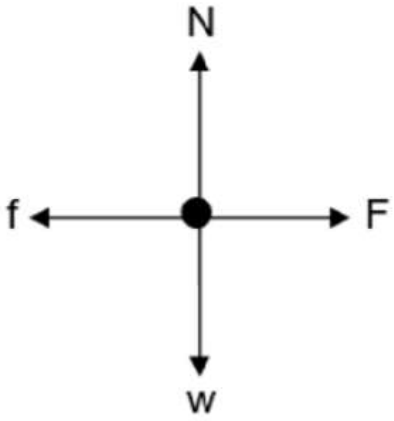
C. The action reaction pair cancels each other out.

D. The force Hlumelo exerts on Themba is the same as the force that Themba exerts on Hlumelo.

1.4 A constant force F is applied to an object, causing the object to move at a CONSTANT VELOCITY over a rough horizontal surface.



The free-body diagram below shows all the forces acting on the box. THE DIAGRAM IS NOT DRAWN TO SCALE.



Which ONE of the following relationships is correct?

A. F > f

B. F < f

C. F = w

D. F = f

1.5 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 greater than that on the moon.

C. The weight of an object on Earth is less than that on the moon.

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

1.6 The force between two charges is **F**. If the first charge is doubled, the second charge halved and the distance between the charges increased by a factor of 4, the new force will be

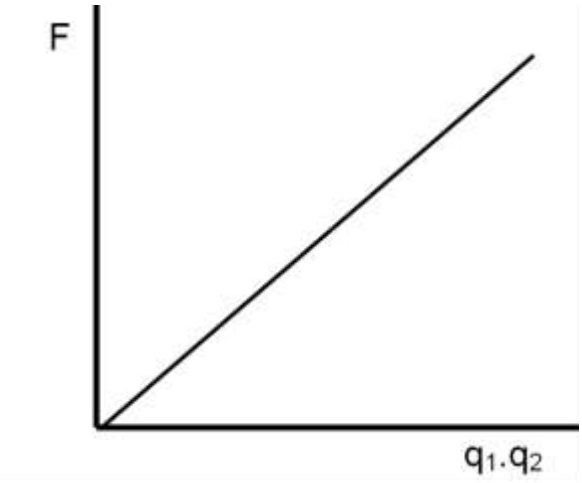
A. $\frac{1}{4} \times \mathbf{F}$

B. $\frac{1}{8} \times \mathbf{F}$

C. $\frac{1}{16} \times \mathbf{F}$

D. $\frac{1}{32} \times \mathbf{F}$

1.7 A group of scientists investigate the relationship between the electrostatic force **F** between two charges $\mathbf{q_1}$ and $\mathbf{q_2}$ a distance **r** apart and obtain the following graph:



The gradient of the graph is

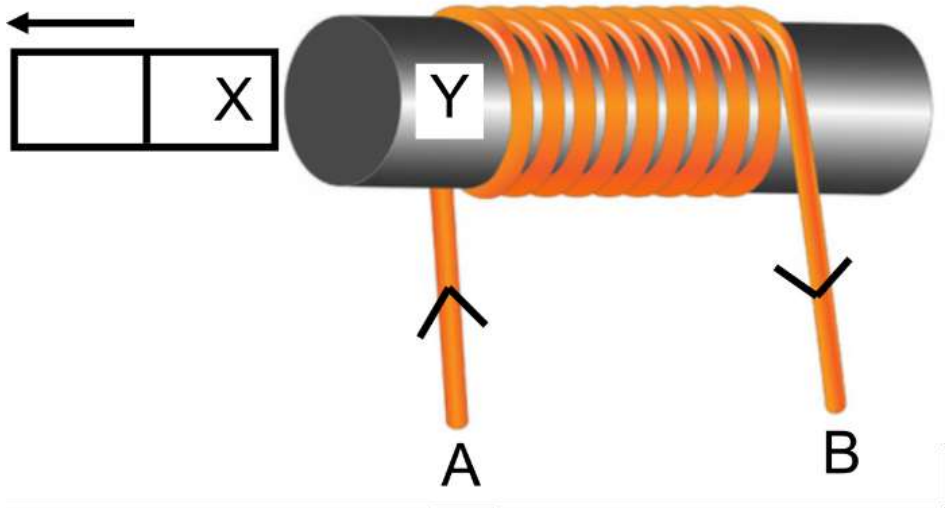
A. 9×10^9

B. $\mathbf{k}$

C. $\frac{1}{\mathbf{r}^2}$

D. $\frac{\mathbf{k}}{\mathbf{r}^2}$

1.8 A magnet is pulled out of a solenoid inducing a current which flows from **A to B** as shown in the diagram below.



Which ONE of the following combinations gives the correct polarity of X and Y?

