

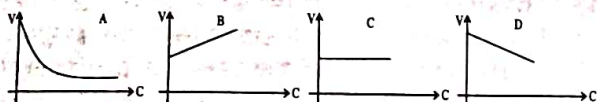
WASSCE SC 2022 PHYSICS 1 OBJECTIVE TEST

- The area under a force-time graph represents
A. change in kinetic energy B. change in momentum C. work done. D. change in internal energy.
- From the principle of flotation, a body sinks in a fluid until it displaces a quantity of fluid equal to its own
A. density B. mass C. weight D. volume.



Suppose three identical steel balls Q, R and S are placed on an undulating ground as illustrated in the diagram above. Which of the balls is/are in neutral equilibrium? A. S only B. Q only C. R only D. Q and S only.

- The length of a simple pendulum is increased by a factor of four. By what factor is its period increased?
A. 0.5π B. 2 C. 2π D. 4
- The linear expansivity, α , and cubic expansivity, γ , of a material are related by the equation
A. $\gamma = \alpha$ B. $\gamma = 3\alpha$ C. $\gamma = 2\alpha$ D. $\gamma = \frac{1}{3}\alpha$
- Which of the illustrated graphs below represents a body moving with uniform retardation?



- The correct relationship between the displacement, s , of a particle initially at rest in a linear motion and the time, t , is
A. $s \propto t^2$ B. $s \propto t^{-1}$ C. $s \propto t$ D. $s \propto t^2$
- The Joule is equivalent to
A. $kg\ m^2\ s^{-1}$ B. $kg^2\ m\ s^{-2}$ C. $kg\ m^2\ s^{-2}$ D. $kg\ m\ s^{-1}$
- Which of the following statement(s) is/are correct about a fixed mass of gas compressed in an inexpandable container?
I. The average speed of the molecules increases.
II. The temperature of the gas increases.
III. The molecules hit the walls of the container more often than before the compression.
A. I only B. I and II only C. I and III only D. I, II and III
- An example of a mechanical wave is
A. water waves B. radio waves C. x-rays D. light rays.
- Which of the following descriptions of the image formed by a plane mirror is not correct? The image is
A. erect and of the same size as the object.
B. laterally inverted and of the same size as the object.
C. erect and bigger than the object.
D. virtual and of the same size as the object.
- The efficiency of a wheel and axle is 100% and the ratio of their radii is 5:1. Calculate the effort required to lift a load of mass 20kg using this machine. [$g = 10\ ms^{-2}$]
A. 20 N B. 25 N C. 40 N D. 100 N
- A freely suspended compass needle on the earth's surface settles in a plane called
A. geographic meridian B. magnetic meridian C. magnetic declination D. isogonals.
- An object is placed at different distances, u , from

- a converging lens of focal length, 15.0 cm. For what value of u does the lens act as a simple microscope?
A. $u = 15\ cm$ only B. $u = 30\ cm$ only C. $u < 15\ cm$ only D. $u > 30\ cm$ only
- The periodic rise and fall in the intensity of sound produced when two notes of nearly equal frequencies are sounded together is called
A. doppler effect B. beat C. interference D. resonance.
- The power of a lens is +2.5 D. What is its radius of curvature?
A. 2.5 cm B. 25.0 cm C. 40.0 cm D. 80.0 cm.
- The reason for having a large number of turns in the coil of a moving coil galvanometer is to
A. make the deflection of the needle proportional to the current B. increase the sensitivity of the galvanometer C. decrease the magnetic flux produced by the magnet D. make the permanent magnet stronger.
- Current is passed through two parallel conductors in the same direction. If the conductors are placed near each other, they will
A. move in a circle B. repel each other C. remain stationary D. attract each other.
- The period of a 10 kHz radio wave travelling at $3.0 \times 10^8\ ms^{-1}$ is
A. $3.0 \times 10^{-5}\ s$ B. $1.0 \times 10^{-4}\ s$ C. $1.0 \times 10^4\ s$ D. $3.0 \times 10^4\ s$.
- The magnetic material produced from the chemical combination of metal oxides and has a very high resistance to electric current is called a
A. ferrite substance B. paramagnetic substance C. ferromagnetic substance D. diamagnetic substance.
- A body of mass, M , moving with velocity, V , has a wavelength, γ , associated with it. This phenomenon is called
A. photoelectric effect B. Heisenberg's uncertainty principle C. Compton effect D. wave-particle paradox.
- Which of the following statements about a straight current-carrying wire placed in a uniform magnetic field is correct? The wire experiences
A. maximum motor force if the current reverses its direction B. no motor force if it is parallel to the field C. no motor force if it is perpendicular to the field D. a motor force with constant direction if either the current or the magnetic field is reversed.
- Three cells each of emf, 1.1 V, and internal resistance, 2Ω , are connected in parallel across a 3Ω resistor. Determine the current in the resistor.
A. 0.90 A B. 0.39 A C. 0.30 A D. 0.01 A.
- Which of the following statements about electric potential energy is not correct?
A. The electric potential energy of a positively charged particle increases when it moves to a point of higher potential B. The electric potential energy of a negatively charged particle increases when it moves to a point of lower potential C. The electric potential energy of a positively charged particle decreases when it moves to a point of higher potential D. The work done in taking a charged particle around a closed path in an electric field is zero.

