Uganda Advanced Certificate of Education

Mock Examinations 2024

Physics Paper 1

2 hours 30 minutes

Instructions to candidates:

Answer five questions including at least one from each of the sections A, B and C but not more than two from each section.

Any additional questions answered will not be marked.

Non-programmable scientific calculators may be used.

Assume where necessary:

Acceleration due to gravity, g	= $9.81 ms^{-2}$
Electron charge, e	= 1.6×10^{-19} C
Electron mass	= 9.11×10^{-31} kg
Planck's constant, h	= 6.6×10^{-34} J
Speed of light in vacuum, C	= 3.0×10^{8} ms^{-1}
Avogadro's number. N_A	= 6.02×10^{23} mol^{-1}
Stefan-Boltzmann's constant, S	= 5.67×10^{-8} $wm^{-2}K^{-4}$
Radius of the sun	= 7.0×10^{8}m
Radius of the earth	= 6.4×10^{6} m
Radius of the earth's orbit about the sun	= 1.5×10^{11} m
Universal gravitational constant, G	= 6.67×10^{-11} Nm^2kg^{-2}
Gas constant, R	= 8.31 $Jmol^{-1}K^{-1}$
Faraday constant, F	= 9.65×10^{4} C mol^{-1}

SECTION A

Qn1 a) Define the following;

i) moment of force (1)

ii) relative density (1)

b) i) State the conditions for a body to be in equilibrium under the action of coplanar forces. (2)

ii) Explain how to locate center of gravity of irregular objects (4)

c) Describe an experiment to measure the relative density of a liquid (4)

d) i) Define pressure (1)

ii) Derive the expression for pressure, P at a point depth, h in a fluid of density, ρ (3)

e) i) State Archimedes' principle (1)

ii) A tank contains a liquid of density 1.2×10^3 kg m^{-3}. A block of volume $5.0 \times 10^{-3} m^3$ and density 900 kg m^{-3} is totally immersed in the liquid and is attached by a thread fixed to the bottom of the tank. Calculate the tension in the thread. (3)

Qn2 a) Define the terms;

i) scalar quantity (1)

ii) conservative force (1)

b) i) State the work-energy theorem. (1)

ii) Explain why a greater force is required to push a wheelbarrow up the incline than along a level road. (3)

c) i) State the laws of static friction. (3)

ii) Describe an experiment to measure the coefficient of kinetic friction. (4)

d) List two dangers and two uses of friction. (2)

e) An engine pulls a car of mass 1500kg on a level road at a constant velocity of $5 ms^{-1}$ against a resistance to motion of 500N. Calculate the:

i) Power the engine generates (2)

ii) extra power the engine must develop to move the car up an incline of 1 in 10 at the same speed. (3)

Qn3a) Define the terms:

i) strain (1)

ii) young's modulus (1)

b) i) State Hooke's Law (1)

ii) Sketch a stress-strain curve for a metal wire and rubber on the same axes (3)

iii) Explain the features of the curve for rubber. (2)

c) A constant force, F is applied to a metal wire of length, l, cross-sectional area, A and Young's modulus, Y to produce an extension, e. Derive an expression for the energy stored in the wire in terms of quantities given. (3)

d) i) Describe an experiment to measure the Young's modulus of a steel wire. (6)

ii) A 20m length of continuous steel metal bar of cross-sectional area 80 cm^2 is welded in place after heating to a uniform temperature of 40^oC. Given Young's modulus of steel is 2.0×10^{11}Pa and its linear expansivity is $12 \times 10^{-6} K^{-1}$, Calculate the strain energy in the metal bar at 15^oC. (3)

Qn4 a) Define the terms:

i) angular velocity (1)

ii) centripetal force (1)

b) i) State Kepler's laws of planetary motion. (3)

ii) A satellite of mass, m moves round the earth of mass, m_e at a distance, r from its centre. Derive the expression for total energy, E of the satellite. (3)

iii) Explain the effect of air resistance on the satellite in (ii) above. (3)

c) Describe an experiment to determine the universal gravitational constant, G. (6)

d) A body executing simple harmonic motion has a velocity of $3cms^{-1}$ when its displacement is 4cm and a velocity of $4cms^{-1}$ when its displacement is 3cm. Calculate the period of oscillation. (3)

