education

DEPARTMENT: EDUCATION
MPUMALANGA PROVINCE

GERT SIBANDE DISTRICT

GRADE 11

PHYSICAL SCIENCES TOPIC TEST

TOPIC: ELECTRICITY & MAGNETISM

APRIL 2023

MARKS: 50

TIME: 1 hour

This question paper consists of 8 pages including the data sheet

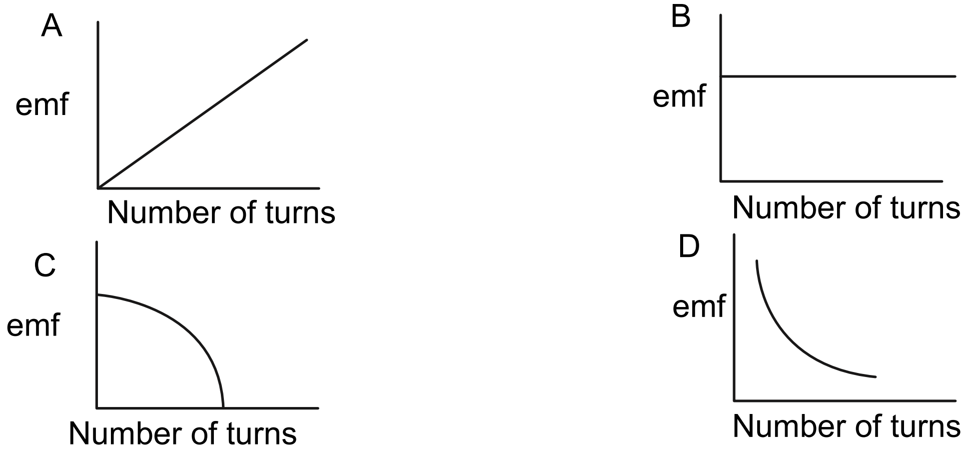
INSTRUCTIONS AND INFORMATION

1. This question paper consists of FOUR 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 sub questions, 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 SHEETS.
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

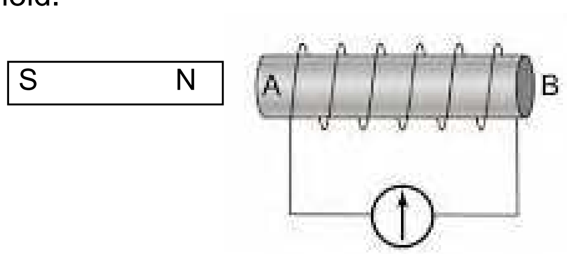
Four options are provided as possible answers to the following questions. Each question has only ONE correct answer. Choose the answer and write only the letter (A – D) next to the question number (1.1 – 1.3) in the ANSWER BOOK, for example 1.5 D.

1.1 Consider the emf induced in a coil when a magnet is moved into the coil. Which of the following graphs correctly describes the relationship between the induced emf and the number of turns (N) in the coil?



(2)

1.2 In the diagram below, the north pole of a bar magnet approaches end **A** of a solenoid.

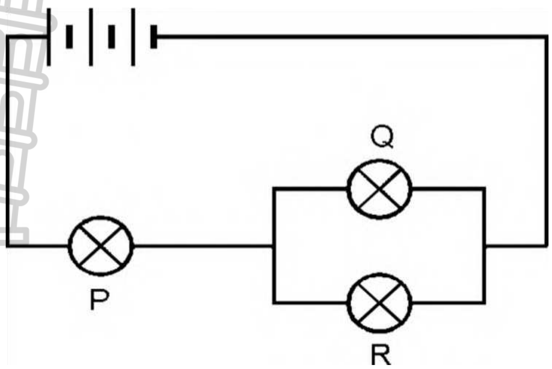


Which ONE of the following statements about the polarity of **A** and the direction of the magnetic field INSIDE the solenoid is CORRECT as the NORTH POLE approaches **A**?

	POLARITY OF A	DIRECTION OF FIELD IN SOLENOID
A	South pole	A to B
B	North pole	B to A
C	North pole	A to B
D	South pole	B to A

(2)

1.3 Three identical light bulbs **P**, **Q** and **R** are connected in the circuit with a battery of a negligible internal resistance.