	Polarity of X	**Polarity of Y**
A.	North	South
B.	South	North
C.	North	North
D.	South	South

1.9 A graph of dissipated **Power** vs **Current** when a varying voltage is supplied over a resistor, will be a…

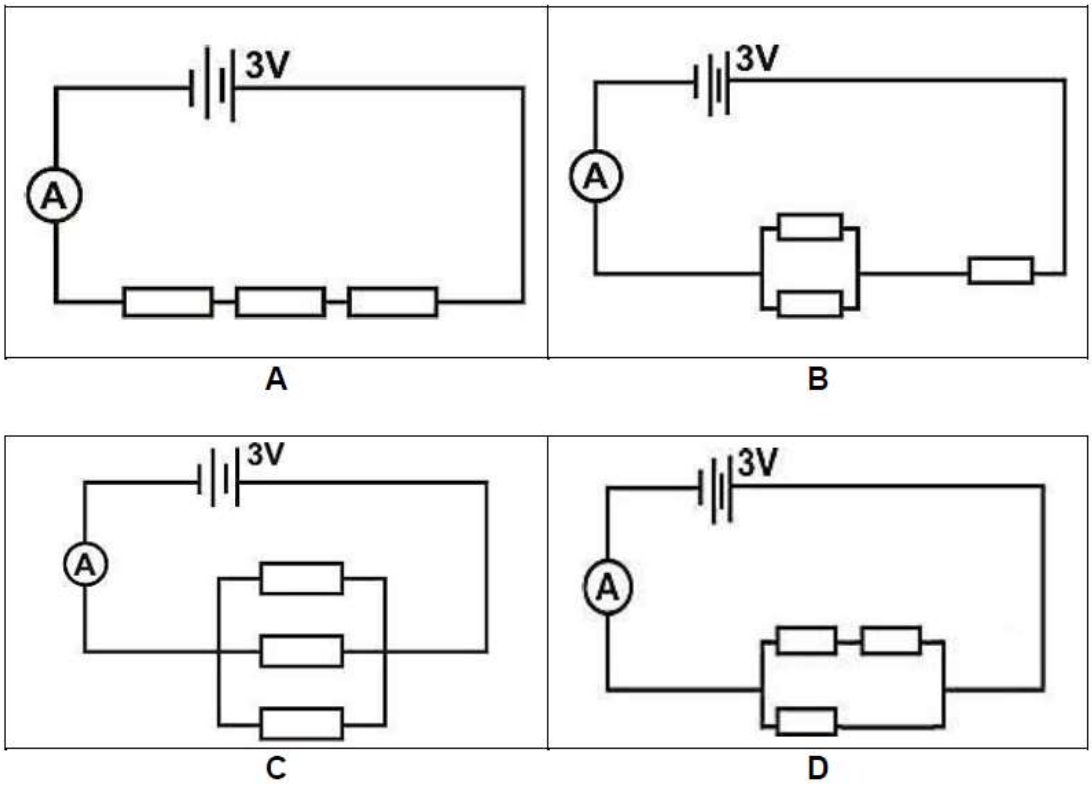
A. …straight line.

B. …hyperbola.

C. …parabola.

D. …exponential.

1.10 A learner is provided with three identical resistors to insert in any manner in a circuit. Which ONE of the following circuit diagrams will allow the largest current through the ammeter?



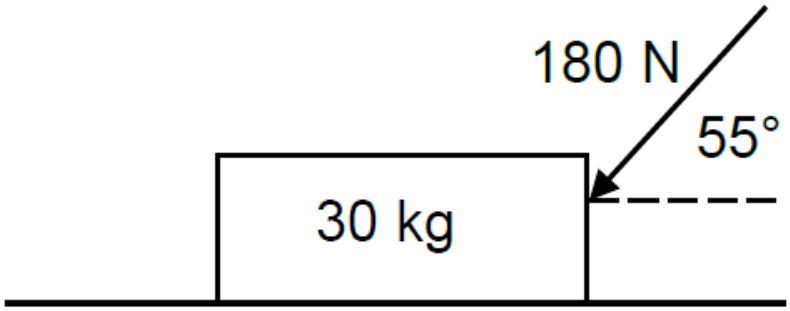
TOTAL SECTION A = [20]

SECTION B

(answer on folio paper)

QUESTION 2: (start the question on a new side of a page)

A force of 180 N is acting on a block at 55° to the horizontal as shown in the diagram. The block remains stationary.