25. A galvanometer with a full scale deflection of 20 mA is converted to read 8 V . By connecting a 395Ω resistor in series with it. Determine the internal resistance of the galvanometer. A. 2.5Ω B. 5.0Ω C. 8.0Ω D. 10.0Ω
26. An inductor of inductance 10 H is connected across an a.c. circuit source of 50 V , 100 Hz . What is the current in the circuit? [$\pi = 3.14$] A. 0.200 A B. 0.070 A C. 0.0500 A D. 0.008 A .
27. The speed of **fast moving** neutrons in a nuclear reactor can be reduced by using A. graphite rods B. concrete shield C. iron rods D. boron rods.
28. In a series $R-L-C$ circuit at resonance, impedance is A. maximum B. minimum C. capacitive D. inductive.
29. A lamp is rated 240 V , 60 W . Determine the resistance of the lamp when lit. A. 120Ω B. 240Ω C. 540Ω D. 960Ω .
30. One **major** reason why electrical appliances in homes are normally earthed is that the A. person touching the appliance is safe from electric shock B. appliances are maintained at a higher $p.d$ than the earth C. appliances are maintained at a lower $p.d$ than the earth D. appliances are maintained at the same $p.d$ with that of the earth.
31. In doping an intrinsic semiconductor to produce a p -type semiconductor, A. the semiconductor is heated up B. a donor element is added C. an acceptor element is added D. the semiconductor is connected to a battery.
32. Arrange the following radiations in order of increasing ionization of air.
I. Alpha
II. Gamma
III. Beta
A. $I < III < II$ B. $II < I < III$ C. $II < III < I$ D. $I < II < III$
33. If the kinetic energy of an electron is 100 eV , what is the wavelength of the de-Broglie wave associated with it? [$h = 6.6 \times 10^{-34}\text{ Js}$, $e = 1.6 \times 10^{-19}\text{ C}$, $m_e = 9.1 \times 10^{-31}\text{ kg}$] A. $1.22 \times 10^{-10}\text{ m}$ B. $4.10 \times 10^{-10}\text{ m}$ C. $3.90 \times 10^{-10}\text{ m}$ D. $5.50 \times 10^{-10}\text{ m}$
34. Gamma rays are produced when A. high velocity electrons are abruptly stopped in metals B. energy changes occur within the nuclei of atoms C. energy changes occur within the electronic structure of atoms D. electrons are deflected in very strong magnetic fields.
35. The half-life of a radioactive substance is 15 hours. If at some instance, the sample has a mass of 512 g , calculate the time it will take $\frac{7}{8}$ of the sample to decay. A. 15 hours B. 30 hours C. 45 hours D. 60 hours.
36. When the direction of vibration of the particles of a medium is perpendicular to the direction of propagation of a wave, the wave is said to be A. longitudinal B. transverse C. mechanical D. a sound wave.
37. A hunter fires a gun at a point 408 m away from a cliff. If he hears an echo 2.4 s later, determine the speed of the sound wave. A. 340 ms^{-1} B. 380 ms^{-1} C. 400 ms^{-1} D. 680 ms^{-1} .
38. The distance between the fixed points of a mercury-in-glass thermometer is 30 cm . Determine the temperature when the mercury level is 10.5 cm above the lower fixed point. A. 28.6°C B. 30.0°C C. 35.0°C D. 40.5°C .
39. Which of the following statements about electromagnetic waves is **not correct**? A. They carry energy as they travel through space B. They travel with the speed of light C. They are longitudinal D. The electric and magnetic fields are at right angles to each other.
40. The diameter of a brass ring at 30°C is 50.0 cm . To what temperature **must** this ring be heated to increase its diameter to 50.29 cm ? [linear expansivity of brass = $1.9 \times 10^{-5}\text{ K}^{-1}$] A. 152.6°C B. 182.6°C C. 306.1°C D. 335.3°C .
41. Which of the following concepts is a method of heat transfer that does not require a material medium? A. Conduction B. Diffusion C. Convection D. Radiation
42. Which of the following statements about light travelling from one material medium to another is **not correct**?
A. The refracted angle is less than the incident angle if the speed is higher in the first material
B. It bends away from the normal if the speed is lower in the first material
C. Its wavelength does not change
D. Its frequency changes.
43. The engine of a car provides a forward force of 1240 N and the total resistive force on the car is 800 N . If the mass of the car is 1220 kg , determine the distance the car has to travel from the rest before acquiring a speed of 4 ms^{-1} A. 44.0 m B. 22.2 m C. 11.1 m D. 5.5 m .
44. A quantity of water at 0°C is heated to 30°C . For **each** degree rise in temperature, its density will A. rise steadily B. fall steadily C. fall and then rises D. rise and then falls.
45. A small object of mass 50 g is released from a point A. Determine the velocity of the object when it reaches a point B, a vertical distance of 30 m below A. [$g = 10\text{ ms}^{-2}$] A. 1.5 ms^{-1} B. 6.0 ms^{-1} C. 17.3 ms^{-1} D. 24.5 ms^{-1} .
46. Molecules move in random motion within a liquid. The total internal energy of the liquid depends on all of the following **except** its A. temperature B. mass C. specific heat capacity D. melting point.
47. The viscosity of a fluid depends on the following factors **except** the A. relative motion between the layers of the fluid B. nature of the material of the fluid C. surface area of the fluid in contact D. normal reaction in the fluid.
48. Using vernier calipers, which of the following readings gives the correct measurement for the length of a rod? A. 4.1 cm B. 4.13 cm C. 4.125 cm D. 4.1254 cm .
49. The basic principle of operation of a beam balance is A. Archimedes principle B. law of flotation C. Hooke's law D. principle of moments.
50. In which of the following situations is friction **not** useful? A. Operation of a grinding machine B. Walking C. Application of brakes D. Moving piston in a sleeve.

ANSWERS TO WASSCE SC 2022 PHYSICS 1 OBJECTIVE TEST

1. B.
2. C.
3. A.

4. From $T \propto \sqrt{l}$

$$\frac{T_1}{T_2} = \frac{\sqrt{l_1}}{\sqrt{l_2}}$$

Given $l_2 = 4l_1$

$$\Rightarrow \frac{T_1}{T_2} = \frac{\sqrt{l_1}}{\sqrt{4l_1}}$$

$$\frac{T_1}{T_2} = \frac{1}{2}$$

$$T_2 = 2T_1$$

5. B.
6. D.
7. D.

8. Joules is unit for Energy.

$$\text{Energy} = m \times g \times h$$

$$= \text{kgms}^{-2} \times m$$

$$= \text{kgm}^2\text{s}^{-2}$$

9. D.
10. A.
11. C.

12. Since efficiency = 100%

$$\Rightarrow \text{M.A} = \text{V.R}$$

$$\text{M.A} = \frac{\text{Load(L)}}{\text{Effort(E)}}$$

$$L = 20 \times 10 = 200\text{N} \quad E = ?$$

$$\text{V.R} = \frac{R}{r} = \frac{5}{1}$$

$$\therefore \frac{L}{E} = \frac{R}{r}$$

$$\frac{200}{E} = \frac{5}{1}$$

$$E = \frac{200}{5} = 40\text{N}$$

13. A.
14. C.
15. B.

16. Given power = 2.5D

$$f = \frac{1}{p}$$

Also $f = \frac{r}{2}$

$$\Rightarrow \frac{r}{2} = \frac{1}{p}$$

$$r = \frac{2}{p} = \frac{2}{2.5} = 0.8\text{m}$$

$$= 80\text{cm}$$

17. D.
18. D.

19. Given $T = 10 \times 10^3\text{Hz}$.

$$V = 3.0 \times 10^8\text{ms}^{-1}$$

$$T = ?$$

$$T = \frac{1}{f} = \frac{1}{10 \times 10^3\text{Hz}}$$

$$= 1.0 \times 10^{-4}\text{s}$$

B.

