RESOURCEFUL MOCK 2017

Uganda Advanced Certificate of Education

PHYSICS P510/1

TIME: 2½ HOURS

INSTRUCTIONS TO CANDIDATES

- *Answer **five** questions, including at least **one**, but not more than **two** from each of the sections **A, B** and **C**.*
- *Non-programmable scientific calculators may be used.*

Assume where necessary

Acceleration due to gravity, g = 9.81ms^{-2}

Electron charge, e	*= 1.6 x 10^{-19}C*
Electron mass	*= 9.11 x 10^{-31}Kg*
Mass of the earth	*= 5.97 x 10^{24} kg*
Plank's constant, h	*= 6.6 x 10^{-34} JS*
Stefan's –Boltzmann's constant, σ	*= 5.67 x 10^{-8} Wm^{-2} K^{-4}*
Speed of light in a vacuum, C	*= 3.0 x10^{8} ms^{-1}*
Thermal conductivity of iron	*= 80Wm^{-1}K^{-1}*
Universal gravitational constant, G	*= 6.67 x 10^{-11} Nm^{2} kg^{-2}*
Arogadro's number, N_A	*= 6.02 x 10^{23} mol^{-1}*
Density of water	*= 1000kg m^{-3}*
Density of mercury	*= 13600kg m^{-3}*
Gas constant, R	*= 8.31 Jmol^{-1} K^{-1}*
Young's Modulus for copper	*= 1.2 x 10^{11} Pa*
Young's modulus for steel	*= 2.0 x 10^{11} Pa*
Specific latent heat of fusion of ice	*= 3.3 x 10^{5}J kg-1*
Specific heat capacity of copper	*= 400J kg^{-1} K^{-1}*
Radius of earth	*= 6.4 x 10^{6} m*

SECTION A

1. a) i. Define surface tension. [1mk]

   ii. Give the molecular explanation of surface tension.

   b) i. Derive the expression for the pressure difference inside and outside a soap bubble of radius ***r*** and surface tension ***y***. [3mks]

   ii. Two soap bubbles of radii 2.2cm and 3.0cm respectively coalese under isothermal conditions. If the surface tension of the soap solution is $2.6x10^{-2}Nm^{-1}$, calculate the excess pressure inside the resulting soap bubble. [4mks]

   c) i. Surface Bernouli's principle. [1mk]

   ii. Explain why an earoplane has to bank its wings in order to make a curved path in space. [4mks]

   iii. Describe how Bernoulli's principle can be verified. [4mks]

2. a) Distinguish between elastic and perfectly inelastic collisions. [2mks]

   b) A bullet of mass 0.012kg and horizontal speed $70ms^{-1}$ strikes a block of wood of mass 0.4kg and instantly comes to come with respect to the block. The block is suspended from the ceiling by means of a thin string.

   i) Calculate the height to which the block rises. [4mks]

   ii. Estimate the amount of heat produced in the block. [2mks]

   c) i. Define the following terms, Young's modulus and working hardening as used in relation to properties of matter. [2mks]

   ii) Show that the energy stores per unit volume of a stretched wire is given by $\frac{1}{2}E\,(strain)^2$ where E is Young's modulus. [4mks]

   d) A copper wire and steel wire of the same diameter and of length 1.0m and 2.0m respectively are connected end to end. A force is applied which stretches their combined length by 1.0cm, find;

   i) The extension in each wire [4mks]

   ii) The stress in the composite wire [2mks]

3. a) State Kepler's laws of planetary motion. [3mks]

   b) i. The moon moves in a circular Orbit of radius, R about the earth of mass M_e with period T. Show that $R^3 = \frac{gre^2T^2}{4\pi^2}$, where r_e = radius of the earth, g is acceleration due to gravity on the earth's surface. [5mks]

ii. The period of the moon around the earth is 655.2 hours. If the distance of the moon from the earth is 3.83 x 10^8m, calculate the acceleration due to gravity at the surface of the earth. [4mks]

iii. Explain why resistance to the forward motion of an artificial satellite results into increase in its speed. [3mks]

c) i. State Archimedes principle. [1mk]

ii. Use Archimedes principle to determine an expression for the resultant force on a body of weight W and density σ totally immersed in a fluid of density δ

4. a) Define simple harmonic motion. [1mk]

b) Sketch the following graphs for a body performing simple harmonic motion.

