HILLCREST HIGH SCHOOL
PHYSICAL SCIENCE
GRADE 11
PAPER 1 - Physics

NOVEMBER 2022
TIME: 2 HRS

Total: 100

Instructions

1. Answer ALL the questions.
2. This question paper consists of TWO sections:
3. SECTION A (20)
   SECTION B (80)

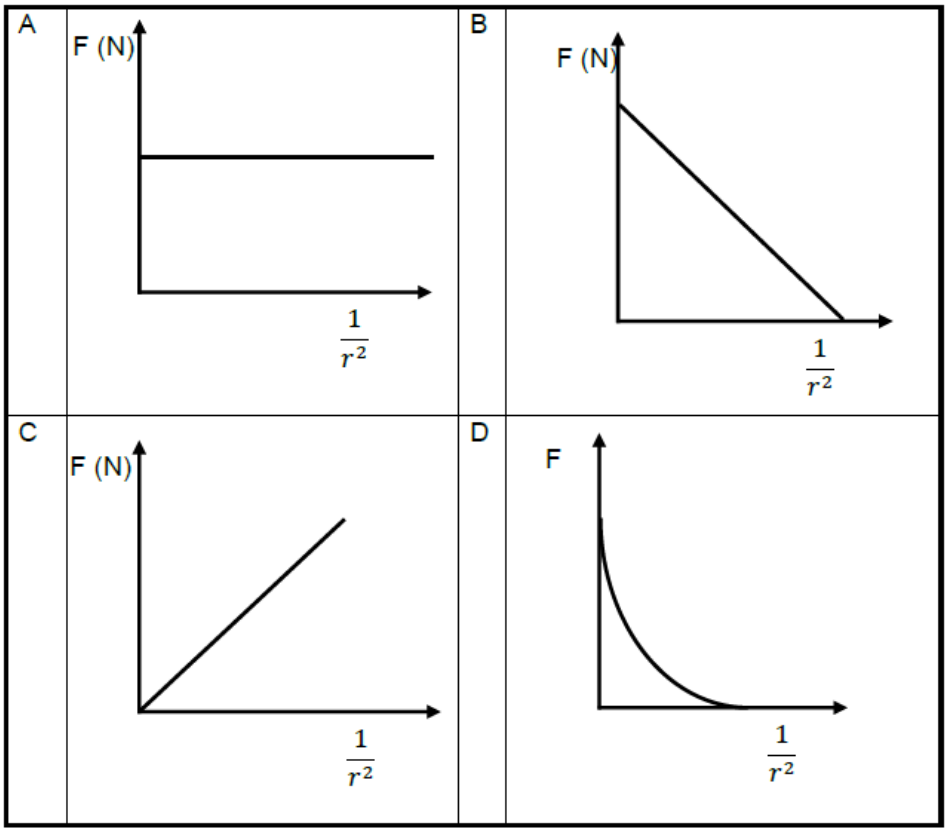
   Answer SECTIONS A and B in the ANSWER BOOK.
4. Non-programmable calculators may be used.
5. Appropriate mathematical instruments may be used.
6. Number the answers correctly according to the numbering system used in this question paper.
7. Data sheets are attached for your use.
8. Give brief motivations, discussions, et cetera where required.
9. Numbers must be rounded off to **two decimal** places.

SECTION A

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.

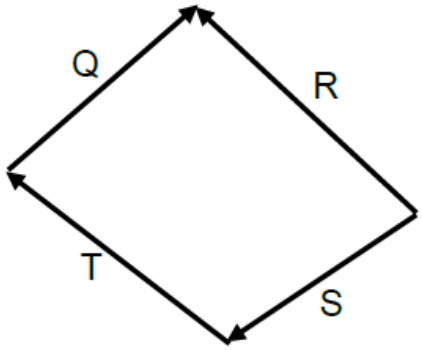
1.1 Which graph shows the correct relationship between the F and r^2 between 2 objects.



1.2 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

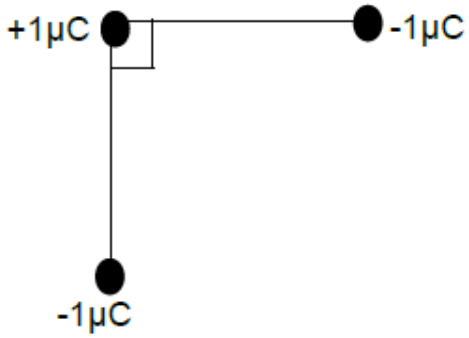
1.3 The diagram below represents four vectors Q, R, S and T.