20. D.
21. A.
22. B.

23. Given $E = 1.1\text{V}$ $R = 3\Omega$

$$r_1 = r_2 = r_3 = 2\Omega$$

$$\frac{1}{r_T} = \frac{1}{r_1} = \frac{1}{r_2} = \frac{1}{r_3}$$

$$\frac{1}{r_T} = \frac{1}{2} = \frac{1}{2} = \frac{1}{2}$$

$$r_T = \frac{2}{3}\Omega$$

24. A.

25. $r = ?$ $I = 0.02\text{A}$ $R = 395\Omega$

$$V_1 = Ir = 0.02r$$

$$V_2 = 8 - 0.02r$$

$$R = \frac{V}{I} = \frac{8 - 0.02r}{0.02} = 395$$

$$\Rightarrow 7.9 = 8 - 0.02r$$

$$0.02r = 8 - 7.9$$

$$r = \frac{0.1}{0.02} = 5\Omega$$

B.

26. Given $L = 10\text{H}$ $V = 50\text{V}$, $f = 100\text{Hz}$

$$I = \frac{V}{X_L} = \frac{v}{2\pi fL} = \frac{50}{2 \times 3.142 \times 100 \times 10}$$

$$= 0.008\text{A}$$

D.

27. A
28. B

29. $R = \frac{V^2}{P} = \frac{240 \times 240}{60}$

$$= 960\Omega$$

D.

30. A.
31. B.
32. C.

33. $\lambda = \frac{hc}{E} = \frac{6.6 \times 10^{-34} \times 3 \times 10^8}{100 \times 1.6 \times 10^{-19}}$

$$= 1.22 \times 10^{-10}\text{m}$$

A.

34. B.

35. Amount left = $\frac{1}{8} \times 512$

$$= 64\text{g}$$

$$\therefore \begin{array}{r} 512 \xrightarrow{15} 256 \\ 256 \xrightarrow{15} 128 \\ 128 \xrightarrow{15} 64\text{g} \end{array}$$

$$\text{Time taken} = 15 + 15 + 15$$

$$= 45\text{hours}$$

36. B.

37. Using $V = \frac{2d}{t} = \frac{2 \times 408}{2.4}$

$$= 340\text{ms}^{-1}$$

D.

A.

38.
$$\Rightarrow = \frac{100 - 0}{x - 0} = \frac{30 - 0}{10.5 - 0}$$

$$\Rightarrow = \frac{100}{x} = \frac{30}{10.5}$$

$$x = \frac{100 \times 10.5}{30}$$

$$= 35^\circ\text{C}$$

39. C.

40. Area expansivity (β) = $\frac{A_2 - A_1}{A_1 (\theta_2 - \theta_1)}$

Area = $\frac{\pi d^2}{4}$

$d_1 = 50.0\text{cm}, d_2 = 50.29$

$\theta_1 = 30, \theta_2 = ? \beta = 2\alpha$

$\Rightarrow 2 \times 19 \times 10^{-5} = \frac{\pi/4 [50.29^2 - 50^2]}{\pi/4 [50^2] [\theta_2 - 30]}$

$\Rightarrow \theta_2 - 30 = \frac{50.29^2 - 50^2}{50^2 [1.9 \times 2 \times 10^{-5}]}$

$\theta_2 = 30 + \frac{50.29^2 - 50^2}{50^2 [3.8 \times 10^{-5}]}$
 $= 306.1^\circ\text{C}$

41. D.

42. C.

43. $F_1 = 1240\text{N}, F_2 = 800\text{N}, S = ?$
 $m = 1220\text{kg} \quad v = 4\text{ms}^{-1} \quad u = 0$
 $F_N = 1240 - 800$
 $= 440\text{N}.$
 $F_N = ma = 440.$
 $a = \frac{440}{1220} = \frac{11}{61}\text{ms}^{-2}$

$V^2 = u^2 + 2as$

$4^2 = 0^2 = 2 \times \frac{11}{61}(s)$

$16 \times \frac{22}{61}(s)$

$s = \frac{61 \times 61}{22} = 44.0\text{m}$

A.

44. D.

45. $V^2 = u^2 + 2gh$

$V^2 = 0^2 + 2 \times 10 \times 30$

$V = \sqrt{600}$
 $= 24.5\text{ms}^{-1}$

D.

46. D.

47. D.

48. B.

49. D.

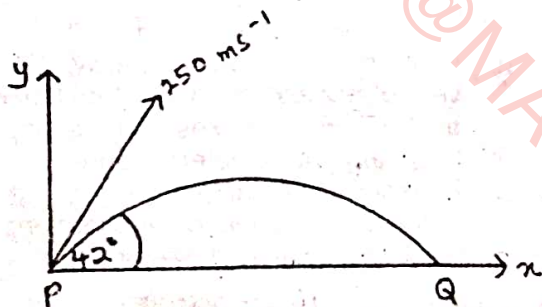
50. D.

WASSCE SC 2022 PHYSICS 2 ESSAY QUESTIONS

PART I

Answer any five questions from this part.

1. The diagram below illustrates the trajectory of a fired missile from point P at 250ms^{-1} .



If the missile hits point Q after 40 s, calculate the distance |PQ|.

2. State three properties of an intrinsic semiconductor.
3. The effective potential energy, E, of a lunar satellite of mass, m_1 , moving in an elliptical orbit around the moon of mass, m_2 is given by $E = \frac{K^2}{2m_1 r^2} - \frac{Gm_1 m_2}{r}$ where r is the distance of the satellite from the moon and G is the universal gravitational constant of dimensions, $\text{M}^{-1}\text{L}^3\text{T}^{-2}$. Determine the dimensions of the angular momentum, K, of the satellite using dimensional analysis.
4. A 50 N force is applied to the free end of a spiral spring of force constant, 100Nm^{-1} . Calculate the work done by the force to stretch the spring.
- 5.(a) What is a geostationary satellite?
 (b) Name two types of LASERS.

6. State:
 (a) the S.I. unit of the intensity of a blackbody radiation.
 (b) two features of the intensity-wavelength graph of a perfect blackbody at different temperatures.
7. State three differences between magnetic and non-magnetic materials.

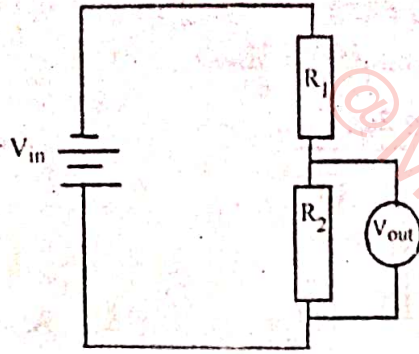
PART II

Answer three questions from this part.

