Province of the
EASTERN CAPE
EDUCATION

NATIONAL SENIOR CERTIFICATE

GRADE 11

NOVEMBER 2023

PHYSICAL SCIENCES P1

MARKS: **150**

TIME: **3 hours**

IPHSCE1

This question paper consists of 20 pages, including 3 data sheets and an answer sheet.

INSTRUCTIONS AND INFORMATION

1. Write your full NAME and SURNAME in the appropriate space on the ANSWER BOOK.
2. Answer ALL the questions.
3. Start EACH question on a NEW page in the ANSWER BOOK.
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, etc. where required.
11. Use the attached ANSWER SHEET to answer QUESTION 10.3.
12. You are advised to use the attached DATA SHEETS.
13. Write neatly and legibly.

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, for example 1.11 E.

1.1 Which of the following quantities are ALL vectors?

A	Mass	Acceleration	Velocity
B	Electric field	Distance	Velocity
C	Force	Electric field	Acceleration
D	Speed	Mass	Force

(2)

1.2 What is the NAME of the perpendicular force that a surface exerts on an object in contact with the surface?

A Tension

B Normal force

C Gravitational force

D Kinetic frictional force (2)

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

A acceleration.

B inertia.

C Newton's second law.

D Newton's third law. (2)

1.4 The mass and radius of planet **A** is double the mass and radius of planet **B.** The mass of a person on planet **A** is **m**. What will be the mass of the same person on planet **B**?

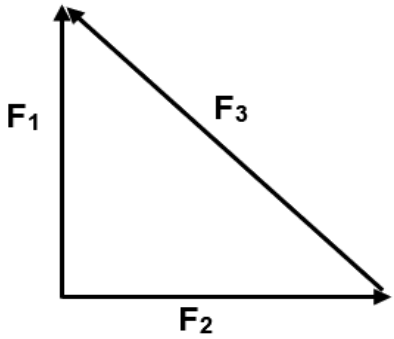
A **m**

B 2**m**

C 4**m**

D ⅓**W** (2)

1.5 In the vector diagram below, the resultant (net) vector is …



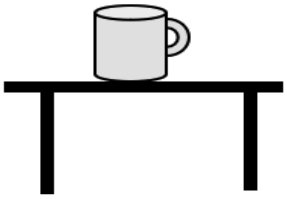
A F_1.

B F_2.

C F_3.

D Zero. (2)

1.6 If a mug is placed on a table, the reaction force due to the weight of the mug, according to Newton's third law, is the force of the …



A earth on the mug.

B table on the mug.

C mug on the table.

D mug on the earth. (2)

1.7 Two charged objects repel each other with a force **F** when they are separated by a distance **r**. The distance between the charges is reduced to ⅓ **r**. The new force, in terms of **F**, will now be ...

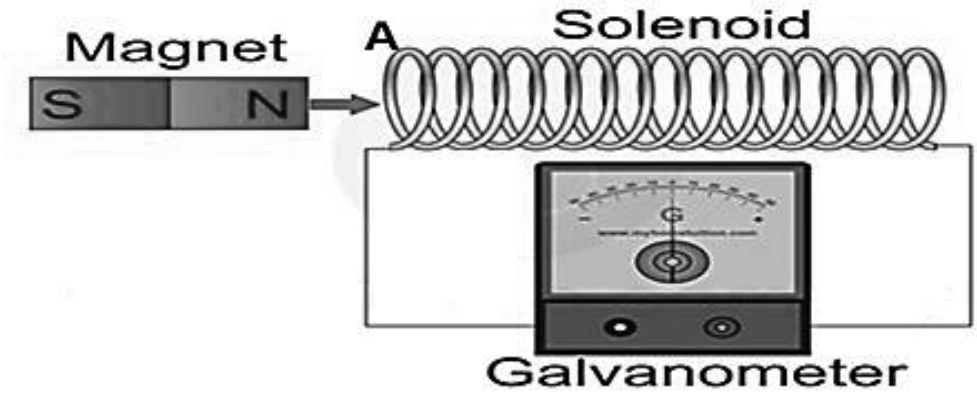
A **F**.

