TERM 2 - 2023

PHYSICS THEORY – PAPER 2 (232/2)

FORM THREE (3)

MARKING SCHEME

SECTION A: 25 MARKS

1. Give one difference between luminous and non-luminous sources of light. (1mk)

A luminous source of light emits light while a non-luminous source reflects light ✓

2. When a negatively charged rod is brought near the cap of a leaf electroscope, the leaf rises. Explain this observation. (2mks)

Electrons are repelled from the cap and flow to the leaf and plate.✓ Repulsion between the electrons on the plate and those on the leaf causes the leaf to rise. ✓

3. **Figure 1** represents a displacement-time graph for a wave.

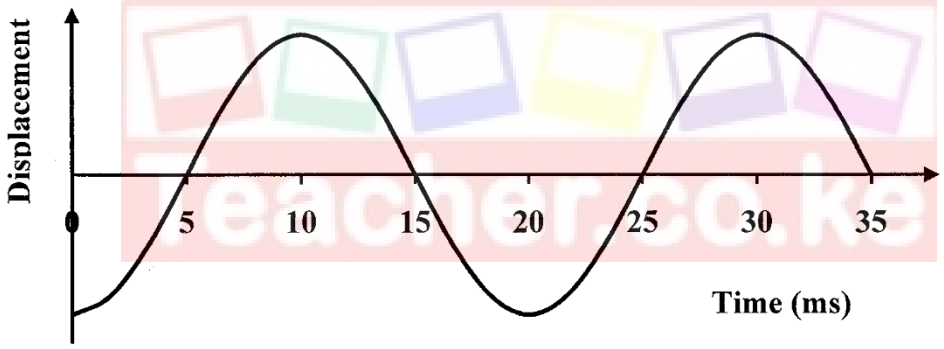


Figure 1

Determine the frequency of the wave. (3mks)

$f = \frac{Numberofwaves}{Timetaken}$✓ $= \frac{1\frac{3}{4}}{35\times10^{-3}} = 50Hz$✓

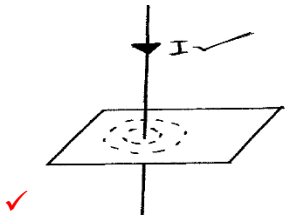
Alt.

$f = \frac{1}{T} = \frac{1}{(25-5)\times10^{-3}} = 50Hz$✓

4. ***State*** the conditions necessary for a wave incident on a slit to be diffracted. (2mks)

Width of the aperture/ slit ✓should be approximately or nearly equal to λ ✓of the incident wave;

5. **Figure 2** shows the magnetic field pattern round a current-carrying conductor. Indicate on the conductor the direction of the current. (1mk)



✓

6. In an experiment to determine the focal length of a concave mirror, magnification M was determined for various image distances v. Figure 3 shows a graph of magnification M against image distance v for the results from the experiment.