- 8.(a)(i) State the law of inertia.
 (ii) Use the law stated in 8(a)(i) to explain how wearing a safety belt in a moving vehicle could reduce the possibilities of severe injuries when the vehicle is involved in a collision.
- (b)(i) Define the term moment of a force.
 (ii) A uniform plank measures 2 m long from its ends point A to point B. If the weight of the plank is 54 N and it rests on a knife edge 0.50 m from end B and point A is supported by a vertical string so that AB balances horizontally:
 I. Draw a force diagram for the arrangement;
 II. Determine the tension, T, in the string;
 III. Determine the force, F, acting on the knife edge.
- (c) State three differences between solid friction and viscosity.
- (d) State one method of increasing the velocity ratio of a pulley system.
- 9.(a)(i) State Coulomb's law of electrostatics.
 (ii) The electron and proton of a hydrogen atom are separated by a mean distance of $5.2 \times 10^{-10}\text{m}$. Calculate the magnitude of the electrostatic

force between the particles. [$e = 1.6 \times 10^{19} \text{ C}$, $(4\pi\epsilon_0)^{-1} = 9.0 \times 10^9 \text{ m F}^{-1}$]

- (b)(i) The diagram below shows a potential divider circuit.



I. Show that $V_{out} = V_{in} \frac{R_2}{R_1 + R_2}$

II. If $\frac{V_{in}}{V_{out}} = 2.5$ and $R_2 = 30\Omega$, calculate R_1 .

- (ii) Define the volt.
 (c) Explain why wood is **not** suitable for use as the core of transformers.
 (d) State **one** application of the cathode ray tube.
 10.(a) State **one** condition **each** necessary for **each** of the following occurrences:
 (i) constructive interference of waves;
 (ii) total internal reflection;
 (iii) production of beats.
 (b) In a resonance tube experiment using a tuning fork of frequency 256 Hz , the **first** position of resonance was 35 cm , the **next** position was 100 cm . Calculate the velocity of sound in air from the experiment.
 (c)(i) State the **three** classifications of musical instruments.
 (ii) Give **one** example **each** of the classifications stated in 10(c)(i).
 (d) Calculate the critical angle for light travelling from glass to air. [refractive index of glass = 1.5]
 (e) The speed of sound in a medium at a temperature of 102°C is 240 ms^{-1} . If the speed of sound in the medium is 310 ms^{-1} . Calculate its temperature.

ANSWERS TO WASSCE SC 2022 PHYSICS 2 ESSAY QUESTIONS

1. Calculation of Distance

$$\begin{aligned} |PQ| &= \text{Range} = U_x \cdot T \\ &= UT \cos \theta \\ &= 250 \times 40 \cos 43^\circ \\ &= 7431 \text{ m } (7.4 \text{ km}) \end{aligned}$$

2. Properties of Intrinsic Semiconductors

- They trivalent.
- They have thermally generated charge carriers.
- They have equal number of charge carriers.
- They are pure, i.e. contain no impurities.
- They have low electrical conductivity/high resistivity.

3. Dimensions of Angular momentum, K

$$\frac{[k]^2}{[m^1 r]^2} = \frac{[G] [m^1] [m^2]}{[r]}$$

- 11.(a) State **two** factors that affect the rate of evaporation of a liquid.
 (b) Explain the term *latent heat*.
 (c) Explain **each** of the following phenomena:
 (i) On a dry day, water in a clay pot is cooler than water in a rubber container;
 (ii) Cooking of food is faster in a pressure cooker than in an ordinary pot.
 (d) A 40 V electric heater is used to supply a current of 12 A for 1400 seconds to a body of mass 1.5 kg at its melting point. The body melts and its temperature rises by 60° C in an extra 1.2 minutes . Calculate the:
 (i) latent heat of fusion of the body;
 (ii) specific heat capacity of the body.
 (e) State **two** differences between *evaporation* and *boiling*.

- 12.(a)(i) What is meant by the term *artificial radioactivity*?
 (ii) Complete the table below.

Emission	Nature	Charge	Ionizing ability
	High speed electron		moderately ionizing
		Neutral	negligible ionizing ability
Alpha particle		Positive	

- (b) In an x-ray tube, an electron is accelerated from rest towards a metal target by a 30 kV source. Calculate the kinetic energy of the electron. [$e = 1.6 \times 10^{-19} \text{ C}$]
 (c) Corresponding kinetic energies of the photoelectrons.

Frequency $\times 10^{14} (\text{Hz})$	6.8	8.0	9.2	10.0	11.0
Kinetic energy $\times 10^{-19} (\text{J})$	0.8	1.6	2.9	2.4	3.8

- (i) Plot a graph of kinetic energy, *K.E.*, on the vertical axis and frequency, *f*, on the horizontal axis starting both axes from the origin (0, 0).
 (ii) From the graph, determine the:
 I. Planck's constant;
 II. threshold frequency of radiations
 III. Work function of the metal.

$$\frac{[k]^2}{ML^2} = \frac{M^{-1} L^3 T^{-2} M^2}{L}$$

$$\begin{aligned} [K] &= (M^2 L^4 T^{-2})^{1/2} \\ \therefore [K] &= ML^2 T^{-1} \end{aligned}$$

4. Calculations of Workdone by the Force to Stretch the String

$$W = \frac{1}{2} k^2 = \frac{F^2}{2k} \quad \left| \quad e = \frac{F}{k} = \frac{50}{100} \cdot 5.0 \text{ m} \right.$$

$$W = \frac{50^2}{2 \times 100}$$

$$W = \frac{1}{2} k^2$$

$$W = 12.5 \text{ J}$$

$$\begin{aligned} W &= \frac{1}{2} \times 100 \times 0.5^2 \\ W &= 12.5 \text{ J} \end{aligned}$$

5.(a) It is a satellite that appears to be located at a fixed point in space when viewed from the earth's surface.

- (b) - Solid-state laser
- Gas laser
- Laser diode

6.(a) Candela

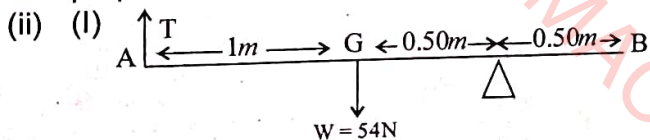
- (b) - Sun intensity, - Speed of light

Magnetic	Non - magnetic
They can attract other magnetic materials	They do not attract others
They have two poles which are North and South	They do not have two poles
They can be iron and steel	They may be wood or glass

8.(a)(i) A body will continue in its present state of rest. **OR** If it is in motion, it will continue to move with uniform speed in a straight line unless it is acted upon by a force.

(ii) When the brakes of the moving vehicles are suddenly applied, or the vehicle collides, the passenger jerks forward as they tend to continue in a straight line. The seat belt helps to provide a backward force and reduces injuries.

