UCE physics paper 2

Instructions: Answer any five questions

1. (a) State the law of floatation. (01mark)

The law of floatation states that a floating body displaces its own weight of the fluid it floats

(b) The reading on a spring balance when a block of wood is suspended from it is 5N. When the block is completely submerged in water, the reading of the spring balance is 1N

(i) State the forces that act on the block when completely immersed in water (03marks)

- weight
- up thrust
- tension

(ii) Determine the volume of the block. (03marks)

Up thrust = weight in air – weight in water

= 5 -1 = 4N

Mass of water displaced = upthrust / acceleration due to gravity

= 4/10 = 0.4kg

Volume = $\frac{mass}{density} = \frac{0.4}{1000} = 4\ x\ 10^4 m^3$

(iii) Explain why the reading of the spring balance will increase when the wooden block is completely submerged in paraffin instead of water. (03marks)

Paraffin is less dense than water thus it exerts less upthrust than water

(c) What is terminal velocity? (01mark)

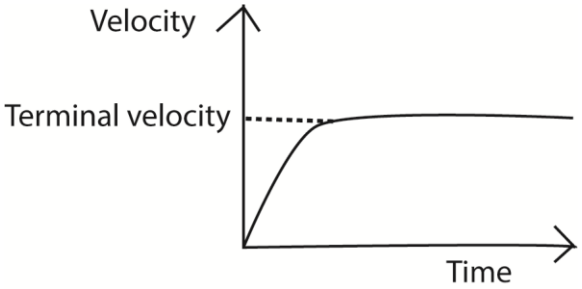
It is the maximum constant velocity a falling body attains in a fluid

(d) A ball-bearing is released from just below the surface of lubricating oil contained in tall glass tube

(i) Describe the motion of the ball bearing from release. (03marks)

The ball initially accelerates until it reaches a constant terminal velocity

(ii) Sketch the velocity- time graph for the motion in (d)(i). (02marks)



2. (a)(i) Define linear momentum (01mark)

Linear momentum is the product of mass and its velocity in a straight line.

(ii) State the units of linear momentum (01mark)

$Kgms^{-1}$

(iii) State the law of conservation of linear momentum. (01mark)

When two or more bodies act upon one another, their total momentum remains constant provided no external force acts on them.

(iv) What is the difference between elastic and inelastic collision? (01mark)

In elastic collision kinetic energy is conserved, while in an inelastic collision kinetic energy is lost on collision.

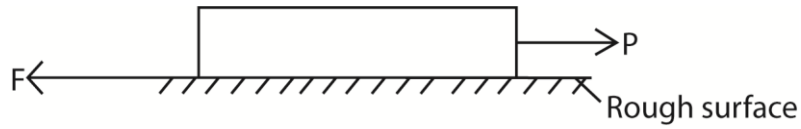
(b) (i) Explain what happens to a boat at the point when it occupant jump out of it (02marks)

When a person in a boat jumps out, the boat gains momentum equal but opposite to that of a person, thus making the boat to move in the opposite direction

(ii) Explain why a person feels heavier than usual at the interval a lift starts accelerating upwards (03marks)

Because a person exerts a force on the floor of the lift = mg + ma where a is the acceleration of the lift, m= mass of the person and g = acceleration due to gravity., The addition force, ma, makes the person to feel heavier than usual.

(c)



A block of mass 10kgis pulled by a force p on a rough surface as shown in figure 1. If the coefficient of friction between the block and the surface is 0.25 and the acceleration of the block is $3ms^{-2}$.

Find the

(i) Frictional force **F** on the block. (02marks)

Friction force, $F = \mu R = \mu mg$

$= 0.25 \times 10 \times 10$

$= 25N$

(ii) Pulling force **P**. (03marks

Accelerating force, $ma = P - F$

$10 \times 3a = P - 25$

$P = 55N$

(iii) The acceleration if **P** is doubled. (02marks)

$ma = 2P - F$

$10a = 110 - 25$

$a = 8.5ms^{-2}$

3. (a) What is meant by the following:

(i) An ideal gas, (01mark)

An ideal gas s one that obeys all the three gas laws perfectly.

