basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

# NATIONAL SENIOR CERTIFICATE

## GRADE 11

## TECHNICAL SCIENCES: PAPER 1

## EXEMPLAR 2017

**MARKS: 150**

**TIME: 3 hours**

**This question paper consists of 17 pages and one data sheet.**

## INSTRUCTIONS AND INFORMATION

1. This question paper consists of EIGHT questions. Answer ALL the questions in the ANSWER BOOK.

2. Start EACH question on a NEW page in the ANSWER BOOK.

3. Number the answers correctly according to the numbering system used in this question paper.

4. Leave ONE line between two subquestions, for example between QUESTION 2.1 and QUESTION 2.2.

5. You may use a non-programmable calculator.

6. You may use appropriate mathematical instruments.

7. You are advised to use the attached DATA SHEET.

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 et cetera where required.

11. Write neatly and legibly.

## QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Various options are provided as possible answers to the following questions. Write down the question number (1.1–1.10), choose the answer and make a cross (X) over the letter (A–D) of your choice in the ANSWER BOOK.

**EXAMPLE:**

| | | | | |
|---|---|---|---|---|
| ***1.11*** | **A** | **B** | **C** | **D** |

1.1 The SI-unit for force:

A Ton

B Newton

C Pound

D Kilogram (2)

1.2 The y-axis on the Cartesian plane represents the …

A horizontal component.

B diagonal component.

C vertical component.

D the straight-line component. (2)

1.3 Vectors are indicated by the symbol ...

A $\overrightarrow{F}$

B V

C R

D X (2)

1.4 The longest side of the triangle opposite the right angle is called the ...

A opposite.

B adjacent.

C contiguous.

D hypotenuse. (2)

1.5 Which ONE of the following statements is NOT correct? A frictional force is ...

A dependent on the normal force.

B always opposing the motion or attempted motion of one surface across another.

C a non-contact force.

D a contact force. (2)

1.6 Which ONE of the following materials will be attracted by a magnet? A piece of …

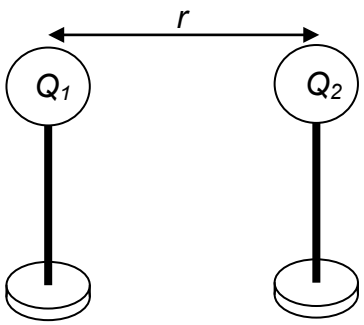
A rubber.

B string.

C metal rod.

D wood. (2)

1.7 The centres of two identical spheres are *r* metres apart. They carry charges of $Q_1$ and $Q_2$ respectively, as shown in the diagram below. Each sphere exerts an electrostatic force of magnitude *F* on the other sphere.




The distance between the charges is now halved. What is the magnitude of the new force between the charges now?

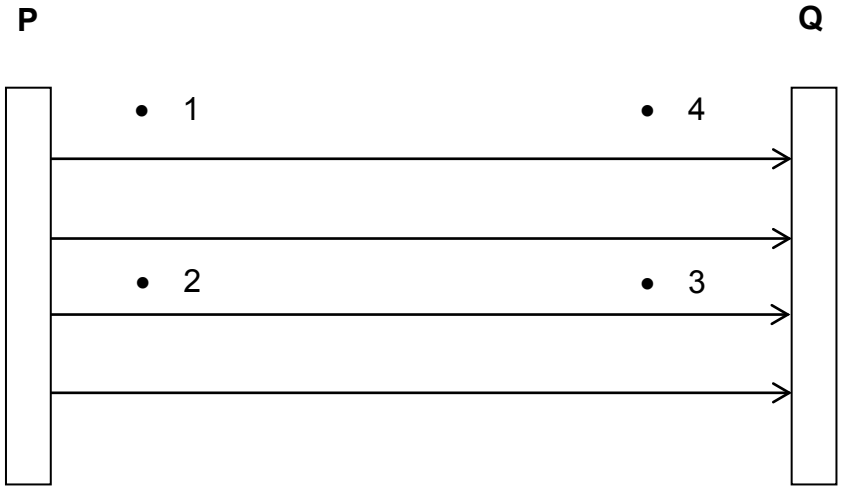
A *F*

B 2*F*

C 4*F*

D 8*F* (2)

1.8 The diagram below shows different points in an electric field between two oppositely charged parallel plates, **P** and **Q**.




