Hillcrest High School

PHYSICAL SCIENCE P1

Nov 2025

Grade 11

MARKS: 125
TIME: 2,5 Hours

EXAMINER: Ms N. Badenhorst
MODERATOR: Mrs J. Knox-Whitehead

Instructions:

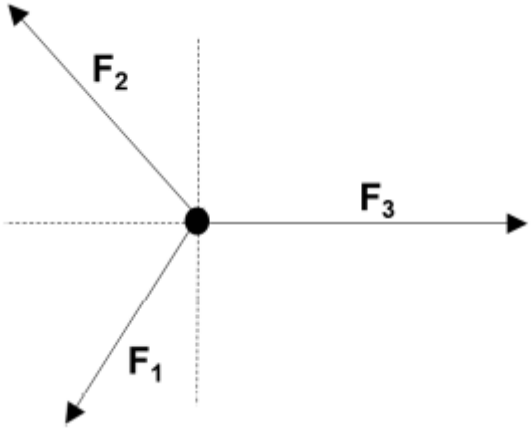
1. Answer ALL the questions.
2. This question paper consists of TWO sections:
3. SECTION A (18)
   SECTION B (107)
4. Answer SECTIONS A and B in the ANSWER BOOK.
   Non-programmable calculators may be used.
5. Appropriate mathematical instruments may be used.
6. Number the answers correctly according 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 <u>two decimal</u> places

SECTION A

QUESTION 1: MULTIPLE CHOICE QUESTIONS

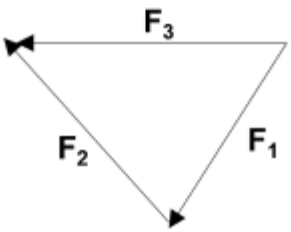
Four options are provided as possible answers to the following questions. Each question has only one correct answer. Write only the letter (A-D) next to the question number (1.1-1.10) in the answer book.

1.1 The following three forces are in equilibrium on a single point.

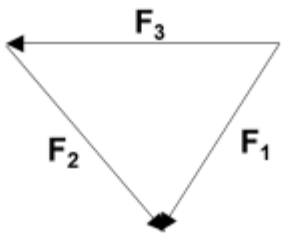


Which vector diagram correctly shows the relationship between the forces?

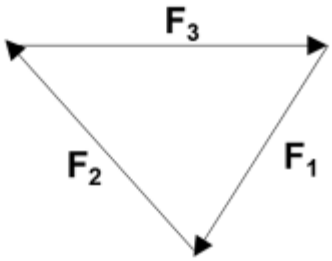
A.



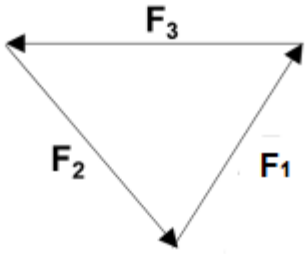
B.



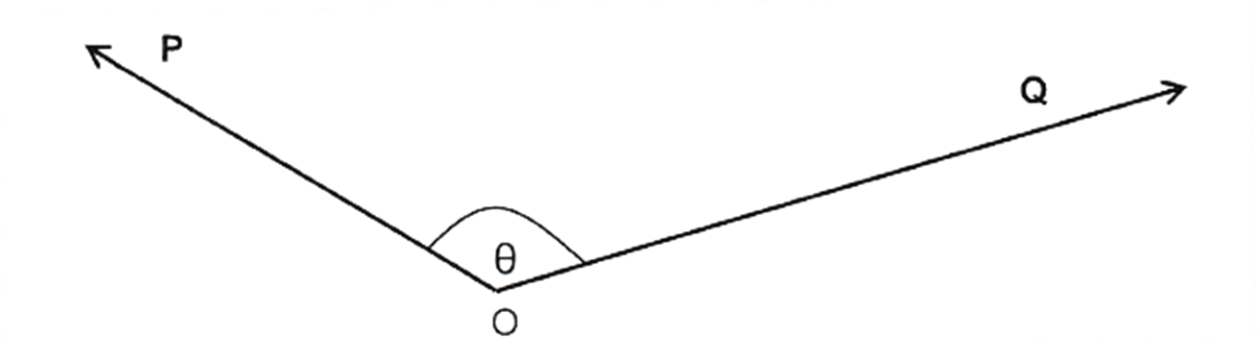
C.



