GERT SIBANDE DISTRICT

MSTA SUB HUB

GRADE 12

PHYSICAL SCIENCES

TOPIC TEST JULY 2022

TOPIC: ELECTRODYNAMICS

MARKS: 40

TIME: 50 MINUTES

This question paper consists of 5 pages including the data sheet

INSTRUCTIONS

1. Attempt ALL questions.

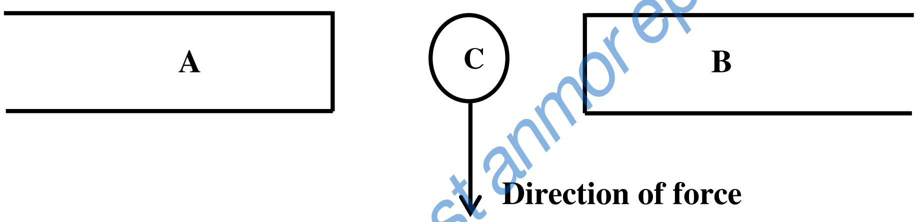
2. Round off the final answers to a minimum of TWO decimal places

3. Write neatly and legibly.

QUESTION 1

Four options (A – D) are given as possible answers to the following questions. Choose the answer and write only the letter (A – D) next to the question number (1.1 – 1.3).

1.1 In the diagram below a straight current carrying conductor, C, lies between two magnets A and B. The conductor experiences a downward force when placed between the two magnets.



Which ONE of the following combinations is correct?

	Direction of the magnetic field due to A and B	Direction of the current in C
A	B to A	into the paper, away from the reader
B	B to A	out of the paper, towards the reader
C	A to B	out of the paper, towards the reader
D	A to B	into the paper, away from the reader

(2)

1.2 In a DC generator the current to the external circuit is delivered through the…….

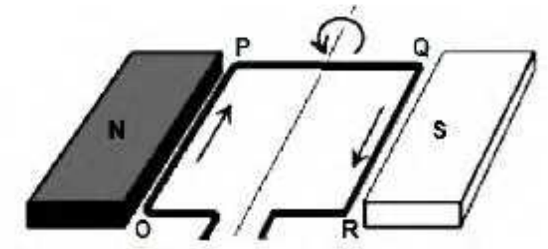
A coils.

B battery.

C slip rings.

D split rings (commutators). (2)

1.3 A DC current passes through a rectangular wire loop OPQR placed between two pole pieces of a magnet, as shown below.



Which TWO segments of the loop will experience an electromagnetic force when the loop is in the position above?

A OP and PQ

B QR and RO

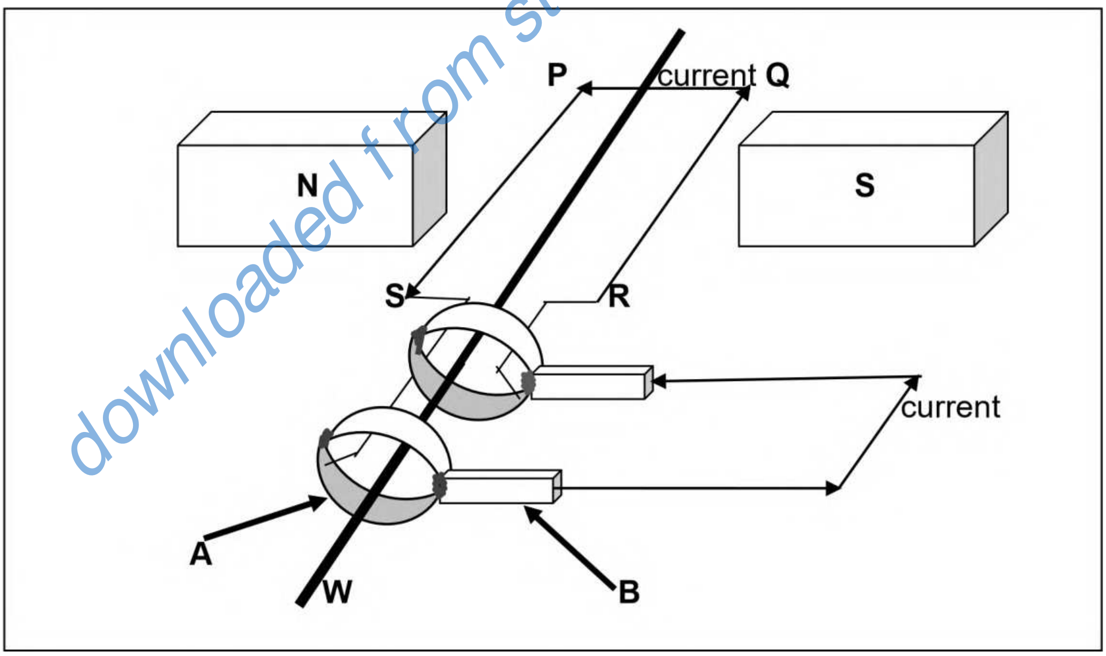
C OP and QR

D RO and OP (2)

[6]

QUESTION 2

The simplified diagram shows the basic structure of an AC generator. Study the diagram thoroughly and answer the following questions.



