P510/1
PHYSICS
THEORY
PAPER 1
AUGUST 2024
2 ½ HRS

UNNASE MOCK EXAMINATIONS

UGANDA ADVANCED CERTIFICATE OF EDUCATION

PHYSICS (THEORY)

Paper 1

Time: 2hours 30minutes

INSTRUCTIONS TO CANDIDATES

- *Answer FIVE questions, including at least one, but not more than two questions from each of the sections **A, B** and **C**.*
- *Non-programmable scientific electronic calculators may be used.*
- ***Assume where necessary:***
  - *Acceleration due to gravity, g* = $9.81\ ms^{-2}$
  - *Electronic charge, e,* = $1.6 \times 10^{-19}\ C$
  - *Mass of the earth* = $5.97 \times 10^{24}\ Kg$
  - *Plank's constant, h,* = $6.6 \times 10^{-34}\ Js$
  - *Stefan's Boltzman's constant, σ,* = $5.67 \times 10^{-8}\ wm^{-2}\ K^{4}$
  - *Radius of the earth* = $6.4 \times 10^{6} m$
  - *Radius of the sun* = $7 \times 10^{8} m$
  - *Universal gravitational constant, G,* = $6.67 \times 10^{-11}\ Nm^{2}\ Kg^{-2}$
  - *Avogadro's number, N_A* = $6.02 \times 10^{23}\ mol^{-1}$
  - *Surface tension of water* = $7.0 \times 10^{-2}\ Nm^{-1}$
  - *Gas constant, R,* = $8.31\ Jmol^{-1}\ K^{-1}$
  - *The constant* $\frac{1}{4\pi\varepsilon_o}$ = $9.0 \times 10^{9}\ F^{-1}\ m$

SECTION A

1. a) (i) Define plastic deformation (01 mark)
   (ii) Explain the energy changes during plastic deformation (04 marks)
   b) (i) In the determination of Young's modulus of a material in form of a wire, explain why a second steel wire usually suspended adjust to the specimen wire. (03 marks)
   (ii) A mass of 20kg is suspended from a copper wire of diameter 2mm, density 900Kgm^{-3}, specific heat capacity 400JKg^{-1}K^{-1} and Young's Modulus 1.2 x 10^{11}Pa suddenly breaks. Calculate the change in temperature of the wire. (05 marks)
   c) Derive an expression for the energy stored in a stretched wire of length L and extension e having Young's modulus E. (03 marks)
   d) State and explain the precautions taken while determining Young's modulus of a wire. (04 marks)

2. a) (i) Define surface tension in terms of surface energy (01 mark)
   (ii) Explain molecular occurrence of surface tension (04 marks)
   b) (i) A soap bubble of radius 4cm is attached to another bubble of radius 6cm. Find the excess pressure in the common interface formed. (04 marks)
   (ii) Explain why detergents should have a small angle of contact. (02 marks)
   c) (i) Define Coefficient of viscosity of a liquid (01 mark)
   (ii) Describe a simple experiment to demonstrate stream line and turbulent flow in a substance. (05 marks)
   d) (i) Sketch a graph of potential energy against separation of two molecules in a substance. (01 mark)
   (ii) Explain the main features of the graph in d(i) (03 marks)

3. a) (i) Define the term angular velocity (01 mark)
   (ii) Explain briefly the action of a centrifuge (03 marks)
   b) (i) Derive an expression for angular velocity w in terms of linear speed V and arc radius r. (03 marks)
   (ii) Explain why racing car travels faster on a banked track than on a flat road. (04 marks)
   c) A curve of radius 30m is to be banked so that a car may make a turn at a speed of 13ms^{-1} without depending on friction. Calculate the slope of the curve. (03 marks)

d) (i) State the law of floatation (01 mark)

(ii) A block of wood of volume 600cm^3 floats with two thirds of its volume immersed in a liquid of relative density 0.8. A piece of aluminum of density 2700kgm^{-3} is attached to the wood so that it can just float in a liquid of relative density 1.20. Calculate the volume of aluminum used. (05 marks)

4. a) Define the following terms.

(i) Simple harmonic motion (01 mark)

(ii) Critical damping (01 mark)

(iii) Free oscillations (01 mark)

b) (i) Explain why oscillations ultimately come to rest for a slightly displaced simple pendulum. (03marks)

(ii) Sketch a graph of kinetic and potential energy for a body executing SHM. (03 marks)

c) A glass U-tube of length L containing a liquid of density ρ is tilted slightly and then released. Show that the liquid oscillates with simple harmonic motion. (04 marks)

d) State the principle of conservation of linear momentum (01 mark)

e) A 7500kg truck traveling at 5.0ms^{-1} East wards collides with a 1500kg car moving at 20ms^{-1} in a direction S60^{0}W. After collision the two vehicles remain tangled together. Calculate the;