D.



1.2 Two forces P and Q act at the same point O as shown in the sketch below.



If the magnitude of force P is 4 N, and Q is 8 N, which of the forces given CANNOT resultant of the forces when the angle, Θ, changes?

A 8 N

B 11,31 N

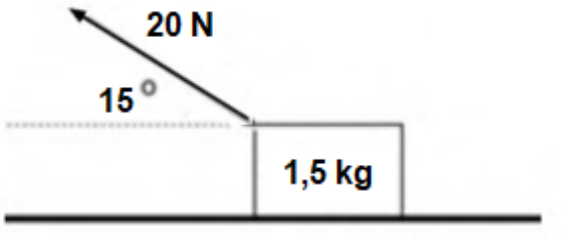
C 2 N

D 10 N

1.3 A wooden block is pulled up a rough, inclined surface using a rope. The wooden block moves at constant velocity. This means that:

A There are no forces acting on the block.
B There are no vertical forces acting on the block.
C Only gravitational force acts on the block,
D The vector sum of all forces acting on the block is equal to zero.

1.4 A box of 1,5 kg is being pulled with a force of 20 N at an angle of 15° to the horizontal, as shown in the diagram.



The normal force is …

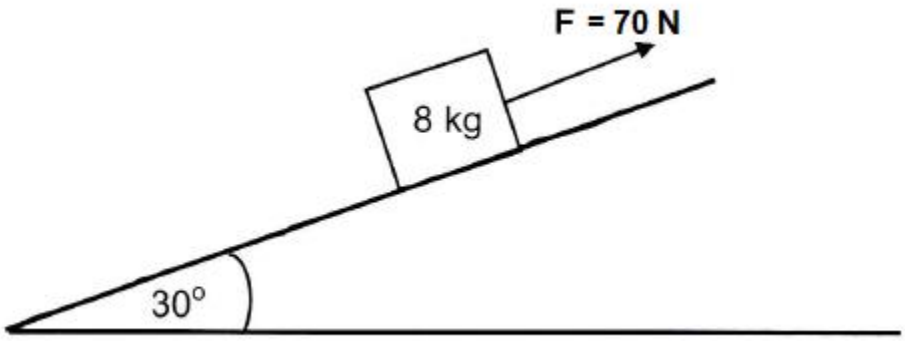
A 14,70 N

B 9,52 N

C 19,88 N

D 5,18 N

1.5



The normal force acting on the above object is:

A 39,2 N

B 67,9 N

C 78,4 N

D 30,8 N

1.6 The MASS of an object on Earth is represented by $\frac{x}{g}$.

Which ONE of the following represents the MASS of the object on a planet, that has TWICE the mass of earth and HALF the radius of the Earth?

A $\frac{8x}{g}$

B $\frac{x}{g}$

C $\frac{x}{2g}$

D $\frac{x}{8g}$

1.7 The electrostatic force that two charged spheres exert on each other is **F** when they are placed a distance ***r*** metres apart. The charge on each sphere is now tripled and the distance between them is $\frac{1}{2}$ ***r.*** The force that the spheres exert on each other will now be …