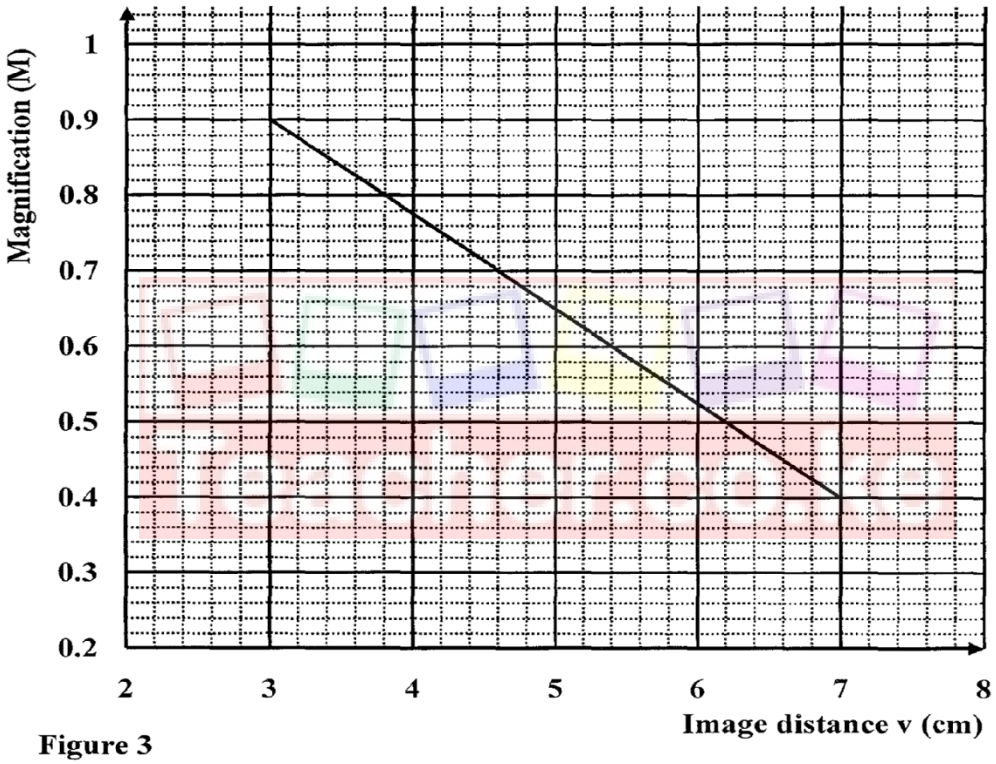


Figure 3

Figure 2

Given that M = 1 $-\frac{v}{f}$, determine the focal length f of the mirror. (3mks)

Slope = $\frac{0.9-0.4}{3-7}$ ✓ = $-\frac{1}{f}$ ✓

= $-\frac{0.5}{5}$ = 0.125

f = 8cm ✓

7. Why is repulsion the sure test for a magnet? (1mk)

Repulsion only occurs between like poles of magnets while attract also occur between a magnet and a magnetic material✓

8. A positively charged material was brought close to an insulated metallic ball as shown in Fig 4. State and explain the distribution of charge in the ball (2mks)

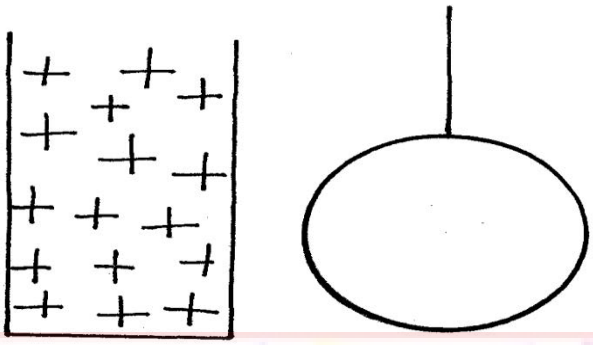
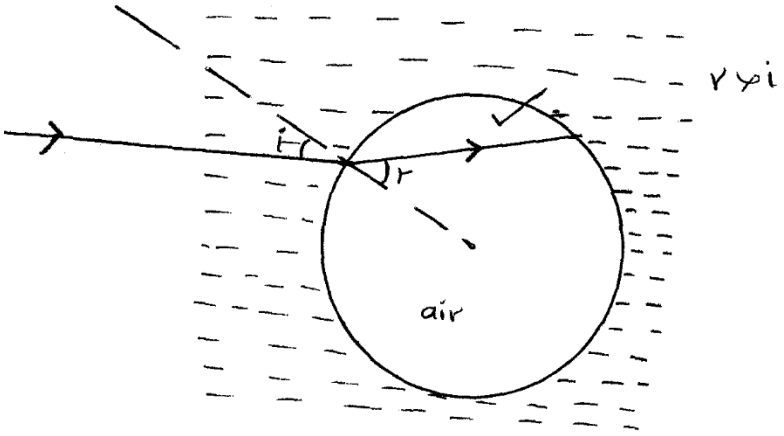


Figure 3

Electrons are attracted towards✓ the rod leaving the atoms at the other end of the ball with net positive charges✓

9. **Figure 5** shows a ray of light incident on an air bubble which is inside water, Complete the ray to show the path it follows through the air bubble. (1mk)



10. Explain how polarization of a cell increases the cell's internal resistance. (2mks)

Hydrogen gas bubbles form around the positive plate. ✓ The hydrogen gas insulates the positive plate thus increasing internal resistance ✓

11. Explain why sound cannot be heard from far when one shouts in a forest (1mk)

Trees absorb sound✓

12. A cell of internal resistance O.5 Ω is in a circuit containing a 10 Ω resistor. A current of 2A flows in the circuit. Determine the emf of the cell. (3mks)

E = Ir + IR ✓
= 2 x 0.5 + 2 x 10
= 11V ✓

13. A glass of thickness 14 cm is placed on a mark drawn on a plain paper. The mark is viewed is normally through the glass. Calculate the apparent depth of the mark and hence the vertical displacement (Refractive index of glass = 3/2) (3mks)