(b)(i) Moment of a force can be defined as the product force and perpendicular distances as the point to the line of action of the force. **OR** Moment of a force can be defined as the product of the distance from the point of application of the force and the component of the force perpendicular to the line of the distance.



$$54 \times 0.5 = F \times 0.5$$

$$27 = F \times 0.5$$

$$F = 27 \times 0.5 = 13.5$$

(II) clockwise moment = Anticlockwise moment

$$T \times 1.5 = 54 \times 0.5$$

$$T = 54 \times \frac{0.5}{1.5} = 18\text{N}$$

(III) $F + T = W$

$$F = W - T = 54 - 18 = 36\text{N}$$

(c) **Differences between Solid Friction and Viscosity**

Solid friction	Viscosity
occurs on solid surfaces.	occurs within fluids.
is independent of areas of surfaces in contact	depends on the area of the surfaces in contact
is independent of temperature	is independent of the speed of motion of the surfaces in contact
depends on normal reaction	is independent of normal reaction

(d) By increasing the number of pulleys.

9(a)(i) The electrostatic force between two charged bodies is directly proportional to the product of their charges and inversely proportional

to the square of the distance between them.

Calculation of the Magnitude of the Electrostatic Force

(ii) $F = kq_1 q_2$

$$F = \frac{9.0 \times 10^9 \times 1.6 \times 10^{-19} \times 1.6 \times 10^{-19}}{(5.2 \times 10^{-11})^2}$$

$$= 8.52 \times 10^{-8} \text{ N}$$

(b)(i) (I) **Proof of V_{out}**

$$I = \frac{V_{in}}{R_1 + R_2}$$

$$V_{out} = IR_2$$

$$\left(\frac{V_{out}}{V_{in}}\right) = x \cdot 2$$

$$\frac{V_{out}}{V_{in}} = \frac{V_{in} \times \left(\frac{R_2}{R_1 + R_2}\right)}{V_{in}}$$

$$\frac{V_{out}}{V_{in}} = \frac{R_2}{R_1 + R_2}$$

(II) Given $\frac{V_{out}}{V_{in}} = \frac{R_2}{R_1 + R_2} = 2.5$ (where $R = 30\Omega$)

$$\frac{R_1 + 30}{30} = 2.5$$

$$R_1 + 30 = 75 \Rightarrow R_1 = 75 - 30 = 45\Omega$$

(ii) **Definition of the Volt**

Volt is the unit of potential difference between two points when one joule of work is done in taking one coulomb of charge between points.

(c) **Why Wood is not Suitable for Use as the Core of Transformers**

- Wood is a non-magnetic material.

- It would not provide magnetic coupling between the coils for electromagnetic induction.

(d) Cathode-ray tubes are used in X-ray production and burglar alarms. **OR** Used to test visual acuity, contrast sensitivity, visual fields, and early development of vision in preverbal children. **OR** Used in medicine for visual function.

10.(a) **Conditions necessary for:**

(i) **Constructive interference of waves**

- It must involve at least two waves.

- Waves must vibrate in phase.

- The distance between the sources of the wave must be of the order of the wavelength.

(ii) **Total internal reflection**

- The waves must travel from a denser medium to a less dense medium.

- The angle of incidence (in the denser medium) must be greater than the critical angle.

- It must involve two media of different optical densities.

(iii) **Production of beats**

- The amplitude of the two interfering waves should be the same.

- The difference between the frequencies of interfering waves should be small.

- The two sources of waves must be sounded together.

(b) $F_1 = 256\text{Hz}$, $L_1 = 35\text{cm}$, $L_2 = 100\text{cm}$, $V = ?$
 $V = \lambda f \Rightarrow F = \frac{V}{\lambda}$
 $\therefore F = \frac{V}{2(L_2 - L_1)} \Rightarrow 256 = \frac{V}{2(1 - 0.35)}$
 $256 = \frac{V}{1.3}$
 $V = 256 \times 1.3 = 332.8 \text{ ms}^{-1}$

(c)(i) -Wind instrument - String instrument - Percussion instrument

(ii) Wind - trumpet
 String - guitar
 Percussion - talking drum

(d) $\sin C = \frac{1}{n} = \sin C = \frac{1}{1.5} = 0.667$
 $C = \sin^{-1} 0.667 = 42.07^\circ$

(e) $V_1 = 24 \text{ ms}^{-1}$, $V_2 = 310 \text{ ms}^{-1}$, $T_1 = 102^\circ\text{C}$, $T_2 = ?$
 $V_1 T_1 = V_2 T_2$, $240 \times 102 = 310 \times T_2$
 $T_2 = \frac{24480}{310} = 78.9^\circ\text{C} \approx 79^\circ\text{C}$

11(a) -Temperature. - Nature of liquid. - Area of liquid exposed. - Wind and dryness of air. - Air pressure. - Surface area of the liquid.

(b) This is the heat energy required to convert a substance from its solid form to its liquid form without a change in temperature. **OR** The heat required to convert a solid into a liquid or vapour, or a liquid into a vapour, without a change in temperature.

(c)(i) Clay pot is a poor absorber of heat and rubber is a good absorber of heat. **OR** A clay pot has pores which allow evaporation to occur while the plastic container has no pores.

(ii) In a pressure cooker, more pressure is retained within the pot. The rate of collision will be faster than in an ordinary cooking pot. **OR** Pressure cooker raises the pressure within it, which raises the temperature to/above the boiling point, thus cook faster.

(d) (i) $V = 40\text{v}$, $I = 12\text{A}$, $t = 1400\text{s}$, $m = 1.5\text{kg}$,
 $\theta = 60^\circ\text{C}$, $t = ?$

Heat supplied by heater in the first 1400s

$IVT_0 = mL \Rightarrow L = \frac{IVt}{m}$
 $L = \frac{12 \times 40 \times 1400}{15}$, $L = 44800 \text{ Jkg}^{-1}$

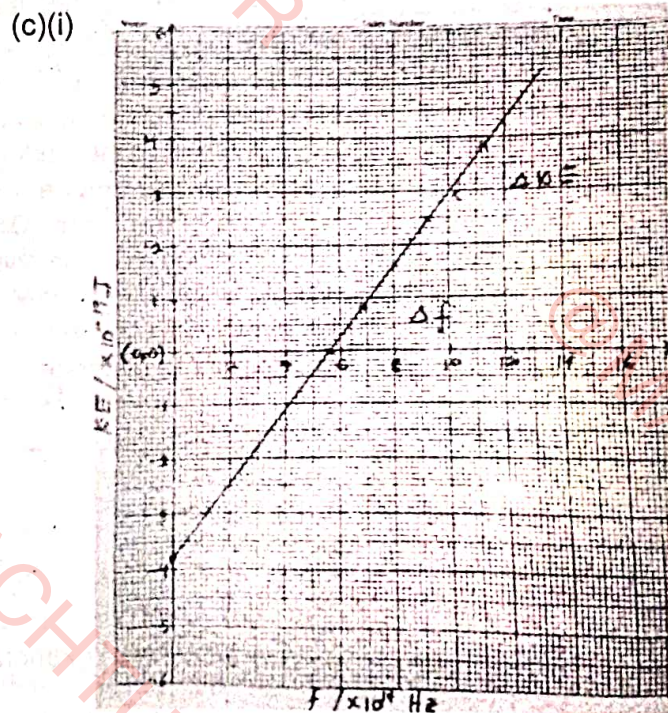
(ii) $IVt = mL + mc\theta$
 $12 \times 40 \times 1472 = 1.5 \times 4.48 \times 10^4 + 1.5 \times c \times 50$
 $706560 = 6.672 \times 10^4 + 75C$
 $7.065 \times 10^5 - 6.72 \times 10^4 = 75C$
 $0.345 \times 10^5 = 75C$
 $3.45 = 75C$
 $C = 0.046$
 $C = 4.6 \times 10^{-3} \text{ Jkg}^{-1}$

Evaporation	Boiling
- Occurs at all temperature	- Occurs at a fixed temperature
- Occurs only at the surface	- Occurs throughout the whole liquid.
- Temperature is not steady.	- Temperature remains steady during boiling.
- It is wind-aided.	- It is not wind-aided.