Which ONE of the following statements is CORRECT?

The charge on plate **P** is …

A positive and a positive charge is at a higher potential at point 2 than at point 3.

B negative and a positive charge is at a higher potential at point 2 than at point 3.

C positive and a negative charge is at a higher potential at point 1 than at point 4.

D negative and negative charge is at a higher potential at point 1 than at point 4. (2)

1.9 The unit of measurement of the rate of flow of charge in a conductor is …

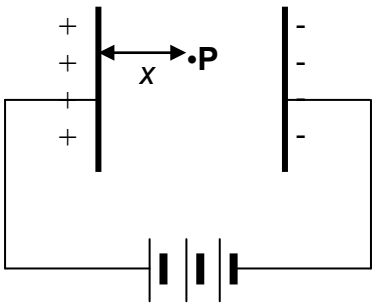
A watt.

B volt.

C ampere.

D coulomb. (2)

1.10 Point **P** is a distance *x* from the positive plate of a parallel plate capacitor, as shown in the diagram below.




The magnitude of the electric field at **P** is *E*. At a distance $\frac{1}{2}x$ from the positive plate, the magnitude of the electric field will be …

A ¼ E

B ½ E

C E

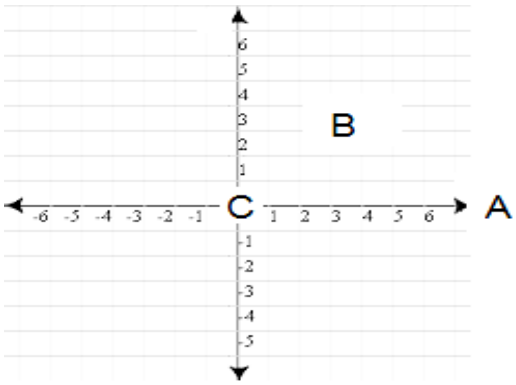
D 2 E (2)

