HILLCREST HIGH SCHOOL

PHYSICAL SCIENCE

GRADE 11

PAPER 1- Physics

NOVEMBER 2020

TIME: 3 HRS

Total 150

Instructions

1. Answer ALL the questions.
2. This question paper consists of TWO sections:
3. SECTION A (20)
   SECTION B (130)

   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

A learner is sitting on a chair. According to Newton's Third Law of Motion, the reaction force to the learner's weight is the force of the …

A learner on the chair.

B chair on the learner.

C earth on the learner.

D learner on the earth.

1.2

A dove accidentally flies into the windscreen of an oncoming truck. In comparison with the magnitude of the force of the truck on the dove, the magnitude of the force of the dove on the truck during the crash is …

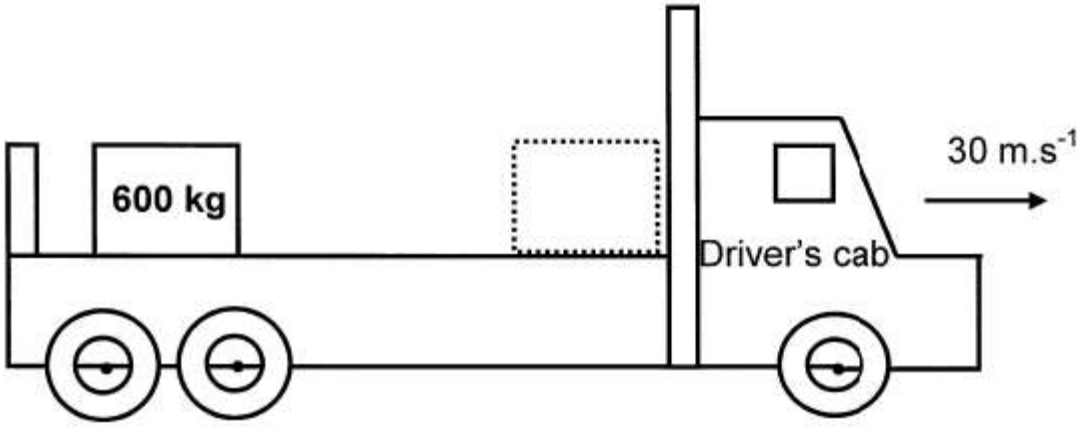
A zero

B the same

C smaller

D greater

1.3 A flatbed truck carrying a 600 kg concrete block, near the back of its flatbed, is travelling to the right along a straight level road at 30 $m.s^{-1}$.



The truck collides head on with a stationary truck and stops immediately. The concrete block slides into the back of the driver's cab. Which ONE of the following is the best explanation why the block slides forward?

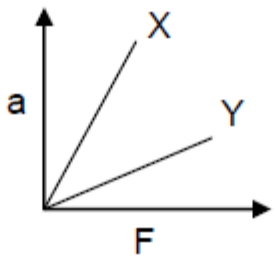
A The truck exerts a force on the block.

B The inertia of the concrete block causes it to slide forward.

C The velocity of the concrete block relative to the ground remains constant.

D The concrete block experiences an acceleration due to a resultant force.

1.4 The graphs below show the relationship between the net force and the acceleration for two masses X and Y.



Which one of the following statements is true?

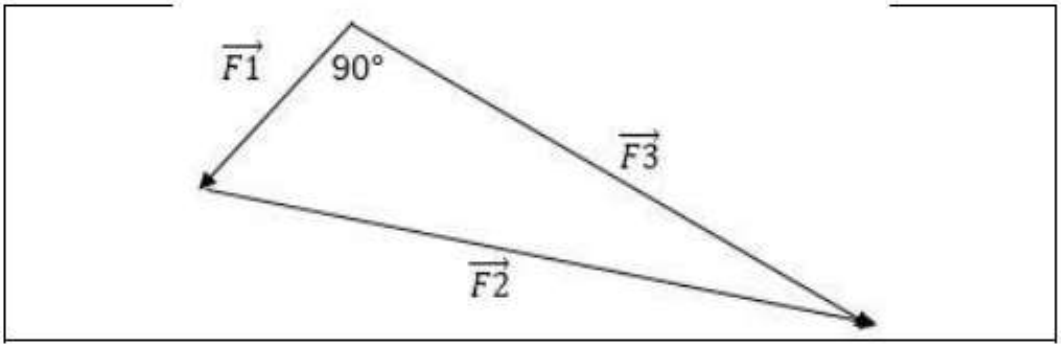
A. The bodies have equal masses.
B. Body X has a smaller mass.
C. Body Y has a smaller mass.
D. The mass does not affect the gradient of the graphs.