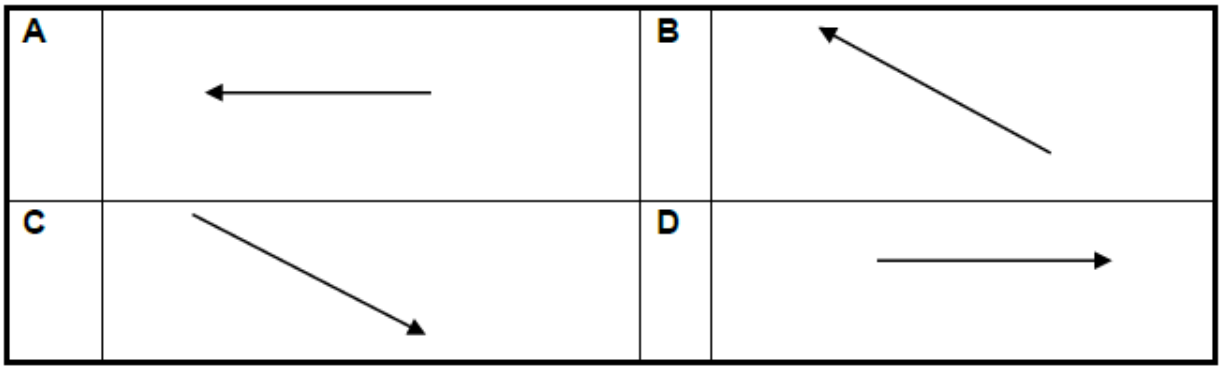
Which ONE of the vectors is the resultant of the other three vectors?

A Q
B R
C S
D T

1.4 Three point-charges of magnitude +1 μC, -1 μC and -1 μC are placed in a vacuum to form a right-angle as shown in the diagram below.

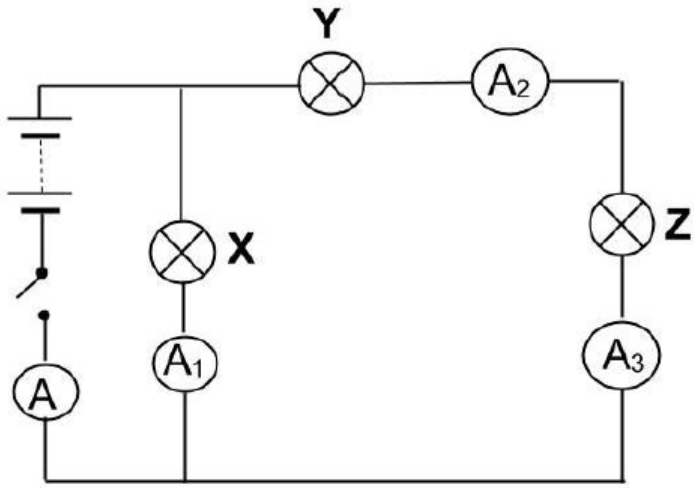


The net force acting on the + 1 μC can by represented by …



1.5 Three light bulbs, **X**, **Y** and **Z**, are connected in a circuit as shown below. **X** and **Y** are identical and both has a resistance **R**, while the resistance of **Z** is **2R**. The battery has negligible internal resistance.

When switch **S** is closed, all the bulbs glow. The reading on ammeter **A** is 2,0 A.



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

	A	**A_1**	**A_2**	**A_3**
A	2	2	0	0
B	1,5	1,5	0	0
C	1	0,5	0,5	0
D	0,6	0,2	0,2	0,2

1.6 The magnitude of the electrostatic force on a charge Q_1 due to another charge Q_2 is ***F***. The distance between charges Q_1 and Q_2 is ***r***. One of the charges is now doubled and the distance between the charges is halved.

The magnitude of the electrostatic force that Q_2 now exerts on Q_1 will be:

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

B **F**

C 4**F**

D 8**F**

1.7

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 $\frac{g}{16}$

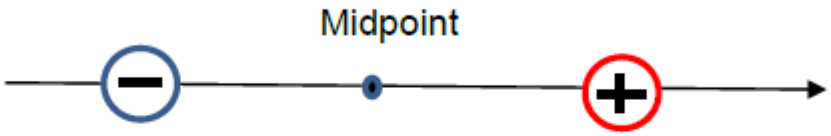
B $\frac{g}{4}$

C $\frac{g}{2}$

D $2g$

1.8

The sketch below shows a negative and a positive point charge. The magnitude of the positive charge is greater than that of the negative charge.



