



Province of the
EASTERN CAPE
EDUCATION

**NATIONAL
SENIOR CERTIFICATE**

GRADE 11

NOVEMBER 2020

**PHYSICAL SCIENCES P1
(EXEMPLAR)**

MARKS: 150

TIME: 3 hours



This question paper consists of 19 pages including 2 datasheets.

INSTRUCTIONS AND INFORMATION

1. Write your full NAME and SURNAME in the appropriate space on the ANSWER BOOK.
2. This question paper consists of TEN questions. Answer ALL the questions in the ANSWER BOOK.
3. Start EACH question on a NEW page.
4. Number the answers correctly according to the numbering system used in this question paper.
5. Leave ONE line between two sub questions, for example between QUESTION 2.1 and QUESTION 2.2.
6. You may use a non-programmable calculator.
7. You may use appropriate mathematical instruments.
8. Show ALL formulae and substitutions in ALL calculations.
9. Round off your FINAL numerical answers to a minimum of TWO decimal places.
10. Give brief motivations, discussions, et cetera where required.
11. You are advised to use the attached DATA SHEETS.
12. Write neatly and legibly.

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

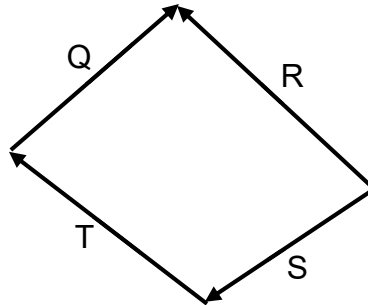
Four possible options are provided as answers to the following questions. Each question has only ONE correct answer. Choose the best answer and only write down (A–D) next to the question numbers (1.1–1.10) in the ANSWER BOOK, for example 1.11 D.

1.1 Which ONE of the following forces CANNOT be equal to zero?

- A Normal force
- B Frictional force
- C Gravitational force
- D Applied force

(2)

1.2 The diagram below represents four vectors Q, R, S and T.



Which ONE of the vectors is the resultant of the other three vectors?

- A Q
- B R
- C S
- D T

(2)

1.3 A girl of weight 600 N is standing on a bathroom scale in a lift that is moving and she noticed that the scale reads 560 N. Which ONE of the following is the CORRECT conclusion about the motion of the lift? The lift is ...

- A accelerating upwards.
- B accelerating downwards.
- C moving upwards at constant velocity.
- D moving downwards at constant velocity.

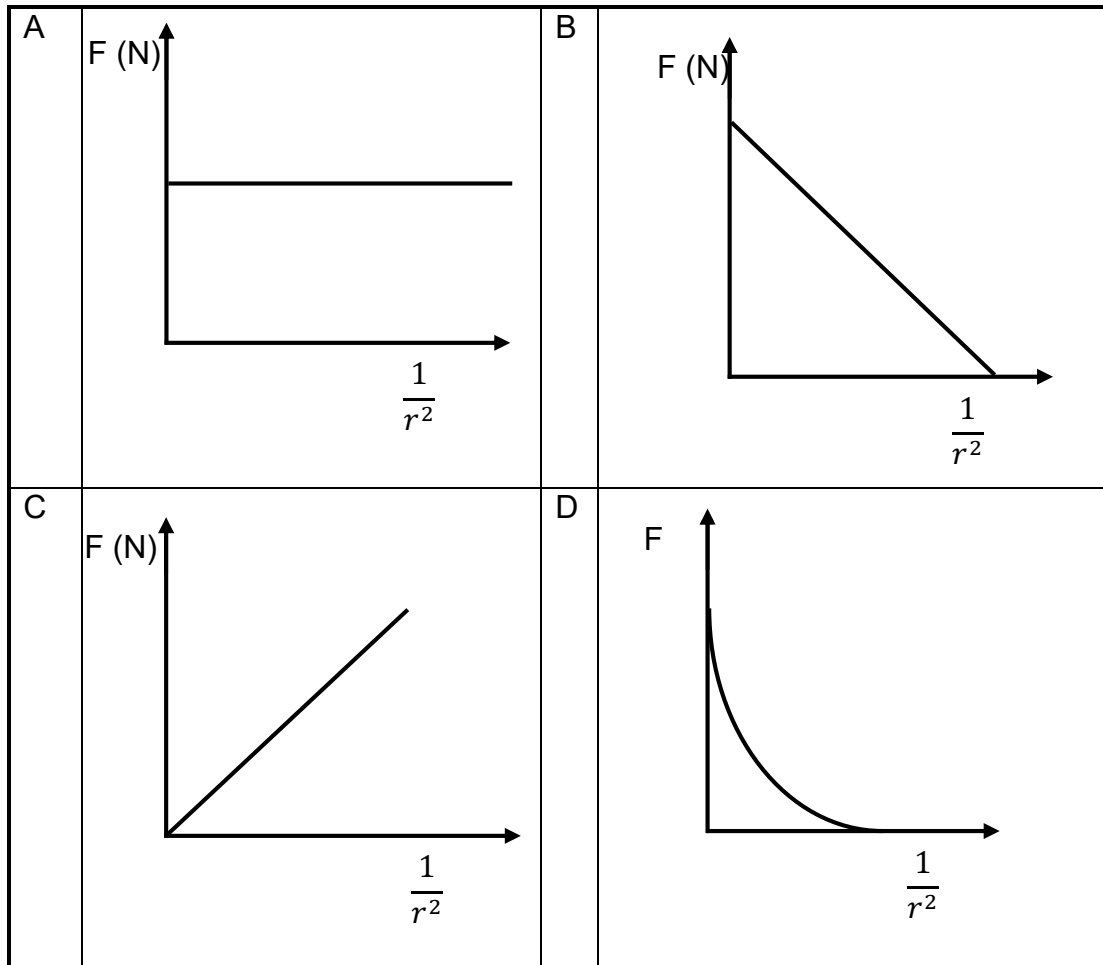
(2)