1.5 The magnitude of the electrostatic force between two identically charges spheres is given as F_0.

If the charge on each sphere is doubled, while the distance between them is halved, the new electrostatic force between the spheres will be …

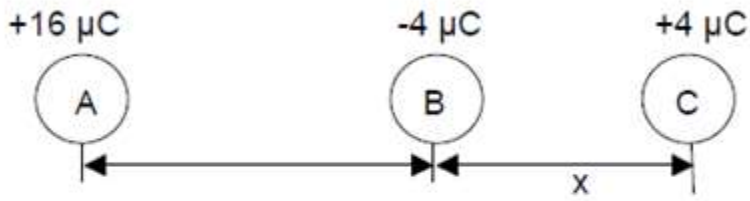
A $16\,F_0$.
B $4\,F_0$.
C F_0.
D $\frac{1}{2}F$.

1.6 Which of the following is true for the given sketch?



A $\overrightarrow{F1} + \overrightarrow{F2} = \overrightarrow{F3}$
B $\overrightarrow{F1} + \overrightarrow{F3} = \overrightarrow{F2}$
C $\overrightarrow{F3} + \overrightarrow{F2} = \overrightarrow{F1}$
D $\overrightarrow{F1} + \overrightarrow{F2} + \overrightarrow{F3} = 0$

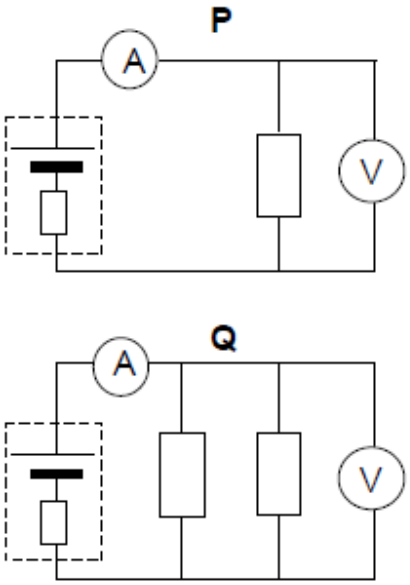
1.7 Three small identical spheres, **A**, **B** and **C** are charged as shown in the diagram. The distance between sphere **B** and **C** is **x**.



For sphere **B** to experience no resultant electrostatic force, the distance between **A** and **B** must be …

A ¼ x.
B ½ x.
C 2 x.
D 4 x.

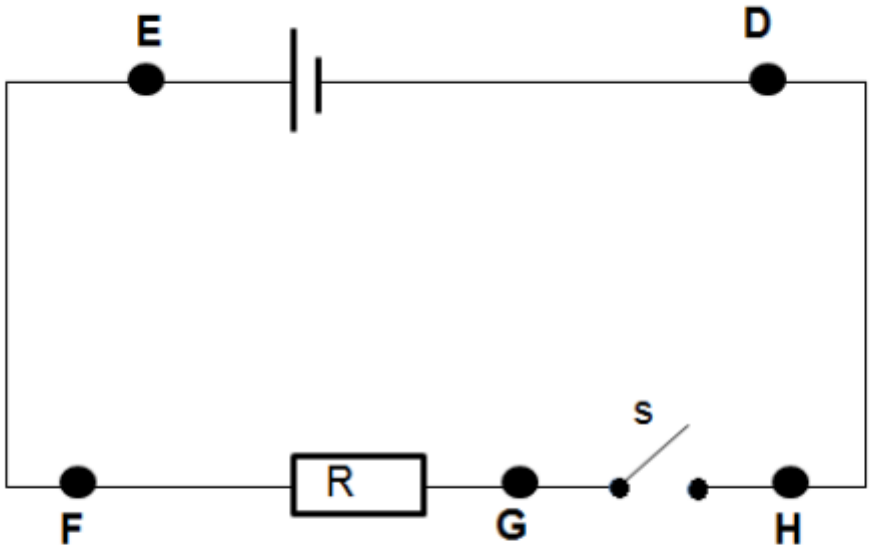
1.8 In the circuits shown below all resistors and cells are **identical.**



