P510/1

Physics

Paper 1

July 2024

2 ½ HOURS

ACEITEKA JOINT MOCK EXAMINATIONS 2024

Uganda Advanced Certificate of Education

PHYSICS

Paper 1

Time: 2 hours 30 Minutes

INSTRUCTIONS:

Answer any **FIVE** questions **only**, including **ONE**, but not more than **TWO** from each of the Section **A, B** and **C**.

Assume where necessary the following constants: -

- Acceleration due to gravity, g = $9.81. ms^{-2}$
- Electron charge, e = $1.6 \times 10^{-19} C$
- Electron mass = $9.11 \times 10^{-31} Kg$
- Plank's constant, h = $6.6 \times 10^{-34} Js$
- Radius of the earth = $6.4 \times 10^{6} m$
- Speed of light in a vacuum, C = $3.0 \times 10^{8} ms^{-1}$
- Universal gravitational constant, G = $6.67 \times 10^{-11} Nm^{2} Kg^{-2}$
- Gas constant, R = $8.31 Jmol^{-1} K^{-1}$
- Specific heat capacity of water = $4200 JKg^{-1} K^{-1}$
- Unified mass unit, $1U$ = $1.66 \times 10^{-27} Kg$
- One electron volt, eV = $1.6 \times 10^{-19} J$
- Density of water = $1000 Kgm^{-3}$
- Stefan's constant, σ = $5.67 \times 10^{-8} Wm^{-2} K^{-4}$
- Radius of the sun = $7 \times 10^{8} m$
- Radius of earth's orbit about the sun = $1.5 \times 10^{11} m$
- Thermal conductivity of copper = $390 Wm^{-1} K^{-1}$
- Thermal conductivity of aluminum = $210 Wm^{-1} K^{-1}$
- Charge of mass ratio, $^{e}/_{m}$ = $1.8 \times 10^{11} C\ Kg^{-1}$

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SECTION A

1. a) i) State Newton's laws of motion. **(03mks)**

ii) Use Newton's law to show that, $F = ma$ **(02mks)**

b) i) State the principle of conservation of linear momentum. **(01mk)**

(ii) Two particles of masses $2.5kg$ *and* $3.0kg$ moving at speeds of $2ms^{-1}$ and $1.2ms^{-1}$ respectively in a direction at right angles to each other collide in a perfectly inelastic collision. Calculate the magnitude and direction of the final velocity of the particles. **(05mks)**

c) i) Define the terms intensity of gravity and Gravitational potential. **(02mks)**

(ii) Explain why the rotation of the earth about its axis affects the value of acceleration due to gravity, g at the equator. **(03mks)**

(iii) Show that the magnitude of potential energy of a satellite is twice the magnitude of its Kinetic energy. **(04mks)**

2. a) i) Define coefficient of viscosity. **(01mk)**

(ii) Explain the effect of temperature on the viscosity of a gas. **(03mks)**

b) (i) Derive an expression for the terminal velocity of a steel ball bearing of radius r and density ρ falling through liquid of density σ and coefficient of viscosity η. **(04 mks)**

(ii) Sketch acceleration- time graph for the motion of the steel ball bearing above. **(01 mk)**

c) (i) State Stoke's law. **(01 mk)**

ii) Describe an experiment to determine the coefficient of viscosity of oil of a known density using Stoke's law. **(06 mks)**

d) (i) State Bernoulli's principle. **(01 mk)**

(ii) Explain why it is not advisable to stand by the road side when a fast moving trailer is passing. **(03 mks)**

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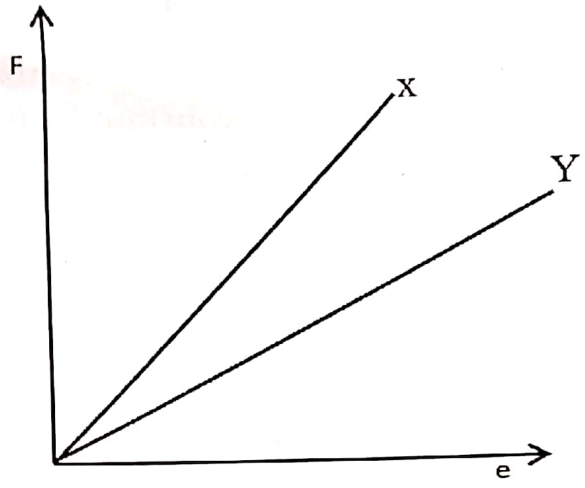
3. a) Define the term Elastic limit and proportional limit. **(02 mks)**

b) The figure below shows the variation of F the load applied to two wires $X$and Y and their extension, e. The wires are both made of iron and have the same length



(i) Which wire has a smaller cross-sectional area and why? **(02 mks)**

(ii) Explain how you would use the graph for X to obtain a value for the young's modulus for iron, listing down the additional measurements needed. **(04 mks)**

c) A uniform steel wire of density $7800kgm^{-3}$ weighs $16g$ and is $250cm\ long. It\ lengths\ by\ 1.2mm$ When stretched by a force of $80N$. Calculate the;

(i) Value of young's modulus for the steel wire. **(03 mks)**

(ii) Energy stored in the wire. **(02 mks)**

d) (i) Define relative density of a substance. **(01 mk)**

(ii) Describe an experiment to determine the relative density a liquid using Archimede's principle and principle of moments. **(06mks)**

4. a) (i) What is meant by simple Harmonic motion **(01 mk)**

(ii) Define the terms amplitude and period as applied to oscillatory motion. **(02 mks)**

b) Sketch graphs to show variation of;

(i) Kinetic energy with time **(01mk)**

(ii) Total energy with time of an object performing simple harmonic motion. **(01 mk)**

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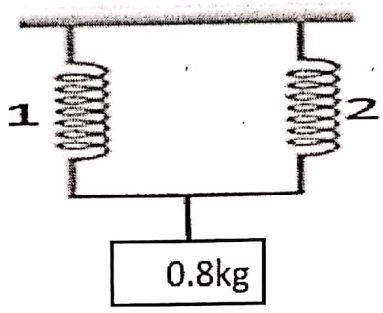
c)(i) Show that a simple pendulum oscillates with S.H.M, when displaced slightly from its equilibrium position and derive an expression for the period of the motion. ***(06mks)***

(ii) Explain how you would use the above expression to obtain the value of acceleration due to gravity. ***(04 mks)***

d) The figure below show's a mass of $0.8kg$ being suspended from the free end of two springs 1 and 2 of force constants $120Nm^{-1}$ and $60Nm^{-1}$ respectively.