**[20]**

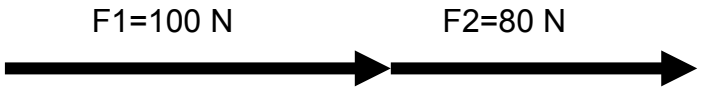
**QUESTION 2 (Start on a new page.)**

2.1 Define the term *resultant*. (2)

2.2 Study the diagram below and provide labels for the parts **A**, **B** and **C**. (3)

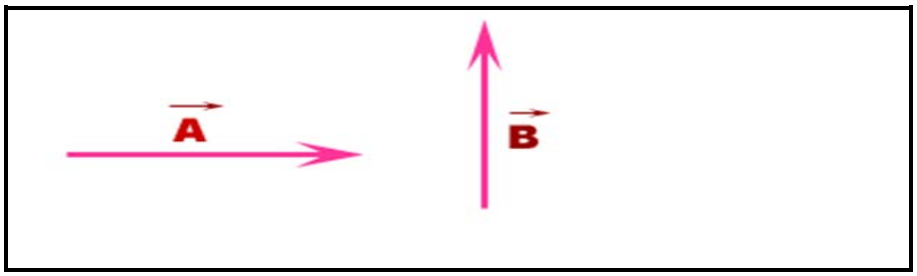



2.3 Calculate the total vector if two forces, of 100 N and 80 N, are exerted on an object, as shown below.



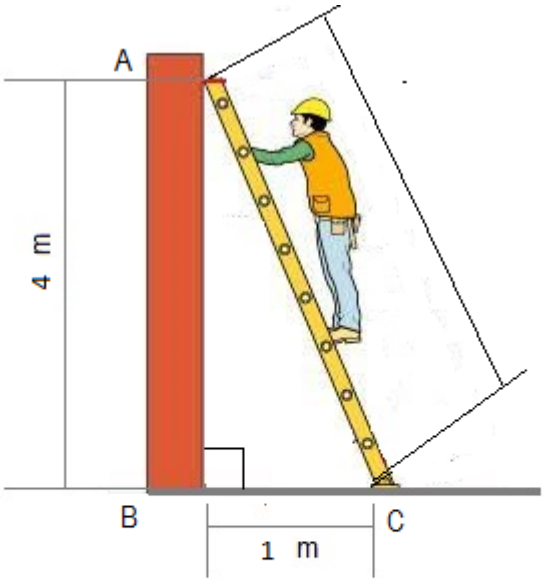

(3)

2.4 Siya walks 6 metres in an easterly direction and then continues to walk 5 metres north. The directions are indicated in the figure below.




Use the head-to-tail method and graphically determine the direction of his displacement. (6)

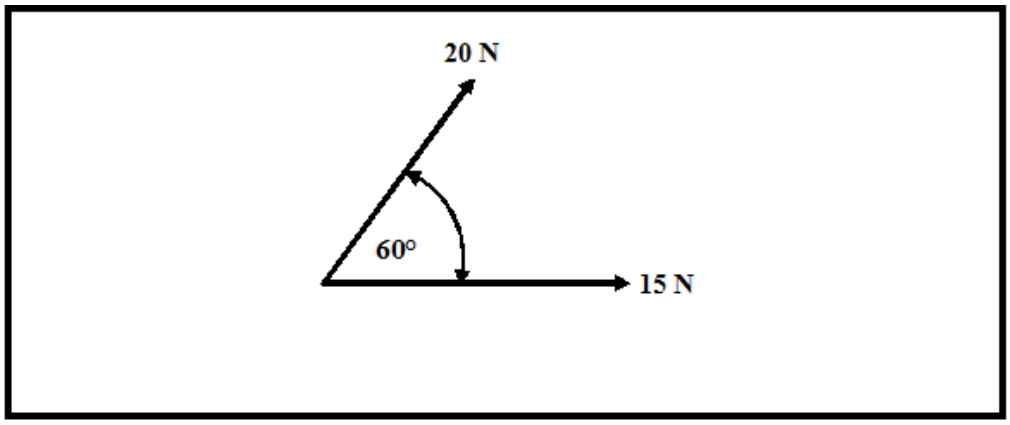
2.5 A worker is using a ladder to fix a light bulb on a wall. The top of the ladder is resting against the wall at a point 4 metres above the ground. The base of the ladder is 1 metre away from the bottom of the wall, as shown in the figure below.