Which ONE of the following gives the correct comparison between the voltmeter and ammeter readings in circuit **P** and **Q.**

	VOLTMETER READING	AMMETER READING
A	$V_P > V_Q$	$A_p > A_Q$
B	$V_P > V_Q$	$A_p < A_Q$
C	$V_P < V_Q$	$A_p = A_Q$
D	$V_P = V_Q$	$A_p < A_Q$

1.9 A cell is connected to a resistor and an open switch. Five points are labelled D, E, F, G and H respectively.



A voltmeter has a zero reading if it is connected across points …

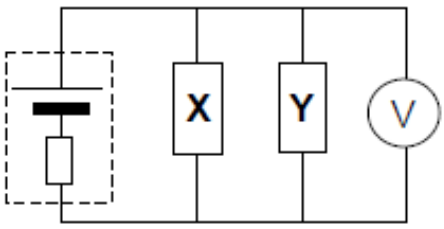
A ED

B FH

C FG

D GH

1.10 In the circuit shown below the resistance of X is **R** and that of Y is **2R**.



If the power dissipated by **X** equals **P**, then the power dissipated by **Y** will be …

A ¼ P.

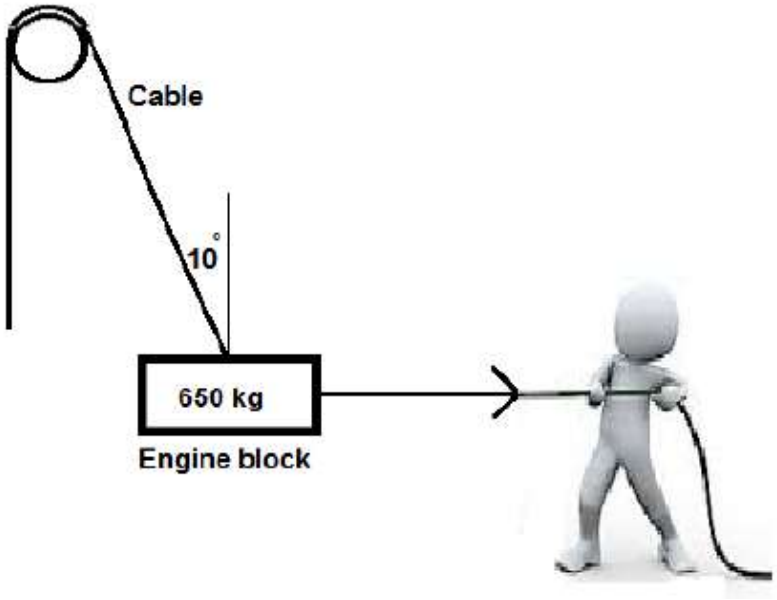
B ½ P.

C 2P.

D 4P.

Question 2

An engine block with a total mass of 650 kg, is suspended by a cable over a frictionless pulley. A learner pulls a rope, attached to the engine block, horizontally to the right so that the cable forms an angle of 10^{o} with vertical. It is then kept in this position.