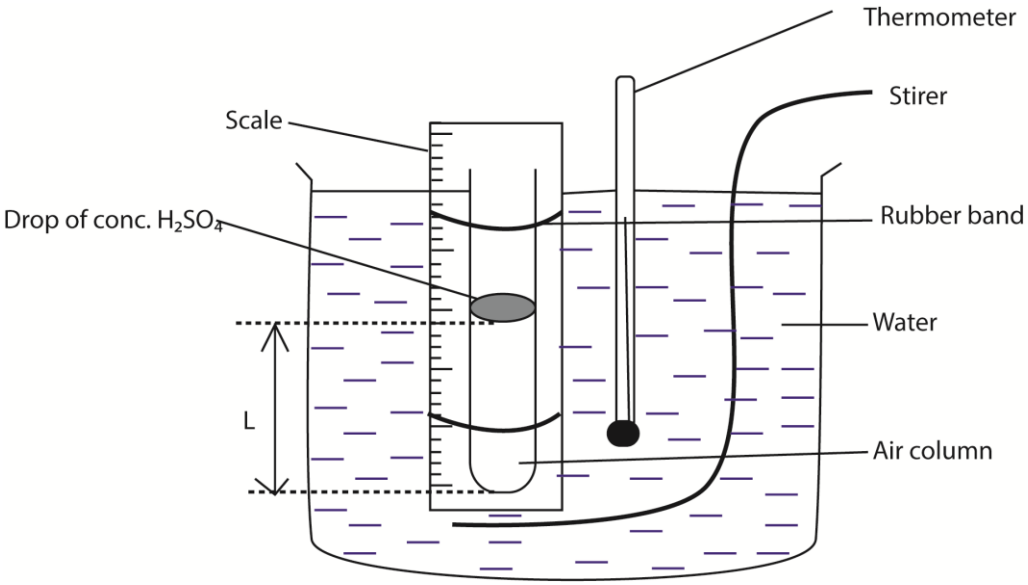
(ii) An equation of state? (01mark)

An equation of state one that relates pressure, P, volume, V, and absolute temperature, T; i.e. $PV = nRT$ where, n is the number of moles of a gas, R is a constant.

(b) (i) State Charles's law. (01mark)

Charles's Law states that the volume of a fixed mass of a gas is directly proportional to absolute temperature at a fixed pressure.

(ii) With the aid of a diagram, describe an experiment to verify Charles's Law. (06marks)



- A dry gas is trapped in a capillary tube by use of conc. H_2SO_4 and immersed in water as shown in the diagram.
- The initial absolute temperature θK of water (or air) and length, L of air column are noted
- The length of the air column is measured at different absolute temperatures.
- A graph of L against θK is a straight line showing that volume is proportional to absolute temperature.

(c) A gas occupies a volume of $12cm^3$ when its pressure is 800mmHg and its temperature is 127^0C. Find its volume at standard temperature and pressure. (03marks)

From $\frac{PV}{T} = constant$

$\frac{800\ x\ 12}{(273+127)} = \frac{760\ x\ V}{273}$

$V = 8.6cm^3$

(d) Explain in terms kinetic theory, why the pressure of a gas decreases when its temperature falls at constant volume. (03marks)

When the temperature fall, the kinetic energy of the molecules decreases. The molecules bombard the walls of the vessel less frequently with reduced force. This decreases the pressure.

(e) Why is it easier to compress a gas than a solid? (01mark)

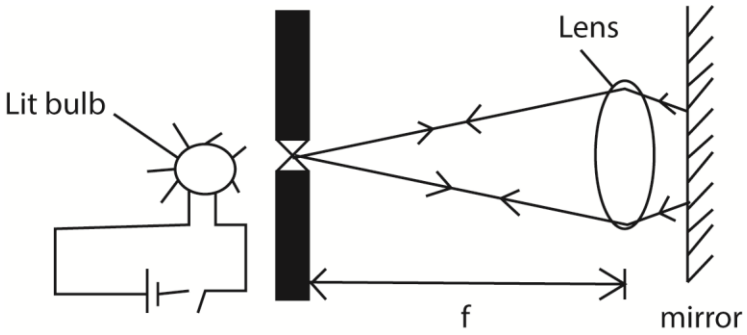
The molecules of the gas are more widely spaced than in solid

4. (a)(i) Distinguish between primary and secondary colours. (02marks)
Primary colours are those that cannot be obtained by mixing any colours while secondary colours are those obtained by mixing other colours.
(ii) Give two examples of each of the colours in (a)(i) (02marks)
Examples of primary colours: red, green and blue
Examples of secondary colours are yellow, magenta, cyan

(iii) Explain why an object illuminated by white light may appear coloured. (02marks)

When white light falls on a body, some colours are absorbed while others are reflected. The body takes on the colours that are reflected.