Calculate the length of the ladder. (6)
**[20]**

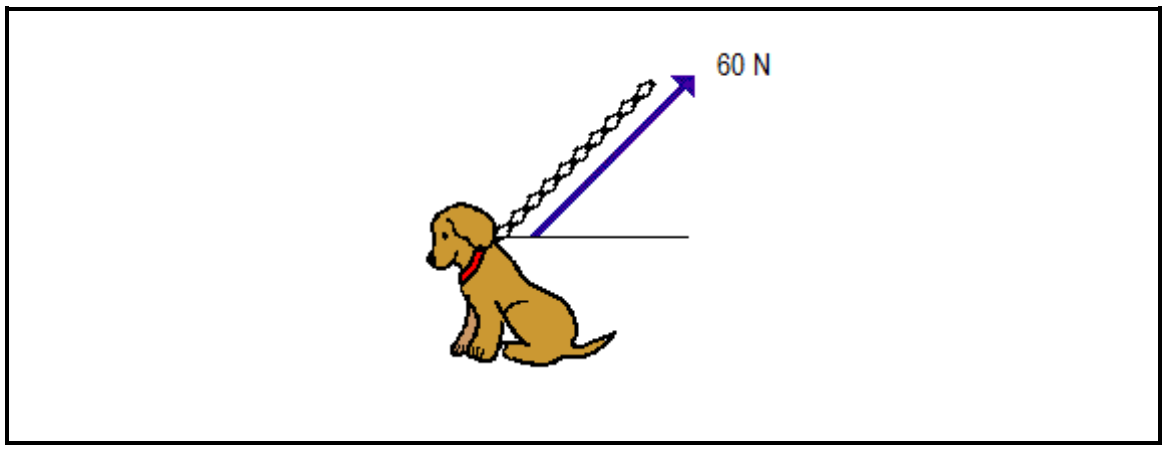
**QUESTION 3 (Start on a new page.)**

3.1 Use the parallelogram of forces and determine graphically the magnitude and direction of the resultant for the system of forces, as indicated in the figure below. (Use scale: 1 mm = 5 N)




(6)

3.2 A 60 N force is exerted by a person pulling on the leash of a dog in the opposite direction. The leash is at an angle of 40 degrees with the horizontal, as shown in the figure below.




3.2.1 Calculate the horizontal component. (3)

3.2.2 Calculate the vertical component. (3)

3.2.3 Graphically show the direction of the horizontal and vertical components, as calculated above, by means of a sketch. (3)

**[15]**

**QUESTION 4 (Start on a new page.)**

A box of 3 kg is resting on a table. A learner pushes the box with a horizontal force of 50 N to the right. The coefficient for static friction ($\mu_s$) = 0,35.

4.1 Define *frictional force*. (2)

4.2 Calculate the maximum static frictional force before the box moves to the right. (5)

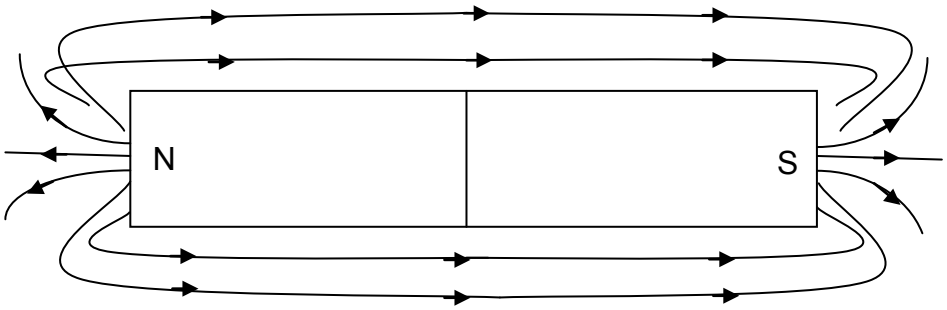
4.3 Draw a free body diagram to indicate all the forces experienced by the box. (4)

4.4 The kinetic friction is 40% of the normal force. Calculate the kinetic frictional force that the box is experiencing while moving towards the right. (5)
**[16]**

**QUESTION 5 (Start on a new page.)**

5.1 Define the term *magnetic field*. (2)

5.2 A Grade 11 learner performed an experiment to determine the direction and pattern of the magnetic field around a bar magnet. Based on her results, she drew the following diagram in which the north and south poles of the magnet are correctly labelled.




5.2.1 Identify THREE mistakes that the learner made in the drawing. (3)

5.2.2 Name the device that the learner used to determine the direction of the magnetic field. (1)

5.2.3 The learner accidentally dropped the magnet and it broke in the middle into two pieces. Draw a sketch of the two pieces and label the resulting poles. (2)

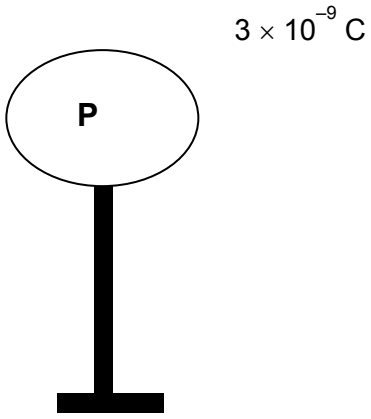
5.3 People that are living near the North pole of Earth can see the northern lights (Aurora Borealis). It is a spectacular display of coloured light in the sky. Briefly describe why it is visible near the geographical North pole of Earth and how it is formed. (4)