2.1 Explain the concept of *Forces in Equilibrium.* (2)

2.2 Draw a labelled, free-body vector diagram showing ALL the forces acting on the engine block. Indicate the magnitude of at least ONE angle. (4)

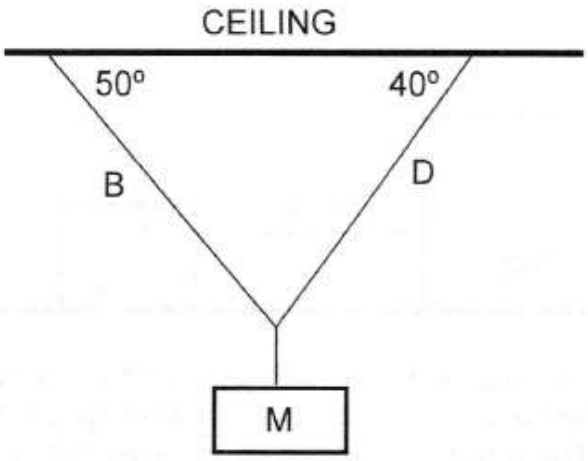
2.3 Calculate the magnitude of the tension in the cable. (3)

2.4 The cable can withstand a maximum tension of 7000 N. The engine block is now pulled further to the right so that the angle of the cable with the vertical is 32^{o}. Determine whether or not the cable will snap. (4)

[13]

Question 3

An object, M, of unknown mass is supported in a stationary position, from a ceiling by two strings, B and D as shown in the sketch below:



Each of the strings B and D can withstand a maximum force of 727.51 N.

3.1 Draw a labelled closed vector diagram of forces, showing ALL the forces acting on the object. Also correctly indicate ALL THE ANGLES on the diagram. (6)

3.2 Give a reason why string B will break first. (2)

3.3 Calculate the magnitude of the force in string D when string B breaks. (3)

3.4 Define the term resultant vector. (2)

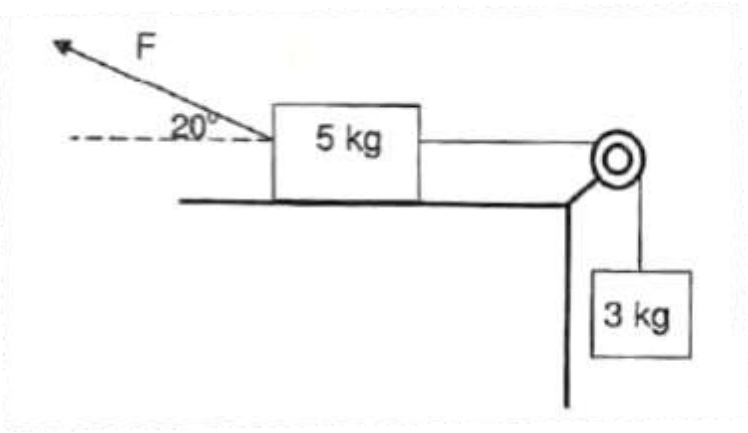
3.5 Calculate the maximum mass of M that can be supported without the strings breaking. (4)

[17]

Question 4

A 5kg 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 3kg 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 5kg block and the surface is 0.2
The 5kg block accelerates to the left.



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

4.2 Calculate the magnitude of the:

4.2.1 Vertical component of F if the magnitude of the horizontal component of F equals 38 N. (2)

4.2.2 Normal force acting on the 5kg block. (3)

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

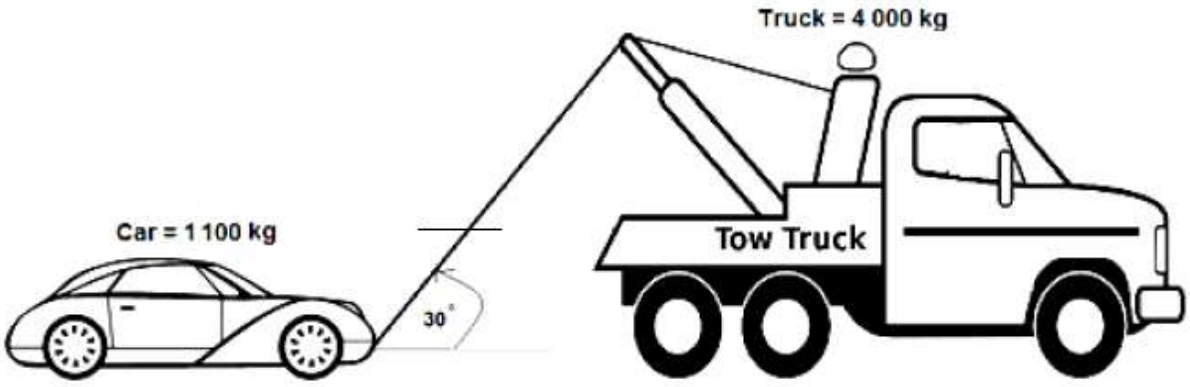
4.4 Draw a labelled free-body diagram to indicate all the forces acting on the 3kg block. (2)