i. Velocity against displacement graph [2mks]

ii. Acceleration against displacement graph [2mks]

c) A small bob of mass 0.20kg is suspended by an inextensible string of length 0.80m. The bob is then rotated in a horizontal circle of radius 0.4m, find the;

i. Linear speed of the bob [3mks]

ii. Tension in the string [2mks]

d) i. State the law of flotation. [1mk]

ii. Show that the weight of fluid displaced by an object is equal to the up thrust on the object. [4mks]

e) A cylindrical vessel of cross-sectional area A, contains air of volume V at pressure P trapped by frictionless air tight position of mass M, the piston is pushed down and released. If the piston oscillates with simple harmonic motion, find its frequency f. [5mks]

SECTION B

5. a) i. Define thermometric property and give two examples.

ii. With reference to a platinum resistance thermometer, describe briefly how the total radiation pyrometer can be used to measure temperature of a hot body. [5mks]

c) i. The resistance, R_θ of a platinum wire at temperature Θ^0C, measured on the gas scale is given by

$R_\theta = R_0(1+\propto \theta + \beta\theta^2)$, where $\propto = 3.8\,x\,10^{-3}$ and $\beta = -5.6\,x\,10^{-7}$. Find the temperature indicated by the platinum resistance thermometer when the temperature on the gas scale is 200^0C. [4mks]

ii. Briefly explain why the two temperature in (c i) are different. [1mk]

d) i. State and explain the source of inaccuracies while using the mercury in-glass thermometer.

ii. State two advantages of a thermocouple over an electrical resistance thermometer.

6. a) i. State Boyle's law. [1mk]

ii. Describe an experiment that can be used to verify Boyle's law. [6mks]

b) Explain the following observations using the kinetic theory.

i. A gas fits any container in which it is placed and exerts a pressure on its walls. [3mks]

ii. The pressure of a fixed mass of a gas rises when its temperature is increased at constant volume. [2mks]

c) i. What is meant by a reversible process? [1mk]

ii. State the conditions necessary for isothermal and adiabatic process to occur. [4mks]

d) A mass of an ideal gas of volume 200cm3 at 144K expands adiabatically to a temperature of 137K. Calculate its new volume [take CP/CV = 1.4] [3mks]

7. a) i. What is meant by critical temperature of a gas? [1mk]

ii. Distinguish between a gas and a vapour. [2mks]

b) i. Sketch a P – V graph for a real gas undergoing compression below its critical temperature. [2mks]

ii. Explain the main features of the curve in (b i). [3mks]

c) Two similar cylinders X and Y contain different gases at the same pressure when gas is released from X, the pressure remains constant for some time before it starts dropping. When gas is released from Y, the pressure continuously drops. Explain the observations above. [3mks]

d) i. State the kinetic theory of matter. [1mk]

ii. Describe briefly an experiment that you can carry out in support of Kinetic theory of matter. [3mks]

e) A helium gas occupies a volume of $0.02m^3$ at a pressure of 200K pa and temperature 27^0C. Calculate

i. Mass of the helium gas [3mks]

ii. The root –mean –square speed of the molecules of the helium gas [Take molecular mass of helium = 4g] [2mks]

SECTION C

8. a) i. Describe with the aid of a labeled diagram the main features of a cathode ray oscilloscope (C.R.O) [8mks]

ii. State two uses of a C.R.O. [1mk]

iii. The gain control of a C.R.O is set on 0.5V cm^{-1} and an alternating voltage produces a vertical trace of 2.0cm long with the time base off. Find the root mean square value of the applied voltage. [2mks]

b) A beam of electrons is accelerated through a potential difference of 2000V and is directed mid-way between two horizontal plates of length 5.0cm and a separation of 2.0cm. The potential difference across the plates is 80V.

i. Calculate the speed of the electrons as they enter the region between the plates. [3mks]

ii. Explain the motion of the electrons between the plates. [2mks]

iii. Find the speed of the electrons as they emerge from the region between the plates. [4mks]

9. a) What is meant by the following terms;

i. nuclear number [2mks]

ii. binding

b) Calculate the energy released during the decay of $^{220}_{86}Rn$ nuclear into $^{216}_{84}P_0$ and an ∝- particle.

Mass of $^{220}_{86}Rn$ = 219.964176u
Mass of $^{216}_{84}P_0$ = 215.955794u
Mass of $^{4}_{2}He$ = 4.001566u
1u = 931MeV

[4mks]

c) Describe the Bainbridge mass spectrometer and explain how it can be used to distinguish between isotopes. [7mks]

d) i. Explain how you would use a decay curve for a radioactive material to determine its half-life. [2mks]

ii. A radioactive source contains 1.0μg of plutonium of mass number 239. If the source emits 2300 ∝ - particles per second, calculate the half-life of plutonium. [Assume $N = N_0 e^{-\lambda t}$ [5mks]

END