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**GRADE 10**

**NOVEMBER 2018**

**TECHNICAL SCIENCES P1**

**MARKS:** 150

**TIME:** 3 hours

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This question paper consists of 17 pages including 2 information sheets.

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## INSTRUCTIONS AND INFORMATION

Read the following instructions carefully before answering the questions.

1. Write your FULL NAME and SURNAME in the appropriate spaces on the ANSWER BOOK.
2. Answer ALL the questions.
3. Start each question on a NEW page in the ANSWER BOOK.
4. You may use a non-programmable calculator.
5. Appropriate mathematical instruments may be used.
6. Number the answers correctly according to the numbering system used in this question paper.
7. Show ALL formulae and substitutions in ALL calculations.
8. Round off your FINAL numerical answers to a minimum of TWO decimal places.
9. Give brief motivations, discussions, et cetera where required.
10. TWO DATA SHEETS are attached for your use.
11. Write neatly and legibly.

**QUESTION 1**

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, for example 1.12 E.

1.1 Which ONE of the following is a VECTOR quantity?

- A Time
- B Speed
- C Distance
- D Moment of a force

(2)

1.2 A block hangs from a string attached to a roof.



The force exerted by the string on the block is called ...

- A weight.
- B normal.
- C friction.
- D tension.

(2)

1.3 A single rigid length of material supported horizontally to carry vertical loads is called a ...

- A beam.
- B fulcrum.
- C simple machine.
- D mechanical advantage.

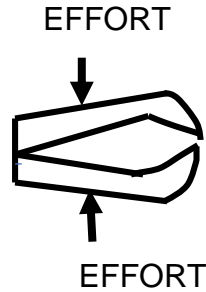
(2)

1.4 The SI unit of force is ...

- A Newton.
- B Joule.
- C Ampère.
- D Volt.

(2)

- 1.5 The diagram below shows a staple remover



Which CLASS of lever does the staple remover represent?

- A First class
- B Second class
- C Third class
- D Fourth class

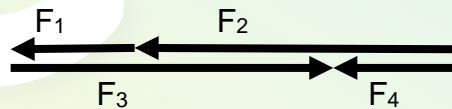
(2)

- 1.6 Which quantity represents the rate of change of velocity?

- A Speed
- B Acceleration
- C Displacement
- D Resultant vector

(2)

- 1.7 The diagram below shows a vector diagram of forces acting on a body in the horizontal direction.



Which ONE of the forces represents the RESULTANT?

- A  $F_1$
- B  $F_2$
- C  $F_3$
- D  $F_4$

(2)

- 1.8 A plastic ruler is charged POSITIVELY using a cloth.

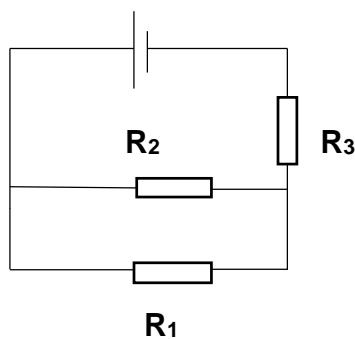
Which particles are transferred during the charging process?

- A Protons only
  - B Neutrons only
  - C Electrons only
  - D Both electrons and protons
- (2)

- 1.9 Which ONE of the following instruments is used to measure electrical current in a circuit?

- A Rheostat
  - B Voltmeter
  - C Ammeter
  - D Resistor
- (2)

- 1.10 In the circuit below all the resistors are identical.



Which ONE of the following statements is NOT TRUE?

