**MARKING SCHEME**

**Instructions to candidates**

* *This paper consists of two sections A and B.*
* *Answer all the questions in the two sections in the spaces provided after each question*
* *All working must be clearly shown.*
* *Electronic calculators, mathematical tables may be used.*
* *All numerical answers should be expressed in the decimal notations.*

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| **SECTION** | **QUESTION** | **MAX MARKS** | **CANDIDATE’S SCORE** |
| **A** | **1 – 11** | **25** |  |
| **B** | **12** | **10** |  |
|  | **13** | **13** |  |
|  | **14** | **11** |  |
|  | **15** | **11** |  |
|  | **16** | **10** |  |
| **TOTAL** |  | **80** |  |

**SECTION A (25 MARKS)**

**Answer all the questions in the space provided**

1. The figure below shows a ray of light reflected from a mirror.

300

Complete the ray diagram and find the new angle of reflection after it is rotated 100 anticlockwise with the incident ray fixed. (2marks)

*The angle of incidence = 500*

1. Three electric bulbs are connected in series with a battery of two dry cells and a switch. At first the bulbs light brightly.
2. State a reason why they gradually light dim. (2marks)

*Polarization increases internal resistance of the cell reducing the flow of current*

1. The switch is put off for sometimes. Explain why the bulbs again shine brightly. (1mark)

*Manganese (IV) oxide depolarizes, increasing the flow of current*

1. A positively charged rod is brought near the cap of a lightly charged electroscope. The leaf first collapses and as the rod comes nearer, the leaf diverges.
2. What is the charge on the electroscope? (1mark)

 *negative*

1. Explain the behavior of the leaf. (2marks)

*More electrons are attracted to the cap leaving the rod and leaf neutral as it is moved closer more electrons are pulled up leaving the rod and leaf more positive so the leave divergence increase*

1. The figure below shows a bar magnet attracting steel pin as shown

N

S

X

Y

Steel pin

 State and explain what would happen when a North pole of a bar magnet is brought near the tips of steel pin X and Y. (2marks)

*Steel pins X and Y are attracted to the pole of the magnet. Unlike pole attract*

1. Determine the equivalent resistance between P and Q for the following resistors shown. (2marks)

30Ω

70Ω

19Ω

P

Q

*Total resistance = 19 +* $\frac{30 x 70}{30+70}$ *= 19 + 21 = 40Ω*

1. The figure below shows a wave profile for a wave whose frequency is 5Hz.

t3

t5

t7

t9

t1

Time (s)

Displacement (cm)

1

-1

-2

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Determine the value of t8. (2marks)

*t8 = 0.2 x2 = 0.4 second*

1. An electromagnetic radiation whose wavelength is greater than that of microwaves has a wavelength of 306.1224 m. Take speed of light in air, c = 3 x108 m/s.
2. Identify the radiation. (1mark)

*Radio wave*

1. Calculate its frequency. (2marks)

*Frequency =* $\frac{3 x 10^{8}}{306.1224}$ *= 9.8 x 105Hz*

1. Two heating coils A and B connected in parallel in a circuit produces power of 36W and 54W respectively. What is the ratio of their resistance?(2marks)

*P =* $\frac{v^{2}}{R}$ *PA =* $\frac{v^{2}}{R\_{A}}$ *PB =* $\frac{v^{2}}{R\_{B}}$$\frac{R\_{A}}{R\_{B}}$ *=* $\frac{P\_{B}}{P\_{A}}= $$\frac{54 W }{36 W} $*=* $\frac{3}{2}$

*RA:RB = 3:2*

1. State **two** conditions necessary for total internal reflection to occur. (2marks)
* *Light must travel from an optically denser medium to a less dense medium*
* *The angle of incidence must be greater than the critical angle*
1. Define coherent source of a wave. (1mark)

*Have same speed, frequency and wavelength.*

1. The figure below show a conductor carrying electric current place between two magnetic poles.

N

S

Complete the diagram by sketching the magnetic field and also show the direction of the force on the conductor. (3 marks)

*Sketch magnetic field patterns around the conductor; the field patterns due to permanent magnet ; and the resultant force which is acting downwards;*

**Section B (55 marks)**

**Answer ALL the questions in the spaces provided**

1. (a) State **one** factor that affects the force between two charged bodies. (1mark)

 – *the distance between two charged bodies.*

 *– the amount of charge present in the bodies*

(b) To investigate charge distribution on metallic surfaces, electric charges were collected from different parts of the surfaces using a proof plane as shown below:

Proof Plane

Metallic conductor

Insulator

A

B

C

D

Fig. (i)

Fig. (ii)

The proof plane was then placed on the cap of a neutral electroscope.

1. State and explain the leave divergence of the electroscope as the proof plane is placed at various points round the spherical surface in figure (i) above. (2marks)
* *leaf divergence is the same because charge is uniformly/evenly distributed*
1. State with reason which part of the conductor in figure (ii) gave the greatest deflection of the electroscope. (2marks)

*- B , has the highest charge distribution as it is most curved/greatest curvature.*

(c) The figure below shows a 10µF capacitor being charged from a 12V battery by connecting the switch terminal on R. The switch is then connected to S to discharge the 4µF capacitor.