B 3**F**.

C 6**F**.

D 9**F**. (2)

1.8 In the diagram below, the North pole of a bar magnet approaches end **A** of a solenoid.

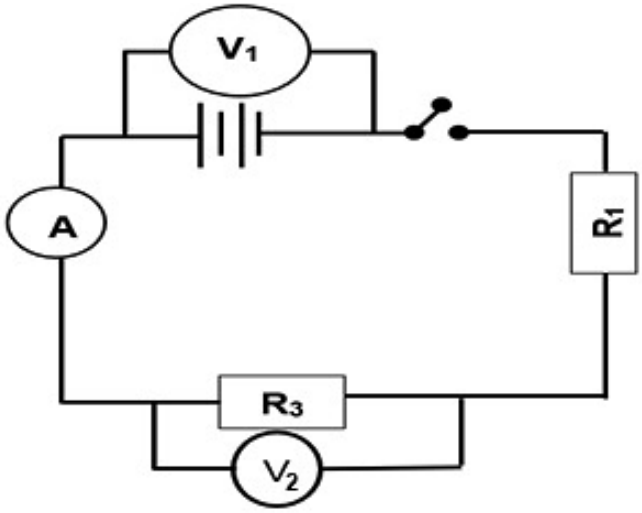


Which ONE of the following statements about the polarity of **A** and the direction of the induced current, as shown by the deflection of the galvanometer needle, is CORRECT?

	POLARITY OF A	**DEFLECTION OF GALVANOMETER NEEDLE**
A	North pole	Left
B	South pole	Right
C	North pole	Right
D	South pole	Left

(2)

1.9 The potential difference across the battery in the circuit diagram below is 10 V. The internal resistance of the battery can be ignored. Two voltmeters V_1 and V_2 are connected in the circuit as shown in the diagram below.



When the switch is open the correct readings on voltmeter V_1 and V_2 will as follows.

	VOLTMETER V_1	VOLTMETER V_2
A	0	10
B	10	0
C	0	0
D	10	10

(2)

1.10 The unit for electrical power is …

A $N.C^{-1}$.

B $J.s^{-1}$.

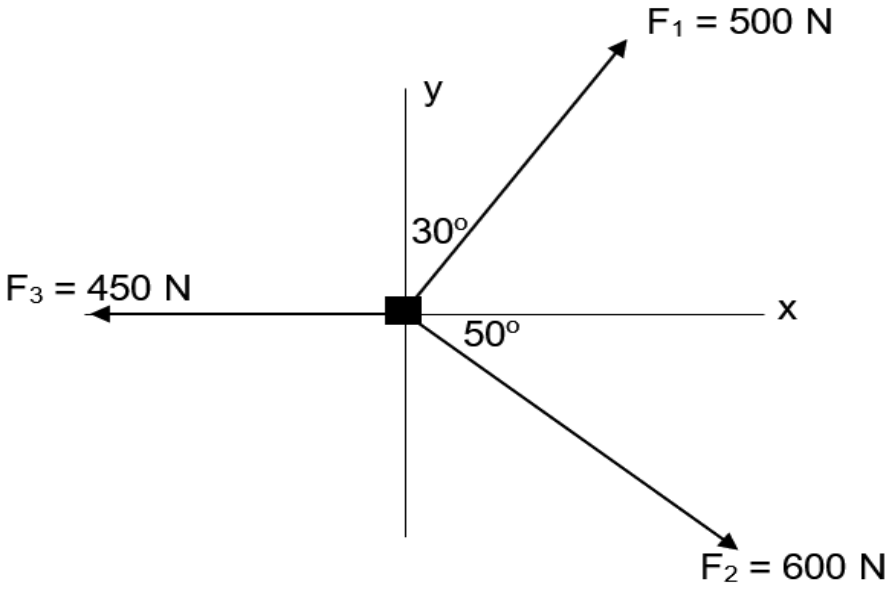
C $kg.m.s^{-1}$.