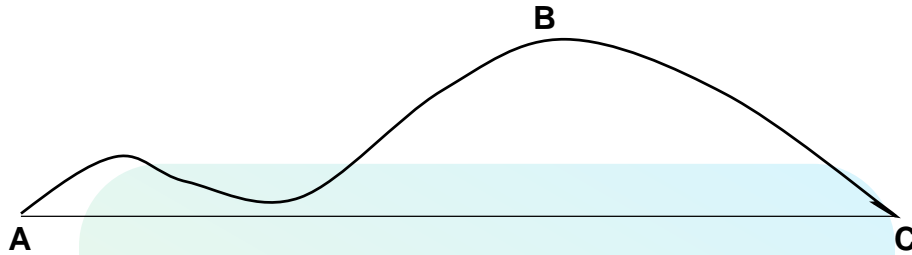
- A The parallel combination of resistors is in series with  $R_3$
- B The resistance of the parallel combination is greater than the resistance of  $R_3$
- C Resistors  $R_1$  and  $R_2$  are connected in parallel
- D The potential difference across  $R_1$  and across  $R_2$  is the same

(2)  
[20]

## QUESTION 2

- 2.1 A girl walks from her home at point **A** to her school situated at point **C**. She walks along path **ABC** which is 2,9 km long. She carries her school bag with a mass of 2 230 g.

Point **C** is 2 km to the RIGHT of point **A**.

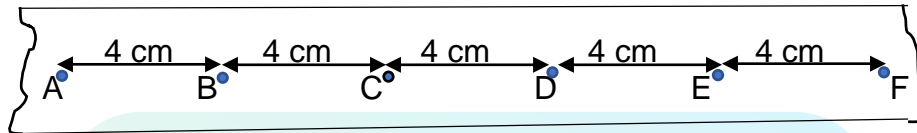


- 2.1 Differentiate between a *scalar* and a *vector quantity*. (4)
- 2.2 2.2.1 Convert 2 230g to kg. (2)
- 2.2.2 Convert 2,9 km to SI units. (2)
- 2.2.3 Express 2 230 in scientific notation. (2)
- 2.3 Define *displacement*. (2)
- 2.4 Write down the:
- 2.4.1 Distance travelled by the girl. (1)
- 2.4.2 Magnitude and direction of the girl's displacement. (2)
- 2.5 The girl takes 1 800 seconds to move from **A** to **C** along path **ABC**. Calculate the girl's average velocity for the motion. (4)

- 2.6 The girl walks from school back to her home.

Draw a vector diagram showing the girl's displacement vectors as she moves to and from school. Indicate magnitudes and directions of the vectors. Write down the magnitude of the resultant displacement. (3)

- 2.7 The following strip is obtained from the analysis of motion of a trolley using a ticker tape timer.



- 2.7.1 Is the trolley ACCELERATING? Answer Yes or No.

Explain the answer. (3)

The frequency of the ticker timer used is 50 Hz.

Calculate the:

- 2.7.2 Time elapsed from **A** to **F** (4)

- 2.7.3 Velocity of the trolley (in  $\text{m.s}^{-1}$ ) (4)

**[33]**



### QUESTION 3

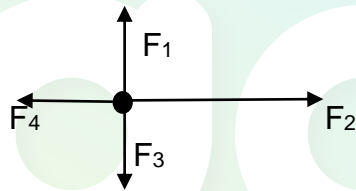
A 2 kg block is pulled horizontally by a learner across a rough table.

The learner exerts a force of 50 N on the block.



3.1 Define the term *resultant force*. (2)

3.2 The free-body diagram showing all the forces acting on the block is given below.



Name the following forces:

3.2.1  $F_1$  (1)

3.2.2  $F_2$  (1)

3.2.3  $F_3$  (1)

3.2.4  $F_4$  (1)

3.3 Write down the NAME of a non-contact force acting on the block. (1)

3.4 Calculate the magnitude of the weight of the block. (3)

3.5 Determine the resultant force acting on the block if the magnitude of  $F_4$  is equal to 15 N. (3)

3.6 To keep the block in equilibrium a force **F** has to be applied to the block.

3.6.1 What is the magnitude of the resultant force when the block is in equilibrium? (1)

Write down the:

3.6.2 NAME of force **F** (1)

3.6.3 Magnitude and direction of force **F** (2)  
[17]



#### QUESTION 4

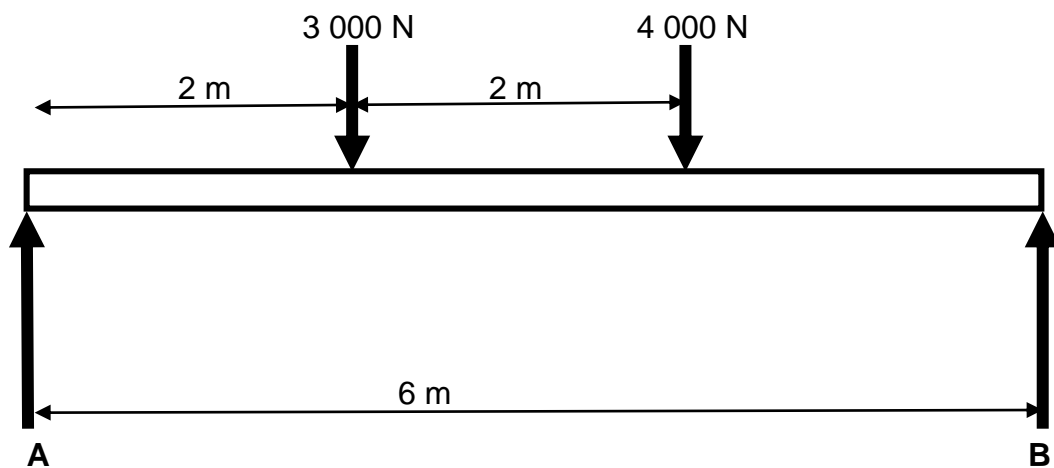
4.1 Write down a TERM for EACH of the following definitions:

4.1.1 Turning effect of a force about a point (1)

4.1.2 A beam where one end is fixed and one end is free to move (1)

4.1.3 Ratio of load to effort (1)

4.2 In the diagram below a beam is subjected to a two-point load.



Calculate:

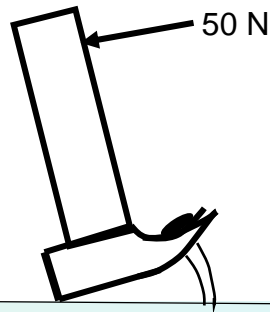
4.2.1 The sum of clockwise moments at **A** (4)

4.2.2  $R_A$ , the reaction at **A** (in SI units) (6)

4.3 Make a neat, labelled sketch of a CLASS TWO lever showing the fulcrum, load and the effort. (6)

- 4.4 A carpenter uses a hammer to remove a nail from a wooden truss. A force of 400 N must be applied to remove the nail.

The carpenter exerts a force of 50 N on a hammer to remove the nail.



- 4.4.1 Classify the hammer as CLASS 1, CLASS 2 or CLASS 3 lever.

Explain the answer.

(2)

- 4.4.2 Calculate the length of the load arm if the effort arm is 20 cm.

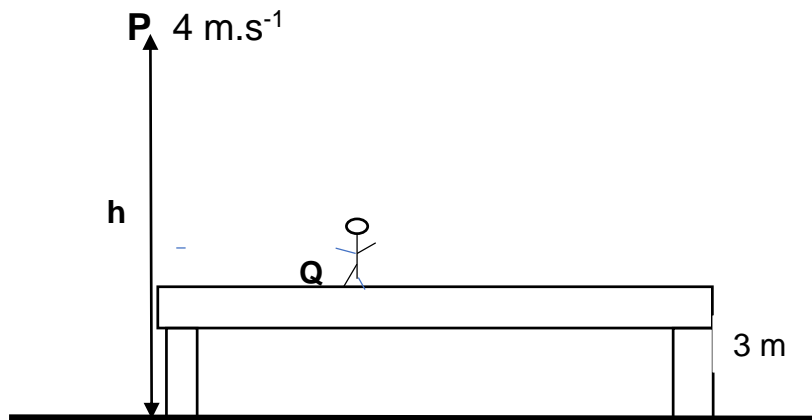
(4)

[25]

### QUESTION 5

The diagram below shows a gymnast of mass 60 kg standing on a trampoline that is 3 m above the ground. The gymnast jumps upwards reaching a speed of  $4 \text{ m.s}^{-1}$  at a height  $h$  metres above the ground.

(Ignore air resistance in ALL calculations.)