4.5 Calculate the magnitude of the tension in the string connecting the two blocks. (6)

[17]

Question 5

A breakdown truck pulls a small car using a light rope as shown in the diagram. The inelastic rope forms an angle of 30^{o} with the horizontal.



The two vehicles move from rest on a straight horizontal road to the right. The mass of the car is 1100 kg and the mass of the breakdown truck is 4000 kg. The truck's engine applies a force of 18 000 N. A frictional force of 1617 N is working on the car and a frictional force of 5880 N on the breakdown truck.

5.1 Draw a labelled free-body diagram of all the forces working on the car. (4)

5.2 Calculate the acceleration of the car. (6)

5.3 Calculate the magnitude of the tension T in the rope. (3)

5.4 Using equation of motion, calculate the distance that the car will travel in 6s. (3)

5.5 After a while the breakdown truck and the car travel at a constant velocity. The rope now exerts a horizontal force of 1617 N on the car. Calculate the normal force of the road on the car. (4)

5.6 Define Newton's First Law of Motion in words. (2)

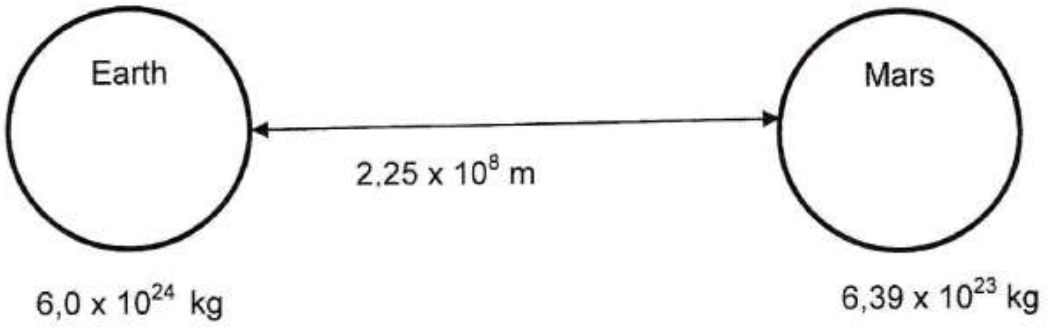
5.7 Towing with a rope can be dangerous. Refer to Newton's laws of motion to explain this. (2)

5.8 If the force of horizontal tension in the rope from the car on the truck is 1617 N, what is the horizontal force of the truck on the car? Explain with reference to the relevant scientific principles. (2)

[26]

Question 6

The Earth and Mars are positioned in the universe such that they are 2,25 x 10^8 m apart. The radius of the Earth is 6,37 x 10^6 m.
If the radius and mass of Mars is 3,39 x 10^6 m and 6,39 x 10^{23} kg respectively.



6.1 State Newton's Universal Law of gravitation. (2)

6.2 Calculate the force that Mars exerts of Earth. (5)

6.3 Is the force calculated in 6.2 a contact or non-contact force? (1)

6.4 Calculate the acceleration due to gravity on Mars. (4)

6.5 What will be the force that the Earth exerts on Mars? (1)

[13]

Question 7

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

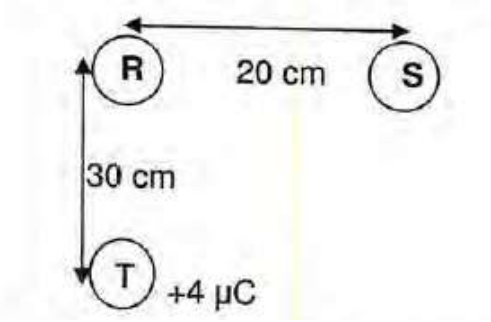
7.1 State *Coulumb's Law* in words. (2)