D N.s. (2)

[20]

QUESTION 2

Three forces, F_1, F_2 and F_3, are applied to a crate of 15 kg as shown on the diagram below.



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

2.2 Calculate the resultant of the three forces. (9)

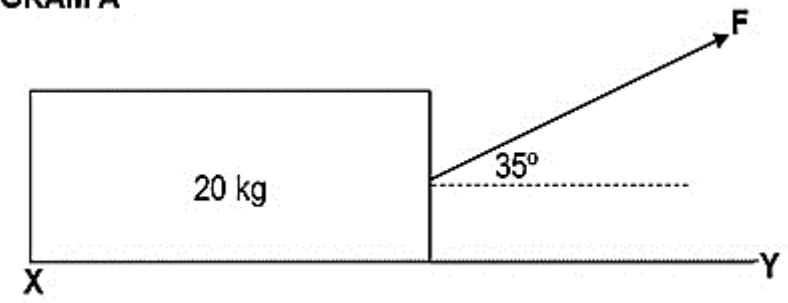
2.3 Explain why the three forces will not form a closed vector diagram. (2)

[13]

QUESTION 3

A constant force, **F**, pulls a 20 kg block at a constant speed over a rough horizontal surface, **XY**, as shown in Diagram **A** below. The coefficient of kinetic friction (μ_k) between the block and the surface is 0,2.

DIAGRAM A



3.1 Give a reason why the coefficient of kinetic friction has no unit? (1)

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

3.3 State Newton's first law of motion in words. (2)

3.4 Calculate the magnitude of:

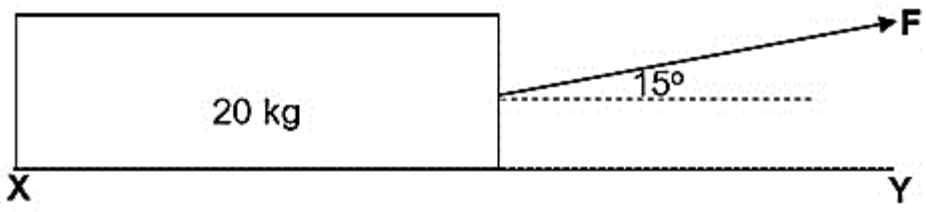
3.4.1 Force **F** (6)

3.4.2 Normal force (2)

3.4.3 Frictional force (2)

3.5 The same constant force, **F**, is now applied to the block over the same rough horizontal surface as before, at an angle of 15° with the horizontal, as shown in Diagram **B** below.

DIAGRAM B



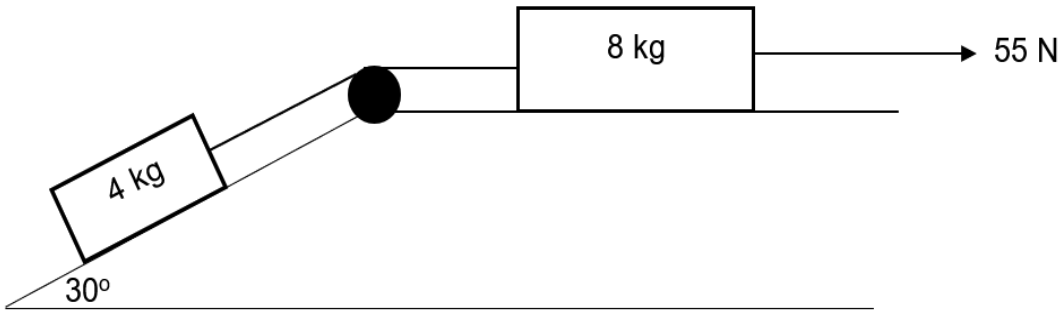
How will the frictional force of the block in Diagram **B** compare with the frictional force of the block in Diagram **A**?

Write only HIGHER, LOWER or REMAINS THE SAME. (2)

[19]

QUESTION 4

In the diagram below, an 8 kg block is connected to a 4 kg block by means of a light, inextensible string. A constant force of 55 N is applied to the 8 kg block to accelerate the combination of blocks to the right.