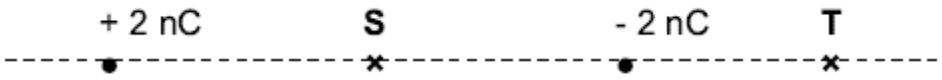
A 9 F

B 18 F

C 27 F

D 36 F

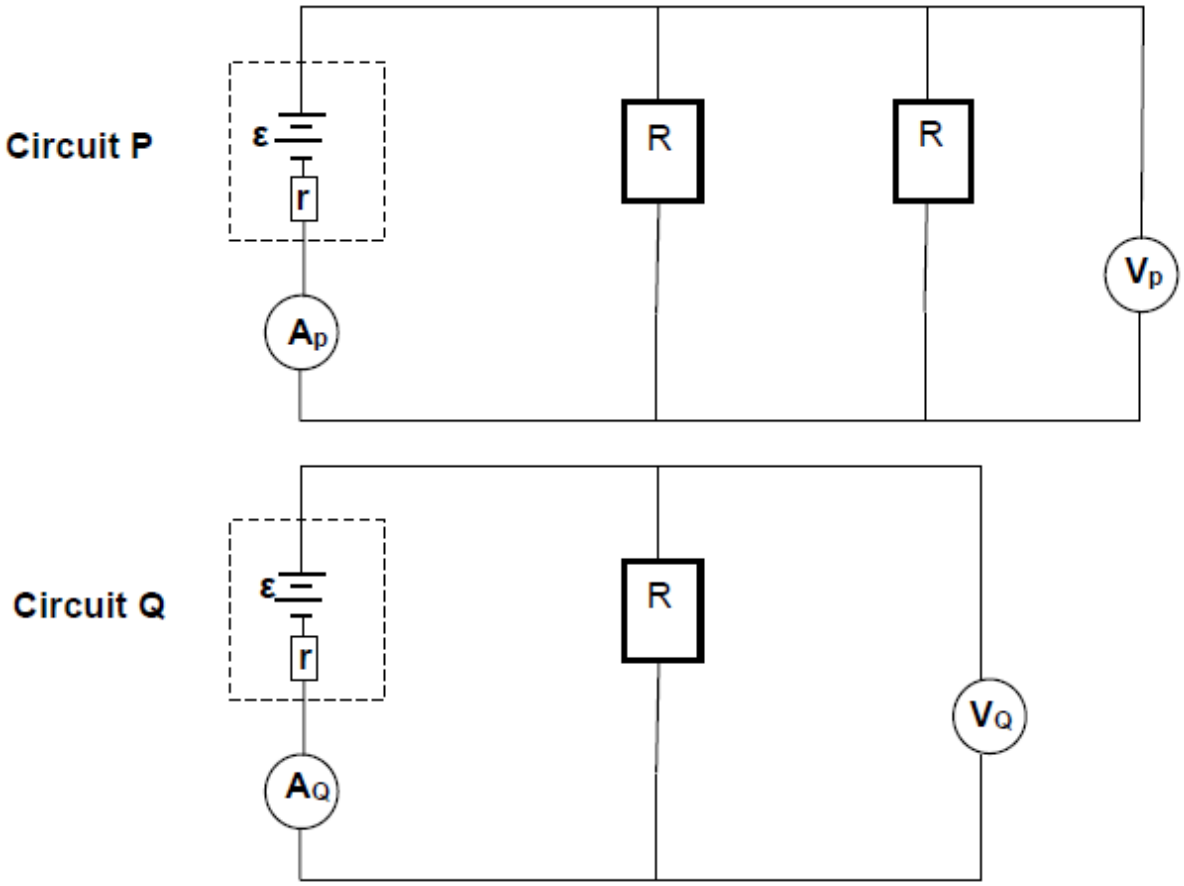
1.8 Two charges of +2 nC and -2nC are located on a straight line. S and T are two points that lie on the same straight line as shown in the diagram below.



Which ONE of the following correctly represents the directions of the RESULTANT electric fields at S and T?

	RESULTANT ELECTRIC FIELD AT POINT S	**RESULTANT ELECTRIC FIELD AT POINT T**
A	Right	Left
B	Left	Left
C	Right	Right
D	Left	Right

1.9 In the circuits below all resistors and cells are identical.



Which one of the following gives the correct relation between the voltmeter and ammeter readings in circuits in circuits **P** and **Q**.

