P510/1
PHYSICS
PAPER 1
JULY/AUGUST 2024
2 ½ hours

ASSHU ANKOLE JOINT MOCK EXAMINATIONS 2024

Uganda Advanced Certificate of Education

PHYSICS

PAPER ONE

2hours 30minutes

INSTRUCTIONS TO CANDIDATES:

Attempt**five**(5) questions including atleast one but not more than two questions from each of the sections A,B and C.

Additional questions attempted will not be marked.

Assume where necessary:

- Acceleration due to gravity, g = $9.8 ms^{-2}$
- Electron Charge, e = $1.6x10^{-19}C$
- Electron mass = $9.11x10^{-31}kg$
- Speed of light in vacuum, C = $3.0X10^{8} ms^{-1}$
- Planks constant, h = $6.6 x10^{-34} Js$
- Avogadro's number, NA = $6.02X10^{23} mol^{-1}$
- Mass of Earth = $5.97x10^{24} kg$
- Radius of the Earth = $6.4x10^{6} m$
- Specific heat capacity of water = $4200 Jkg^{-1}K^{-1}$
- Stefan's –Boltzmann's constant,δ = $5.67x10^{-8} Wm^{-2}K^{-4}$
- Universal gravitational constant, G = $6.67X10^{-11} Nm^{2}kg^{-2}$
- Gas Constant, R = $8.31 Jmol^{-1}k^{-1}$
- Permitting of free space = $8.85x10^{-12} Fm^{-1}$
- Thermal conductivity of iron = $66 Wm^{-1}K^{-1}$
- Specific latent heat of vaporisation of water = $2200 kJkg^{-1}$
- Density of copper = $8960 kgm^{-3}$
- Specific heat capacity of copper = $400Jkg^{-1}K^{-1}$

SECTION A

1 (a) What is meant by dimensions of a Physical quality? *(01mark)*

(b) The power, P developed by a wind turbine depends on the radius, r of its blades, Velocity V of wind passing through the blades and density, ρ of air.

(i) Use dimensions to drive an expression for P in terms of V,ρ and r. (Take $k = \frac{\pi}{2}$)

(04marks)

(ii) Hence find the maximum power developed by aturbine where blades have a radius of 6.8m, driven by wind moving at speed $15ms^{-1}$. *(02marks)*

(Density of air = $1.29\ kgm^{-3}$)

(c) State Newton's second law of motion and define anewton. *(02marks)*

(d) Aforce of 9.8N acts on ablock of mass3.125kg at an angle of 25^0 to the horizontal as shown in figure 1

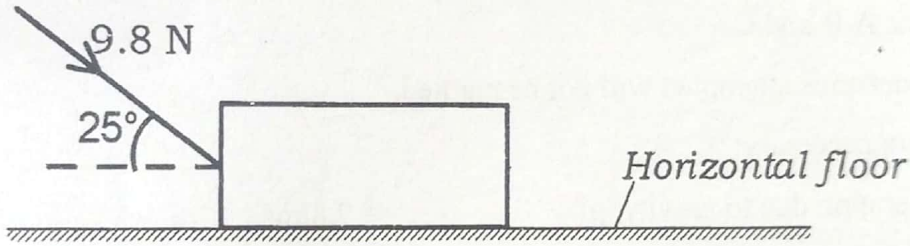


Fig. 1

If the frictional force between the block and the floor is 3.88N and that the block is initially at rest, determine

(i) the acceleration of the block *(03marks)*

(ii) the distance the block covers if the 9.8N force is withdrawn after the 6s, *(03marks)*

(e) Explain briefly the importance of the soft cushion inside a helmet when a bodaboda rider accidentally falls on a tarmac road. *(03marks)*

2. (a) What is meant by centripetal force? *(02marks)*

(b) Explain how the shape of the Earth affects the magnitude of acceleration due to gravity at different points on the Earth's surface *(03marks)*

(c) Describe briefly the action of a centrifuge. *(03marks)*

(d)State:

i) Newton's law of universal gravitation. *(01marks)*

ii) Kepler's laws of planetary motion. *(03marks)*

iii) Asatellite is travelling in a circular orbit which is 200km above the Earth's surface. Find the Period of the satellite given that the radius of the Earth is 6.4×10^6m.

(04marks)

(e) (i) What is meant by aparking orbit? (01mark)

(ii) A satellite is launched in a parking orbit which is at a height, h above the earth's surface. If the earth's radius is R and its density is ρ, show that the period of revolution of the satellite around the earth is given by

$$T = \sqrt{\frac{3\pi(R+h)^3}{G\rho R^3}}$$

Where G is the universal gravitational constant. *(03marks)*

3. (a) (i) Define Young's modulus of amaterial *(01mark)*

ii) Differentiate between elastic limit and yield point as applied to an elastic material *(02marks)*

(b) Acopper wire is stretched gradually until it breaks.