1.4 Passengers in a moving car are advised to wear safety belts. This will reduce their chances of getting injured in the event of an accident. This precaution is an application of which ONE of the following Physics laws?

- A Newton's first law
- B Newton's second law
- C Newton's third law
- D Newton's law of universal gravitation

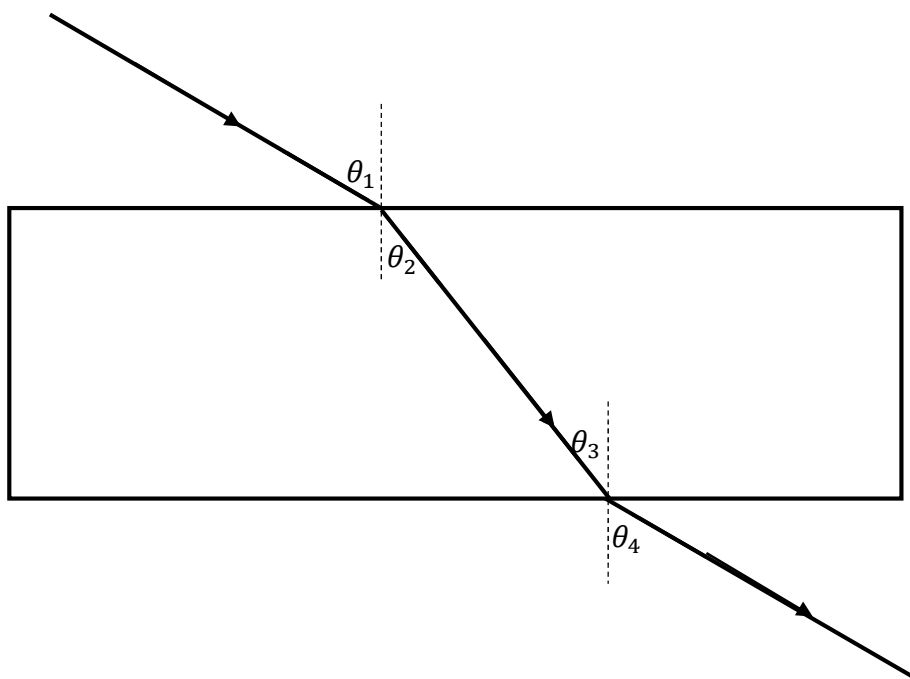
(2)

- 1.5 Which ONE of the graphs below represents the relationship between the gravitational force F between two objects and the distance r between the objects?



(2)

- 1.6 A light ray passes from air into a glass prism. The ray is refracted through the prism and emerges out of the prism as shown in the diagram below.

