TERM 2 - 2023

PHYSICS THEORY – PAPER 2 (232/2)

FORM FOUR (1)

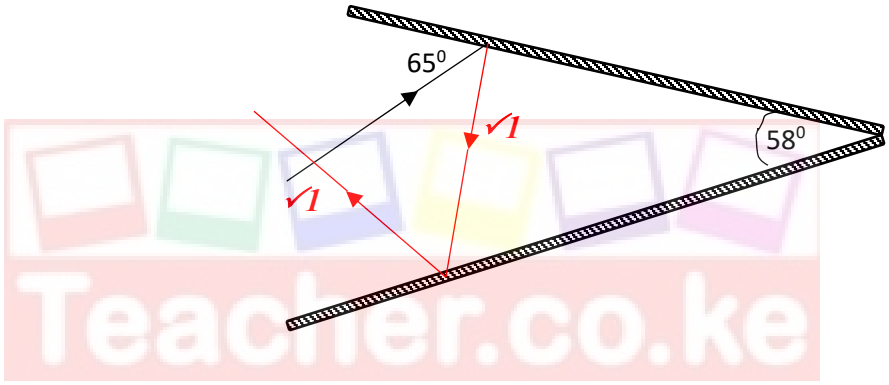
Time - 2 Hours

MARKING SCHEME

SECTION A: 25 MARKS

1. The figure below shows a ray of light incident on a plane mirror at an angle of 65^{o} to the surface of the first mirror as shown below.

Sketch the path of the ray until it emerges and state the angles. (3 marks)



2. State the reason why an increase in leaf divergence is the only sure way of determining whether an object is negatively charged using a negatively charged electroscope. (1 mark)

Increase in divergence only occurs only occurs when like charges repel each other.✓

3. State two measurements that should be taken for one to decide whether a lead acid accumulator is due for charging. (2 marks)

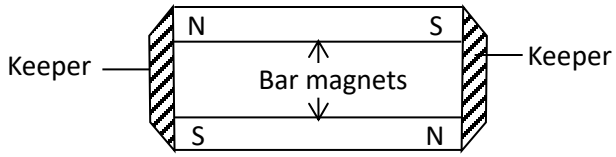
-Relative density of the acid.✓

-Potential difference across the terminals of the battery✓

4. (a) State the basic law of magnetism. (1mark)

-Like poles repel, while unlike poles attract.✓

(b) The figure **below** shows how magnets are stored in pairs with keepers at the ends.

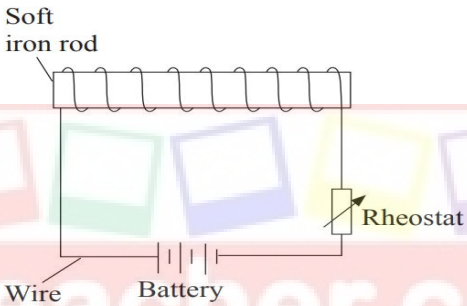


Explain how this method of storing helps in retaining magnetism longer. (2 marks)

The keepers acquire polarities so that the dipoles in the magnet and the keepers form complete loops. ✓The dipoles thus retain their orientation and magnetism is maintained.✓

5. Why is a convex mirror better than plane mirror when used as a driving mirror? (1 mark)
Convex mirrors give a wider field of view.✓

6. You are provided with the following apparatus: connecting wires, a soft iron rod, a battery of 3 cells, a switch, a long-insulated copper wire and a rheostat.
(a) Using a suitable diagram, show how an electromagnet can be made with the given apparatus. (1mark)

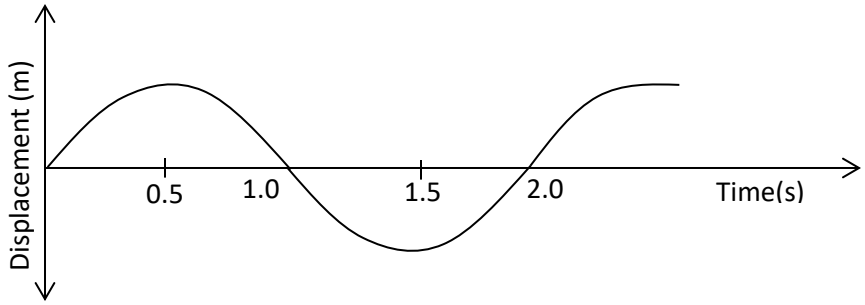


(b) State two ways by which the strength of an electromagnet can be increased. (2 marks)
By increasing the amount of current. ✓
By increasing the number of turns on the solenoid.✓

7. (a) Distinguish between a transverse and a longitudinal wave. (1 mark)