Where on the line that passes through the charges is the total electric field zero?

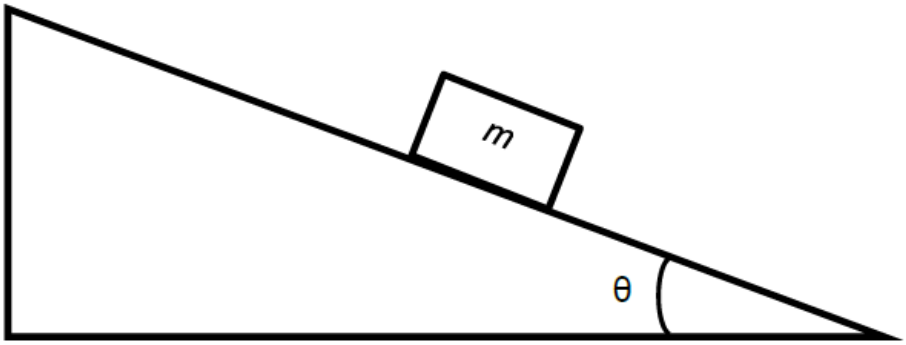
A To the right of the positive charge.

B To the left of the negative charge.

C Between the charges, to the left of the midpoint.

D Between the charges, to the right of the midpoint.

1.9 A block of mass *m* is placed on a smooth inclined plane of inclination θ with the horizontal. What is the magnitude of the normal force exerted by the surface on the block?