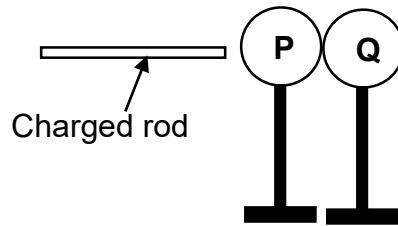


Which ONE of the following statements is TRUE regarding the diagram above?

- A $\theta_4 = \theta_3$
 - B $\theta_4 = \theta_1$
 - C $\theta_4 = \theta_2$
 - D $\theta_1 = \theta_2$
- 1.7 Every point of a wave front serves as a point source of spherical, secondary waves that move forward with the same speed as the wave. This definition represents ...
- A refraction.
 - B diffraction.
 - C wave front.
 - D Huygens' principle.

(2)

- 1.8 Two identical neutral spheres **P** and **Q** are placed on insulating stands. They are brought into contact with each other and a charged rod is brought near sphere **P** as shown on the diagram below.



After the spheres made contact, they were separated and it was found that electrons were transferred from sphere **P** to sphere **Q**. Which ONE of the following concerning the charges on the two spheres is TRUE?

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

(2)

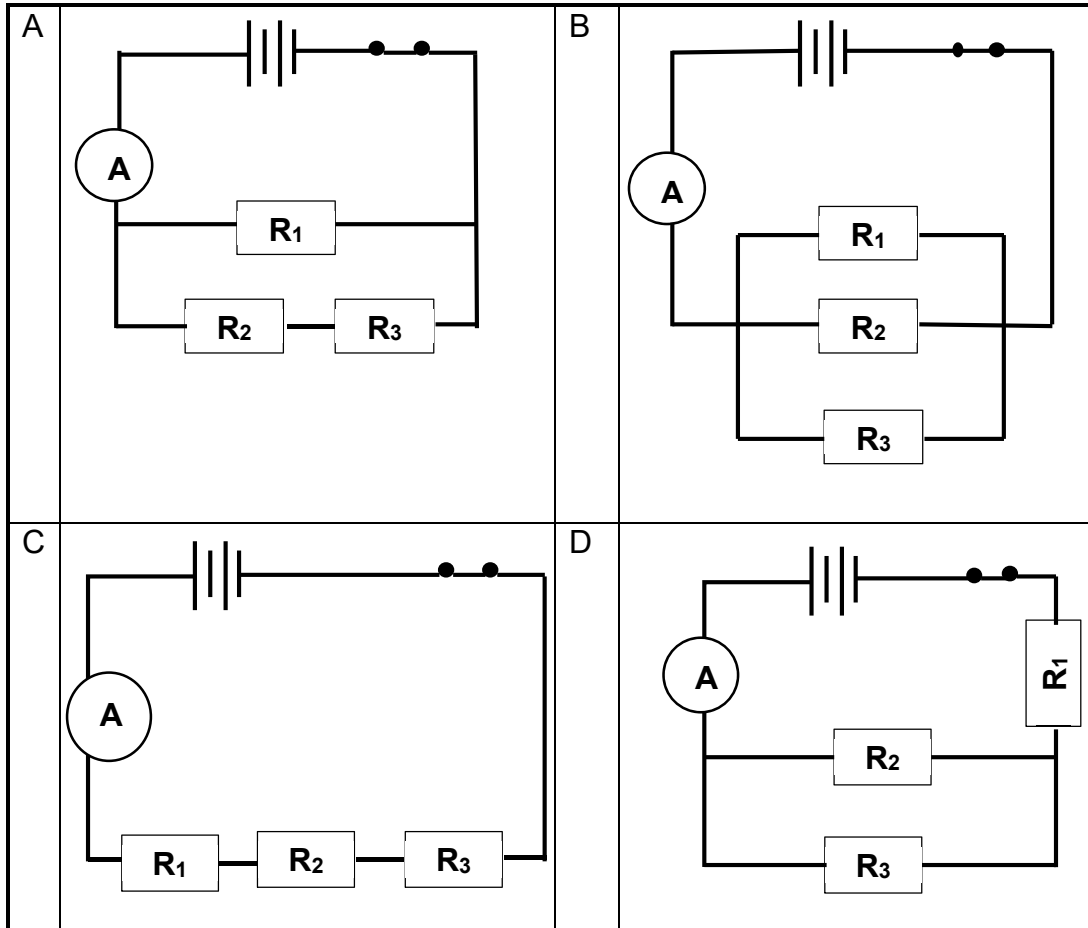
- 1.9 The magnitude of the induced emf across the ends of a loop is equal to the ...