2.1 Calculate the magnitudes of the x- and y-components of the force. (4)

2.2 Hence, calculate the magnitude of the normal force. (3)

2.3 Define the term *resultant vector*. (2)

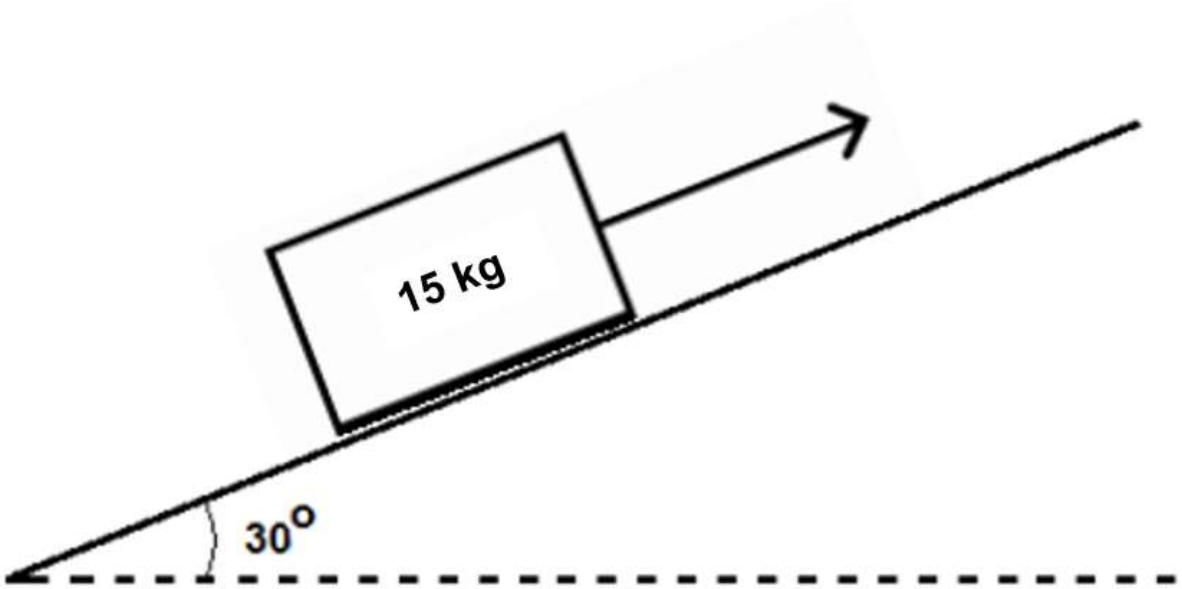
2.4 Draw a **vector diagram** (not a free-body diagram) for the block showing all the forces acting on the block. (4)

2.5 What can be concluded from the diagram in 2.4? (2)

[15]

QUESTION 3: (start the question on a new side of a page)

A 15 kg block is pulled up a rough inclined plane with a force of 120 N. The plane makes an angle of 30° with the horizontal. Throughout the motion, the block moves at constant velocity.