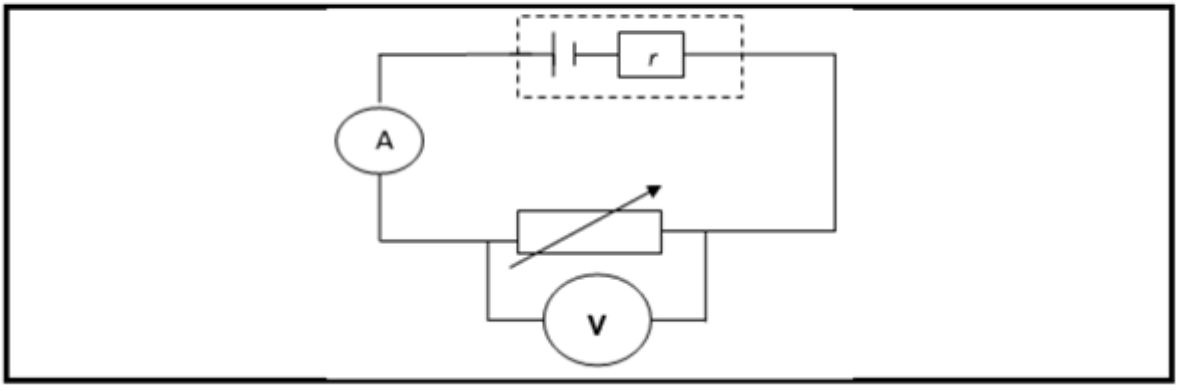
A mg

B mg cos θ

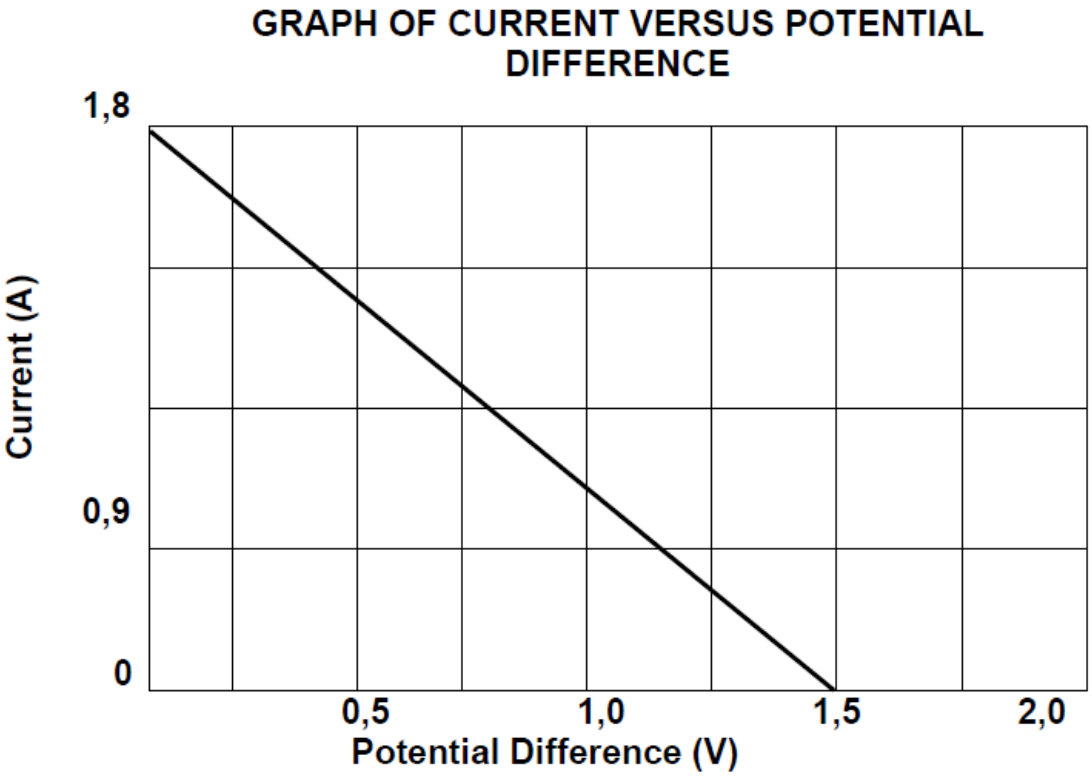
C mg sin θ

D mg tan θ

1.10 Learners conduct an experiment as shown in the diagram below.



The results obtained are shown in the graph below.



The internal resistance of the cell is:

A 0,83 Ω

B 1,2 Ω

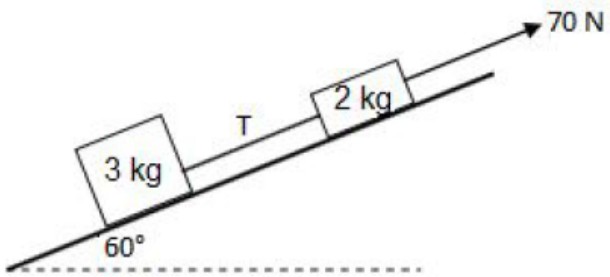
C 1,8 Ω

D 1,5 Ω

[2 x 10 = 20]

Question 2 – newton

Two objects with masses 2 kg and 3 kg, respectively, are attached with a light, inelastic string. The objects are being pulled by constant force of 70 N up a rough inclined plane, at an angle of 60° to the horizontal. Ignore the mass of the string.



The kinetic friction coefficient is 0,3 for the 3 kg object. The tension in the string is T.

2.1 State Newton's Second Law of Motion in words. (2)

2.2 Draw a labelled free body diagram showing ALL the forces acting on the 3 kg object, as it moves up the inclined plane. (4)

2.3 Calculate the magnitude of the kinetic frictional force acting on the 3 kg object. (4)

The magnitude of the kinetic frictional force acting on the 2 kg object is 1,96 N.

2.4 Calculate the:

2.4.1 Magnitude of the acceleration of the objects as it moves up the inclined plane. (4)

2.4.2 Value of T, the magnitude of the tension in the string. (2)

[16]

Question 3

A 400 kg research satellite is orbiting the Earth at a certain average height above the Earth's surface. The Earth exerts a force of 2×10^3 N on the satellite to keep it in orbit.