- A radius of the loop.
- B thickness of the wire.
- C temperature of the wire.
- D rate of change the magnetic flux linkage with the wire.

(2)

1.10 In the circuit diagrams below the SAME battery and SAME IDENTICAL resistors are used. The internal resistance of the battery is ignored.

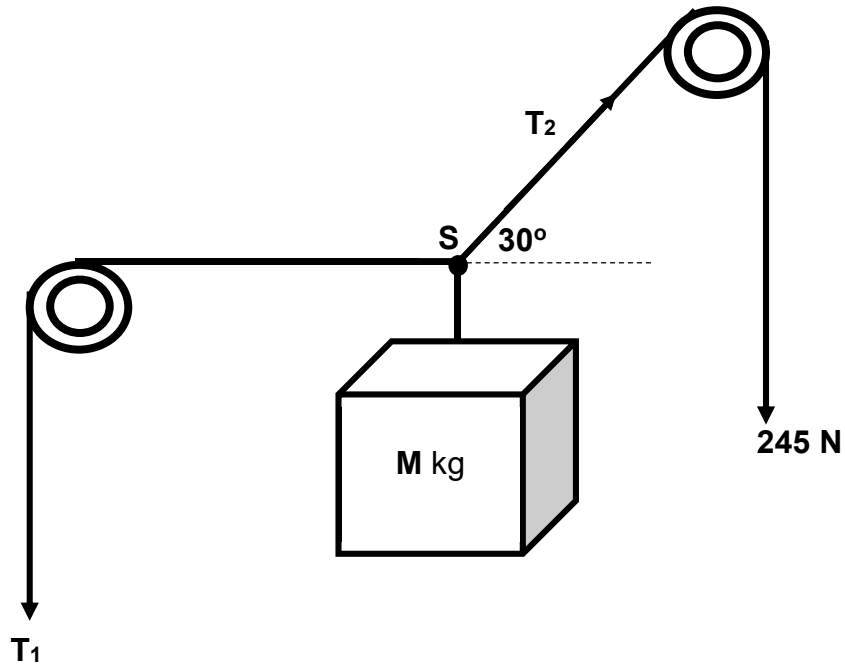
In which ONE of the following circuits will the resistors have the highest potential difference?



(2)
[20]

QUESTION 2

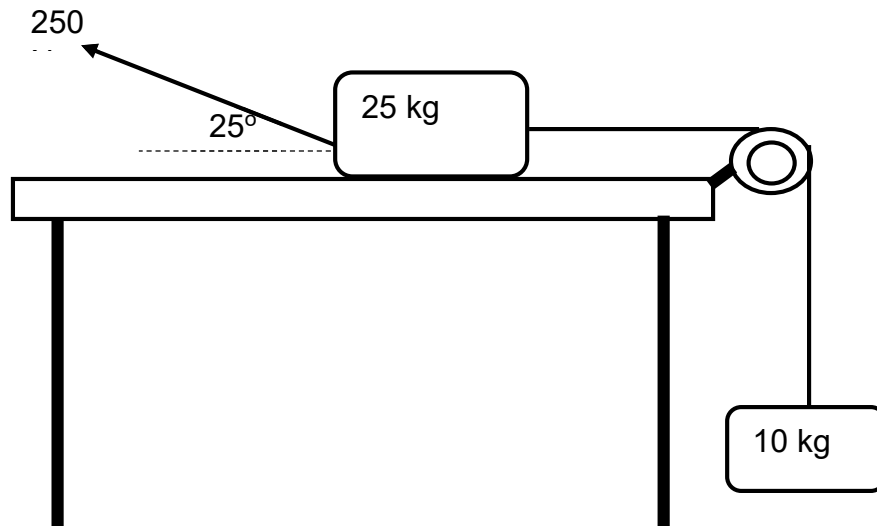
A pulley system is used to keep a crate of mass **M** kg **stationary** as shown on the diagram below.



- 2.1 Define the term *resultant vector*. (2)
- 2.2 Calculate the:
- 2.2.1 Vertical and horizontal components of T_2 (4)
- 2.2.2 Magnitude of T_1 (2)
- 2.2.3 Mass M of the crate (3)
- [11]**

QUESTION 3

A 250 N force is applied on a block of mass 25 kg. The 25 kg block is connected to a 10 kg block by a light inextensible string through a frictionless pulley as shown on the diagram below. The 250 N force acts at an angle of 25° to the horizontal so that the system of blocks accelerates to the left. The coefficient of kinetic frictional force between the 25 kg block and the surface is 0,15.