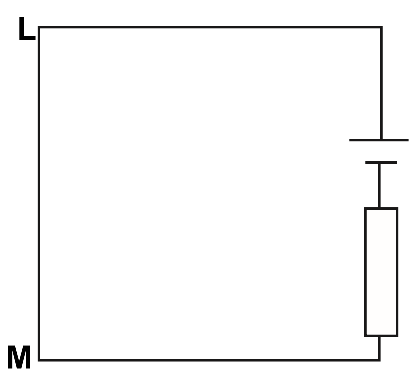
The filament of light bulb **R** breaks and the bulb stops working.
Therefore, light bulbs **P** and **Q** will …

	Light bulb P	**Light bulb Q**
A	burn more brightly	burn less brightly
B	burn unchanged	burn more brightly
C	burn less brightly	burn more brightly
D	burn less brightly	burn less brightly

(2)
[6]

QUESTION 2

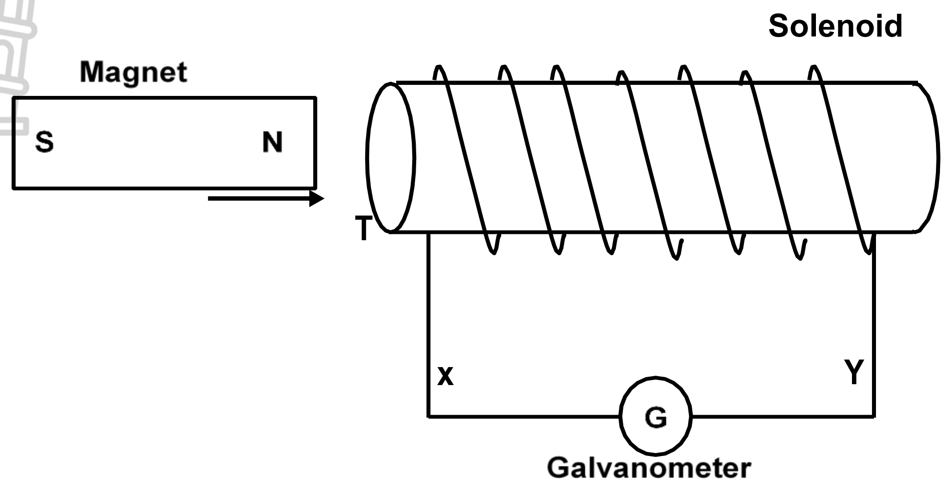
2.1 A current passes through a straight conductor **L-M** as shown in the diagram below



2.1.1 What is the direction of current? Write down only **L** to **M** or **M** to **L**. (1)

2.1.2 Draw a diagram of the magnetic field that forms around the wire **L-M**. (3)

2.2 The setup of apparatus below was used to demonstrate Faraday's law of electromagnetic induction.



2.2.1 State *Faraday's law of electromagnetic induction* in words. (2)

2.2.2 Write down the polarity (North pole or South pole) of the end of the solenoid at point **T** as the bar magnet approaches the solenoid. (1)

2.2.3 The bar magnet is then held stationary inside the solenoid. Write down what will be observed on the galvanometer. Give a reason for the answer. (2)

2.2.4 In which direction will the induced current flow? Write only FROM **X** to **Y** or FROM **Y** to **X**. (1)

2.3 A coil with area 0,6 m^2 is held with its axis coinciding with the direction of a magnetic field of strength 0,4 T.

2.3.1 Calculate the magnetic flux linkage. (3)

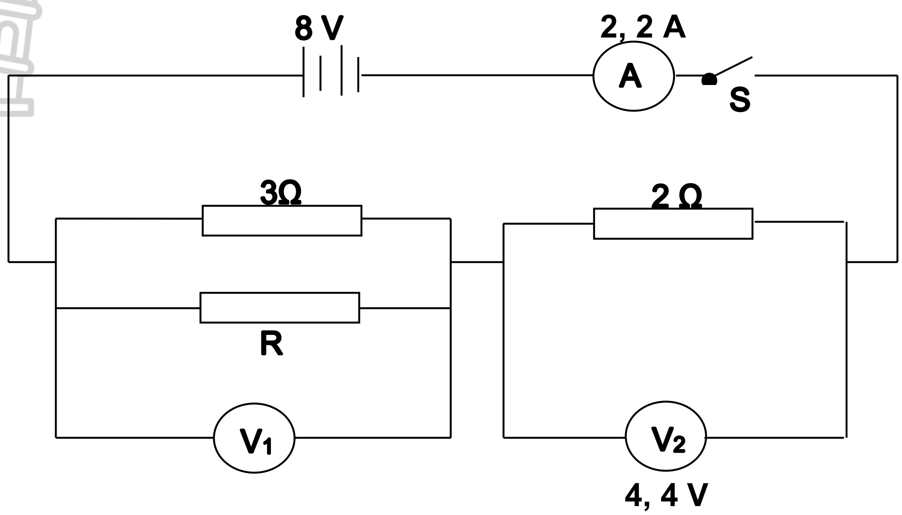
In order to produce an emf of 9 V, the area of the coil, with its axis coinciding with the direction of a magnetic field, is halved from 0,6 m^2 to 0,3 m^2 in 2 minutes.