The kinetic frictional force between the 4 kg block and the inclined plane is 4 N while the kinetic frictional force between the 8 kg block and the horizontal plane is 8 N.

4.1 State Newton's second law of motion in words. (2)

4.2 Draw a free body diagram of all forces acting on the 4 kg block. (4)

4.3 Calculate the tension in the string connecting the two blocks. (6)

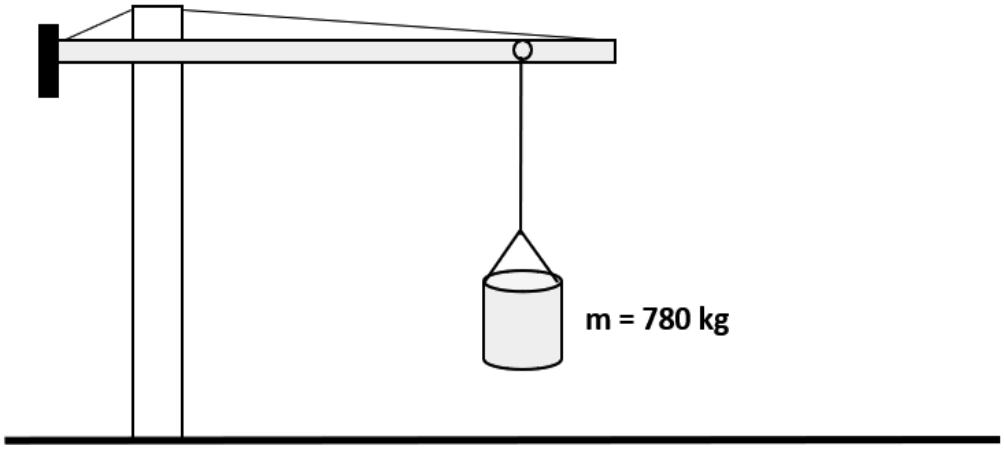
4.4 The angle of inclination is decreased to 10°. How will the change affect the coefficient of kinetic friction?

Choose from INCREASES, DECREASES or REMAINS THE SAME.

Explain your answer. (2)
[14]

QUESTION 5

A crane at a building site lifts a container filled with concrete and their combined total mass is 780 kg. The container is lifted upward at a CONSTANT SPEED by means of a light, inextensible cable as shown in the diagram below. Ignore the effect of air friction.



5.1 Draw a labelled free-body diagram of ALL force acting on the container as it is being lifted upwards. (2)

5.2 Calculate the tension in the cable. (3)

5.3 The crane changes the tension in the cable to 7 800 N.

5.3.1 How does this change influence the acceleration of the container?

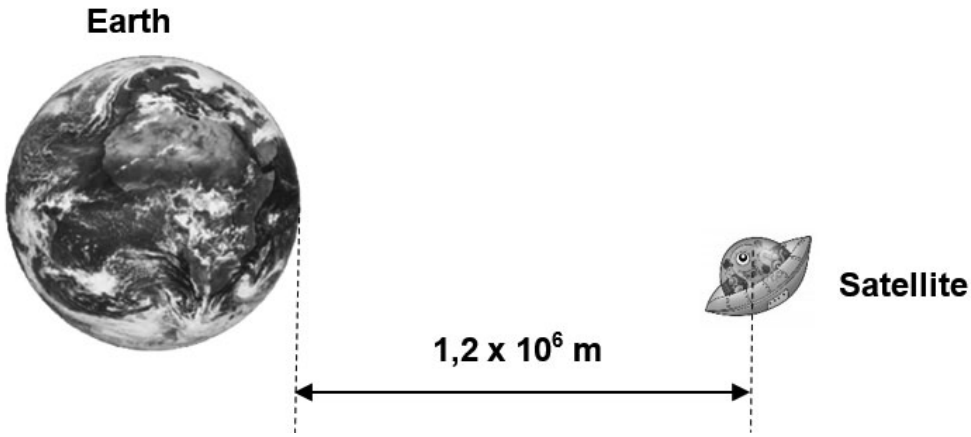
Write only INCREASES, DECREASES or STAYS THE SAME.