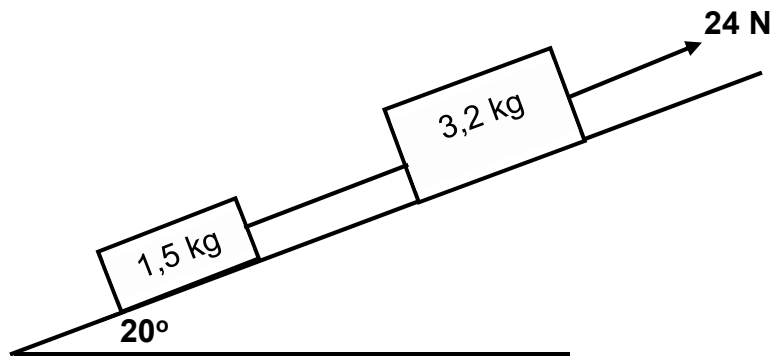


- 3.1 Define the term *kinetic frictional force*. (2)
- 3.2 Draw a labelled free-body diagram of all forces acting on the 25 kg block. (5)
- 3.3 Calculate the:
- 3.3.1 Normal force exerted by the surface on the 25 kg block (3)
- 3.3.2 Acceleration of the system of blocks (7)
- [17]**

QUESTION 4

Two blocks of masses 1,5 kg and 3,2 kg are connected by a light inextensible string. A 24 N force is applied on a system of blocks to move them up an inclined surface which is 25° to the horizontal at a **CONSTANT VELOCITY** as shown on the diagram below.

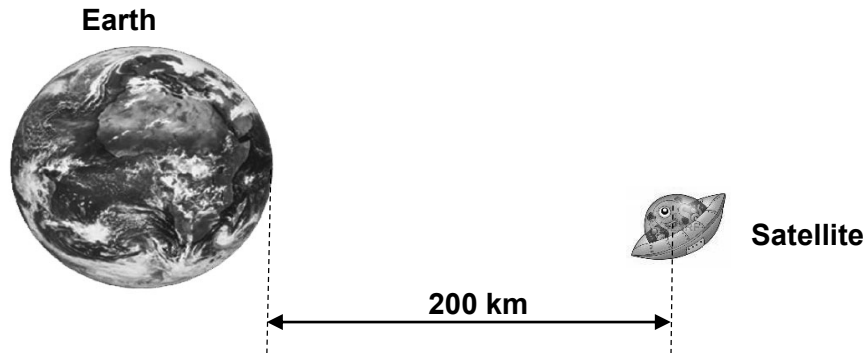
The 1,5 kg box experiences a constant frictional force of 2 N as it moves up the incline.



- 4.1 State Newton's Second Law of Motion in words. (2)
- 4.2 Draw a labelled free-body diagram of all forces acting on the 1,5 kg block. (4)
- 4.3 Calculate the:
- 4.3.1 Tension in the string connecting the blocks (5)
- 4.3.2 Coefficient of kinetic frictional force between the 3,2 kg block and the surface (6)
- [17]**

QUESTION 5

A satellite of mass 1 000 kg is orbiting the earth at a distance of 200 km from the surface of the earth as shown on the diagram below.