2.3.2 Calculate the number of turns in the coil. (4)

[17]

QUESTION 3

The circuit below shows the 8 V battery with negligible internal resistance and resistance of the connecting wires. When switch **S** is closed, the reading on ammeter **A** is 2, 2 A, while the reading on voltmeter **V_2** is 4, 4 V.



3.1 State *Ohm's law* in words. (2)

3.2 Calculate:

3.2.1 The reading on voltmeter **V_1**. (2)

3.2.2 The value of the resistor **R**. (5)

3.2.3 The energy dissipated in the **2 Ω** resistor within 5 seconds. (3)

3.2.4 The power delivered by the 3 resistor. (3)

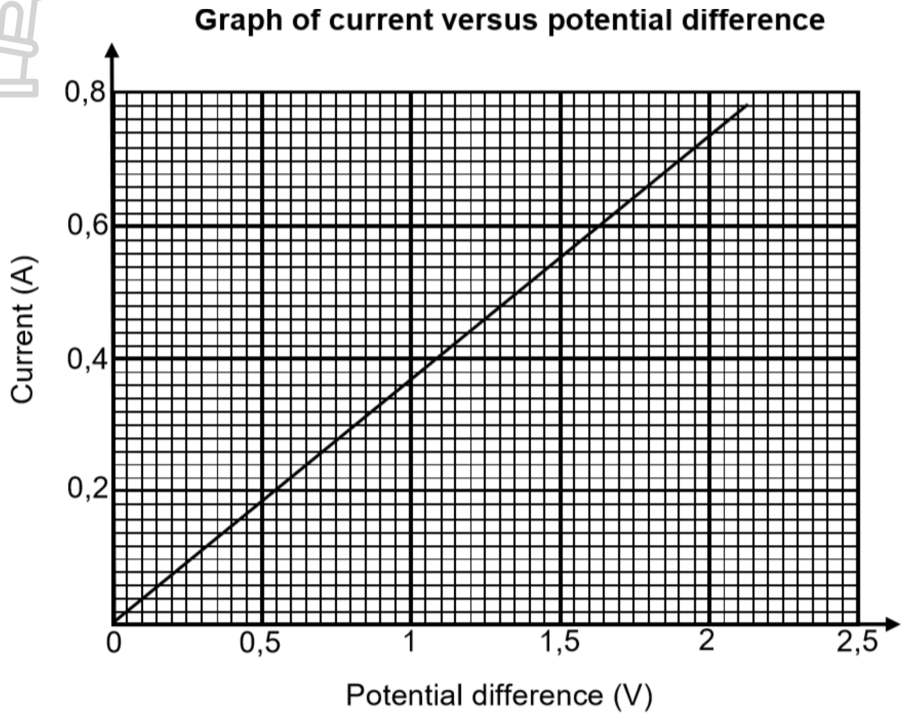
3.3 Give a reason why the voltmeters **V_1** and **V_2** are connected in parallel as shown in the diagram above. (1)

3.4 Will the ammeter reading INCREASE, DECREASE or REMAIN THE SAME if the 3 Ω resistor is removed from the circuit? Give a reason for the answer. (2)

[18]

QUESTION 4

Learners carried out an investigation in which they measured the current through the resistor **R** for different potential differences across its ends. The results obtained were used to draw the graph shown below.



4.1 What conclusion can be made from the graph above? (1)

4.2 Write down the independent variable in this investigation. (1)

4.3 Use the graph to calculate the resistance of the resistor **R**. (4)

4.4 Electric heater is marked 3000 W. What is the cost of heating the room using this heater for one day, if the electricity costs 70c per kWh? (3)
[9]

TOTAL: 50

PHYSICAL SCIENCES DATA SHEET GRADE 11

TABLE 1: ELECTROMAGNETISM

$\varepsilon = -N\frac{\Delta\Phi}{\Delta t}$	$\Phi = BA\cos\theta$

TABLE 2: ELECTRIC CIRCUITS

$R = \frac{V}{I}$	$q = I\,\Delta t$	$W = Vq$
$R_s = R_1 + R_2 + ...$	$P = \frac{W}{\Delta t}$	$W = VI\Delta t$
$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + ...$	$P = VI$	$W = I^2R\Delta t$
	$P = I^2R$	$W = \frac{V^2\Delta t}{R}$
	$P = \frac{V^2}{R}$	

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MARKING GUIDELINES

MARKS: 50

These marking guidelines consist of 4 pages

QUESTION 1

1.1 A✓✓ (2)

1.2 B✓✓ (2)

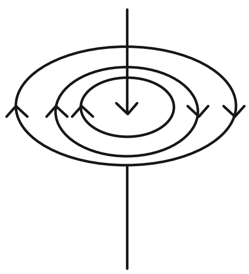
1.3 C✓✓ (2)