For a transverse wave, particles of matter vibrate perpendicularly to the direction of the wave motion while for a longitudinal wave, the particles of matter vibrate along the direction of the wave motion✓

(b) Determine the frequency of the wave shown below. (2 marks)



$T = 2.0\ Seconds$✓

$f = \frac{1}{T} = \frac{1}{2} = 0.5Hz$✓

8. When a germanium crystal is doped with arsenic it becomes an N-type semi-conductor. Explain how this change occurs.

(Number of electrons in the outermost shell for germanium=4, arsenic=5) (2 marks)

4 electrons from arsenic bond covalently ✓with germanium leaving a free electron that is responsible for conductivity.✓

9. A nuclide X with mass number 234 and atomic number 92 decays to nuclide Y with mass number 218 and atomic number 84. Determine the number of alpha particles emitted. (2 marks)

$$^{234}_{92}X \longrightarrow {}^{218}_{84}Y + b\left({}^{4}_{2}He\right)$$

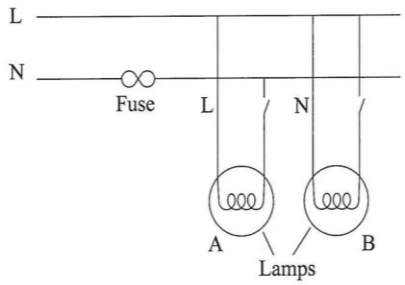
where b is the number of alpha particles.

Using mass number ;	Using atomic number
$234 = 218 + 4b$	$92 = 84 + 2b$
$16 = 4b$	$8 = 2b$
$b = 4$	$b = 4$

10. State how the intensity of x-rays in an x-ray tube can be increased. (1 mark)

Increasing the potential difference across the heater filament.✓

11. The figure below shows part of the lighting circuit in a house.



State two errors in the wiring circuit. (2 marks)

- The fuse is connected to the neutral instead of the live wire✓
- The switch is connected to the neutral wire instead of the live wire✓

12. Calculate the energy of photons associated with radiation of frequency 4.8×10^{14}Hz, stating your answer in eV . (3 marks)

$E = hf$✓

$(6.63 \times 10^{-34}) \times (4.8 \times 10^{14}) = 3.18 \times 10^{-19} J$✓

$Work\ done\ in\ eV = \frac{Work\ in\ joules}{1.6 \times 10^{-19}} = \frac{(3.18 \times 10^{-19})}{(1.6 \times 10^{-19})} = 1.9875 eV$✓

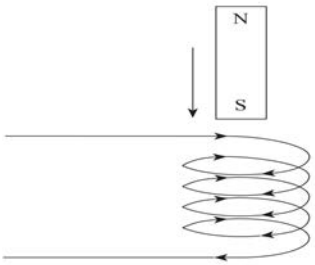
SECTION B. (55 MARKS)

Answer all questions in this section

13. a) State Lenz's law. (1 mark)

Lenz's law states that the direction of the induced current is always such as to oppose the change producing it.✓

b) A magnet is driven into a coil such that the direction of flow of current in the coil. Is as shown in the diagram below. Indicate on the diagram the polarity of the magnet, and the direction in which it is driven into the coil. (2 marks)



c) Electrical energy is transmitted at very high voltages and low current.

I. Describe how the high voltages are attained. (1 mark)

By stepping up the low voltage input to high voltage output for transmission.✓

II. State two reasons why thick aluminium wires are preferred to copper wires for transmission over long distances. (2 marks)

-They are lighter in weight than copper✓
-They are cheaper than copper✓
-They are better conductors of electricity than copper✓
- They are durable/last longer than copper✓

d) A student has some colored bulbs rated 60W, 240V to be connected for decorations.

I. State the number of such bulbs that can be connected normally to a 240V supply through a 5A fuse. (2 marks)

$P = VI = 240V \times 5A = 1200Watts$✓

$Number\ of\ bulbs = \frac{1200w}{60w}$=20bulbs✓

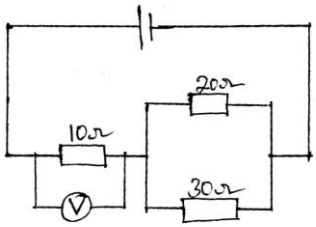
II. If the cost of electric energy is ksh.3.00 per kWh, determine the cost of running the bulb in (d) I above for 5hours daily for 20days. (3 marks)

$60w \times 5hrs \times 20days = 6000whr = 6kwhr$✓✓
$6kwhr \times 3 = ksh\ 18$✓

14. (a) State Ohms law. (1 mark)

The current flowing through a conductor is directly proportional to potential difference a cross it provided temperature and other physical condition are kept constant. ✓1

b) The cell in the figure below has an e.m.f of 2.5V and negligible internal resistance.