SECTION B

Qn5 a) Define the following;

i)thermometric property (1)

ii) absolute temperature (1)

b) Outline the steps taken to verify Newton's law of cooling. (4)

c) i) With the aid of a labelled diagram, describe the operation of the optical pyrometer. (5)

ii) List two advantages of the platinum resistance thermometer. (2)

d) A liquid flows through a tube and is heated by a heater rated 37.8W. The inflow and outflow temperatures are maintained at 15.2^oC and 17.4^oC when the liquid flow rate is $231.8gm^{-1}$. When the flow rate is changed to $150gm^{-1}$ and rate of heating to 25.2W, the inflow and outflow temperatures are unaltered. Calculate the;

i) specific heat capacity of the liquid (4)

ii) rate of heat loss from the tube. (3)

Qn6 a) Define the following;

i) saturated vapor pressure (1)

ii) root mean square speed (1)

b) i) State Dalton's law of partial pressures. (1)

ii) Using the expression $P=\frac{1}{3}\rho\overline{c^2}$, to verify Dalton's law of partial pressures. (3)

Distinguish between ideal gas and real gas. (2)

c) With the aid of a labelled diagram describe an experiment to determine the saturated vapor pressure of water. (6)

d) A gas of volume $0.03m^3$ at a pressure of $2x10^5Pa$ and temperature of 27^oC is heated at constant pressure until its volume increases to $0.04m^3$. Given mass of gas is 16g and molar mass is 32g whose molar heat capacity at constant volume is $0.8Jmol^{-1}K^{-1}$, Calculate the;

i) external work done (2)

ii) increase in internal energy of the gas. (4)

Qn7 a) Define thermal conductivity and state its unit. (2)

b) Explain how heat transfer takes place in a solid which is an insulator. (3)

c) i) With the aid of labelled diagram describe an experiment to determine the thermal conductivity of wood. (6)

ii) State why the wood in (i) above is made thin and large cross-sectional area. (2)

d) i) What is meant by a black body? (1)

ii) List two examples of black body?

e) The solar flux of radiation incident on the earth's surface is $1.40x10^3Wm^{-2}$. Calculate the:

i) temperature of the surface of the sun (3)

ii) total power emitted by the sun. (2)

SECTION C

Qn8 a) Define the following:

i. photoelectric emission (1)

ii. Ionization energy (1)

b) i Explain the emission line spectrum (3)

ii The work function of sodium and nickel are 1.92 eV and 5.0 eV respectively. Which of the metals will not give photoelectric current from a photo cell for a radiation of 3.30×10^{-7} m? (4)

c) i With the aid of a labelled diagram, describe the operation of x- ray tube. (5)

ii Explain the effect of intensity of x-rays with the variation of the low p.d (2)

iii Distinguish between hard x-rays and soft x-rays (2)

iv Sketch the graph of intensity against wave length of x-rays (2)

Qn9 (a) Define the following:

i) cathode rays (1)

ii) specific change (1)

b) i) Explain how thermionic emission occurs (3)

ii) Charged particles of charge, Q and mass M are accelerated by a potential difference, V and then enter a field of strength, E between plates of length, L. Drive an expression for the angle ɵ through which the particles will have been deflected by the time they leave the plates in terms of E, V and L. (4)

c) i With the aid of a labelled diagram, describe how to determine the specific charge of ions using a Bain bridge spectrometer

(ii)Give two advantages of a cathode rays oscilloscope (1)

d) Abeam of electrons is accelerated through a PD of 500V and enters a uniform electric field of strength 3.0×10^{3} Vm^{-1} created by two parallel plates of length 2.0cm. Calculate the vertical component of velocity as the electrons emerge from the field, taking $e/m = 1.76 \times 10^{11}$ Ckg^{-1} (4)

Qn 10(a) Define the following:

i) half- life (1)

ii) binding energy (1)

b) i) Explain why very high temperature is required for nuclear fusion to take place (2)

ii) Sketch a graph of binding energy per nucleon against mass number (2)

c) i) with the aid of a labelled diagram, describe the operation of a diffusion cloud chamber (6)

ii) List two uses and two dangers of radioactive radiations (2)

iii) Explain why neutrons are used as bombarding particles in nuclear fusion (2)

d) A sample of 100mg from living matter has a decay rate of 200 disintegrations per minute due to radioactive Carbon -14. A piece of ancient wood of the same mass is found to have a decay rate of 50 disintegrations per minute. Calculate the age of wood given half-life of carbon-14 is 5700 years. (4)

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