(i) Sketch a graph of stress against strain for the wire *(02marks)*

(ii) Use the graph in b(i) to account for the energy used. *(02marks)*

(c) Describe, with the aid of a diagram, an experiment to determine Young's modulus of a material in firm of awire *(07marks)*

(d) A unform wire of density 7800kgm^{-3} weighs 16g and is 2.5 m long. It extends by 1.2 mm when stretched by aload of 2kg. Calculate the Young's modulus of the wire. *(04marks)*

4. (a)State and illustrate Archimedes' principle *(5 marks)*

(b) What is meant by up thrust? *(1 mark)*

(c) Describe an experiment to determine density of an irregular object, which floats in water, using Archimedes' Principle. *(4 marks)*

(d) A hot air balloon has a volume of 500m^3. The balloon moves upwards at a constant speed in air of density 1.2kgm^{-3} when the density of the hot air inside it is 0.8kgm^{-3}. Using g = 10ms^{-2}, determine the;

i) combined mass of the balloon and the air inside it.

ii) upward acceleration of the balloon when the temperature of the air inside the balloon is increased so that its density is 0.7kgm^{-3}.

(e) (i) State Bernoulli's Principle. *(1 mark)*

(ii) Figure 2 shows part of a venturimeter in which a liquid of density ρ flows at speed V.

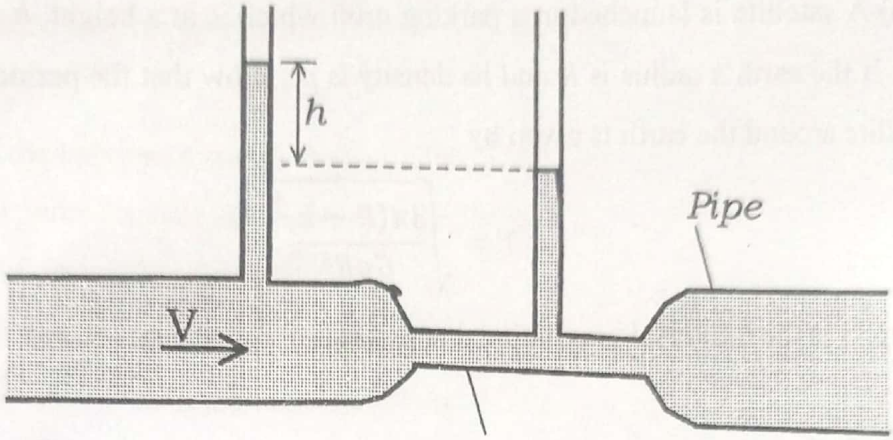


Fig. 2

The ratio of the cross-sectional area of the main pipe to that of the constriction is x. Show that the speed, V of the liquid in the main pipe is given by $V = \sqrt{\frac{2gh}{x^2-1}}$ where g is the acceleration due to gravity. *(3 marks)*

SECTION B

5. (a)(i) Define the term thermometric property. *(1 mark)*

(ii) State any four characteristics of a good thermometric property. *(2 marks)*

(iii) The resistance R of platinum line at a temperature θ^0C as measured by a mercury – in – glass thermometer is given by $R_\theta = R_0 (1 + b\theta + \alpha \theta^2)$ where b = 3.8 x $10^{-3}K^{-1}$ and α = -5.6 x $10^{-7}K^{-2}$. Calculate the temperature of platinum thermometer corresponding to 200^{0}C on the glass scale. *(4marks)*

(iv) Why do the two thermometers give different readings? *(1 mark)*

(b) (i) State any three ways in which heat looses are minimized in calorimetry experiments. *(3 marks)*

(ii) Describe an experiment to determine the specific latent heat of vaporization of water by method of mixtures *(6 marks)*

(c) Explain why the specific latent heat of vaporization is greater than that of fusion for the same substance at same pressure *(3 marks)*

6. (a)(i) What is meant by the terms coefficient of thermal conduction and temperature gradient? *(2 marks)*

(ii) Describe an experiment to determine the coefficient of thermal conduction of a plastic material *(6 marks)*

(iii) A cooking saucepan made of iron has a base area of $0.05m^2$ and thickness 2.5mm. It has a thin layer of soot of average thickness 0.5mm on its bottom surface. Water in the saucepan is heated until it boils at 100^0C. 10g of water boil away per second and the side of the soot nearest to the heat source is at 150^0C. Find the thermal conductivity of soot. *(4 marks)*

(b) (i) State Stephen's law of blackbody radiation. *(1 mark)*

(ii) What is meant by the term intensity of radiations? *(1 mark)*

(iii) Sketch a graph to show how relative intensity of radiation's varies with wave length for two different temperatures *(2 marks)*

(c) A metal sphere with a black body surface and radius 30mm is cooled to -73^0C and is placed inside an enclosure at a temperature of 27^0C. Calculate the initial rate of temperature rise of the sphere. *(4 marks)*

7. (a)(i) State Charle's law *(1 mark)*

(ii) Show that the ideal gas equation is consistent with Charle's law. *(3 marks)*