5.4 Name ONE difference between the Earth's magnetic field and the magnetic field of a permanent bar magnet. (2)

5.5 Give a reason why the Earth's magnetic field is important. (2)
**[16]**

**QUESTION 6 (Start on a new page.)**

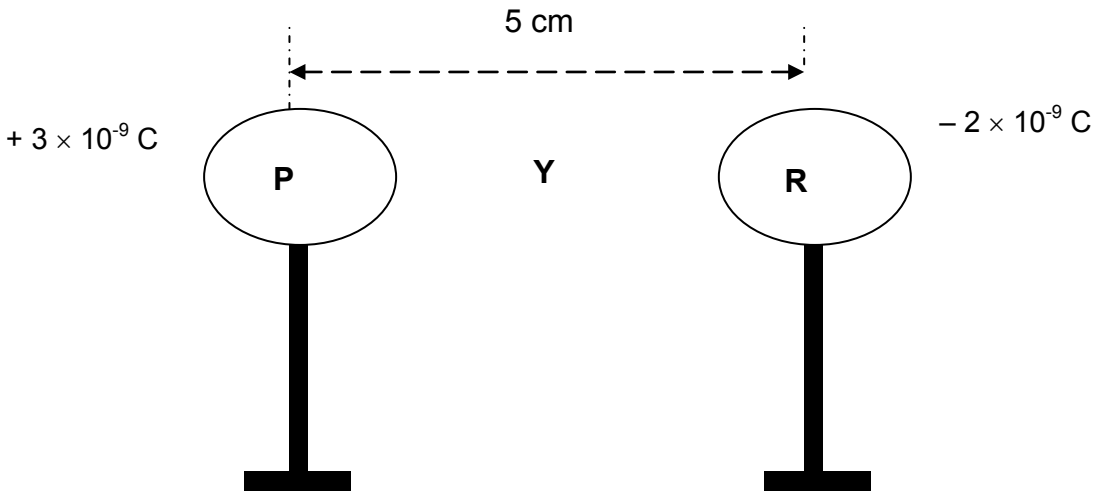
6.1 A small metallic sphere, **P**, on an insulated stand carries a charge of $3 \times 10^{-9}$ C.




Sketch the electric field pattern around sphere **P**. (2)

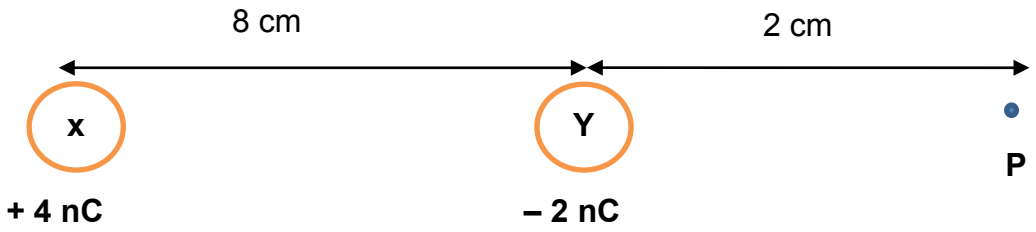
6.2 State Coulomb's law in words. (2)

6.3 Another small metallic sphere, **R**, carrying a charge of $-2 \times 10^{-9}$ C, is now placed at a distance of 5 cm from sphere **P**.




Calculate the magnitude of the electrostatic force that sphere **P** exerts on sphere **R**. (4)

6.4 Two charges, **X** and **Y**, with charges of + 4 nC and – 2 nC respectively, are placed 8 cm apart. A point charge, **P**, is placed 2 cm from **Y**, as shown in the sketch below.