Briefly explain your answer. (2)

5.3.2 Calculate the acceleration of the container. (4)

[11]

QUESTION 6



A satellite of mass 1000 kg is orbiting the earth at a distance of 1 200 km from the earth's surface.

6.1 How does the force which the earth exerts on the satellite compare with the force that the satellite exerts on the earth?

Answer only GREATER THAN, LESS THAN or EQUAL TO.

State the relevant physics law that you applied to answer the question. (2)

6.2 State Newton's law of universal gravitation in words. (2)

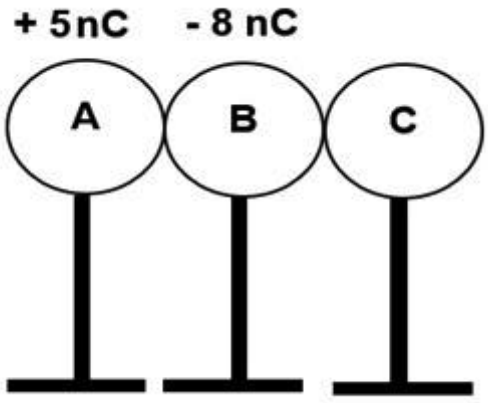
6.3 Calculate the force that the earth exerts on the satellite to keep it in orbit. (5)

6.4 The mass and radius of the planet **A** are $7,35 \times 10^{22}$ kg and 1 737 km respectively. Calculate the acceleration due to gravity on planet **A**. (4)

[13]

QUESTION 7

Three identical spheres **A**, **B** and **C** are placed on plastic stands as shown in the diagram below. The charge on sphere **A** is + 5 nC, spere **B** is – 8 nC and **C** is neutral. The three spheres are brought in contact with each other and then separated.

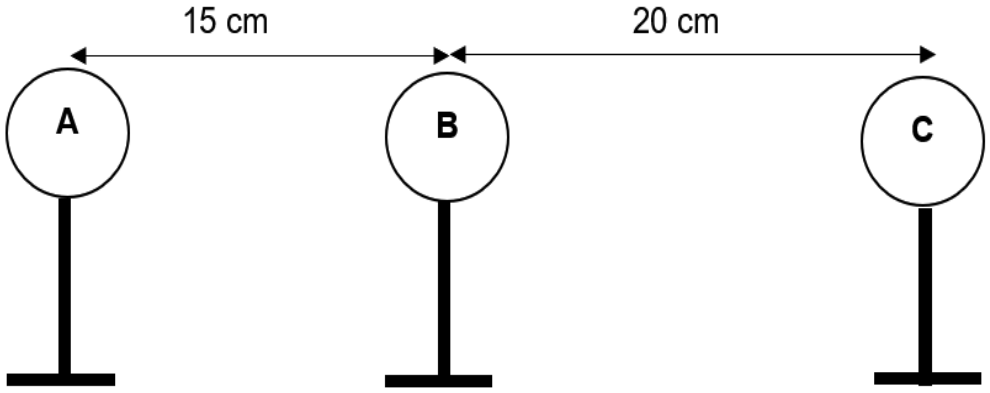


7.1 Calculate the:

7.1.1 Net charge on each sphere after separation (3)

7.1.2 Number of electrons in excess or deficit on sphere **C** after separation (3)

They are then placed a distance apart as shown in Diagram **2** below.