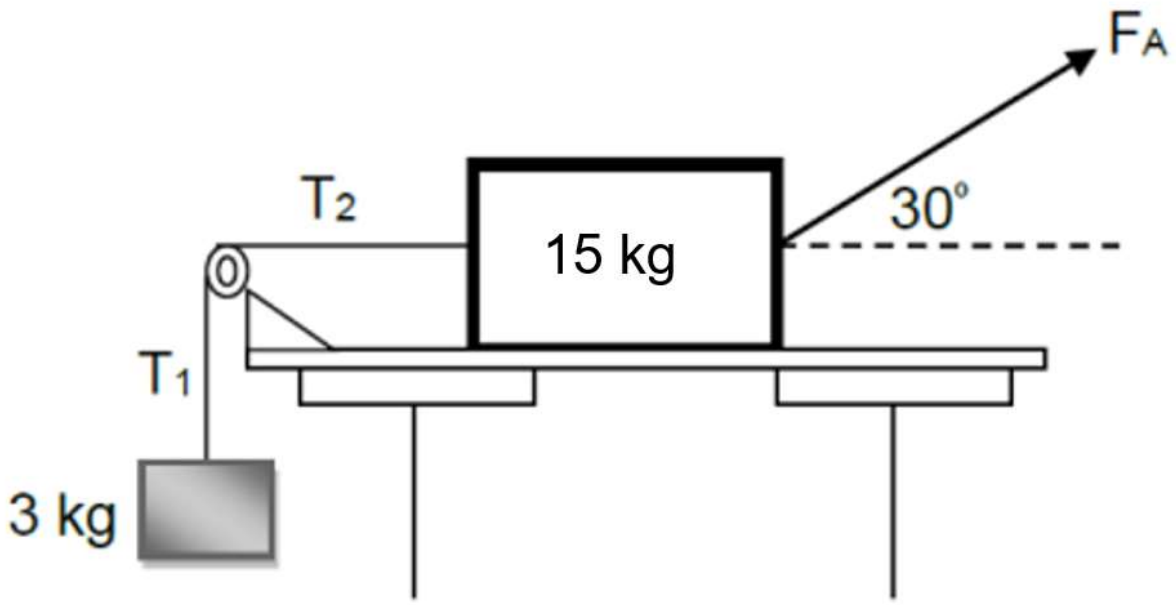


3.1	State *Newton's First Law of Motion* in words.	(2)
3.2	Draw a free body diagram showing all the forces acting on the block.	(4)
3.3	Calculate the magnitude of the normal force.	(3)
3.4	Calculate the kinetic friction acting on the block.	(4)
3.5	Determine the coefficient of kinetic friction between the block and the plane.	(3)
3.6	If the angle between the slope and horizontal increases, would the magnitude of the frictional force INCREASE, DECREASE or STAY THE SAME?	(1)
3.7	Give a reason for your answer in 3.6 by referring to the mathematical relationship between the normal force and the frictional force.	(2)
3.8	If the angle between the slope and horizontal increases (as in 3.6), would the coefficient of kinetic friction between the block and the plane INCREASE, DECREASE or REMAIN THE SAME?	(1)

[20]

QUESTION 4: (start the question on a new side of a page)

An object with a mass of 3 kg is allowed to hang over a frictionless pulley with a light inextensible string that is attached to a 15 kg box. The box is pulled on a rough surface with a force, F_A, of 100 N. The force makes and angle of 30° with the horizontal.



The coefficient of kinetic friction between the table and the block is 0,4.

4.1	State *Newton's Second Law of Motion* in words.	(2)
4.2	Draw a free-body diagram of all the forces acting on the 15 kg block.	(5)
4.3	Calculate the magnitude of the kinetic friction between the table and the 15 kg block.	(5)
4.4	Calculate the acceleration of the 15 kg block.	(6)
4.5	Calculate the magnitude of the tension in the string.	(2)

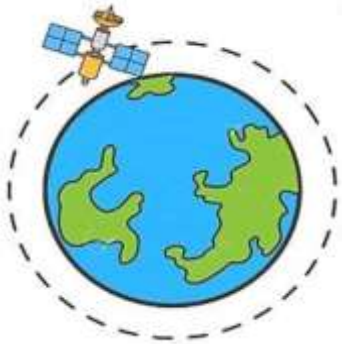
[20]

QUESTION 5: (start the question on a new side of a page)

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

5.2 Use Newton's Law of Universal Gravitation to show that gravitational acceleration (g) on Earth is equal to 9,8 $m.s^{-2}$. (3)

5.3 The Earth exerts a force of 1 850 N to keep a satellite of mass 1 000 kg in orbit around Earth as shown in the diagram below.