Determine the

(i) Total resistance in the circuit. (2 marks)

$R_T = R_1 + (\frac{R_2 \ x \ R_3}{R_2 + R_3})$

$= 10 + (\frac{20 \ x \ 30}{20+30})$ ✓1

$= 22\Omega$ ✓1

(ii) Current in the circuit. (2 marks)

$V = IR \qquad 2.5V = I \times 22\Omega$

$I = 0.113636$ A ✓1

(iii) Reading on the voltmeter. (2 marks)

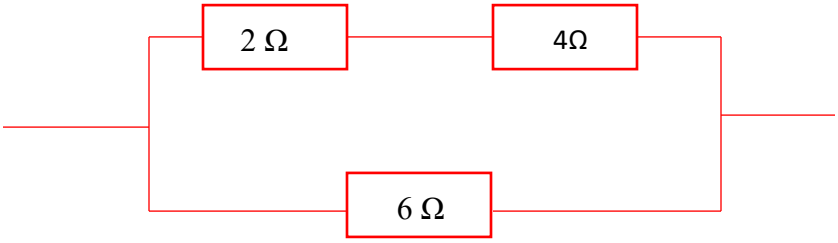
$V = IR$

$V = 0.113636 \times 10$ ✓1$= 1.13636V$✓1

c) Three resistors of resistance 2.0Ω, 4.0Ω and 6.0Ω are connected together in a circuit.

Show the combination which gives;

(i) Effective resistance of 3.0Ω. (1 mark)



(ii) Minimum resistance. (1 mark)

When are arrange in parallel so that the effective resistance is 0.9167Ω✓1

d) Define electrical resistance and name the S.I. unit. (2 marks)

It is the opposition offered by a device to the flow of current ✓1 and the SI unit is Ohm✓1

15.(a) State any two uses of echoes. (2 marks)

a) In the ship to determine the depth of the sea. ✓
b) In under water exploration of gas and oil.✓
c) In fishing boats with pulse echo equipment to locate shoals of fish.✓
d) In special types of spectacles used by the blind people to tell how far objects are ahead of them.✓
e) By bats to detect the presence of obstacles in their flight path✓

(b) Water waves are observed as they pass a fixed point at a rate of 30crests per minute. A particular wave crest takes 2s to travel between two fixed points 6m apart. Determine for the wave:

(i) The frequency. (3marks)

30 crests per minute; Frequency = 30/60 ✓1= 0.5Hz✓1

(ii) The wavelength. (2 marks)

Velocity = distance/time=6m/2s= 3m/s ✓

V = f λ, ✓ 3 = 0.5 x λ, λ = 6m✓1

(c) The figure below shows two loud speakers **L_1** and **L_2** connected to a signal generator.

(i) Why are the speakers connected to the signal generator? (1 mark)

So as to produced two identical sound signal. ✓1

(ii) An observer walks along **XY**. State what is observed and give reason for the observation. (2 marks)

An alternate region of loud and soft sound is heard. ✓1This is because of constructive and destructive interference of the two sound produced. ✓1

(iii) Another observer walks along OC. State what he observed. (1 mark)

He will hear a loud sound throughout the path. ✓1

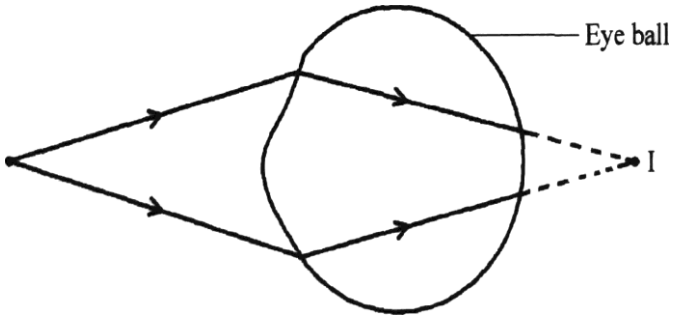
(iii) What is the effect on the observation if the frequency of the signal is increased? (1 mark)

The distance between the fringes will reduced or there will be no region of constructive or destructive interferences✓1

16.a) State the use of the eye piece lens in a compound microscope. (1 mark)