5.1 Define the following terms:

5.1.1 Gravitational potential energy (2)

5.1.2 Mechanical energy (2)

5.2 Calculate the:

5.2.1 Kinetic energy of the gymnast at point P (3)

5.2.2 Gravitational potential energy at point Q (3)

5.3 At point P the gravitational potential energy of the gymnast is equal to 2 469,6 J.

Calculate the height  $h$ . (3)

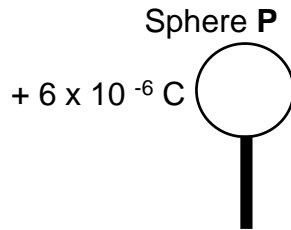
5.4 The kinetic energy of the gymnast when she jumps up from point Q is equal to 705,6 J.

Calculate the speed with which she leaves the trampoline. (3)

[16]

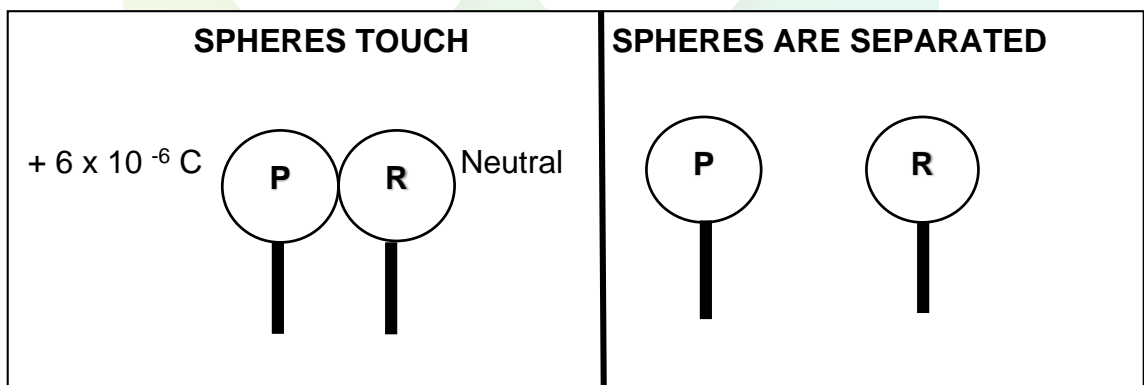
**QUESTION 6**

A neutral metal sphere **P** is charged. The charged sphere is then placed on an insulated stand as shown below.



- 6.1 Were electrons **ADDED** or **REMOVED** when the sphere was charged? (1)
- 6.2 Calculate the number of electrons **ADDED** or **REMOVED**. (3)
- 6.3 Give a reason why the charged sphere must be placed on an insulated stand. (2)
- 6.4 Another sphere **R** that is identical to sphere **P** is brought into contact with sphere **P**. Sphere **R** is **NEUTRAL**.