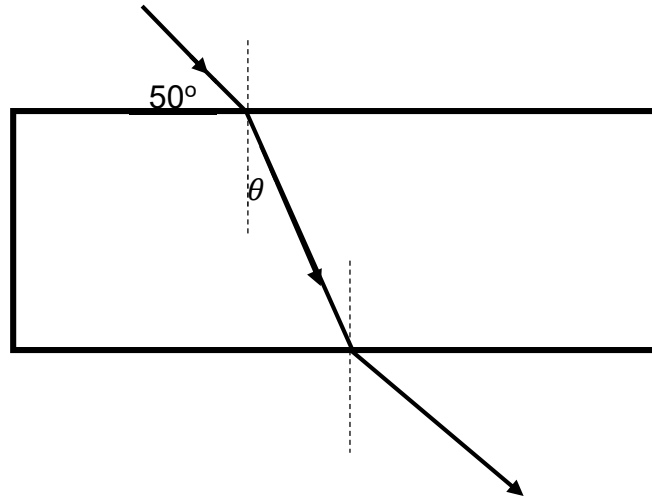


- 5.1 State Newton's Law of Universal Gravitation in words. (2)
- 5.2 Calculate the magnitude of the force that the earth exerts on the satellite to keep it in orbit. (5)
- 5.3 Calculate the weight of the satellite on the earth surface. (3)
- 5.4 The same satellite is now orbiting the earth at a distance twice the radius of the earth from the centre of the earth. Without any further calculations, determine the force that the earth exerts on the satellite at the new distance. Explain how you arrived at your answer. (3)

[13]

QUESTION 6

A light ray from a ray box is incident on a rectangular glass prism and the path of the incident ray and emergent ray was traced to obtain the diagram below. The refractive index of air and the refractive index of a glass are 1,00 and 1,52 respectively.



- 6.1 State Snell's law in words. (2)
- 6.2 Calculate the:
- 6.2.1 Angle θ , on the diagram (4)
- 6.2.2 Speed of light in glass (3)
- 6.2.3 Critical angle for glass (4)
- 6.3 Define total *internal reflection*. (2)
- 6.4 State TWO conditions necessary for total internal reflection to occur. (2)

[17]

QUESTION 7

A learner is investigating a certain phenomenon of light. He viewed red light through a single slit and observed the pattern that was formed on a screen. He repeated the experiment using blue light and observed the pattern on a screen again.

- 7.1 Name the phenomenon that the learner is investigating. (1)
- 7.2 Draw separate diagrams for the patterns for red light and blue light that the learner observed on the screen. Label clearly red and blue bands. (4)
- 7.3 Explain the differences observed in the patterns for red and blue light. (2)
- 7.4 Which nature of light does the phenomenon investigated demonstrate? (1)
- 7.5 What are the changes, if any, that the learner will observe if the slit width is made smaller? Explain your answer. (3)

[11]

QUESTION 8

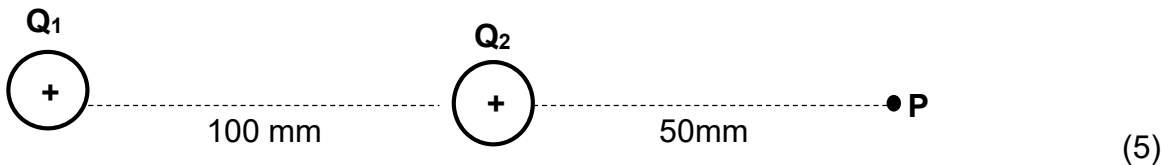
Two identical point charges are placed 100 mm apart in a vacuum as shown below. The electrostatic force that Q_1 exerts on Q_2 is 5,09 N.



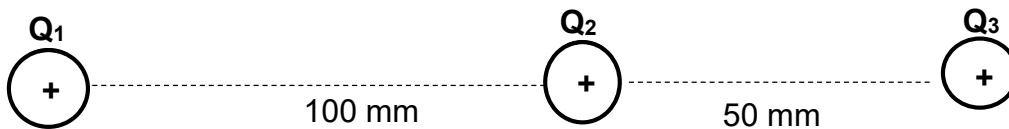
8.1 Draw the electric field pattern between the two charges. (3)

8.2 Calculate the magnitude of each charge. (4)

8.3 Calculate the net electric field at point **P**, as shown on the diagram below.



8.4 A third charge Q_3 of magnitude $5 \mu\text{C}$ is now placed at point **P** as shown in the diagram below.



Calculate the net electrostatic force experienced by point charge Q_2 due to point charge Q_1 and Q_3 .

(5)
[17]

QUESTION 9

- 9.1 The diagram below represents a current-carrying conductor. Draw the magnetic field pattern around this conductor.



(2)

- 9.2 A solenoid with a radius of 5 cm and 350 turns is pulled out of a magnetic field of strength 5,20 T in 0,1 second. The solenoid is placed perpendicular to the magnetic field.