**4 μF**

**R**

**S**

**E = 12V**

**10 μF**

 Determine the resultant potential difference between the two capacitors. (3marks)

*Total charge = CV = 10 x 12= 120µC*

*Total capacitance = 10 +4= 14µF*

*p.d = 120/14 = 8.571V*

(d) State two uses of capacitors. (2marks)

 *In camera flash, reduction of sparking at contacts, rectification*

1. (a) State Faradays law of electromagnetic induction. (1mark)

*The magnitude of induced electromotive force (e.m.f) is directly proportional to the rate of change of magnetic field flux*

(b) The figure below shows a simplified circuit of a generator.

X

Y

N

S

Bulb

1. Identify parts X and Y. (2marks)

X *split ring (commutator)*

Y *carbon brush*

1. State **two** ways of making the bulb light brighter. (2marks)
* *Use a stronger magnet*
* *Increase the speed of rotation*
* *Increase the number of turn of the wire*
* *Wind the wire on a soft iron core*

(c) An a.c generator produces an e.m.f of 50.0V which is used to operate a circuit that requires a minimum of 250.0V. If the power of the generator is 200W, determine the:

(I) Current generated by the a.c source. (2marks)

 *Current =* $\frac{200W}{50V} $*= 4A*

(II) Current supplied to the circuit by the transformer assuming 100% efficiency. (2marks)

 *Secondary current =* $\frac{power}{sec. voltage}$ *=* $\frac{200w}{250v}$ *= 0.8 A*

(III) Ratio of turns in the coils of the transformer, primary: secondary. (2marks)

*Turn ratio = primary voltage : secondary voltage= pry turn : sec. turns 50:250 = 1:5*

(d) Explain how power loses in a transformer are minimized. (2marks)

 (i) Eddy currents

*Laminating the core*

 (ii) Hysteresis losses

*Use soft iron core which is easily magnetized and easily demagnetized.*

1. (a) A disc of a siren with 100 holes is rotated at constant speed making 0.5 revolutions per second. if air is blown towards the holes, calculate:
2. The frequency of the sound produced. (2marks)

 *Frequency = 100 x 0.5 = 50 Hz*

1. The wavelength of the sound produced, if the velocity of sound is 340 m/s. (2marks)

*Wavelength = velocity/frequency = 340/50 = 6.8m*

(b) A ship sends out an ultrasound whose echo is received after 5 seconds. If the wavelength of the ultrasound in water is 0.05 m and the frequency of the transmitter is 50 KHz, calculate the depth of the ocean. (3marks)

 *Velocity = 50000 x 0.05 = 2500m/s*

*Depth = (2500 x 5)/2 = 6250m*

(c) A ray of light is incident at right angles to the face AB, of a right angled isosceles prism of refractive index 1.6 as shown in the figure below.

A

B

B

Liquid

Liquid

Liquid

 If the prism is surrounded by a liquid of refractive index 1.40, determine:

1. the angle of incidence on the face BC. (1mark)

*angle of incidence = 450*

(ii) the angle of refraction on the face BC. (3marks)

­*1.6 sin 450 = 1.40 sin r sin r = 0.8081 r = 53.90*

1. (a) Distinguish between principal focus and focal length of a concave lens. (1mark)

*It is a point on the principal axis for which rays that are close to and parallel to the principal axis appear to diverge from after refraction by the lens while the focal length is the distance between optical centre and the principal focus.*

1. The figure below shows sketches of a window frame and its image formed on a screen by a convex lens.

600mm

480mm

160mm

200mm

1. State the nature of the image formed. (2marks)

*Real and diminished*

1. Calculate the linear magnification of the imaged formed. (2marks)

*Magnification = 600/200 = 3*

1. The imaged of the frame was produced 500mm from the lens. Calculate the focal length of the lens. (3 marks)

*M =* $\frac{v}{f}$ *- 1*

 *f = 500/4 = 125 mm*

1. A student finds that at a distance of 25 cm, the words in a book looked blurred.
2. What eye defect does the student suffering from? (1mark)

*Short sight*

1. In which direction does he/she move the book to be able to see the words clearly from the distance? (1mark)

*Away from the student*

1. Which lens can be used to correct the eye defect? (1mark)

*Concave lens*

1. (a) (i) A graph of 1/v against 1/u for a concave mirror is shown below. Use your graph to determine the focal length of the mirror. (2marks)

0.08

0.04

0

0.12

0

1/u cm-1

1/v cm-1

0.12

0.08

0.04

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*Focal length = 1/0.1 = 10 cm (the reciprocal of the intercepts)*

(ii) Determine the image distance when the magnification is m = 2 for the concave mirror above. (3 marks)

*M =* $\frac{V}{f}$ *- 1*

 *2 =* $\frac{v}{10}$ *– 1 v = 30cm*

(b) State **one** application of each of the following

 (i) Convex mirror. (1mark)

*Side mirror, supermarkets to watch over large floor area.*

(ii) Parabolic mirror. (1mark)

*Solar concentrator, car head lamp, spotlight*

 (c) A small object is placed 15 cm in front of a convex mirror of focal length 10 cm.

(i) Determine the position of the image. (3marks)

$\frac{1}{f}$ *=* $\frac{1}{u}$ *+* $\frac{1}{v}$$\frac{1}{-10}$ *=* $\frac{1}{15}$ *+* $\frac{1}{v}$ *v= -6 cm*