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

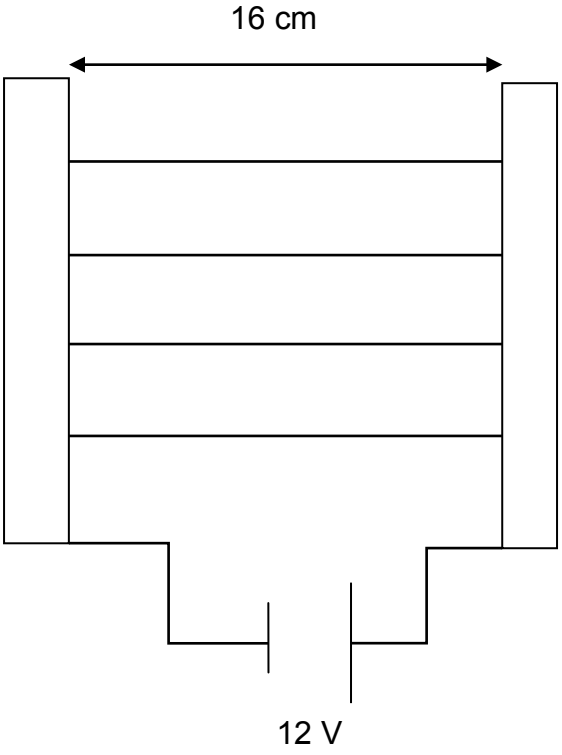
6.4.2 Draw the electric field pattern between two oppositely charged particles. (3)

6.4.3 Calculate the net electric field strength at point **P** due to **X** and **Y**. (7)

6.4.4 Calculate the magnitude and direction of the electrostatic force on an electron if it is placed at point **P**. (3)
**[23]**

**QUESTION 7 (Start on a new page.)**

Two parallel plates are connected to a 12 V power source and positioned as indicated in the diagram below.