Calculate the distance above the EARTH'S SURFACE at which the satellite orbits Earth. (5)

5.4 Write down the magnitude of the force exerted by the satellite on Earth. (1)

5.5 Name the Physics Law that is applicable to the answer given in 5.4. (1)

5.6 Draw a sketch graph of the gravitational force of Earth on the satellite versus the square of the distance between the centre of Earth and the centre of the satellite when the satellite orbits at different heights about Earth. (1)

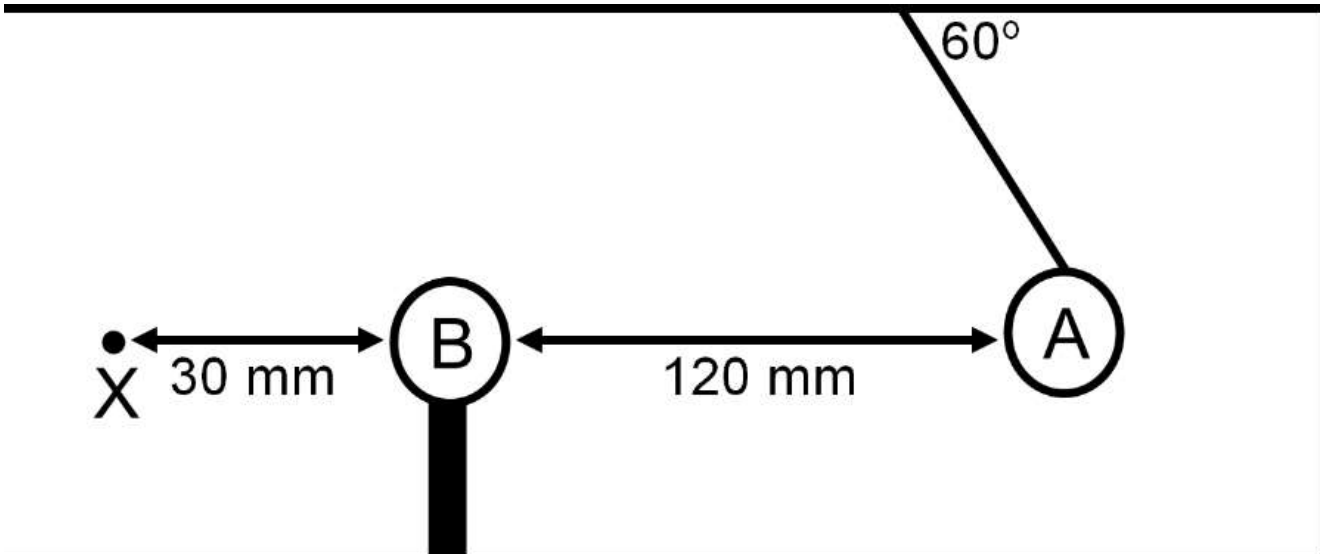
5.7 A new graph between the gravitational force of the Earth on the satellite and product of the masses of Earth and satellites of different masses (orbiting at the same height above the Earth), produces a straight line graph.

What does the gradient of the graph represent? Answer can be given in symbols. (2)

[15]

QUESTION 6: (start the question on a new side of a page)

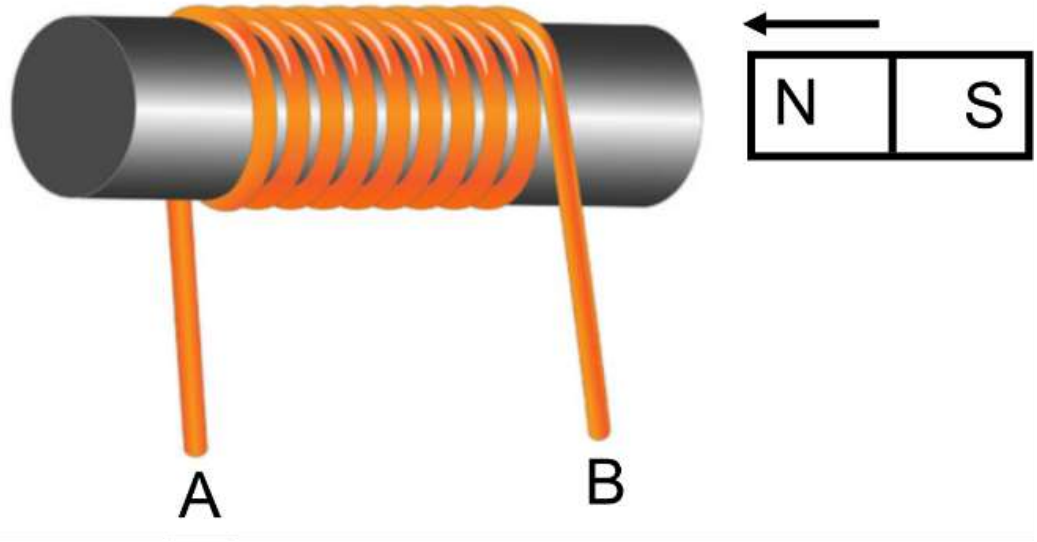
Sphere A, with a charge of -8 μC, is hanging from the ceiling by a string. Sphere B, with a charge of -5 μC, repels sphere A to the right. Sphere A comes to rest 120 mm away from sphere B with the string at an angle of 60° to the ceiling as shown in the diagram below. X is a point 30 mm to the left of sphere B.