Calculate the;

(i) Extension produced. ***(03 mks)***

(ii) Tension in each spring. ***(02 mks)***

SECTION B

5a. (i) State the assumptions made in the derivation of the Kinetic theory expression for the pressure of an ideal gas. ***(02 mks)***

(ii) Which of the assumption made above have to be modified for real gases? ***(01 mk)***

(iii) The equation of state for state of one mole of a real gas is given by the expression; $\left(p + \frac{a}{V^2}\right)(V - b) = RT$. Account for term $\frac{a}{V^2}$ and

(03 mks)

b) Calculate the root mean-square speed of molecules of an ideal gas at 147^0C given that the density of the gas at temperature of 0^0C is $1.5kgm^{-3}$. ***(05mks)***

c) (i) Explain why the pressure of a fixed mass of a gas in closed container of a fixed volume increase when temperatures of the container is raise ***(02 mks)***

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(ii) Explain with the aid of a volume- temperature sketch graph, what happens to a gas cooled at constant pressure from room temperature to zero kelvin. ***(04 mks)***

d) An ideal gas of volume $400cm^3$ at -129°C expands adiabatically to a temperature of – 136°C. Calculate its new Volume. **(Take $\gamma = 1.40$)** ***(03 mks)***

6a. (i) State the desired properties a material must have in order to be used as a thermometric substance. ***(02 mks)***

(ii) Explain why a constant- volume gas thermometer is used to calibrate other thermometers. ***(02 mks)***

b). Describe with the aid of a labeled diagram, how an optical pyrometer can be used to measure high temperatures. ***(06 mks)***

c) (i) What is meant by latent heat of fusion? ***(01 mk)***

(ii) Explain why specific latent heat of vaporization of a substance is much higher than specific latent heat of fusion of the same substance. ***(03 mks)***

d) 50g of ice at 0°C is added to 200g of water initially at 70°C in a vacuum flask. When all the ice has melted, the temperature of the flask and its contents dropped to 40° C. On adding a further 80g of ice the temperature of the flask and its content became 10°C, when all the ice melted. Calculate the specific latent heat of fusion of ice. ***(06 mks)***

7. a (i) Define thermal conductivity ***(01 mk)***

ii) Explain the mechanism of heat transfer in metal. ***(03mks)***

b) A window having two glass panels each of thickness $10mm$ are separated by an air gap of thickness $5.0mm$. the outer faces of the panels are maintained at 20°C and 5°C respectively.

(i) Calculate the temperatures of inner surfaces of the panels. ***(06mks)***

(iii) Compare the rate of heat loss through the layer of air with that through a single glass layer. Take thermal conductivity of air and glass to be respectively $0.02Wm^{-1}k^{-1}$ and $0.6Wm^{-1}k^{-1}$ ***(03 mks)***

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c) (i) State Stefan's law of blackbody radiation. **(01 mk)**

(ii) The average distance of a certain planet from the sun is about 40 times that of the earth from the sun. If the sun radiates as a black body at 6000k, calculate the surface temperature of the planet. **(06 mks)**

SECTION C

8. a) Define half-life and decay constant as used in the study of radioactive decay. **(02mks)**

(b) U^{238} has a half- life of 4.5×10^9 years. It is believed that the earth solidified 4.0×10^9 year ago. What percentage of U^{238} then found on the earth remains un-decayed today. **(04mks)**

(c) (i) With aid of a diagram describe the structure and action of a Geiger Muller tube. **(06 mks)**

(ii) Sketch the count rate-voltage characteristics of the Geiger-Muller tube and explain its main features. **(03 mks)**

(iii) Identify, giving reasons the suitable ranger in (c) (ii) of operation of the tube. **(02 mks)**

d) Briefly explain the use of radio carbon in determining the age of organic archaeological objects. **(03 mks)**

9. (a) State laws of photo-electric emission. **(04 mks)**

(b) Describe an experiment to investigate the occurrence of photo-electric effect. **(05 mks)**

(c) (i) Define work function and threshold frequency. **(02 mks)**

(ii) With the aid of a labeled diagram describe an experiment to verify Einstein's equation of photo-electric emission. **(06 mks)**

(d) A mental surface has a work function of 4.0eV. Calculate the longest wave length of light that will cause emission of photo electrons from the mental surface **(03 mks)**

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10. a) Define specific charge of an electron and state its unit. **(02 mks**

(b) Describe using a well labeled diagram how to determine the specific charge of an electron using Thomson's apparatus. **(06 mks)**

(c) Using a well labeled diagram describe how a cathode ray oscilloscope. (C.R.O) work **(07mks)**

(d) (i) Give two uses of a C.R.O. **(02 mks)**

(ii) The gain control of a C.R.O is set on $0.5 vcm^{-1}$ and an alternating voltage produces a vertical line trace of 10cm long with the time base off. Find the root mean square value of the applied p.d. **(03 mks)**

THE END

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