9.2.1 State Faraday's law in words. (2)

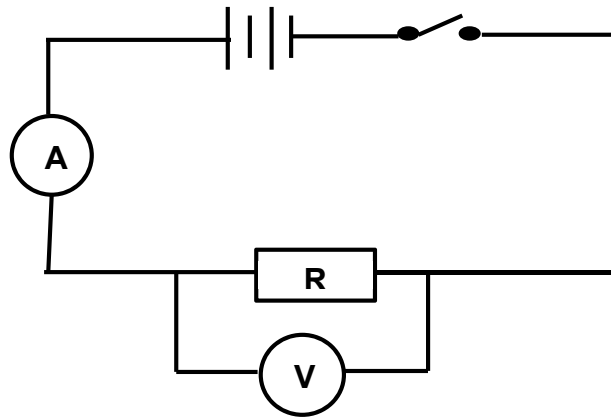
9.2.2 Calculate the magnetic flux linkage (Φ) with the solenoid. (3)

9.2.3 Calculate the induced emf in the solenoid. (3)

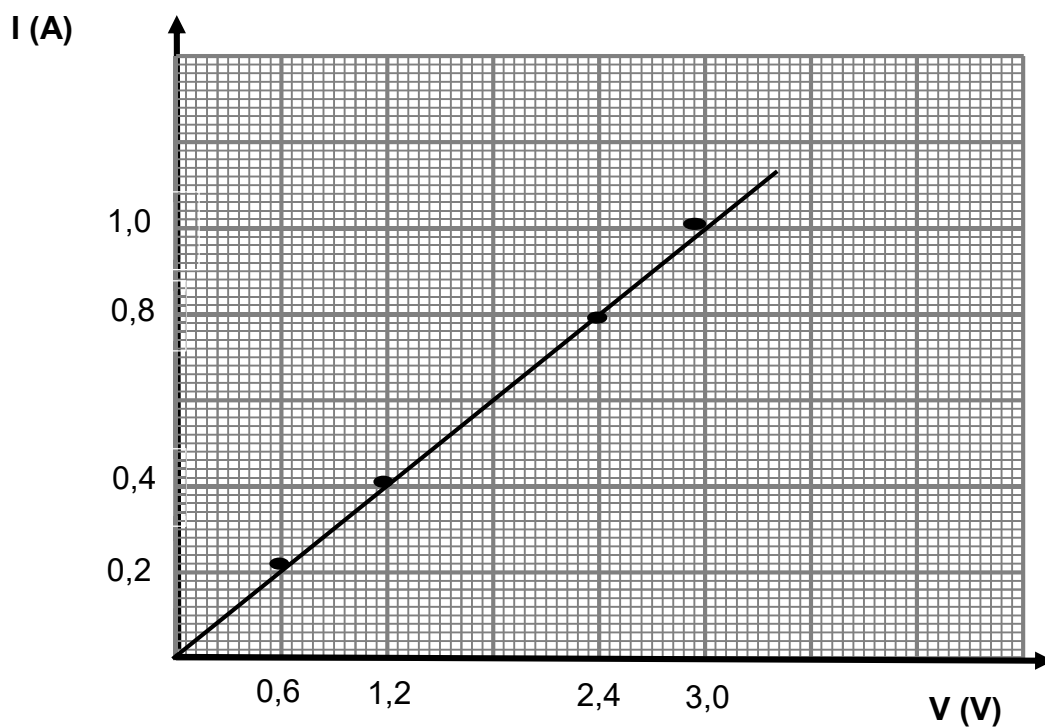
[10]

QUESTION 10

- 10.1 A learner sets up the circuit below to investigate the relationship between current and potential difference across the ends of a conductor. She closes the switch and records the ammeter and voltmeter readings. She repeats the experiment three times; each time she increases the number of cells in the circuit. Then she reads and records the ammeter and voltmeter readings.

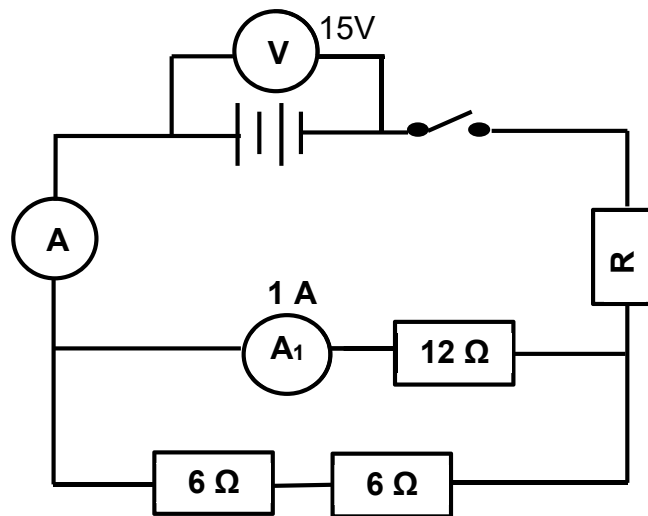


A graph of her results is shown below.