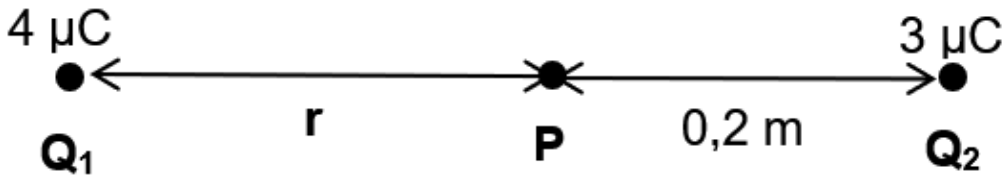
7.2 Draw a vector showing the electrostatic forces acting on the charge **B** due to the presence of **A** and **C**. (2)

7.3 Calculate the net electrostatic force on sphere **B**. (5)

[13]

QUESTION 8

Two charges Q_1 and Q_2 of magnitude +4 µC and 3 µC (sign unknown) respectively are placed in a vacuum as shown in the diagram below. **P** is a point, at distance **r** to the right of Q_1 and 0,2 m to the left of Q_2. The net electric field at point **P** is equal to zero.



8.1 Are the signs on the two charges similar or opposite?

Give a reason for your answer. (2)

8.2 Draw the electric field pattern around a positive point charge. (3)

8.3 Define *electric field at a point* in words. (2)

8.4 Calculate distance **r** in metres. (5)
[12]

QUESTION 9

A coil with 340 turns has an area of 0,06 m^2. It is held with its axis coinciding with the direction of a magnetic field of strength 0,4 T. In order to induce an emf in the coil, it is pulled out of the magnetic field in 0,3 seconds.

9.1 State Faraday's law of electromagnetic induction. (2)

9.2 Mention TWO ways in which the magnitude of the induced emf can be increased. (2)

9.3 Calculate the:

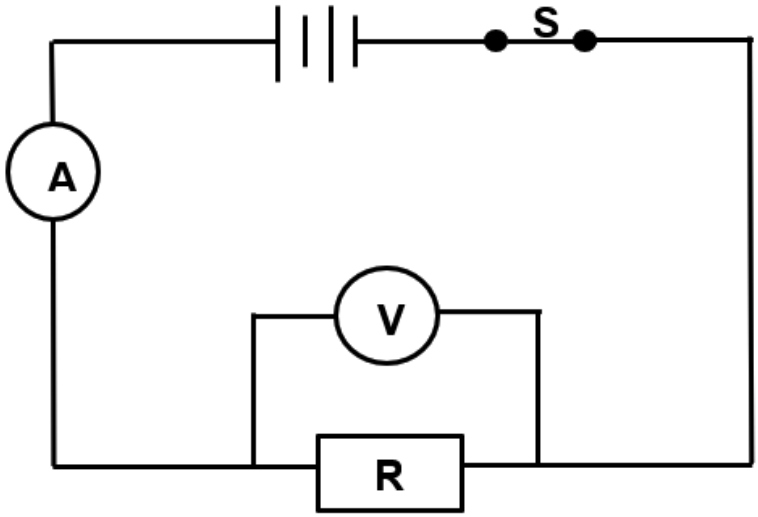
9.3.1 Magnetic flux linkage (3)

9.3.2 Magnitude of the induced emf (3)

[10]

QUESTION 10

A group of learners used the circuit diagram below to investigate the relationship between the potential difference across the ends of a conductor and the current passing through the conductor.



They obtained the results on the table below.