(iii) Describe an experiment to verify Charle's law *(5 marks)*

(b) (i) State the assumption's made in the derivation of the ideal gas equation that do not apply for real gases *(2 marks)*

(ii) For the Vander Waal's gas equation $(P + \frac{a}{V^2})(V - b) = \text{constant}$;

Account for the terms $\frac{a}{V^2}$ and b *(4 marks)*

(c) (i) What is meant by the term saturated vapour pressure (S.V.P)? *(1 mark)*

(ii) Explain the effect of volume change on S.V.P. *(3 marks)*

(iii) Represent the effect in (c) (ii) on a sketch graph for a saturated vapour *(1 mark)*

SECTION C

8. (a)(i) State two differences between cathode rays and positive rays. *(2 marks)*

(ii) An electron gun operating at 3000V is used to project electrons into a space between two oppositely charged parallel plates of length 10cm and 5cm apart. Calculate the vertical deflection of an electron as it emerges from the region between the charged plates when the potential difference across the plates is 1000V. *(5 marks)*

(iii) Explain the motion of the electrons between the plates in a(ii) above *(2 marks)*

(b) (i) State two uses of a cathode ray oscilloscope (C.R.O) *(2 marks)*

(ii) A C.R.O has its Y – sensitivity set to $6Vcm^{-1}$. Asinusoidal input voltage is suitably applied to give a steady p.d. The time base is switched on so that the electron beam takes 0.01s to transverse the screen. If the trace seen has a peak – to peak height of 4cm and contains 2 complete cycles, determine the root mean square value of the input voltage and the frequency of the signal. *(05marks)*

(c) What is meant by the following terms as used in a vacuum diode?

(i) Space change limitation *(03marks)*

(ii) Saturation *(01mark)*

9. (a) (i) Define a photon. *(01mark)*

(ii) State the laws of photo electric emission. *(04marks)*

(iii) Explain why the wave theory of light fails to account for photo electric effect. *(06marks)*

(b) A beam of light of 0.1W and wave length 400*n*m falls on a metal surface of photocell. Calculate the

(i) number of photons that strike the surface per second. *(03marks)*

(ii) resulting photo current if 13 in every 20 photons incident the surface emit photo electrons. *(02marks)*

(iii) Kinetic energy of each photon if the work function of the metal is $3.52x10^{-19}J$ *(02marks)*

(c) When afreshly cleaned Zinc plate is placed on the cap of anegatively charged gold leaf electroscope and ultra-violet is directed on to the Zinc plate, The gold leaf gradually collapses. Briefly explain this observation. *(02marks)*

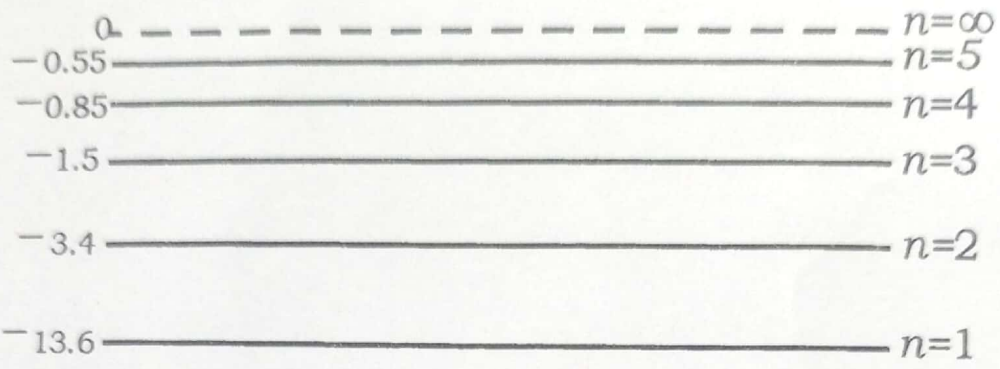
10. (a) Define the following terms:

(i) nucleon number *(01mark)*

(ii) radio isotope *(01mark)*

(b) State Bohr's postulates of the atomic model. *(03marks)*

(c) The diagram below shows some energy levels of the hydrogen atom.



(i) Copy and complete the diagram indicating the electron transition that lead to emission of visible spectrum, infrared and ultraviolet light. *(03marks)*

(ii) Calculate the speed of an electron which would just ionize the hydrogen atom. *(02marks)*

(d) (i) Define the terms **unified atomic mass unit** and **binding energy per nucleon** as applied in nuclear physics. *(02marks)*

(ii) Calculate the binding energyper nucleon of iron (Fe) whose atomic mass is 56 and atomic number is 26 given that the mass of one proton is 1.007825U, mass of a neutron is 1.008665U and IU =931MeV.

(03marks)

(e) i) What is meant by terms **radioactive decay** and **decay constant**?*(02marks)*

ii) Show that the unified atomic mass unit (U) is approximately 934MeV

(03marks)

END