(b) Given a plane mirror, a converging lens, a screen with a wire gauze across a hole at its center and a torch bulb connected to a dry cell, describe how you would determine the focal length of the lens. (04marks)



- The apparatus is arranged as above
- A lens is move to and fro until a sharp image is formed besides the wire gauze.
- The distance, f, is the focal length of the lens.

(c) An object 10cm high is placed20cm away from a diverging lens of focal length 15cm. determine by Scale drawing the

(i) position and the size of the image formed. (04marks)

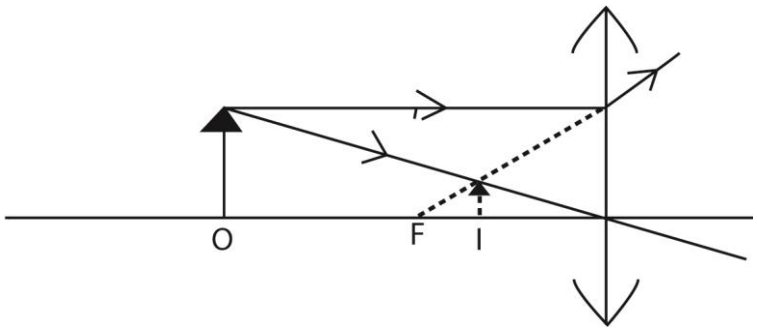


Image distance, V = 8.6cm

Image height, h = 4.3cm

(ii) magnification produced. (02marks)

Magnification = $\frac{image\ distance}{object\ distance} = \frac{4.3}{10} = 0.43$

5. (a)

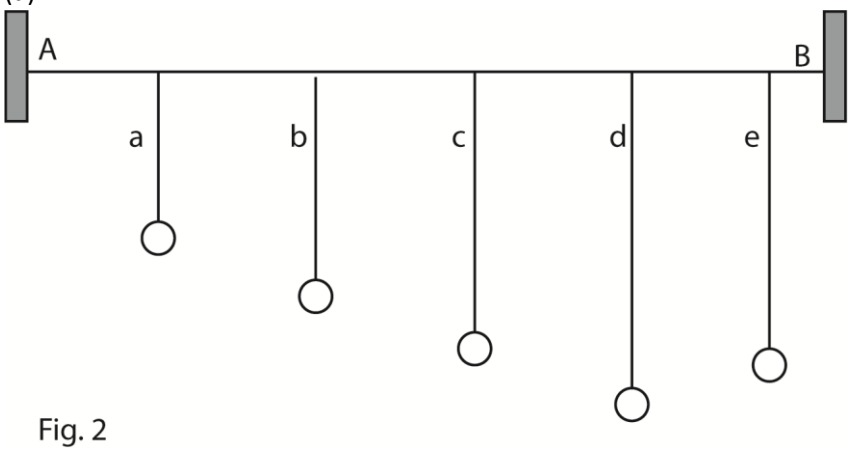


Fig. 2

Figure 2 above shows a stretched wire AB to which pendulums of length a, b, c, d and e are attached.

(i) Which pendulums will have different natural frequency? (02marks)
a, b, d, c (or e)

(ii) Which pendulums will have the same natural frequencies? (01mark)
c and e

(iii) If pendulum e is pulled to one side and released to oscillate freely, explain what happens to both c and e after some time. (03marks)

- The amplitude of c starts to increase while the amplitude of e, decreases as e transfer energy to c.
- Eventually e comes to rest and c oscillates with almost the same amplitude as e had originally.
- The process is reversed and amplitude of e increases as that of c descreases.

(b) (i) What is meant by stationary wave? (01mark)

A stationary wave is formed when two equal progressive waves moving in opposite direction are imposed over one another.

(ii) Describe how stationary wave corresponding to the first three notes may be produced in a string. (04marks)

A string is stretched between two points. The first note is produced by plucking the string midways

The second note is produced by plucking the string a quarter way from one end

The third note is produced by plucking the string a sixth of the way from one end.