The spheres are separated after touching as shown in the diagram

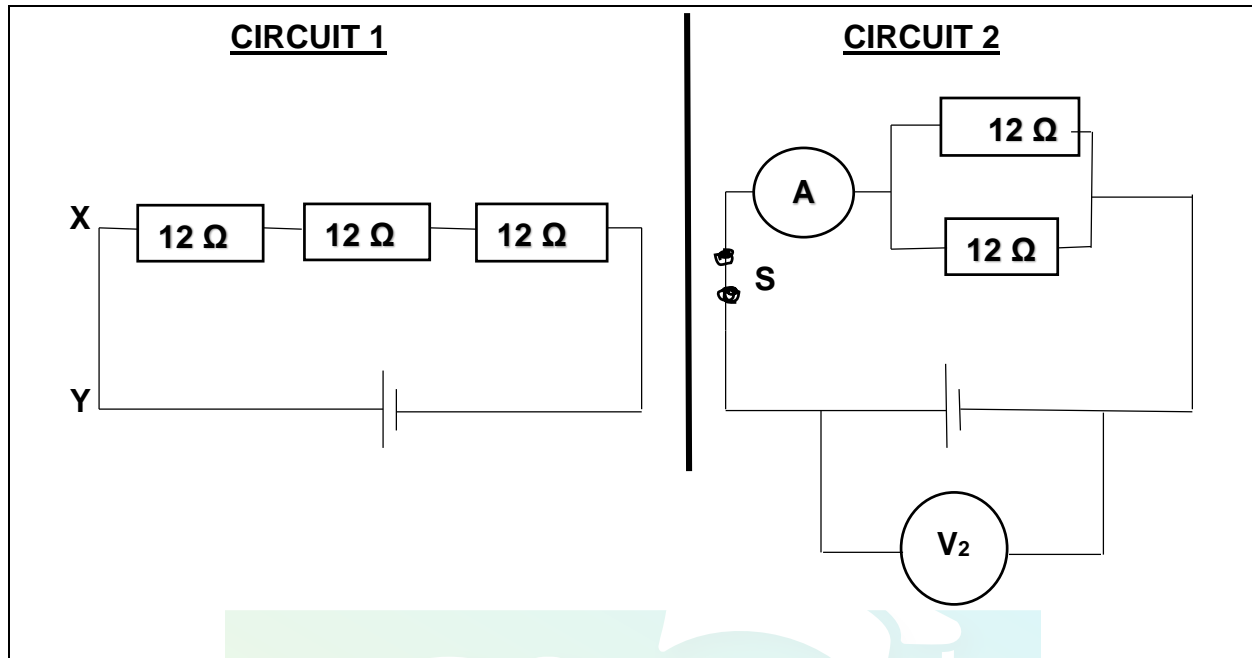


- 6.4.1 State the law of conservation of charge. (2)
- 6.4.2 From which sphere and to which sphere are electrons transferred when the spheres touch.
- Write down only **FROM P TO R** or **FROM R TO P**. (1)
- 6.4.3 Calculate the charge on **sphere R**, after separation. (3)

**[12]**

### QUESTION 7

Consider the TWO electrical circuits below. All the resistors are identical.



- 7.1 Define *electric current* in words. (2)
- 7.2 In which circuit are the resistors:
- 7.2.1 Current dividers (1)
- 7.2.2 Potential dividers? (1)
- 7.3 For **CIRCUIT 1**, write down the direction of CONVENTIONAL current. (1)
- Write down only **X to Y** or **Y to X**. (1)
- 7.4 Consider **CIRCUIT 2**.
- When the switch S is closed in **CIRCUIT 2**, the voltmeter **V<sub>2</sub>** reads 11 V. When the switch is open **V<sub>2</sub>** reads 12 V.
- 7.4.1 Write down the EMF of the cell (1)
- 7.4.2 Calculate the effective resistance of the parallel combination of resistors (3)
- 7.5 Draw a labelled circuit diagram that consists of THREE cells, a closed switch and an ammeter both in series with the battery, TWO bulbs in parallel and a voltmeter connected across the battery. (5)

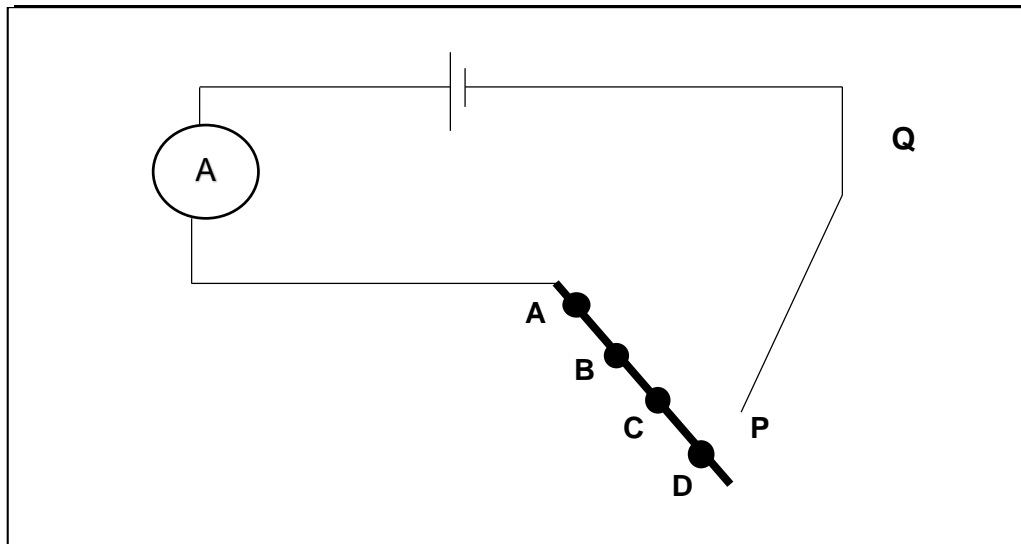
[14]