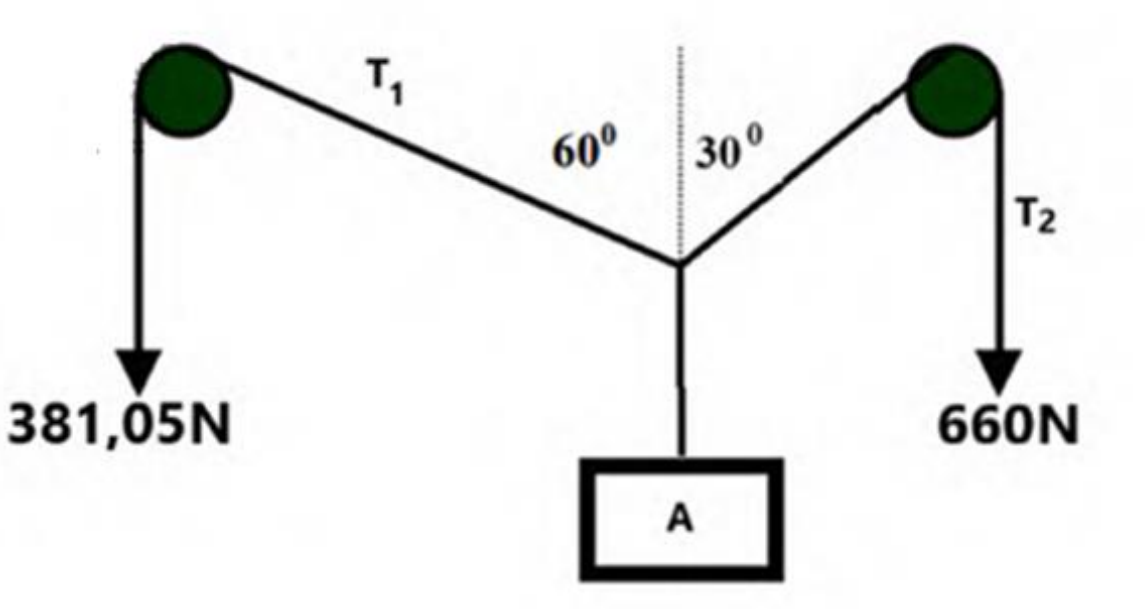
	VOLTMETER READING	AMMETER READING
A	$V_P < V_Q$	$A_P > A_Q$
B	$V_P > V_Q$	$A_P < A_Q$
C	$V_P < V_Q$	$A_P < A_Q$
D	$V_P = V_Q$	$A_P > A_Q$

[2 x 9 = 18]

Section B

Question 2

Learners doing a Force board practical, finds that the following forces could balance object A.



2.1 What is the magnitude of the resultant force of the system? (1)

2.2 State Newton's first Law in words. (2)

2.3 Calculate:

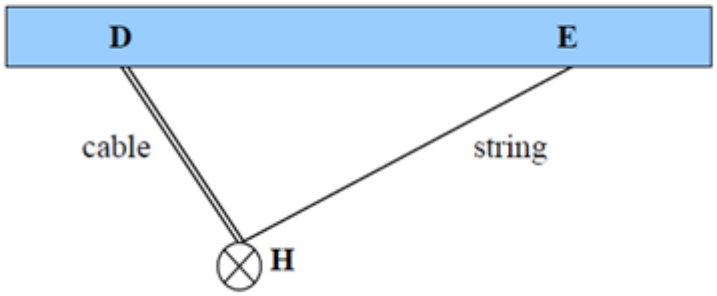
2.3.1 the components of the force in string T_1. (4)

2.3.2 the mass of object A (3)

[10]

Question 3

Senzi decides to hang an electric lamp of mass 0,8 kg above her desk so that she can study. She attaches the lamp with an electric cable and a string to the ceiling. The **cable makes a 60° angle** with the ceiling and the **string makes a 40° angle with the ceiling**.