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 after R and S have touched. (1)

7.3 Calculate the charge that transferred between the spheres when they touched. (2)

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

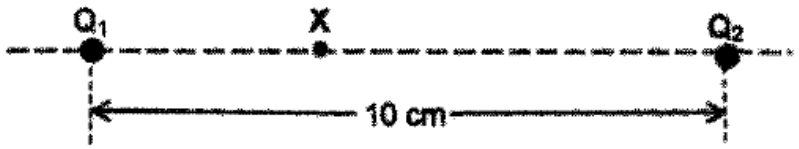


7.3 Calculate the net electrostatic force acting on **R** due to the presence of spheres **S** and **T.** (7)

[12]

Question 8

8.1 The diagram below shows Q_1 with a charge of $+1{,}0 \times 10^{-5}$ C placed 10 cm from a charge Q_2 with a charge of $2{,}0 \times 10^{-6}$.



8.1.1 Draw the electric field pattern between Q1 and Q2 (2)

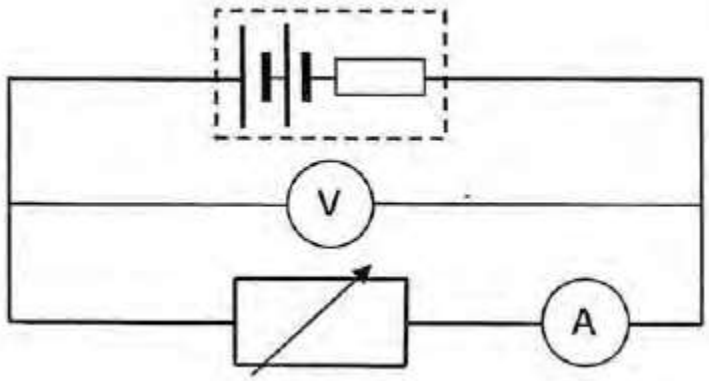
8.1.2 The net electrostatic force exerted on an electron placed at point X is zero newton.

Calculate the distance (in cm) between Q_1 and point X. (5)