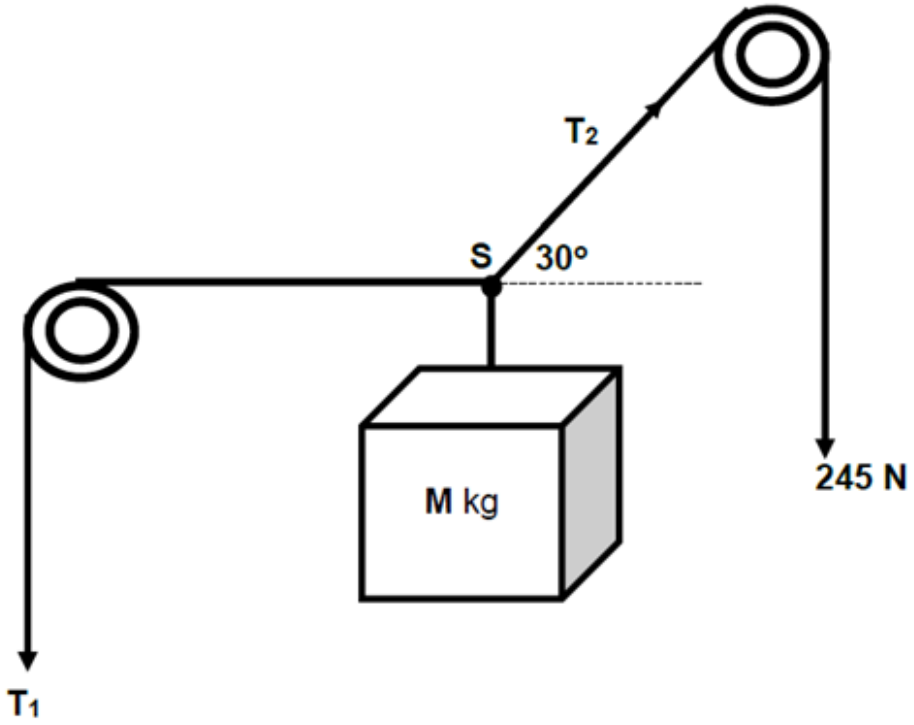
3.1 State Newton's law of universal gravitation. (2)

3.2 What magnitude of force does the satellite exert on the Earth? (1)

3.3 Calculate how many kilometers **above** the Earth's surface the satellite is moving. (5)

[8]

Question 4
The following system is in equilibrium.



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

4.2 Calculate the:

4.2.1 Vertical and horizontal components of T_2 (4)

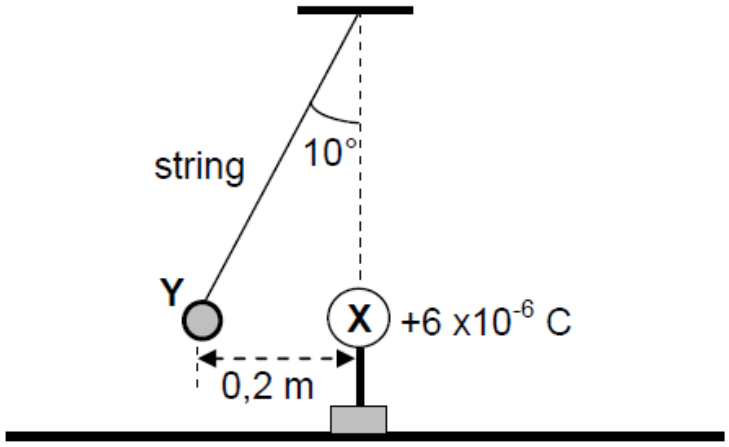
4.2.2 Magnitude of T_1 (2)

4.2.3 Mass M of the crate (3)
[11]

Question 5 - Electrostatics

A small sphere, **Y**, carrying an unknown charge, is suspended at the end of a light inextensible string which is attached to a fixed point. Another sphere, **X**, carrying a charge of +6 x10^{-6} C, on an insulated stand is brought close to sphere **Y**.

Sphere **Y** experiences an electrostatic force and comes to rest 0,2 m away from sphere **X**, with the string at an angle of 10° with the vertical, as shown in the diagram below.



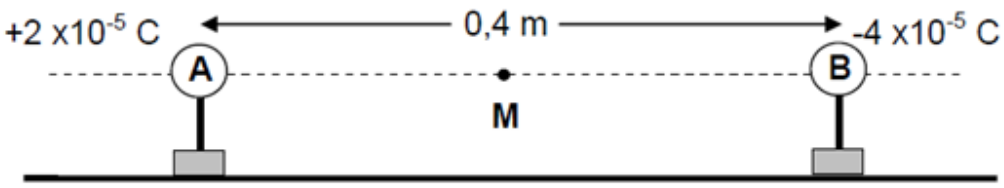
5.1.1 What is the nature of the charge on sphere **Y**? Choose from POSITIVE or NEGATIVE. (1)

5.1.2 Calculate the magnitude of the charge on sphere **Y** if the magnitude of the electrostatic force acting on it is 3,05 N. (3)

5.1.3 Draw a labelled free-body diagram for sphere **Y**. (3)

5.1.4 Calculate the magnitude of the tension in the string. (3)

5.2 Two small charged spheres, **A** and **B**, on insulated stands, with charges +2 x10^{-5} C and -4 x10^{-5} C respectively, are placed 0,4 m apart, as shown in the diagram below. **M** is the midpoint between spheres **A** and **B**.