3.1 What would be the tension in the electric cable if the lamp were hanging down straight, without the string? (2)

3.2 Draw a force diagram of the lamp holder H and label all the forces acting on it. (3)

3.3 Find the tensions in the electric cable and string by using calculations. (6)

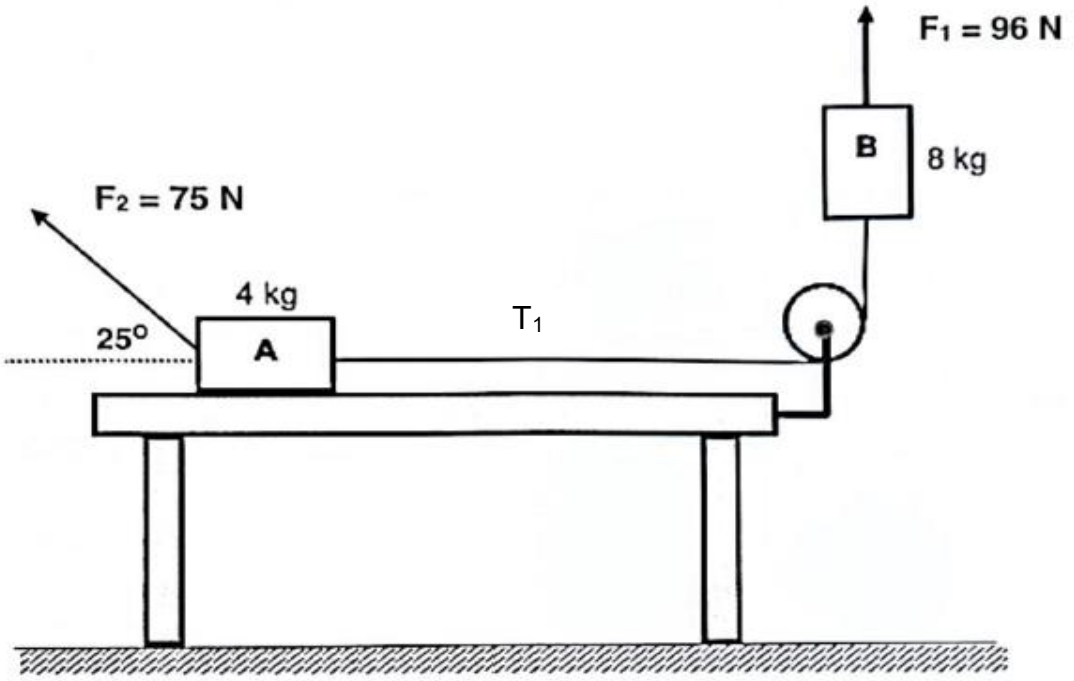
3.4 Senzi decides to hang a heavier lamp. Determine the maximum mass of the lamp that can be supported, if the cable and string can each withstand a maximum force of 8N. (4)

[15]

Question 4

Block **A** with mass 4 kg, that is at rest on a rough horizontal table, is connected to another block **B** with mass 8 kg by a light inextensible string passing over a frictionless pulley.

A force $\mathbf{F_1}$ of magnitude 96 N is applied vertically upwards on block **B** as shown in the diagram below.



A force F_2 of magnitude 75 N is now applied at an angle of 25° with the horizontal on block **A** and the block accelerates to the left. The kinetic frictional force on block **A** is 11,76 N. Ignore the effects of air friction.

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

4.2 Draw a labelled free-body diagram for block A. (5)

4.3 Calculate the magnitude of the:

4.3.1 Acceleration of block A. (5)

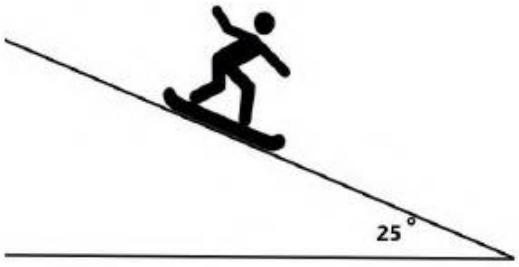
4.3.2 Tension, T_1, in the rope connected to block A. (2)

4.3.3 The normal force, N, on box A. (3)

[17]

Question 5

A child, with a mass of 40 kg on a sandboard with a mass of 1,5 kg, skis down a sand dune with an incline of 25°. The coefficients of friction for the sand is: μ_s = 0,3 and μ_k = 0,12.



5.1 Identify the type of friction that is acting on the child with the board and the sand. (1)

5.2 Draw a free body diagram of all the forces acting on the child. (3)

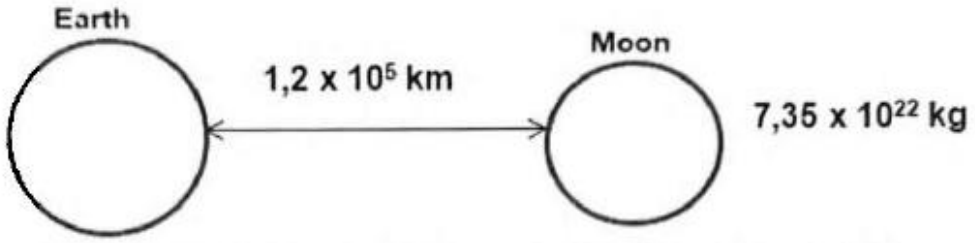
5.3 Calculate the frictional force the child will experience. Show ALL workings. (4)

5.4 The child tries to ski down a sand dune with an incline of 30°. Will the frictional force experience INCREASE, DECREASE OR REMAIN THE SAME? Explain the answer. (3)

[11]

Question 6

The Moon which has the mass of 7,35 x 10^{22} kg is 1,2 x 10^{5} km away from Earth as shown in the diagram below.