**QUESTION 8**

- 8.1 A group of learners investigate the effect of length of a conductor on the resistance of the conductor.

The learners use a copper rod on which they mark points **A**, **B**, **C** and **D** along its length. Wire **QP** is connected to point **A** and the ammeter reading is taken and recorded. The same procedure is repeated for points **B**, **C** and **D**.

The learners' circuit diagram is shown below.

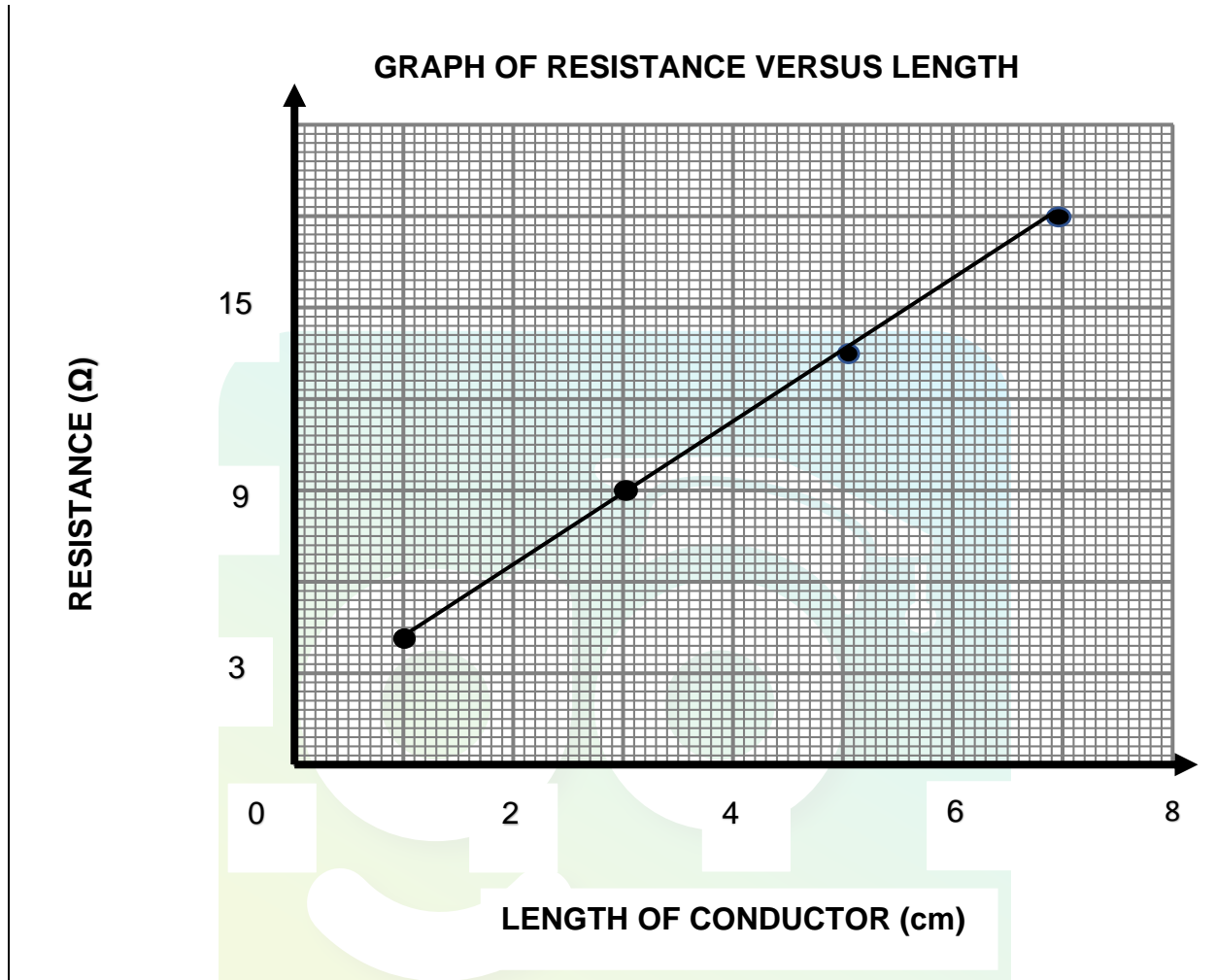


- 8.1.1 Define *resistance*. (2)
- 8.1.2 Write down the independent variable for this investigation. (1)
- 8.1.3 Apart from length of a conductor write down THREE factors that affect the resistance of a conductor. (3)



The learners calculated the values of the reciprocal of current ( $1/\text{current}$ ) and used these values as a measure of resistance.

The learners' results are plotted on a graph as shown below.



8.2 Use information from the graph to:

8.2.1 Write down the relationship between resistance and length of a conductor (2)

8.2.2 Write down the resistance value for which the length of the conductor used is 3 cm (2)

8.2.3 Gradient of the graph (3)

[13]

**TOTAL: 150**

**DATA FOR TECHNICAL SCIENCES GRADE 10 PAPER 1 (PHYSICS)**  
**GEGEWENS VIR TEGNIESE WETENSKAPPE GRAAD 10 VRAESTEL 1 (FISIKA)**

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

NAME/NAAM	SYMBOL/SIMBOOL	VALUE/WAARDE
Acceleration due to gravity <i>Swaartekragversnelling</i>	g	9,8m·s <sup>-2</sup>
Charge on electron <i>Lading op elektron</i>	q <sub>e</sub>	-1,6x10 <sup>-19</sup> C