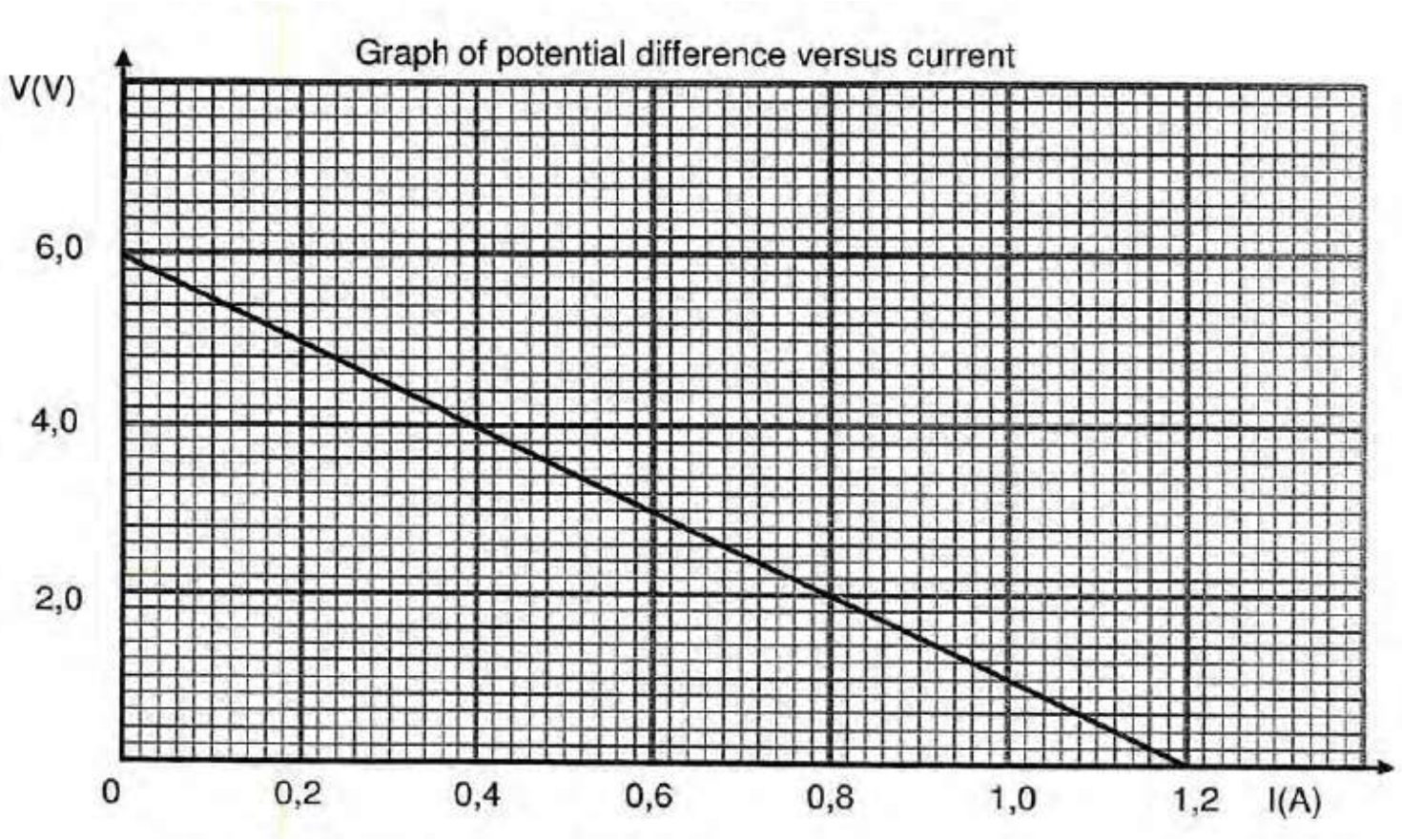
[7]

Question 9

9.1 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



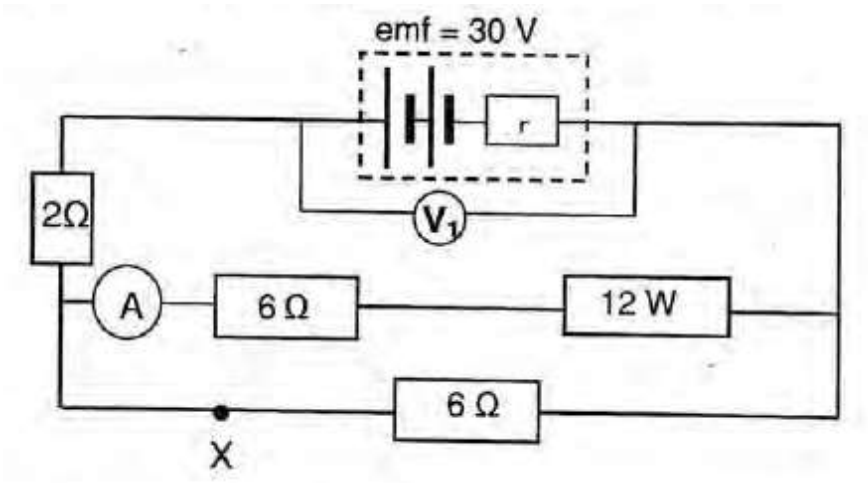
9.1.1 Explain the purpose of the rheostat for this experiment. (2)

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

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

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

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



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

9.2.2 Calculate voltmeter reading V_1. (8)

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

9.2.4 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]

Total 148

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	$5{,}98 \times 10^{24}\ kg$

TABLE 2: FORMULAE/*TABEL 2: FORMULES*

MOTION/*BEWEGING*

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

$F_{net} = ma$
$w = mg$ $F_g = m.g$
$F = \frac{Gm_1m_2}{r^2}$
$g = \frac{Gm}{r^2}$
$f_s^{max} = \mu_s.N$ 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*

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