12.(a)(i) Artificial radioactivity means an ordinary material not normally radioactive is made radioactive by bombarding it with radioactive particles, e.g. neutron.

Emission	Nature	Charge	Ionising ability
Beta particle	High speed electron	Negative	Moderately ionising
Gamma rays	Electromagnetic waves	Neutral	Negligible ionising ability
Alpha particles	Helium nuclei	Positive	Large ionising ability

(b) Given $e = 1.6 \times 10^{-19}\text{C}$, $V = 30\text{kv}$
 $K.E = \frac{1}{2} m v_e^2 = eV$
 $= 1.6 \times 10^{-19} \times 30 \times 10^3$
 $= 4.8 \times 10^{-15} \text{ Joules}$



(ii) (I) Planck's constant, $h = \text{slope of the graph}$
 $h = \frac{\Delta k.e}{\Delta f} = \frac{(3.0 - 0.8) \times 10^{-19}}{(10 - 6.8) \times 10^{14}}$
 $= \frac{3.0 \times 10^{-19}}{3.2 \times 10^{14}}$
 $= 0.69 \times 10^{-23}$
 $= 6.9 \times 10^{-24} \text{ J}$

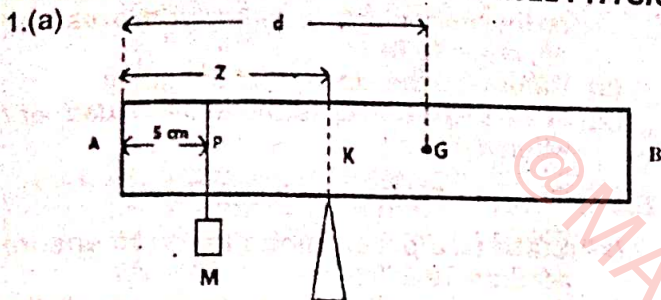
(II) Work function $W_0 = \text{Intercept, C of graph}$
 $= 3.6 \times 10^{-19} \text{ J}$

Threshold frequency = $hF = E_2 - E_1$
 $h \times 3.2 = 3.0 - 0.8$
 $h \times 3.2 = 2.2$

$h = \frac{2.2}{3.2} = 1.45$

(II) $E = hF_0 = 2.2 = 1.45 \times F_0$
 $F_0 = \frac{2.2}{1.45} = 1.52$

WASSCE SC 2022 PHYSICS 3 PRACTICAL QUESTIONS

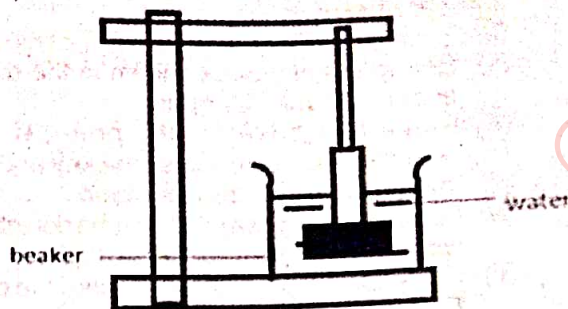


You are provided with a metre rule, a weight hanger, slotted masses, **M**, a piece of string, a weighing balance and a knife edge.

Use the diagram above as a guide to perform the experiment.

- (i) Using the weighing balance, determine and record the mass, M_0 , of the unloaded metre rule.
 - (ii) Determine and record the mass, m , of the weight hanger.
 - (iii) Suspend the metre rule horizontally on the knife edge. Adjust the knife edge to a point **G** on the metre rule where it balances horizontally.
 - (iv) Record the distance, $d = \mathbf{AG}$.
 - (v) Suspend the weight hanger securely at a point, **P**, on the metre rule such that $AP = 5\text{cm}$. Keep the hanger at this point throughout the experiment.
 - (vi) Add a mass, $\mathbf{M} = 20\text{g}$ to the hanger, adjust the knife edge to a point **K** on the metre rule such that it balances horizontally as shown in the diagram above.
 - (vii) Determine and record the distance $\mathbf{z} = \mathbf{AK}$.
 - (viii) Record \mathbf{M} and evaluate $y = (z - 5)$, $x = (d - z)$ and $v = \frac{y}{x}$.
 - (ix) Repeat the experiment for $\mathbf{M} = 40\text{g}, 60\text{g}, 80\text{g}$ and 100g . In each case, evaluate y , x and v .
 - (x) Tabulate the results.
 - (xi) Plot a graph with \mathbf{M} on the vertical axis and v on the horizontal axis, starting both axes from the origin (0,0).
 - (xii) Determine the slope, s , of the graph.
 - (xiii) Determine the intercept, c , on the vertical axis.
 - (xiv) State two precautions taken to ensure accurate results.
- (b) (i) Under what condition is an object said to be in a *stable equilibrium*?
 - (ii) A uniform beam of weight 50 N has a body of weight 100 N hung at one end of it. If the beam is 12 m long, determine the distance of a support from a 100 N body for it to balance horizontally.

2.(a)

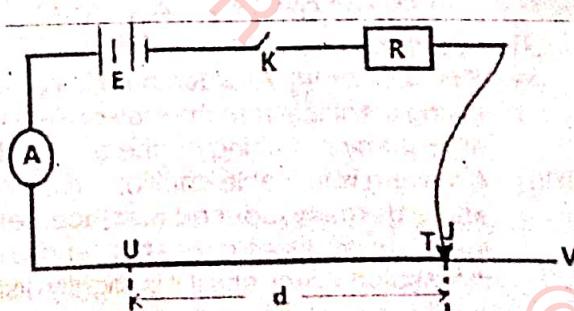


You are provided with masses, a spring balance, a beaker, liquid (kerosene), water, a retort stand and clamp, mass hanger.

Use the diagram above as a guide to perform the experiment.