$n = \frac{\text{Real depth}}{\text{Apparent depth}}$ ✓1 $3/2 = \frac{14}{X}$ $X = \frac{14 \times 2}{3}$ X = 9.3 cm ✓1

14 – 9.3 = 4.7 cm is the vertical displacement✓1

SECTION B. (55 MARKS)

Answer all questions in this section

14. (a) State the laws of refraction. (2mks)

The ratio of the sine of angle of incidence to the sine of angle of refraction is a constant for a pair of media.✓

The incident ray, the refracted ray and the normal at the point of incidence all lie on the same plane. ✓

(b) Give two advantages of totally internally reflecting prisms over plane mirrors. (2mks)

-Do not absorb light energy like mirrors✓
- Not affected by thickness as mirror ✓
- Do not wear off like the peeling of silvering on mirror✓

(c) A ray of light is incident on a kerosene water interface as shown in figure 6 below.

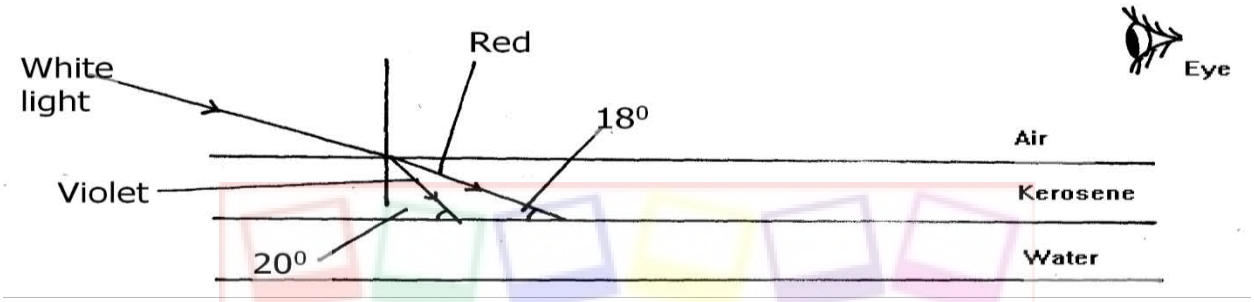


Figure 4

Given that the refractive index of water and kerosene are 1.33 and 1.44 respectively,

Determine

(i) the refractive index for the kerosene – water interface (3mks)

$k^nw = k^na\ a^nw$✓

$= \frac{1}{1.44} \times 1.33$✓ $= 0.9236$✓

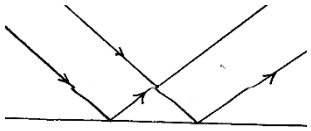
(ii) determine and show on the figure the path of the rays of light between the Kerosene-water surface (3mks)

$i = 70^0$

$\frac{Sini}{Sinr} = 0.9236$✓

$Sin\ r = \frac{sin\ 70^0}{0.9236} = 1.0174$✓

r is greater than 90^0 hence the light reflection✓



(iii) Why does the colors of the light separate at the kerosene layer. (1mk)

The different colours travel at different velocities hence would have different angles of refraction and are dispersed✓

(iv) State and explain the observation that the eye above the two surfaces would see. (2mks)

The eye would see a spectrum✓ since the light rays are dispersed ✓in the kerosene layer and are internally reflected at the kerosene – water surface the eye would see a spectrum at the surface

15. (a) State Ohm's law (1mk)

Current flowing through a conductor is directly proportional to the potential difference across it provided the temperature and other physical conditions are kept constant✓

(b) State two factors that affect the resistance of a metallic conductor. (1mk)

Resistance of a metallic conductor increases with *temperature.* ✓

The resistance of a uniform conductor of a given material is directly proportional to *its length.* ✓

The resistance of a metallic conductor is inversely proportional to its *cross-sectional area*.✓

(c) Use the circuit in figure 7 below to answer the questions that follow (i) Calculate the total resistance in the circuit. (3mks)

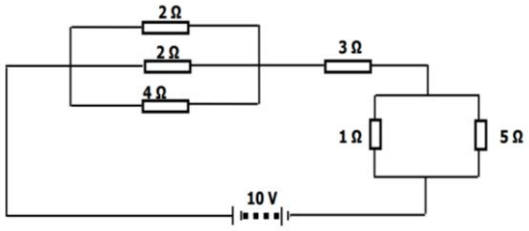


Figure 5

$$3\ Resistors\ in\ paralle, \frac{1}{R_T} = \frac{1}{2} + \frac{1}{2} + \frac{1}{4} = 1.25$$