POTENTIAL DIFFERENCE (V)	CURRENT (A)
1	0,5
2	0,9
3	1,5
4	2

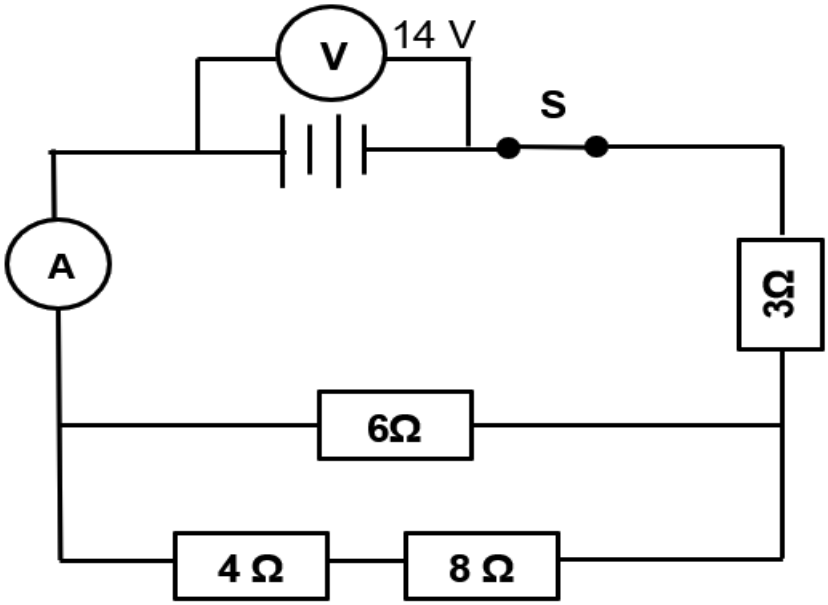
10.1 Write down the independent variable for this investigation? (1)

10.2 Name the law that the learners investigated in words. (1)

10.3 Use the attached ANSWER SHEET to draw a graph of potential difference verses current with the dependent variable on the x-axis, using the results obtained by the learners. (4)

10.4 Write down the conclusion for this investigation that can be made from the graph. (3)

10.5 The battery in the circuit diagram below has an emf of 14 V with negligible internal resistance. Switch **S** is closed.



Calculate the:

10.5.1 Total resistance of the circuit (4)

10.5.2 Reading on the ammeter (3)

10.5.3 Energy dissipated by the 8 Ω resistor in 2 minutes (5)

10.6 The potential difference of household power supply in South Africa is 220 V. A girl uses a hair dryer that allows maximum current of 16 A to pass through it when it is connected to the power source. Calculate how much she will pay for electricity for using the dryer for 30 minutes. 1 kWh = R2,56. (4)

[25]

TOTAL: 150

DATA FOR PHYSICAL SCIENCES GRADE 11

PAPER 1 (PHYSICS)

GEGEWENS VIR FISIESE WETENSKAPPE GRAAD 11

VRAESTEL 1 (FISIKA)

TABLE 1: PHYSICAL CONSTANTS/*TABEL 1: FISIESE KONSTANTES*

NAME/*NAAM*	SYMBOL/ *SIMBOOL*	VALUE/*WAARDE*
Acceleration due to gravity / *Swaartekragversnelling*	g	9,8 $m \cdot s^{-2}$
Universal gravitational constant / *Universele gravitasiekonstante*	G	$6,67 \times 10^{-11}$ $N \cdot m^2 \cdot kg^{-2}$
Speed of light in a vacuum / *Spoed van lig in 'n vakuum*	c	$3,0 \times 10^8$ $m \cdot s^{-1}$
Planck's constant / *Planck se konstante*	h	$6,63 \times 10^{-34}$ J•s
Coulomb's constant / *Coulomb se konstante*	k	$9,0 \times 10^9$ $N \cdot m^2 \cdot C^{-2}$
Charge on electron / *Lading op elektron*	e	$-1,6 \times 10^{-19}$ C
Electron mass / *Elektronmassa*	m_e	$9,11 \times 10^{-31}$ kg
Mass of earth / *Massa op aarde*	M	$5,98 \times 10^{24}$ kg
Radius of earth / *Radius van aarde*	R_E	$6,38 \times 10^3$ 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*

$F_{net} = ma$	$w = mg$
$F = \frac{Gm_1m_2}{d^2}$	$\mu_s = \frac{f_s^{max}}{N}$
$\mu_k = \frac{f_k}{N}$	

WAVES, SOUND AND LIGHT/*GOLWE, KLANK EN LIG*

$v = f\lambda$	$T = \frac{1}{f}$
$n_i \sin\theta_i = n_r \sin\theta_r$	$n = \frac{c}{v}$

ELECTROSTATICS/*ELEKTROSTATIKA*

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

ELECTROMAGNETISM/*ELEKTROMAGNETISME*

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

ANSWER SHEET

LEARNER'S NAME AND SURNAME

QUESTION/*VRAAG* 10.3