- (i) Suspend the Mass (m_1) 100g provided by Thread/Hanger on the spring balance and record its weight.
 - (ii) Using a 500ml beaker with about two-thirds ($\frac{2}{3}$) filled with water, immerse m_1 completely in water with its end freely suspended and well away from the sides and the bottom of the beaker.
 - (iii) Read and record the mass (m_w).
 - (iv) Remove the beaker and empty it. Fill the beaker with about C (two-thirds) full of liquid (kerosene). Immerse the mass (m_1) fully in kerosene with its ends far away from the side and the bottom of the beaker.
 - (v) Read and record the mass (m_1), then fully immerse it in the liquid (kerosene).
 - (vi) Using $W = mg$, evaluate $(w_a - w_l)$ and $(w_a - w_w)$.
 - (vii) Repeat the experiment for mass $m_2 = 150\text{g}$, $m_3 = 200\text{g}$, $m_4 = 250\text{g}$ and $m_5 = 300\text{g}$
 - (viii) Evaluate $S_i = \frac{(w_a - w_l)}{(w_a - w_w)}$. In each case, read and record the value of (S_i).
 - (ix) Tabulate your values.
 - (x) Evaluate the average value of (S_i).
 - (xi) Evaluate $K = 1000 \times S$. What do S and K represent?
 - (xii) State three precautions taken to ensure accurate readings.
 - (xiii) State further explanation on the results.
 - (xiv) State your conclusion.
- (b) State Archimedes' principle and law of floatation.

3.(a)



You are provided with a battery of emf, **E**, a standard resistor, **R**, of resistance 2Ω , a key, **K**,

an ammeter, **A**, a jockey, **J**, a potentiometer, **UV**, and some connecting wires.

- (i) Measure and record the *emf*, **E**, of the battery.
- (ii) Set up the circuit as shown in the diagram above with the key open.
- (iii) Place the jockey at the point, **U**, of the potentiometer wire. Close the key and record the reading, *i*, of the ammeter.
- (iv) Place the jockey at a point **T** on the potentiometer wire **UV** such that $d = UT = 30.0\text{cm}$.
- (v) Close the circuit, read and record the current, *I*, on the ammeter.
- (vi) Evaluate I^{-1} .
- (vii) Repeat the experiment for **four** other values of $d = 40.0\text{cm}$, 50.0cm , 60.0cm and 70.0cm . In **each** case, record *I* and evaluate I^{-1} .
- (viii) Tabulate the results.

- (ix) Plot a graph with *d* on the vertical axis and I^{-1} on the horizontal axis starting **both** axes from the origin (0,0).
- (x) Determine the slope, *s*, of the graph.
- (xi) From the graph determine the value I_0 of *I* when $d = 0$.

(xii) Given that $= \frac{E}{\delta} = s$, calculate δ .

(xiii) State **two** precautions taken to ensure accurate results.

(b)(i) Write down the equation that connects the resistance, *R*, of a wire and the factors on which it depends. State the meaning of **each** of the symbols.

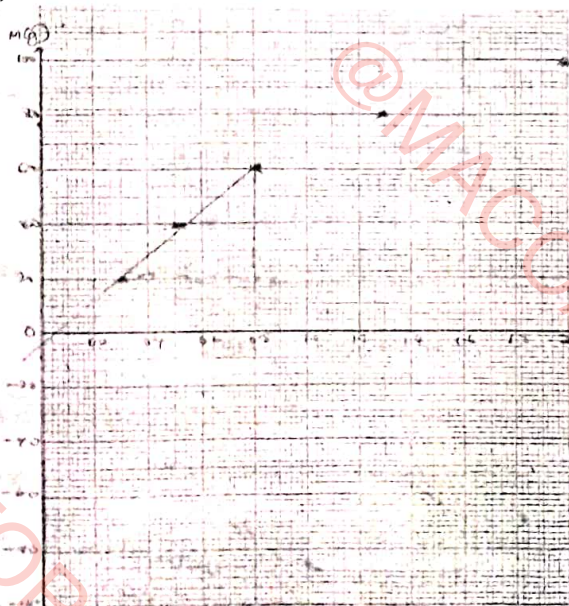
(ii) An electric fan draws a current of 0.75 A in a 240 V circuit. Calculate the cost of using the fan for 10 hours if the utility rate is \$ 0.50 per *kWh*.

ANSWERS TO WASSCE SC 2022 PHYSICS 3 PRACTICAL QUESTIONS

1.(x) $M_0 = 135.00\text{g}$, $d = AG = 50.00$

M(g)	AK = z(cm)	z - 5 = y(cm)	d - z = x(cm)	$\frac{x}{y} = v$
20.00	40.00	35.00	10.00	0.2857
40.00	35.00	30.00	15.00	0.5000
60.00	30.00	25.00	20.00	0.8000
80.00	25.00	20.00	25.00	1.2500
100.00	20.00	15.00	30.00	2.0000

(xi)

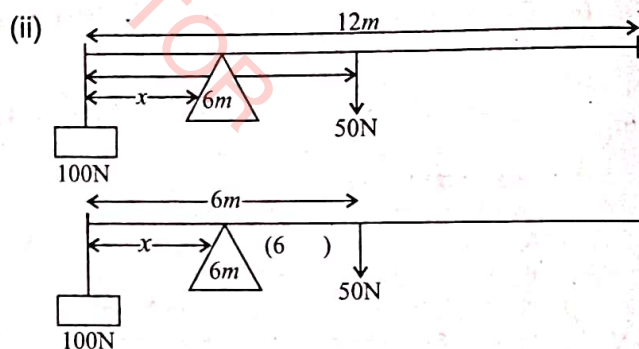


(xii) Slope (*s*) = $\frac{Dm}{Dv} = \frac{60 - 20}{0.8 - 0.3} = \frac{40}{0.5} = 80\text{g}$

(xiii) Intercept, $c = -10.0$

(xiv) **Precautions:** - Avoided parallax error when taking readings from the meter rule. - avoided drought by switching off the electric fans.

(b)(i) A system is in stable equilibrium if it is small, and externally induced displacement from that state produces forces that tend to oppose the displacement and if it is slightly displaced, it will definitely return to its original position.