The gravitational force between the Moon and Earth is 1,91 x 10^{20} N.

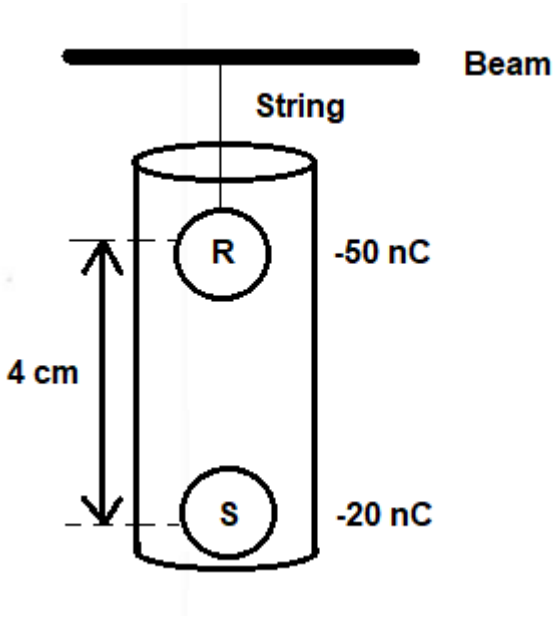
6.1 State Newton's Law of Universal Gravitation in words. (2)

6.2 Calculate the radius of the Moon. (5)

[7]

Question 7

A small sphere, **R,** with a charge of -50nC, is placed in a narrow, cylindrical glass tube vertically above sphere **S**, with a charge of -20nC. The cylinder is closed at the bottom. Sphere **R** is suspended from a light string secured to a beam as shown in the diagram. The mass of sphere **S** is TWICE the mass of sphere **R**. Ignore the effects of air friction.



Both spheres come to equilibrium when the tension on the string 8 N.

7.1.1 State Coulomb's law in words. (2)

7.1.2 Draw a labelled free-body diagram indicating ALL the forces acting on sphere R. (3)

7.1.3 Calculate the mass of sphere S. (6)

[11]

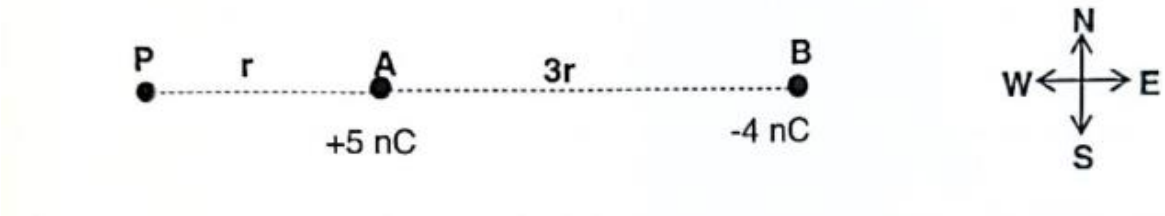
Question 8

Two small spheres, **A** with a charge of +5nC and **B** with a charge of -4nC respectively, are placed a certain distance from each other in a vacuum as shown in the diagram below**.**

8.1 Define the term *electric field* in words. (2)

8.2 Draw the electric field pattern between spheres A and B. (3)

P is a point LEFT of spheres **A** and **B**. Point **P** is at distance **r** from sphere **A** and sphere **A** is at a distance **3r** from sphere **B** as shown in the diagram below. The net electric field at point **P** is 4128 $N.C^{-1}$ west.