**TABLE 2: FORMULAE/TABEL 2: FORMULES**

MOTION / BEWEGING	ENERGY / ENERGIE
<p>speed = distance/time  <i>spoed = afstand/tyd</i>            velocity = displacement/time  <i>snelheid = verplasing/tyd</i>            acceleration = change in velocity/time  <i>versnelling = verandering in snelheid/tyd</i></p> <p align="center"><b>FORCE / KRAG</b></p> <p><math>F_g = mg</math></p> <p align="center"><math>F_{res} = F_1 + F_2</math></p> <p align="center"><b>MOMENTS / MOMENTE</b></p> <p>Torque/<i>Wringkrag</i> = <math>F \times r_{\perp}</math>  <math>\tau = F \times r_{\perp}</math></p> <p align="center"><b>SIMPLE MACHINES / EENVOUDIG MASJIE</b></p> <p align="center"><math>MA = \frac{L}{E} = \frac{e}{l}</math></p>	<p><math>E_p = mgh</math> or <math>(U = mgh)</math>  <math>E_K = \frac{1}{2} mv^2</math> or <math>(U = \frac{1}{2} mv^2)</math></p> <p align="center"><b>ELEKTRICITY / ELEKTRISITEIT ELECTROSTATICS / ELEKTROSTATIKA</b></p> <p align="center"><math>Q = \frac{Q_1 + Q_2}{2}</math></p> <p><math>I = \frac{Q}{\Delta t}</math>  <math>V = \frac{W}{Q}</math>  <math>V = I \times R</math></p> <p align="center"><b>SERIES CIRCUIT / SERIE STROOMBAAN</b></p> <p><math>R_T = R_1 + R_2 + R_3 \dots</math>  <math>V_T = V_1 + V_2 + V_3 \dots</math>      <math>I_T = I_1 = I_2 = I_3 \dots</math></p> <p align="center"><b>PARALLEL CIRCUIT / PARALLELE STROOMBAAN</b></p> <p align="center"><math>\frac{1}{R_P} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}</math></p> <p align="center"><math>V_T = V_1 = V_2 = V_3</math>  <math>I_T = I_1 + I_2 + I_3</math></p>