- 10.1.1 Which physical quantity does the gradient of the graph represent? (1)
- 10.1.2 Use the information from the graph to calculate the resistance of the resistor that the learner used in the investigation. (3)

- 10.2 The battery in the circuit diagram below has negligible internal resistance. The resistance of resistor **R** is unknown. When the switch is closed, the voltmeter reads 15 V and the ammeter A_1 reads 1 A.



Calculate the:

- 10.2.1 Current in ammeter A (3)
- 10.2.2 Resistance of resistor R (5)
- 10.3 The resistor **R** of unknown resistance is now removed from the circuit. How will this change in the circuit affect the reading of the ammeter A?
 Answer INCREASE, DECREASE or REMAIN THE SAME. Explain your answer. (2)
- 10.4 The power rating on an electric stove is 1 500 W. If the stove is used for 3 hours and 30 minutes, calculate how much it will cost to use the stove. 1 unit of electricity (1 kWh of electricity) costs R1,15. (3)

[17]

TOTAL: 150

DATA FOR PHYSICAL SCIENCES GRADE 11
PAPER 1 (PHYSICS)
GEGEWENS VIR FISIESTE WETENSKAPPE GRAAD 11
VRAESTEL 1 (FISIKA)

TABLE 1: PHYSICAL CONSTANTS/TABEL 1: FISIESTE KONSTANTES

NAME/NAAM	SYMBOL/ SIMBOOL	VALUE/WAARDE
Acceleration due to gravity / <i>Swaartekragversnelling</i>	g	9,8 m•s ⁻²
Universal gravitational constant / <i>Universelegravitasiekonstant</i>	G	6,67 × 10 ⁻¹¹ N•m ² •kg ⁻²
Speed of light in a vacuum / <i>Spoed van lig in 'n vakuüm</i>	c	3,0 × 10 ⁸ m•s ⁻¹
Planck's constant / <i>Planck se konstante</i>	h	6,63 × 10 ⁻³⁴ J•s
Coulomb's constant / <i>Coulomb se konstante</i>	k	9,0 × 10 ⁹ N•m ² •C ⁻²
Charge on electron / <i>Lading op elektron</i>	e	-1,6 × 10 ⁻¹⁹ C
Electron mass / <i>Elektronmassa</i>	m _e	9,11 × 10 ⁻³¹ kg
Mass of earth / <i>Massa op aarde</i>	M	5,98 × 10 ²⁴ kg
Radius of earth / <i>Radius van aarde</i>	R _E	6,38 × 10 ³ km

TABLE 2: FORMULAE/TABEL 2: FORMULES

MOTION/BEWEGING

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

FORCE/KRAG

$F_{\text{net}} = ma$	$w = mg$
$F = \frac{Gm_1 m_2}{d^2}$	$\mu_s = \frac{f_s^{\text{max}}}{N}$
$\mu_k = \frac{f_k}{N}$	

WAVES, SOUND AND LIGHT/GOLWE, KLANK EN LIG

$F = \frac{kQ_1Q_2}{r^2}$ ($k = 9,0 \times 10^9 \text{ N.m}^2.\text{C}^{-1}$)	$E = \frac{F}{q}$
$E = \frac{kQ}{r^2}$ ($k = 9,0 \times 10^9 \text{ N.m}^2.\text{C}^{-1}$)	$n = \frac{Q}{q_e}$

ELECTROMAGNETISM/ ELEKTROMAGNETISME

$\varepsilon = -N \frac{\Delta\Phi}{\Delta t}$	$\Phi = BA \cos \theta$
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ELECTRIC CIRCUITS/ELEKTRIESE STROOMBANE

$I = \frac{q}{\Delta t}$	$R = \frac{V}{I}$
$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \dots$	$R_s = R_1 + R_2 + \dots$
$W = Vq$ $W = VI\Delta t$ $W = I^2R\Delta t$ $W = \frac{V^2\Delta t}{R}$	$P = \frac{W}{\Delta t}$ $P = VI$ $P = I^2R$ $P = \frac{V^2}{R}$