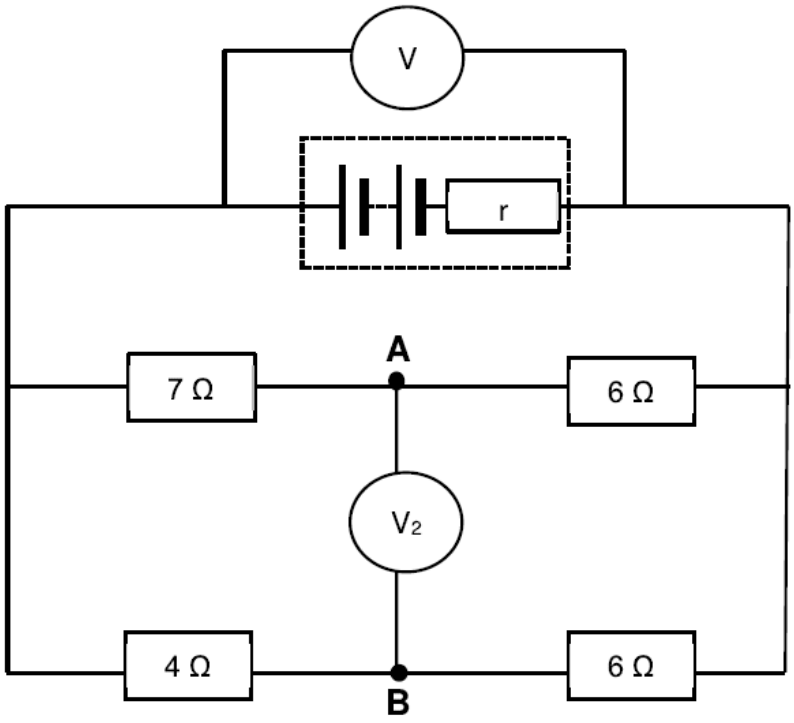


8.3 Calculate the value of r. (6)

[11]

Question 9

In the circuit diagram shown below, the battery has an emf of 15 V. The internal resistance of the battery is 0,45 Ω. Voltmeter V_2 with a very high resistance is placed between point **A** and **B**.



9.1.1 State Ohm's law in words. (2)

Calculate the:

9.1.2 Equivalent resistance of the external circuit (4)

9.1.3 Total current flowing through the circuit (3)

9.1.4 Reading on V_2 (7)

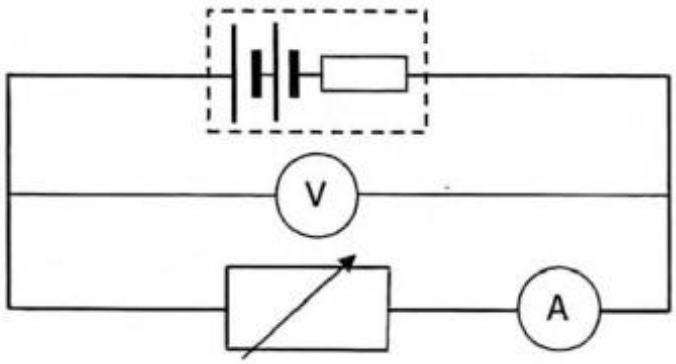
9.2 4 Ω and 6 Ω resistors alongside point **B** are removed. How will this change affect the **V** reading?
Choose from INCREASES, DECREASES or REMAINS THE SAME. (1)