2.1 Name the principle on which this generator operates. (1)

2.2 Write down the name and ONE function of the parts labelled;

2.2.1 A (2)

2.2.2 B (2)

2.3 Name ONE structural change that has to be made to convert this AC generator into a DC generator. (1)

2.4 When a coil indicated as PQRS is rotated using the axis **W**, It causes an induced current to flow in the direction shown in the diagram above.

2.4.1 Determine the direction in which the coil is rotated at an instant the current was flowing in that indicated direction.
Write only CLOCK WISE or ANTI CLOCK WISE. (1)

2.4.2 Will the induced emf be a MINIMUM or a MAXIMUM when the coil is in the position shown in the diagram above? (1)

2.4.3 The AC motor has the same basic structure as the AC generator in the diagram above, but with different operating principal. Write down the principle on which the electric motor operates. (1)

2.5 When the generator in the diagram above was connected to a gazer, it produced a peak (I_{max}) current of 7,0A.

2.5.1 Define the term root mean square (I_{rms}) value of AC current. (2)

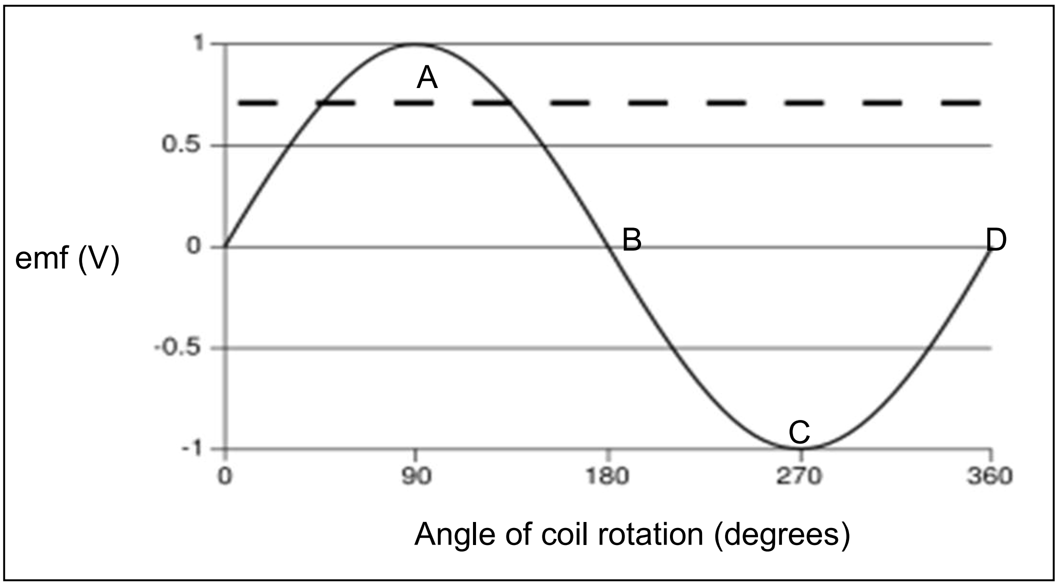
2.5.2 Calculate the rms current (I_{rms}) produced by the generator. (3)

2.6 An Eskom substation produces average power of 5,5 x10^8 W.
Calculate the maximum Voltage output if the power is transmitted at a maximum current of 27 500 A in the transmission lines. (5)

[19]

QUESTION 3

The graph below shows induced emf for a 360° rotation of a coil in a generator.



3.1 What type of generator produced the induced emf shown in the graph above? Write only AC or DC. (1)

3.2 Name the energy conversion in this type of generator. (1)

3.3 For points (A to D) on the graph, state the position of the coil relative to horizontal magnetic field lines. Write only HORIZONTAL or VERTICAL.

3.3.1 A and C (1)

3.3.2 B and D (1)

3.4 The generator named in question 3.1 above was connected to a toaster of 45 Ω resistance. Use the graph above to calculate the average power dissipated in the toaster. (5)

3.5 Draw a sketch graph of current versus time for the type of generator in question 3.1 for two cycle rotation of the coil. Indicate the peak current as I (peak). (3)

3.6 State TWO ways in which the induced emf in the coil can be increased. (2)

3.7 Give ONE reason why Eskom distributes alternating current electricity through the national grid instead of direct current electricity. (1)

[15]