$R_T = 1.25^{-1} = 0.8$✓

$$2\ Resistors\ in\ parallel = \frac{1}{1} + \frac{1}{5} = 1.2$$

$R_T = 1.2^{-1} = 0.833$✓

$Total\ circuit\ resistance = 0.8 + 3 + 0.833 = 4.633\Omega$✓

(ii) Determine the current flowing through the 5Ω resistor. (3mks)

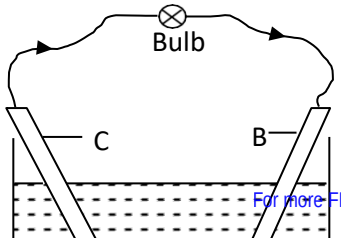
$For\ 2\ resistors\ im\ parallel, R_T = 1.2^{-1} = 0.833\Omega$

$Total\ current\ in\ the\ circuit = \frac{v_t}{R} = \frac{10}{4.633} = 2.158A$✓

$V\ through\ the\ 2\ resistors\ in\ parallel = 2.158 \times 0.833 = 2.991V$✓

$I = \frac{2.991}{5} = 0.5982A$✓

d) The figure 8 below shows a simple cell.



A

Figure 6

I. Name the electrolyte A: Dilute sulphuric acid.✓ (1mk)

II. When the switch is closed the current flows in the direction shown making the bulb to glow for a while. Name the metals B and C (2mks)

B. Copper✓

C. Zinc ✓

III. How can the bulb be made to light again for a longer period. (1mark)

Addition of potassium dichromate (depolarizer). Oxygen from the depolarizer combines with the hydrogen atoms to produce water.✓ Removing copper plate and brushing off the gas bubbles✓

Use of pure zinc. ✓Coating zinc with mercury (amalgamation)

16. (a) Define capacitance of a capacitor (1mk)

capacitance c is the charge stored in a capacitor per unit voltage✓

(b) The figure 9 below shows a charged electroscope two aluminium plates A and B arranged a shown

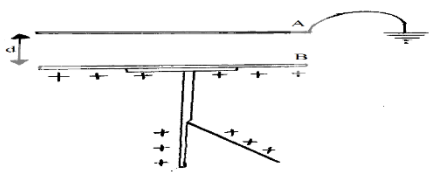


Figure 7

State and explain the observations made when:

(i) d is reduced (2mks)

the deflection of the leaf decreases✓ since the pd reduces with the distance of separation, the greater the deflection, the smaller the capacitance✓

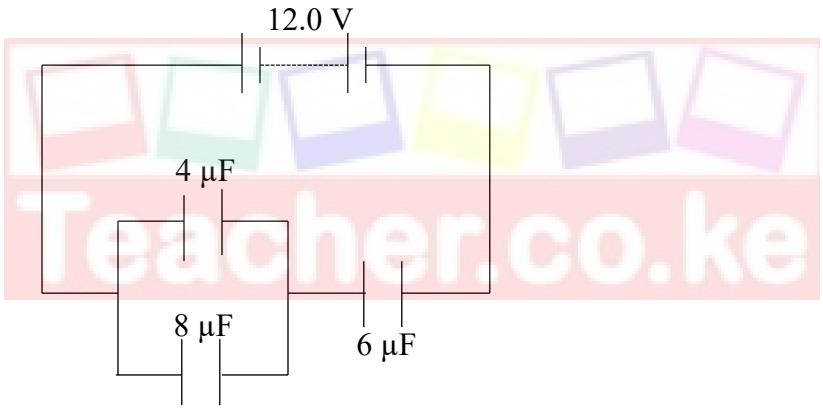
(ii) the plate A is more horizontally (2mks)

the deflection of the decreases✓ since the pd increases with the area of overlaps ✓or the greater the deflection the smaller the capacitance.

(iii) a sheet of polythene is placed between A and B (2mks)

the deflection of the leaf decreases✓, the capacitance increases, since the smaller the deflection the greater the capacitance✓

(c) The figure below shows an arrangement of three capacitors of 4 μF, 6 μF, and 8 μF connected to a 12.0 V d.c power supply.