6.1	Draw the electric field pattern between the two charges.	(3)
6.2	Calculate the number of electrons sphere A gained to obtain its charge.	(3)
6.3	State *Coulomb's Law* in words.	(2)
6.4	Calculate:	
6.4.1	The magnitude of the electrostatic force between A and B.	(3)
6.4.2	The magnitude of the tension in the rope.	(3)
6.5	Define the term *electric field at a point*.	(2)
6.6	Calculate:	
6.6.1	The net electric field at point X.	(5)
6.6.2	The force experienced by a magnesium ion (Mg^{2+}) placed at point X.	(4)
		[25]

QUESTION 7: (start the question on a new side of a page)

In an experiment, the north pole of a magnet is pushed inside a solenoid inducing a current in the wire as shown in the diagram below.



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

7.2 How will each of the following changes affect the magnitude of the induced current? Write only INCREASES, DECREASES or REMAINS THE SAME.

7.2.1 The magnet is pushed inside the solenoid more slowly. (1)

7.2.2 A stronger magnet is used. (1)

7.2.3 The south pole of the magnet is pushed inside the solenoid. (1)

7.2.4 The magnet is pushed inside the solenoid at an angle. (1)

7.3 Does the induced current flow from **A to B** or **B to A**? (2)

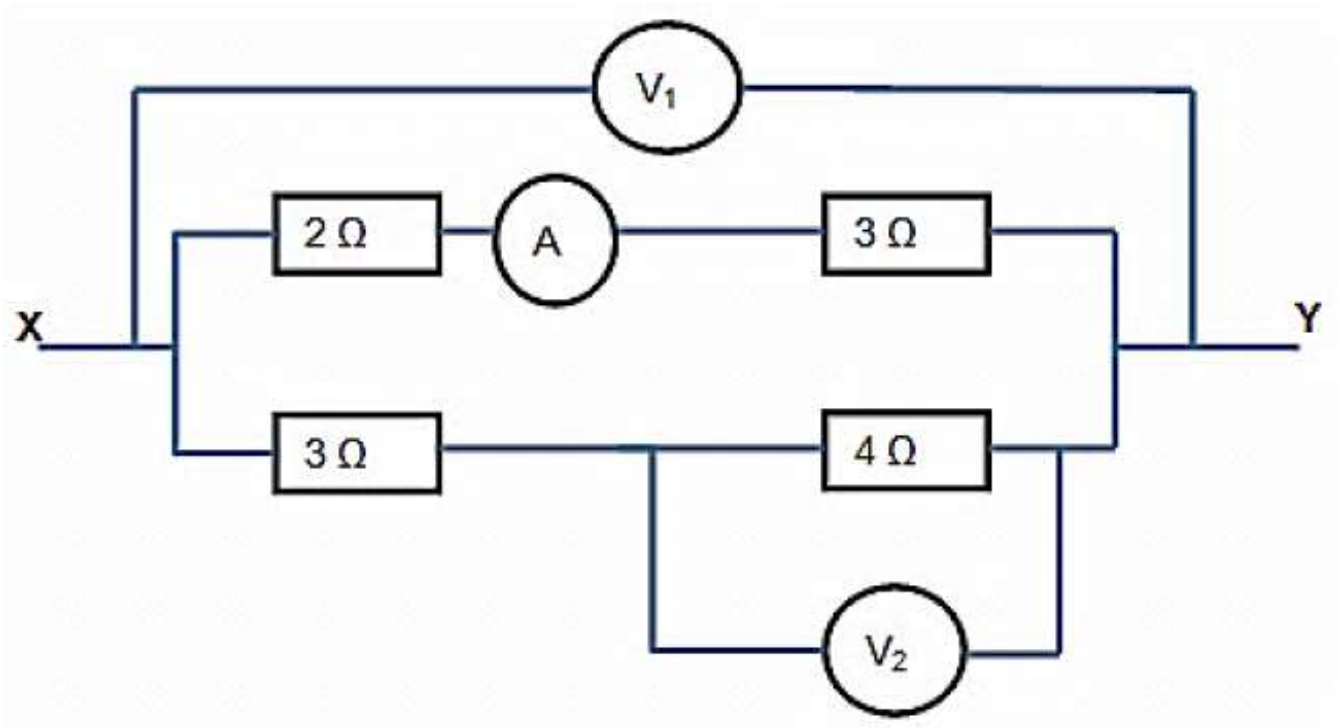
7.4 In a different experiment, current is passed through a straight-wire. A cross-section of this wire is shown in the diagram below.