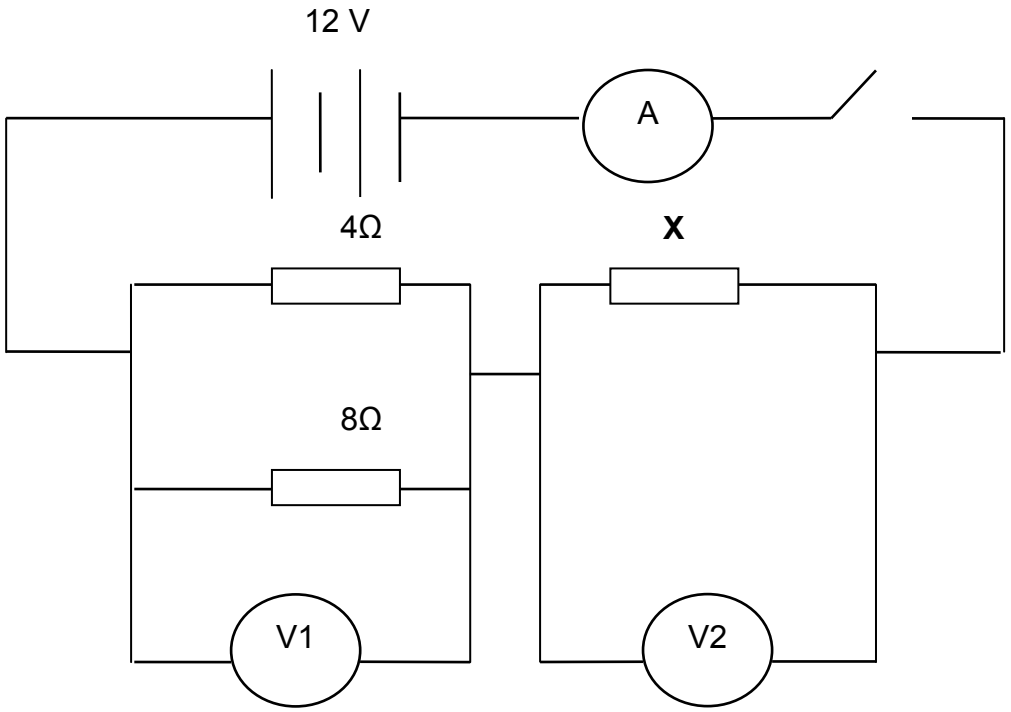

7.1 Redraw this diagram in the ANSWER BOOK and indicate the direction of the electric field lines. (3)

7.2 These field lines are parallel and equally spaced apart. What does this imply? (1)

7.3 Calculate the electric field between the two parallel plates. (4)
**[8]**

**QUESTION 8 (Start on a new page.)**

8.1 In the circuit below the internal resistance of the 6 V battery is negligible. The resistance of the connecting wires can be ignored. When switch **S** is closed, the current in the 8 Ω resistor is 0,6 A.




State Ohm's law in words. (2)

8.2 Calculate the:

8.2.1 Current passing through the 4 Ω resistor (4)

8.2.2 Total current in the circuit (2)

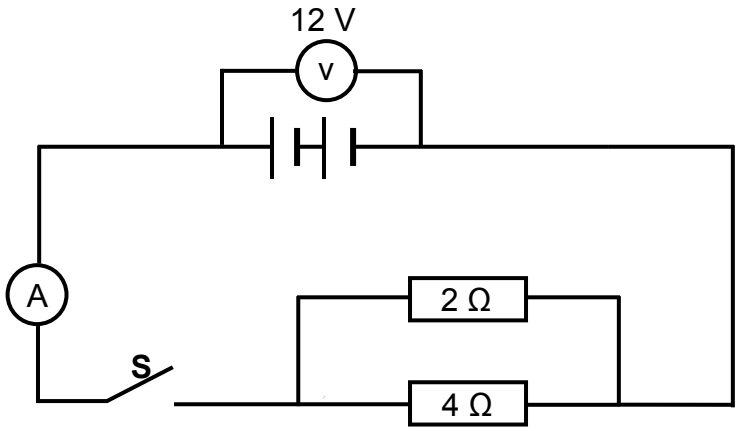
8.2.3 Resistance **X** (3)

8.3 After a while, the 4 Ω resistor gets warmer than the 6 Ω resistor.

Explain this observation. (3)
**[14]**

**QUESTION 9 (Start on a new page.)**

In the circuit diagram below a battery with an emf of 12 V is connected in series with an ammeter, an open switch **S** and a 4 Ω resistor. A 2 Ω resistor is connected in parallel with the 4 Ω resistor.




9.1 Switch **S** is now closed. The voltmeter reading is 9 V.

Briefly explain why the voltmeter reading decreases when switch **S** is closed. (2)