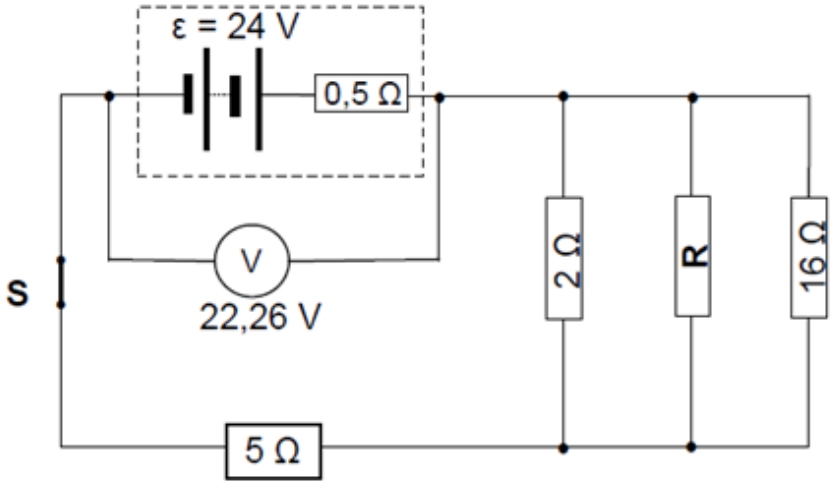
5.2.1 Define the term *electric field at a point*. (2)

5.2.2 Calculate the net electric field at point **M**. (6)

[18]

Question 6

A battery with an internal resistance of 0,5 Ω and an emf (ε) of 24 V is connected in a circuit, as shown below. With switch **S** closed, the high-resistance voltmeter (V) has a reading of 22,26 V



6.1.1 Define the term *emf of 24 V* in terms of work done. (2)

6.1.2 Calculate the power dissipated in the 16 Ω resistor (7)

6.1.3 Calculate the current passing through resistor **R** (4)

Resistor **R** is removed from the circuit

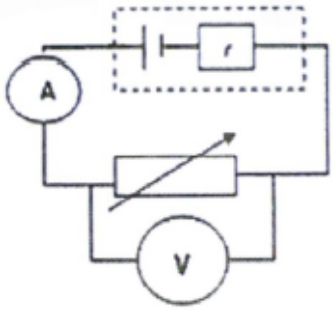
6.1.4 Will the reading on V increase, decrease or remain the same? Explain your answer. (you can use bullet points) (4)

6.2 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)