(iii) A tuning fork of frequency 515 Hz is held over a resonance tube of length 90cm filled with water. The first and second position of resonance are obtained when the air column is 18.3cm and 50.5cm respectively above the water surface. Find the speed of sound in air. (05marks)

$L_1 = \frac{1}{4}\lambda$ = 18.3cm $L_2 = \frac{3}{4}\lambda$ = 50.5cm

$L_2 - L_1 = \frac{1}{2}\lambda = 50.5 - 18.3$ = 32.2cm

λ = 64.4cm = 0.644m

$V = f\lambda = 515 \times 0.644 = 332ms^{-1}$

6. (a) What is a step-down transformer? (01mark)
   A device for reducing the value of alternating voltage
   (b) State three advantages of alternating current (a.c) over direct current (d.c)
   - can easily be stepped up and down
   - a.c. can easily be transmitted with minimum power loss
   - a.c. is easy to generate.
   (c)

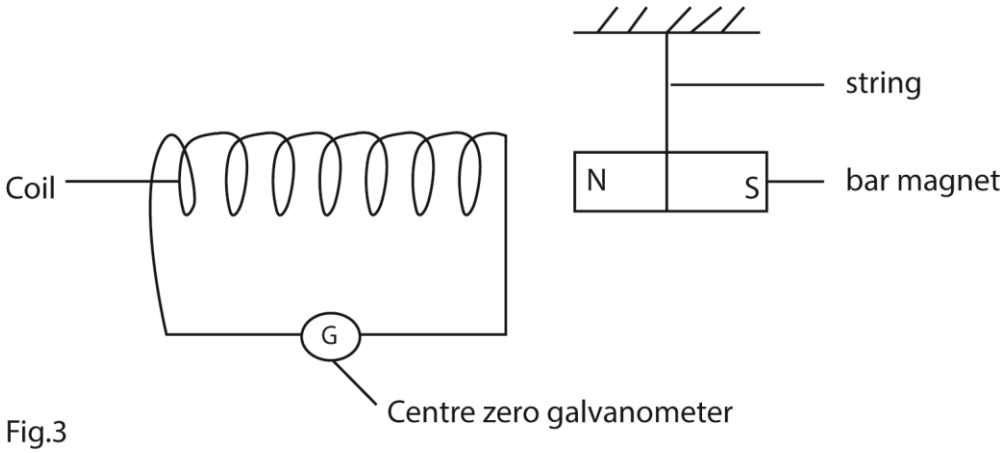


Fig.3

Figure 3 shows a bar magnet freely suspended by a string from a clamp near a coil aligned along the magnet meridian. If the bar magnet is slightly displaced away from the coil and then released to swing freely in and out of the coil, describe what is observed on the galvanometer. (04marks)
Galvanometer deflects to the maximum as the magnet passes the equilibrium position. The deflection drops to zero, it gets to maximum displacement and rest momentarily. As it swings back, the galvanometer deflects in opposite direction to the maximum as it passes equilibrium position again. The deflection then drops to zero as it reaches its starting point and rests momentarily.

(d) Explain why a transformer in use is usually submerged in oil. (04marks)
Oil absorbs heat generated and pass it to the surroundings.

(e) The number of turns in the primary and secondary coil of a transformer are N and 300 respectively. If the output voltage is 120V when the input is 40V, find the value of N (04marks)

From $\frac{N_s}{N_p} = \frac{V_s}{V_p}$

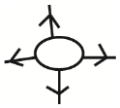
$\frac{300}{N} = \frac{120}{40}$

N = 100 turns

7. (a) What is meant by electrostatic induction? (01mark)
Production of temporary charge on a conductor due to its closeness to a charge

(b) Describe how a gold-leaf electroscope can be charged by electrostatic induction. (04marks)
   - Inducing charge us brought close to the cap.
   - The cap is earthed
   - The earthing is removed
   - The inducing charge is removed.