9.3 Explain the answer to QUESTION 9.2 (2)

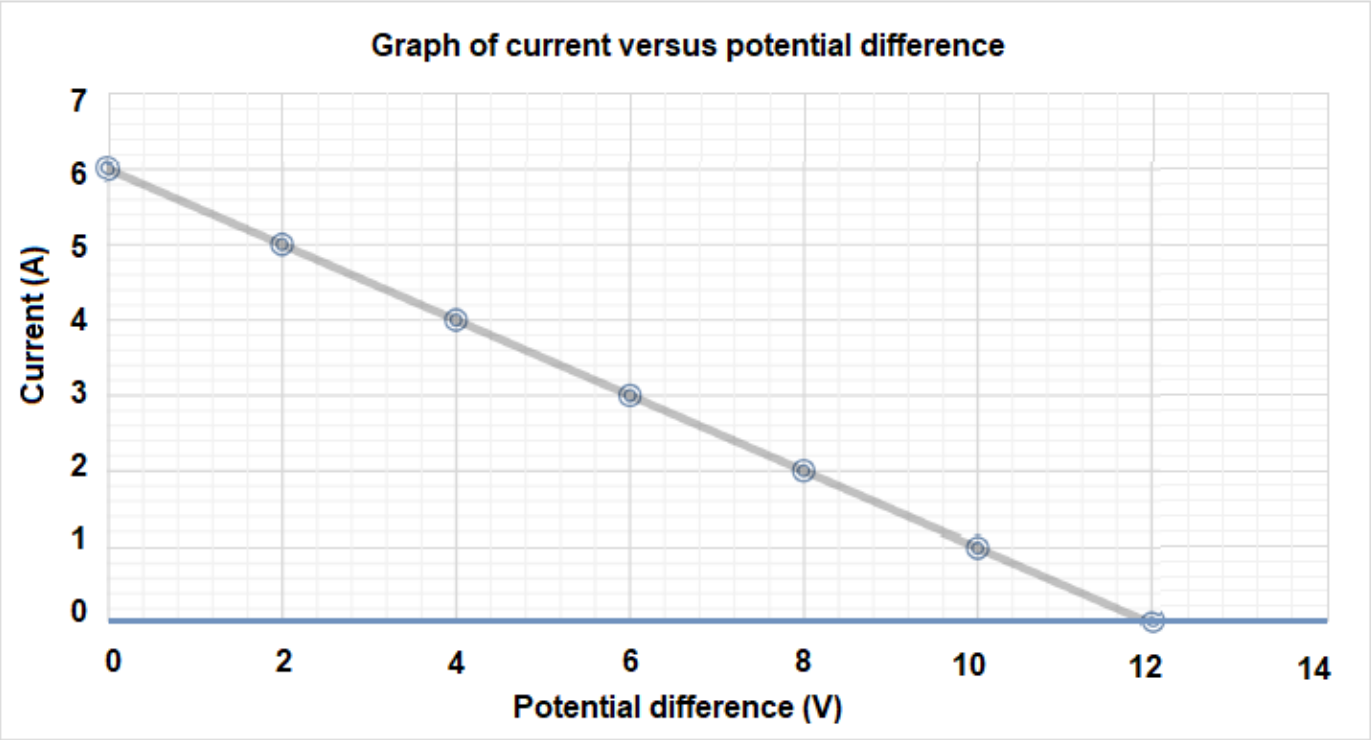
[19]

Question 10

10.1 Grade 11 learners conduct 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 results obtained are shown in the graph below.



Use the graph to determine the value of the following:

10.1.1 Emf (ε) of the battery. (1)

10.1.2 The lost voltage when the current is 2 A. (1)

10.1.3 Internal resistance of the battery, WITHOUT USING THE EQUATION ε = I(R + r) IN YOUR CALCULATION(S). (4)

[6]

Total 125

DATA FOR PHYSICAL SCIENCES GRADE 12
PAPER 1 (PHYSICS)

GEGEWENS VIR FISIESE WETENSKAPPE GRAAD 12
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 gravitasiekonstant*	G	$6{,}67 \times 10^{-11}\ N{\cdot}m^2{\cdot}kg^{-2}$
Radius of the Earth *Radius van die Aarde*	R_E	$6{,}38 \times 10^{6}\ m$
Mass of the Earth *Massa van die Aarde*	M_E	$5{,}98 \times 10^{24}\ kg$
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	$6{,}63 \times 10^{-34}\ J{\cdot}s$
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	$9{,}11 \times 10^{-31}\ kg$

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*

$F_{net} = ma$	$p = mv$
$F_{net}\Delta t = \Delta p$ $\Delta p = mv_f - mv_i$	$w = mg$ Or Fg = m.g
$F = \frac{Gm_1m_2}{r^2}$	$g = \frac{Gm}{r^2}$
$f_s^{max} = \mu_s N$	$f_k = \mu_k N$

WAVES, SOUND AND LIGHT / GOLWE, KLANK EN LIG

$v = f\lambda$	$T = \frac{1}{f}$

ELECTROSTATICS/*ELEKTROSTATIKA*

$F = \frac{kQ_1Q_2}{r^2}$	$E = \frac{kQ}{r^2}$
$E = \frac{F}{q}$	$V = \frac{W}{q}$
$n = \frac{Q}{e}$ or/*of* $n = \frac{Q}{q_e}$	

ELECTRIC CIRCUITS/*ELEKTRIESE STROOMBANE*

$R = \frac{V}{I}$	emf (ε) = I(R + r) emk (ε) = I(R + r)
$R_s = R_1 + R_2 + \ldots$ $\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots$	$q = I\,\Delta t$
W = Vq W = VIΔt W= $I^2R\,\Delta t$ W= $\frac{V^2\Delta t}{R}$	$P = \frac{W}{\Delta t}$ P = VI P = I^2R $P = \frac{V^2}{R}$