9.2 Calculate the:

9.2.1 Current in the 2 Ω resistor (3)

9.2.2 Reading on the ammeter (3)
**[8]**

**QUESTION 10 (Start on a new page.)**

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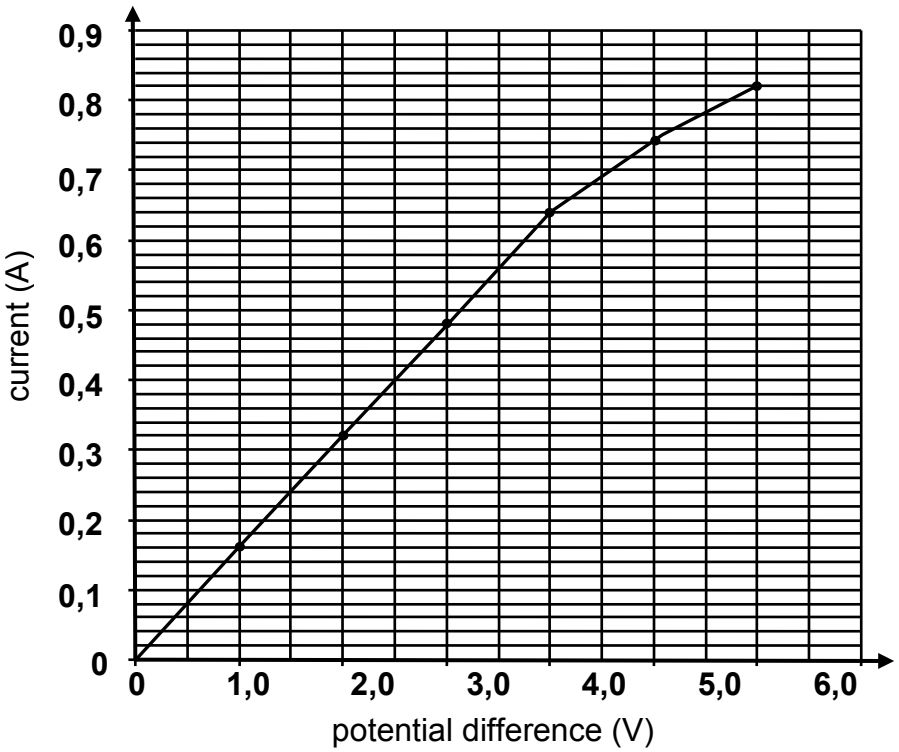
Learners conduct an investigation to verify Ohm's law. They measure the current through a conducting wire for different potential differences across its ends. The results obtained are shown in the graph below.




10.1 Which ONE of the measured quantities is the dependent variable? (1)

10.2 The graph deviates from Ohm's law at some point.

10.2.1 Write down the coordinates of the plotted point from the graph beyond which Ohm's law is not obeyed. (3)

10.2.2 Give a possible reason for the deviation from Ohm's law as shown in the graph. Assume that all measurements are correct. (2)

10.3 Calculate the gradient of the graph for the section where Ohm's law is obeyed. Use this to calculate the resistance of the conducting wire. (4)

**[10]**

**TOTAL: 150**

# DATA FOR TECHNICAL SCIENCES GRADE 11
# PAPER 1

## *GEGEWENS VIR TEGNIESE WETENSKAPPE GRAAD 11*
## *VRAESTEL 1*

### TABLE 1: PHYSICAL CONSTANTS/*TABEL1: FISIESE KONSTANTES*

| NAME/*NAAM* | SYMBOL/*SIMBOOL* | VALUE/*WAARDE* |
|---|---|---|
| Acceleration due to gravity<br>*Swaartekragversnelling* | G | 9,8 $m \cdot s^{-2}$ |
| Charge on electron<br>*Lading op elektron* | -e | $-1,6 \times 10^{-19} C$ |

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

*Motion*

speed = distance/time
velocity = displacement/time
acceleration = change in velocity/time

*Force*

$F_g = mg$

$F_{res} = F_1 + F_2$

*Moments*

Torque = $F \times r_\perp$
$t = F \times r_\perp$

*Simple Machines*

$$MA = \frac{L}{E} = \frac{e}{I}$$

*Vectors*

$F_R = F1 + F2$

*Horizontal Component*

$F_x = F\cos\theta$

*Vertical Component*

$Fy = F\sin\theta$

*Energy*

$E_p = mgh$ or $(U = mgh)$

$E_K = \frac{1}{2} mv^2$ or $(U = \frac{1}{2} mv^2)$

*Electricity/Electrostatic*

$$Q = \frac{Q1 + Q2}{2}$$

$$I = \frac{Q}{\Delta t}$$

$$V = \frac{W}{Q}$$

$V = IxR$

*Series circuit*

$R_T = R_1 + R_2 + R_3 \ldots$

$V_T = V_1 + V_2 + V_3 \ldots$

$I_T = I_1 = I_2 = I_3 \ldots$

*Parallel circuit*

$$\frac{1}{RP} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$$

$V_T = V_1 = V_2 = V_3$

$I_T = I_1 + I_2 + I_3$

### FORCE/*KRAG*

| | |
|---|---|
| $F_{net} = ma$ | $w = mg$ |
| | $f_{s(max)} = \mu_s N$ |

| | |
|---|---|
| $f_k = \mu_k N$ | |