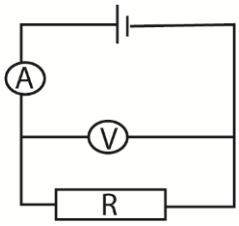
(c) Sketch the electric field pattern outside a positively charged hollow conducting sphere. (02marks)



(d) Explain the dangers of lightning. (03marks)

Flow of large current may occur between charge cloud and the earth. This large current can cause fire and electrocution

(e) (i) You are provided with an ammeter, a voltmeter, connecting wires and a dry cell in its holder. Draw a circuit diagram you would use to measure the resistance of a resistor R. (02marks)



(ii)

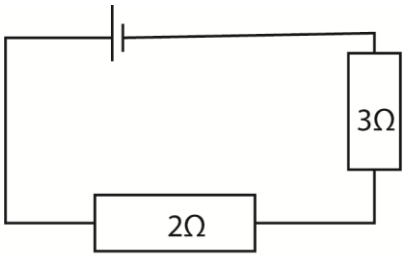


Fig. 4

A cell of e.m.f E and internal resistance 1.0Ω is connected in series with resistors 2Ω and 3Ω as shown in figure 4. If the potential difference across the 3Ω resistor is 1.5V, calculate the e.m.f of the cell. (04marks)

Current I = $\frac{V}{R} = \frac{1.5}{3} = 0.5A$

E = I(R + r)

= 0.5(2 + 3+1) = 3V

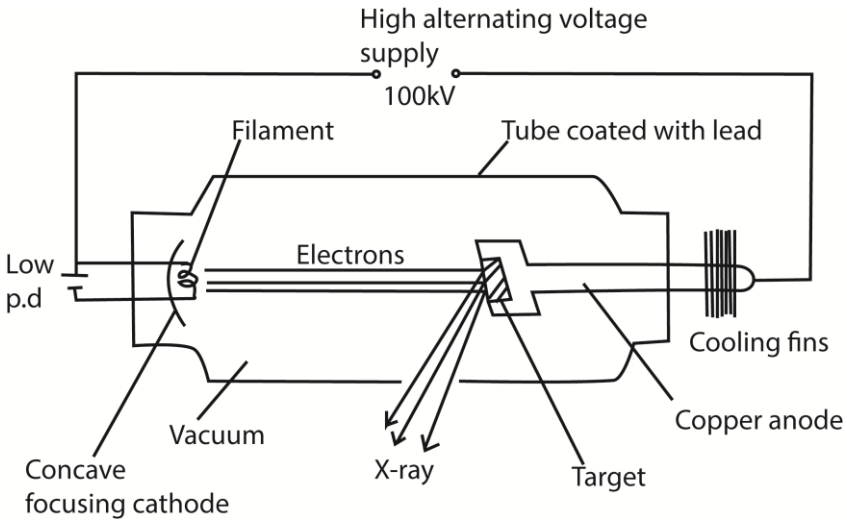
8. (a)(i) What is meant by thermionic emission? (01mark)

It is the emission of a electrons from a hot metal surface

(ii) State four properties of cathode rays. (02marks)

- They are negatively charge
- Move in a straight line
- Deflected by magnetic and electric field
- Produce X-rays when they strike matter
- Possess kinetic energy

(b) (i) Draw a labelled diagram showing the essential parts of an X-ray tube. (03marks)



(ii) Explain how X-rays are produced. (03marks)

Mode of operation

- The filament is heated by a low voltage supply and the electrons are emitted by thermionic emission.
- The concave focusing cathode focuses the electrons from the filament onto the target.
- These electrons are accelerated towards the anode by the high voltage between the filament and the Anode.
- When the electrons (cathode rays) strike the metal target, about only 1% their kinetic energy is converted to X-rays and the 99% of their kinetic energy is converted to heat, which is conducted away by the cooling fins.

(c) (i) State three uses of X-rays (03marks)

- Structural analysis, stresses, fractures in solids, castings and welded joints can be analyzed by examining X-ray photograph.
- Crystallography; Orientation and identification of minerals by analysis of diffraction patterns using Bragg's law.
- Medical uses;
  - Analytical uses. These include location of fractures, cancer and tumour/defective tissue absorbs x-rays differently from normal tissue.
  - Therapeutics use for destroying cancerous cells and tumours. 4. Detection of fire arms at international airports

(ii) State two health hazards caused by X-rays. (02marks)

- Destroy living cells in our bodies especially hard X-rays.
- Cause Gene mutation (genetic changes in our bodies).
- Cause damage of our eye sight and blood.
- Produce deep skin burns.

(iii) Give two similarities between X-rays and Gamma rays (02marks)

- Cause ionization of gases
- Can travel in the vacuum
- Are transverse waves

- Travel at the speed of light
- Can undergo interference, diffraction and polarization