Acts as a magnifying glass.✓
Produces a magnified virtual image of the real image formed by the objective lens✓

b) Figure shows a defect of vision in a human eye



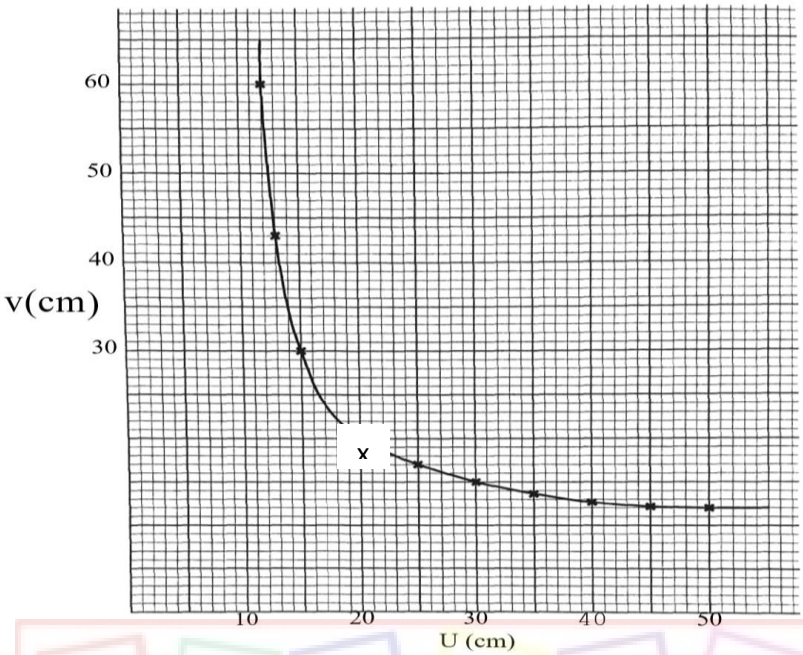
(i) State the type of defect shown. (1 mark)
Longsightedness/Hypermetropia✓

(ii) Identify one cause of this defect. (1 mark)

Too long focal length of the eye✓ • Too short eyeball✓

(iii) State the type of lens that can be used to correct this defect. (1 mark)
It is corrected by using converging lense

c) Figure 11 shows a graph of image distance (V) against the object distance (U) obtained in an experiment to determine the focal length of a concave mirror



(i) Identify and mark a point X on the graph where V = U.

(ii) Use the point X to determine:

i. The radius of curvature r. (1 mark)

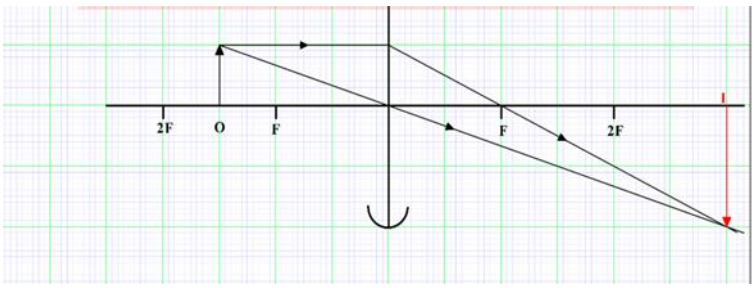
Object at C forms an image I, at C hence U = V = r

$r = 20cm$

ii. The focal length of the lens f. (2 marks)

$$f = \frac{r}{2} = \frac{20}{2} = 10cm$$

d) On the space provided, draw a ray diagram to show how a convex lens forms a magnified real image. (3 marks)



17. (a) It is observed that alpha (α) particles have a lower penetrating power than beta (β) particles. Explain this observation. (2 marks)

Alpha particles have lower penetrating power because they are heavier and slower than beta particles ✓

(b) A radioactive substance has a half-life of 12 years. Determine the time it would take to decay to 12.5% of its original value.

(2 marks)

It takes 3 half lives to decay to 12.5%✓

$Total\ time\ taken = half\ life \times number\ of\ half\ lives = 3 \times 12 = 36year$✓

(c) A Geiger Müller (GM) tube is used for detecting radiations from a radioactive source

State the function of

I. The mica windows. (1 mark)

The thin mica window allows passage of radiations these radiations ionizes the argon gas inside the tube✓

II. Bromine gas in the tube. (1 mark)

-The presence of small amount of bromine in the tube is to help absorbing the kinetic energy of the positive ions to reduce further ionization and enhance quick return to normal.
or
- Bromine gas acts as a quenching agent.✓

(d) In a diffusion chamber, explain why some of the tracks formed are observed to

I. Short. (2 marks)

Alpha particles cause heavy ionization, rapidly losing energy, hence their short range.

II. Straight. (2 marks)

They are massive and their path cannot therefore be changed by air molecules

(e) State two advantages of using a GM tube instead of a diffusion cloud chamber to detect radiations from radioactive substances (2 marks)

GM is easily portable than a cloud chamber. ✓GM is more sensitive. GM tube detects radiation at very low intensity while cloud chamber cannot detect radiation at very low intensity.✓

#END#