[6]

QUESTION 2

2.1.1 L to M✓ (1)

2.1.2



MARKING CRETERIA FOR Q 2.1.2	
Circular field	✓
Arrows in correct direction (Ignore the arrow/direction of arrow for the current)	✓
More than 2 field lines drawn	✓

(3)

2.2.1 The magnitude of induced emf across the ends of the conductor is directly proportional to the rate of change in the magnetic flux linkage with the conductor✓✓ (2)

2.2.2 North pole✓ (1)

2.2.3 There is relative motion between the coil and the magnet/ There is a change in magnetic field around the solenoid,✓then current is induced.✓ (2)

2.2.4 X to Y✓ (1)

2.3.1 $\Phi = BA\cos\theta$ ✓

$\Phi = (0,4)(0,6)\cos 0°$ ✓

$\Phi = 0,24$ Wb/T·m^2 ✓

(3)

2.3.2 **POSITIVE MARKING FROM Q 2.3.1**

$\Phi = BA\cos\theta$

$\Phi_{1/2} = (0,4)(0,3)\cos 0^{o}$

$= 0,12\ Wb/T{\cdot}m^2$ ✓

$\varepsilon = -N\dfrac{\Delta\Phi}{\Delta t}$ ✓

$= -N\dfrac{(\Phi_f - \Phi_i)}{\Delta t}$

$9 = -N\dfrac{(0,12 - 0,24)}{120}$ ✓

N = 9 000 turns/windings ✓ (4)

[17]

QUESTION 3

3.1 The potential difference across a conductor is directly proportional to the current in the conductor at constant temperature. ✓✓ (2)

[2 or 0 MARK]

3.2.1 $V_1 = 8 - 4,4$ ✓

$V_1 = 3,6\ V$ ✓ (2)

3.2.2 **POSITIVE MARKING FROM Q 3.2.1**

OPTION 1	**OPTION 2**
$R_p = \dfrac{V}{I}$ ✓	$R_3 = \dfrac{V}{I}$ ✓
$R_p = \dfrac{3,6}{2,2}$ ✓	$3 = \dfrac{3,6}{I}$ ✓
$R_P = 1,64\ \Omega$ ✓	$I_3 = 1,2\ A$
$\dfrac{1}{R_p} = \dfrac{1}{R_1} + \dfrac{1}{R_2}$	$I_R = 2,2 - 1,2 = 1\ A$ ✓
$\dfrac{1}{1,64} = \dfrac{1}{3} + \dfrac{1}{R}$ ✓	$V_R = I_R R$
$R = 3,6\ \Omega$ ✓	$3,6 = 1R$ ✓
	$R = 3,6\ \Omega$ ✓

(5)

3.2.3

OPTION 1	OPTION 2	OPTION 3
$W = VI\Delta t$ ✓ $W = 4,4 \times 2,2 \times 5$ ✓ $W = 48,4$ J ✓	$W = I^2R\Delta t$ ✓ $W = (2,2)^2 \times 2 \times 5$ ✓ $W = 48,4$ J ✓	$W = \frac{V^2\Delta t}{R}$ ✓ $W = \frac{(4,4)^2 \times 5}{2}$ ✓ $W = 48,4$ J ✓

(3)

3.2.4 **POSITIVE MARKING FROM Q 3.2.1**

OPTION 1	OPTION 2	OPTION 3
$P = \frac{V^2}{R}$ ✓ $P = \frac{3,6^2}{3}$ ✓ $P = 4,32$ W ✓	$V = IR$ $3,6 = (I) \times 3$ $I = 1,2$ A $P = VI$ ✓ $P = 3,6 \times 1,2$ ✓ $P = 4,32$ W ✓	$P = I^2R$ ✓ $P = 1,2^2 \times 3$ ✓ $P = 4,32$ W ✓

(3)

3.3 Voltmeters have high resistance (to the flow of current). ✓ (1)

3.4 DECREASE ✓
The total resistance increases ✓ (2)
[18]

QUESTION 4

4.1 Current increases with potential difference. ✓ (1)

4.2 Potential difference. ✓ (1)

4.3

Gradient = $\frac{\Delta I}{\Delta V}$ ✓ $= \frac{0,7-0}{1,9-0}$ ✓	Gradient = 0,37 ✓ $R = \frac{1}{0,37} = 2,7\ \Omega$ ✓ **[Accepted range: 2,5 Ω – 2,9 Ω]**

(4)

4.4 $P = 3000$ W = 3 kW
$W = P\Delta t = (3)(24) = 72$ KWh ✓
Cost = W (KWh) x Price per KWh
= (72)(R 0,70) ✓
Cost = R 50,4 ✓ (3)
[9]

TOTAL:50