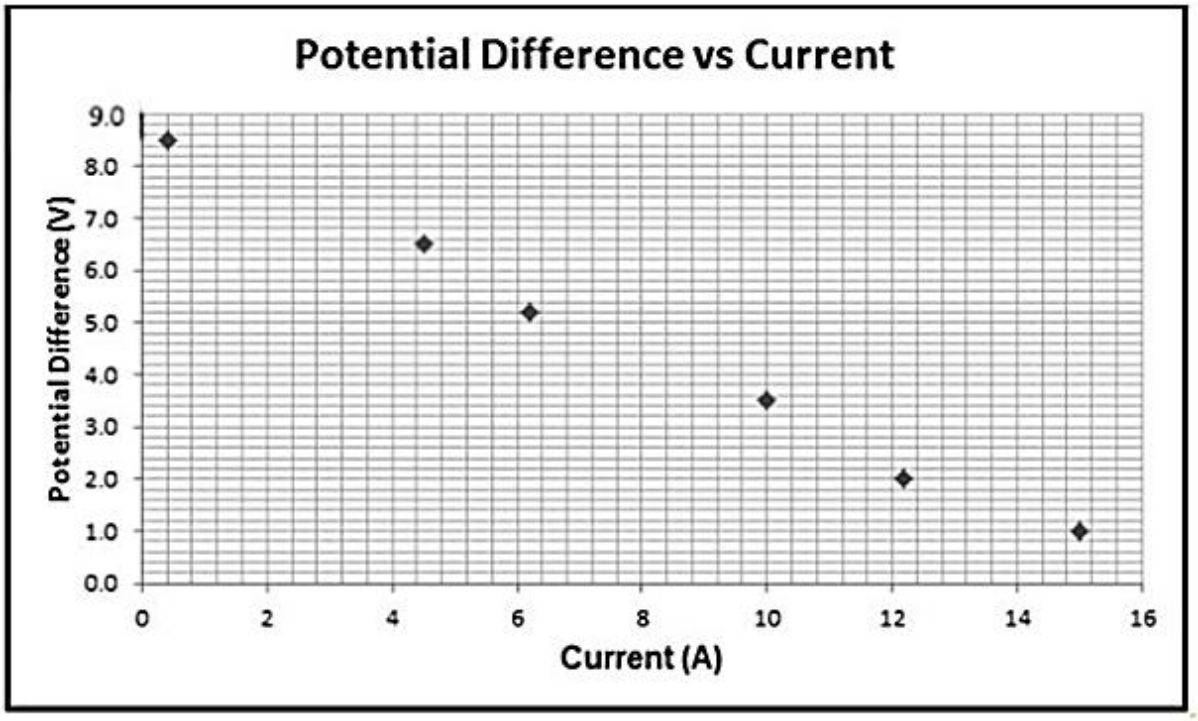
[20]

Question 7

A Grade 12 class did an experiment to determine the internal resistance and emf of an unknown cell provided by the teacher. They completed an electrical circuit with the components as shown in the diagram.



The rheostat was changed to a different setting six times and the readings on the ammeter and voltmeter (V) were taken after each setting. The readings were plotted on a graph. Complete the line graph and answer the following questions.



7.1 What is the independent variable in this experiment? (1)

7.2 Name one constant variable for this experiment. (1)

7.3 Determine the emf of the cell using the graph provided. (1)

7.4 Determine the internal resistance of the cell using the graph. (4)

Total 100

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	$9{,}8\ m{\cdot}s^{-2}$
Gravitational constant *Swaartekragkonstante*	G	$6{,}67 \times 10^{-11}\ N{\cdot}m^2{\cdot}kg^{-2}$
Coulomb's constant *Coulomb se konstante*	k	$9{,}0 \times 10^{9}\ N{\cdot}m^2{\cdot}C^{-2}$
Speed of light in a vacuum *Spoed van lig in 'n vakuum*	c	$3{,}0 \times 10^{8}\ m{\cdot}s^{-1}$
Charge on electron *Lading op elektron*	e	$-1{,}6 \times 10^{-19}\ C$
Electron mass *Elektronmassa*	m_e	$9{,}11 \times 10^{-31}\ kg$
Radius of earth *Radius van aarde*	R_E	$6{,}38 \times 10^{6}\ m$
Mass of earth *Massa van aarde*	M_E	$5{,}98 \times 10^{24}\ kg$

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

$F_{net} = ma$
$W = mg$ $F_g = m.g$
$F = \frac{Gm_1m_2}{r^2}$
$g = \frac{Gm}{r^2}$
$f_s^{max} = \mu_s.N$ or $f_s^{max} = \mu_s.F_N$
$f_k = \mu_k.N$ or $f_k = \mu_k.F_N$

ELECTROSTATICS/*ELEKTROSTATIKA*

$F = \frac{kQ_1Q_2}{r^2}$ $(k = 9{,}0 \times 10^9\ N{\cdot}m^2{\cdot}C^{-2})$	$E = \frac{F}{q}$
$E = \frac{kQ}{r^2}$ $(k = 9{,}0 \times 10^9\ N{\cdot}m^2{\cdot}C^{-2})$	$V = \frac{W}{Q}$

CURRENT ELECTRICITY/*STROOMELEKTRISITEIT*

$I = \frac{Q}{\Delta t}$	$R = \frac{V}{I}$ $emf/emk = I(R+r)$
$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \ldots$	$R = R_1 + R_2 + R_3 \ldots$
$W = Vq$ $W = VI\Delta t$ $W = I^2R\Delta t$ $W = \frac{V^2\Delta t}{R}$	$P = \frac{W}{\Delta t}$ $P = VI$ $P = I^2R$ $P = \frac{V^2}{R}$