Copy the diagram onto your answer booklet and then use magnetic field lines to represent the magnetic field associated with the wire. (2)

[10]

QUESTION 8: (start the question on a new side of a page)

A number of meters and resistors are connected as shown in the diagram. A 3,0 V battery is connected to the terminals X and Y.



8.1.1 State *Ohm's law* in words. (2)

8.1.2 Explain the meaning of the underlined phrase from above: "A 3,0V battery…" (2)

8.1.3 What is the reading on V_1? (1)

8.1.4 Calculate the reading on A. (3)

8.1.5 Calculate the reading on V_2. (4)

8.1.6 How will the ammeter reading change if another resistor is connected in parallel to the 2 Ω resistor? Only write INCREASE, DECREASE or STAY THE SAME. (1)

8.1.7 Explain your answer in 8.1.6. (2)

8.1.8 When an ammeter is accidentally connected in the place of V_1, the battery heats up quickly. **Briefly explain.** (2)

8.2 A tumble dryer is labelled: 220 V; 2600 W

8.2.1 Calculate the resistance of the tumble dryer. (4)

8.2.2 Calculate the total cost of using the tumble dryer every day for 3 hours and 30 minutes, during two 30 day months (in winter), if electricity costs R 2,90 per kWh. (4)

[25]

TOTAL SECTION B = [130]

Formula Sheet

Physical Constants:

Name	Symbol	Value
Acceleration due to gravity	g	9,8 $m.s^{-2}$
Gravitational constant	G	$6,67 \times 10^{-11}$ $N.m^2.kg^{-2}$
Radius of Earth	R_E	$6,38 \times 10^6$ m
Mass of Earth	M_E	$5,98 \times 10^{24}$ kg
Speed of light in a vacuum	c	$3,0 \times 10^8$ $m.s^{-1}$
Planck's constant	h	$6,63 \times 10^{-34}$ J.s
Coulomb's constant	k	$9,0 \times 10^9$ $N.m^2.C^{-2}$
Charge on electron	e	$-1,6 \times 10^{-19}$ C
Electron mass	m_e	$9,11 \times 10^{-31}$ kg

Formulae:

MOTION

$v_f = v_i + a\Delta t$	$\Delta x = v_i\Delta t + \frac{1}{2}a\Delta t^2$ or $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$
$v_f^2 = v_i^2 + 2a\Delta x$ or $v_f^2 = v_i^2 + 2a\Delta y$	$\Delta x = \left(\frac{v_f + v_i}{2}\right)\Delta t$ or $\Delta y = \left(\frac{v_f + v_i}{2}\right)\Delta t$

FORCE

$F_{net} = ma$	$w = mg$
$\mu_s = \frac{f_s^{max}}{N}$	$\mu_k = \frac{f_k}{N}$
$F = G\frac{m_1 m_2}{r^2}$	$g = G\frac{M}{r^2}$

ELECTROSTATICS

$F = \frac{kQ_1Q_2}{r^2}$	$E = \frac{F}{q}$
$E = \frac{kQ}{r^2}$	$n = \frac{Q}{e}$

ELECTRIC CIRCUITS

$I = \frac{Q}{\Delta t}$	$R = \frac{V}{I}$
$\frac{1}{R} = \frac{1}{r_1} + \frac{1}{r_2} + \frac{1}{r_3} + \cdots$ or $R = \frac{r_1 \times r_2}{r_1 + r_2}$	$R = r_1 + r_2 + r_3 + \cdots$
$W = Vq$ $W = VI\Delta t$ $W = I^2R\Delta t$ $W = \frac{V^2\Delta t}{R}$	$P = \frac{W}{\Delta t}$ $P = VI$ $P = I^2R$ $P = \frac{V^2}{R}$