Sum of clockwise = sum of anticlockwise moment

$$50 \times (6 - x)m = 100 \times x$$

$$300 - 50x = 100x$$

$$300 = 150x$$

$$150x = 300$$

$$\therefore x = 2\text{m}$$

2. Spring constant of the spring used = 35N/m.

Volume of the beaker = 50cm³

Calculation of Results

(vi)(a) $M_1 = 100.0\text{g}$, $W_a = 1.00\text{N}$

$$W_w = 0.75\text{N}, W_L = 0.80\text{N}$$

$$W_a - W_w = 1.00\text{N} - 0.75\text{N} = 0.25\text{N}$$

$$W_a - W_L = 1.00\text{N} - 0.8\text{N} = 0.20\text{N}$$

(viii)(a) $S = \frac{W_a - W_L}{W_a - W_w} = \frac{0.20\text{N}}{0.25\text{N}} = 0.80$

(vi)(b) $M_2 = 150.0\text{g}$, $W_a = 1.50\text{N}$

$$W_w = 1.25\text{N}, W_L = 1.25\text{N}$$

$$W_a - W_w = 1.50\text{N} - 1.25\text{N} = 0.25\text{N}$$

$$W_a - W_L = 1.5\text{N} - 1.25\text{N} = 0.25\text{N}$$

(viii)(b) $S = \frac{W_a - W_L}{W_a - W_w} = \frac{0.25\text{N}}{0.25\text{N}} = 1.00$

(vi)(c) $M_3 = 200.0\text{g}$, $W_a = 2.00\text{N}$

$$W_w = 1.75\text{N}, W_L = 1.80\text{N}$$

$$W_a - W_L = 2.00\text{N} - 1.75\text{N} = 0.25\text{N}$$

$$W_a - W_L = 2.00\text{N} - 1.80\text{N} = 0.20\text{N}$$

(viii)(c) $S = \frac{W_a - W_L}{W_a - W_w} = \frac{0.20\text{N}}{0.25\text{N}} = 0.80$

(vi)(d) $M_3 = 250g, W_a = 2.50N$
 $W_w = 2.25N, W_1 = 2.30N$
 $W_a - W_w = 2.5N - 2.25N = 0.25N$
 $W_a - W_L = 2.5N - 2.30N = 0.20N$

(viii)(d) $S = \frac{W_a - W_L}{W_a - W_w} = \frac{0.20N}{0.25N} = 0.80$

(vi)(e) $M_5 = 300.0g, W_a = 3.00N$
 $W_w = 2.75N, W_1 = 2.80N$
 $W_a - W_w = 3.00N - 2.75N = 0.25N$
 $W_a - W_1 = 3.00N - 2.80N = 0.20N$

(viii)(e) $S = \frac{W_a - W_L}{W_a - W_w} = \frac{0.20N}{0.25N} = 0.80$

(ix) **Table of values**

Mass	Mass(g)	$W_a(N)$	$W_L(N)$	$W_s(N)$	$W_a - W_s(N)$	$W_a - W_L(N)$	S
M_1	100.0	1.00	0.80	0.75	0.25	0.20	0.80
M_2	150.0	1.50	1.25	1.25	0.25	0.25	1.00
M_3	200.0	2.00	1.80	1.75	0.25	0.20	0.80
M_4	250.0	2.50	2.30	2.25	0.25	0.20	0.80
M_5	300.0	3.00	2.80	2.75	0.25	0.20	0.80

(viii)(e) $S = \text{average} = \frac{\sum S}{n}$
 $= \frac{0.8 + 1.00 + 0.80 + 0.80 + 0.80}{5} = \frac{4.2}{5}$
 $= 0.84$

(xi) Evaluating K = $1000 \times s$
 $= 1000 \times 0.84$
 $= 840 \text{ kg/m}^3$

S - represents the relative density of kerosene.
 K - represents the experimental value for the density of kerosene.

(xii) **Precautions**

- It was ensured that the mass (M) was gently suspended both in air, water and liquid to avoid damping of the spring and the retort stand.
- It was ensured that the spring balance readings were taken at eye level to avoid error due to parallax.
- It was ensured that the beaker was filled with three quarters of water and liquid (kerosene) to avoid spillage.

(xiii) **Discussion of Result**

It was observed that as the weight increased in air, the weight also increased in water and liquid (kerosene).

(xiv) **Conclusion**

The value obtained for k is 840 kg/m^3 . This experimental value of k is the density of the liquid, i.e. kerosene.

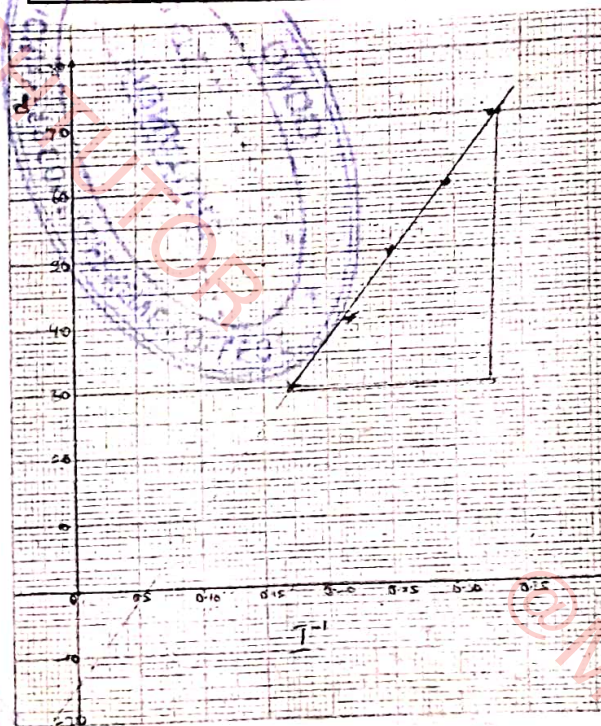
- (b) Archimedes' principle states that when a body is partially or fully immersed in a liquid, it experiences an upthrust which is equal to the quantity (mass/ weight) of the liquid displaced. The principle of floatation states that if the

density of a body is lesser than the density of the liquid and the body is completely immersed in that liquid, it experiences an upthrust force (loss in weight) which is equal to the weight of the liquid displaced.

3.(viii) E.m.f. of the battery $E = 2.0V$

$d(cm)$	I(A)	$\Gamma(A^{-1})$	$\Gamma(A^{-1}) \times 10^{-2}$
30.0	0.58	0.17	17.00
40.0	0.45	0.22	22.00
50.0	0.40	0.25	25.00
60.0	0.35	0.29	29.00
70.0	0.30	0.33	33.00

(ix)



(x) Slope (s) = $\frac{Dd}{DI^{-1}} = \frac{70 - 30}{0.33 - 0.17} = \frac{40}{0.16} = 6.4$

(xii) $\frac{E}{d} = s \Rightarrow \delta = \frac{E}{s} = \frac{2.0}{6.4} = 0.0313$

(b)(i) $R = \frac{\rho L}{A}$

where; R is the resistance
 ρ is resistivity
 L is the length of wire
 A is the cross sectional area

(ii) $I = 0.75A, V = 240V, t = 10\text{hrs}$
 \$0.50 per 1kWh

Amount of electricity consumed or power consumed

$= IVt = 0.75 \times 240 \times \frac{10}{1000} = 1.8\text{kWhr}$

$\therefore \$0.50 = 1\text{kwhr}$
 $\$0.5 \times 1.8 = \0.9