(i) Common velocity of the vehicles (04 marks)

(ii) Gain in the heat energy of the vehicles (02 marks)

SECTION B

5. a) (i) Distinguish between critical pressure and specific critical volume. (02 marks)

(ii) State and explain two conditions under when a real gas may behave as an ideal gas. (04 marks)

b) (i) Derive the Vander Waals equation for one mole of a gas. (04 marks)

(ii) A real gas has a density of 344kgm^{-3} at its critical pressure 7.5x10^{6}Pa and critical temperature 304K. If its total mass is 4.4x10^{-2}kg and $V_c = 3b$, where V_c is critical volume and b is co-volume. Calculate Vander Waals Constants a and b for the gas. (04 marks)

c) State Dalton's law of partial pressure (01 mark)

d) In a pure atmospheric air it may be assumed that 80% of the molecules present are nitrogen of molar mass 0.028kg and 20% are oxygen of molar mass 0.032kg. If atmospheric pressure is 110K Pa and temperature is 27^{0}C. Calculate;

(i) Partial pressure exerted by each gas (03 marks)

(ii) Density of air (02 marks)

6. a) (i) Define a thermometric property (01 mark)
(ii) Give two examples of thermometric properties. (02 marks)
b) Describe the structure and action of a digital thermometer. (05 marks)
c) (i) Define specific latent heat of vaporization of a substance. (01 mark)
(ii) State and explain one application of specific latent heat of vaporization. (04 marks)
(iii) A bath contains 100kg of water at 60°C. Hot and cold taps are turned on to deliver water each at rate of $2.0\times10^{-3}m^3$ per minute at temperature of 70°C and 10°C respectively. How long will it take before the temperature in the bath has dropped to 45°C (05 marks)
d) Explain the significance of latent heat in regulation of body temperature. (02 marks)

7. a) Define partial pressure (01 mark)
b) Two hollow spheres A and B of volume $500cm^3$ and $250cm^3$ respectively are connected by a narrow tube fitted with a tap. Initially the tap is closed and A is filled with an ideal gas at 10°C at a pressure of 3.0×10^5Pa and B is filled with an ideal gas at 100°C at a pressure of 1.0×10^5 Pa. Calculate the equilibrium pressure when the tap is opened. adiabatic (05 marks)
c) (i) Distinguish between reversible a diabetic and reversible Isothermal process. (04 marks)
(ii) State 3 conditions necessary for a reversible process to occur. (03 marks)
d) (i) State the laws of black body radiation (02 marks)
(ii) Draw sketch graph of relative intensity against wavelength for a black body at three different temperatures and use it to explain why the centre of a furnace appears white. (05 marks)

SECTION C

8. a) (i) Define radioactivity decay (01 mark)
(ii) Discuss the nature of the radiations from radioactive nuclides. (04 marks)
(iii) A source emits radiations simultaneously the radiations pass through an absorber of different thickness and are detected. Sketch a graph of intensity of radiation detected against thickness of absorber and explain the main features of the graph. (05 marks)
b) Describe how hoe a G-M tube can be used to detect the presence of the radiations in a (iii) above. (05 marks)

c) The half life of Uranium – 238 is 4.5×10^9 years and that of radon – 226 is 1622 years. Calculate the mass of Uranium presenting in 2.05×10^{-5}kg of very atom of radon. (05 marks)

9. a) (i) Define as semi-conductor (01 mark)

(ii) Describe the mechanism of conduction of charge through a junction decode. (05 marks)

(iii) Sketch the I-V characteristic of the junction diode. (01 mark)

b) (i) Define positive rays (01 marks)

(ii) Describe a simple experiment to show the existence of positive rays (04 marks)

c) Electron beam emitted from a hot cathode enters a region of electric field of intensity 3.75×10^4 Vm^{-1}. If this deflection of the electron beam in the fields is annulled by a magnetic field density 1×10^{-3}T. After the beams proceed into a region of uniform magnetic field of flux density 8.52×10^{-4}T and describes a circular path of radius 0.25m. Find the value of the specific charge of the electron beam. (04 marks)

d) Describe an experiment to show that cathode rays possess kinetic energy (05 marks)

10. a) (i) Define a Photon (01 mark)

(ii) Explain briefly the quantum theory for photoelectric effect. (03 marks)

(iv) State and explain one evidence of the quantum theory of matter. (04 marks)

b) Describe an experiment based on Millikan's principle to verify the equation for photoelectric effect. (06 marks)

c) A 100 mW beam of light of wave length $4000A^0$ is 7m and falls on the caesium surface of a photo cell of radius 4.0cm.

(i) How many photons are emitted on the surface per second from the source. (02 marks)

(ii) If 70% of the photons that fell in the 4.0cm radius of caesium emit photoelectrons, find the resulting photo current. (04 marks)

END

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