TOTAL: 40

DATA FOR PHYSICAL SCIENCES PAPER 1 GARADE 12

TABLE 1: ALTERNATING CURRENT/*WISSELSTROOM*

$I_{rms} = \frac{I_{max}}{\sqrt{2}}$ / $I_{wgk} = \frac{I_{maks}}{\sqrt{2}}$	$P_{ave} = V_{rms} I_{rms}$ / $P_{gemiddeld} = V_{wgk} I_{wgk}$
$V_{rms} = \frac{V_{max}}{\sqrt{2}}$ / $V_{wgk} = \frac{V_{maks}}{\sqrt{2}}$	$P_{ave} = I^2_{rms} R$ / $P_{gemiddeld} = I^2_{wgk} R$
	$P_{ave} = \frac{V^2_{rms}}{R}$ / $P_{gemiddeld} = \frac{V^2_{wgk}}{R}$

GERT SIBANDE DISTRICT

MSTA SUB HUB

GRADE 12

PHYSICAL SCIENCES TOPIC TEST

TOPIC: ELECTRODYNAMICS

JULY 2022

MEMORANDUM

MARKS: 40

This memorandum consists of 4 pages

QUESTION 1

1.1 B✓✓ (2)

1.2 D✓✓ (2)

1.3 C✓✓ (2)

[6]

QUESTION 2

2.1 Electromagnetic induction✓ (1)

2.2.1 Slip ring✓; establish contact with the brushes and allows current to pass to external circuit. ✓ (2)

2.2.2 (Carbon) brush✓

Take current from the coil to the external circuit. ✓

OR: Allows movement and conductivity between coil and external circuit. (2)

OR: Connects the generator to the external circuit.

2.3 Change the slip rings into split rings/commutators✓ (1)

2.4.1 ANTI CLOCKWISE✓ (1)

2.4.2 MAXIMUM✓ (1)

2.4.3 Motor effect✓ (1)

2.5.1 Is the DC current which dissipates the same amount of energy as AC. ✓✓ (2)

2.5.2

$$I_{rms} = \frac{I_{max}}{\sqrt{2}} \checkmark$$

$$= \frac{7,0}{\sqrt{2}} \checkmark$$

I_{rms} = 4,95 A✓ (3)

2.6 $P_{av} = V_{rms} \times I_{rms}$✓

$$P_{av} = V_{rms} \times \frac{I_{max}}{\sqrt{2}}$$

$$5,5\times10^{8} = V_{rms} \times \frac{27500}{\sqrt{2}} \checkmark$$

V_{rms} = 2,86 x 10^4 V✓

$$V_{rms} = \frac{V_{max}}{\sqrt{2}}$$

$$2,86 \times 10^4 = \frac{V_{max}}{\sqrt{2}} ✓$$

$$V_{max} = 4,04 \times 10^4 \text{ V} ✓$$

(5)

[19]

QUESTION 3

3.1 AC✓ (1)

3.2 Mechanical to electrical energy (1)

3.3.1 HORIZONTAL✓ (1)

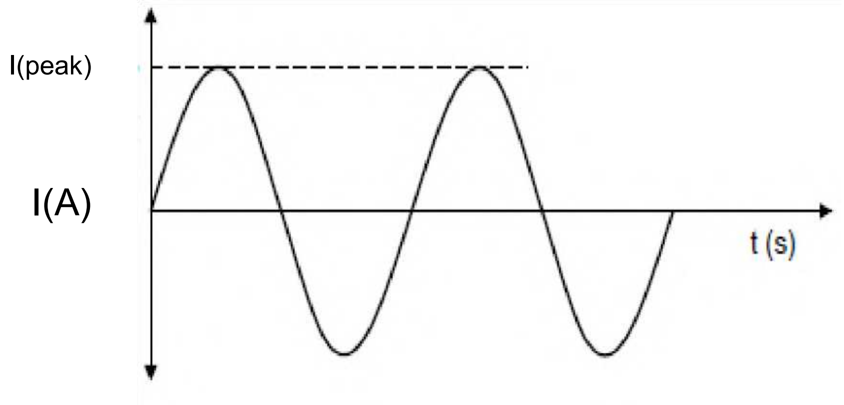
3.3.2 VERTICAL ✓ (1)

3.4

$P_{ave} = \frac{V_{rms}^2}{R}$ ✓ $V_{rms} = \frac{V_{max}}{\sqrt{2}}$ $V_{rms} = \frac{1}{\sqrt{2}}$ ✓ $V_{rms} = 0,71$ V✓	$P_{ave} = \frac{(0,71)^2}{45}$ ✓ Pave = 0,011 W✓

(5)

3.5



Marking Criteria for Q3.5	
Shape of the graph	✓
Labeling of axes	✓
Labeling of I(peak)	✓

(3)

3.6
- Increase the speed of rotation of the coil.
- Increase the magnetic field strength/ Use stronger magnets
- Use more turnings in the loop **[any 2]**✓✓ (2)

3.7
- Lesser energy loss in transmission compared to DC
- Voltage can easily be changed by stepping it up or down.
- Easier to generate and transmit than DC **[Any 1]** ✓ (1)

[15]

TOTAL: 40