(i) Calculate the effective capacitance of the arrangement. (3mks)

Effective capacitance in parallel arrangement $C_T = C_1 + C_2 = 4\ \mu F + 8\ \mu F = 12\ \mu F$✓1

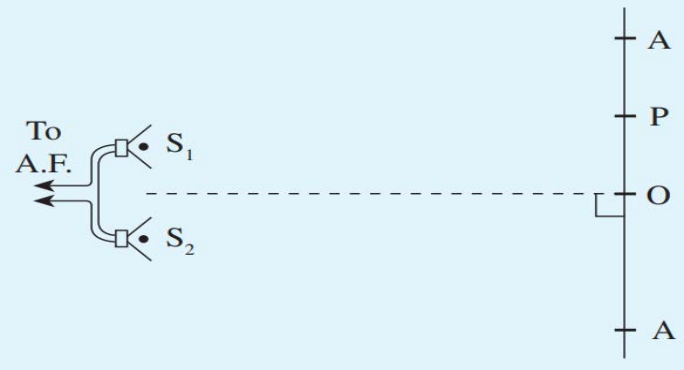
Effective capacitance in series arrangement $C_T = \frac{C_1 X\ C_2}{C_1 + C_2}$ $C_T = \frac{6\ \mu F\ X\ 12\ \mu F}{6\ \mu F + 12\ \mu F}$ ✓1 = 4 μF✓1

(ii) Calculate the charge on the 8 μF capacitor. (3mks)

Total charge flowing in the circuit Q = CV = 4 μF x 12 = 48 μC✓1

Voltage across the 8 μF $V = \frac{Q}{C}$ $V = \frac{4.8 \times 10^{-5}}{1.2 \times 10^{-5}} = 4V$✓1 $Q = CV = 8.0 \times 10^{-6} \times 4 = 3.2 \times 10^{-5}C$ ✓1

17. In an experiment to study interference in sound waves, two identical loudspeakers are connected to an audio frequency generator so that they act as coherent sources S1 and S2 as shown in the figure below



An observer walking several meters ahead and along a line parallel to S1 S2 identifies points A and A1 as the first positions of loud sound on either side after the loud sound at the middle position O between the two sources

(a) What is meant by the term coherent sources? (1mk)

Sources of waves are said to be coherent if they have same frequency and constant phase difference between them.✓

(b) Name the type of interference occurring at points O, A andA1. (1mk)

All the three are points of constructive interference.✓

(c) What name is given to the interference that occurs at point P exactly midway between O and A? (1 mk)

A point P in between two successive points of constructive interference would be a point of destructive interference, giving a soft sound✓

(d) What is an echo? (1 mk)

An echo is a reflected sound✓

(e) A person standing 110 m from the foot of a cliff claps his hands and hears a sound 0.75 seconds later. Find the speed of sound in air. (3 mks)

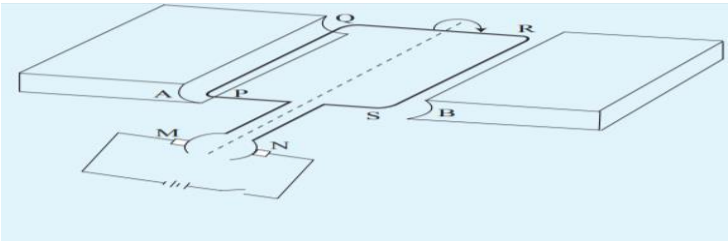
In 0.75seconds, the sound travels 220m

$$speed = \frac{220m}{0.75s} \checkmark\checkmark = 293.3\, m/s \checkmark$$

18. (a) State Fleming's left-hand rule. (1mk)

If the left hand is held with the thumb, the first finger and the second fingers mutually at right angles so that the first finger points in the direction of the magnetic field and the second figure in the direction of current then the thumb points in the direction of motion.✓

(b) The figure below shows a coil PQRS lying between two unlike magnetic pole of pieces A and B of an electric motor.



I. Identify the parts: (2mks)

M M is carbon brush. ✓

N N is half ring or split ring commutator✓

II. Given that PQRS rotates in a clockwise direction, state the polarity of A. (1mk)

A is North pole.✓

III. State three ways how you would increase the speed of rotation of the coil. (3mks)

By increasing the current. ✓ By increasing the number of turns on the coil. ✓Using a stronger magnet.✓

(c) (i) Distinguish between soft and hard magnetic materials. (1mk)

Soft magnetic materials make weak magnets while hard magnetic materials make strong and permanent magnets.✓

(ii) Which of the two types of materials is suitable for use as:

• Compass needle? (1mk)

hard ✓

• Core of an electromagnet? (1mk)

Soft✓

END