P510/1

PHYSICS

Paper 1

2½ hours

Uganda Advanced Certificate of Education

PHYSICS

Paper 1

2 hours 30 minutes

INSTRUCTIONS TO CANDIDATES:

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

Any additional question(s) answered will not be marked

Where necessary, assume the following constants:

Acceleration due to gravity, g = 9.81 m s – 2

Electronic charge, e = 1.6 x 10-19C

Electronic mass = 9.11 x 10-31kg

Avogadro’s number, NA = 6.02 × 10 23 mol – 1

Mass on earth = 5.97 x 1024kg

Charge to mass ratio of an election =

One electron volt, eV = 1.6 × 10 – 19 J

Planck’s constant, h = 6.6 × 10 – 34 J s

Radius of the earth = 6.4 x 106m

Specific heat capacity of water = 4.2 × 10 3 J kg – 1 K – 1

Specific latent heat of fusion of ice = 3.36 x 103JKg-1K-1

Stefan’s – Boltzmann’s constant, δ = 5.67 × 10 – 8 W m – 2 K – 4

Speed of light in Vacuum, c = 3.0 × 10 8 m s – 1

Unified mass unit, U = 1.66 × 10 – 27 kg

Universal gravitational constant, G = 6.67 x 10-11NM2Kg-2

Gas constant, R = 8.31Jmol-1K-1

Permittivity of free space, o = 8.8510-12Fm-1

SECTION A

1. (a) State Newton’s laws of motion. (3 marks)

(b) (i) State the principle of conservation of linear momentum. (1 mark)

(ii) Use Newton’s laws of motion to verify the principle of conservation of linear momentum. (4 marks)

(c) A steel ball of mass 0.1kg moving with a speed of 10ms-1 collides with an identical steel ball at rest. After collision the direction of each ball, makes an angle of 30o with the original direction.

(i) Calculate the velocity of each ball after collision. (5 marks)

(ii) Is this collision elastic? (4 marks)

(d) Explain what is meant by weightlessness. (3 marks)

2. (a) (i) What is a planet? (1 mark)

(ii) State Kepler’s laws of planetary motion. (3 marks)

(b) An artificial satellite of mass m is in a circular orbit of radius, ro round the earth of mass M.

(i) Derive an expression for the total energy of the satellite in the orbit. (4 marks)

(ii) Explain why the speed of the artificial satellite orbiting the earth increase progressively as it comes closer and closer to the earth. (4 marks)

(c) A satellite of mass 300kg orbits the earth at a height of 500km from its surface.

Find the total energy of the satellite. (5 marks)

(d) Explain why the gravitational force of attraction between two bodies of ordinary mass is not noticeable in everyday life. (3 marks)

3. (a) (i) Define surface tension in terms of work. (1 mark)

(ii) Explain why it is easier to wash clothes with a hot soap solution than a cold soap solution. (3 marks)

(b) (i) Define angle of contact. (1 mark)

(ii) Describe an experiment to determine the surface tension of a liquid by capillarity method. (6 marks)

(c) Derive an expression for the excess pressure in an air bubble formed inside a liquid.

(3 marks)

(d) A soap bubble of diameter 1cm is formed at the top of a capillary tube of diameter 1mm dipping into a beaker of water. If the coefficient surface tension of water and soap solution are 7.0 x 10-2 and 3.0 x 10-2Nm-1 respectively. Calculate the height of the water in the capillary tube above the water in the beaker and state any assumptions you have made.

(6 marks)

4. (a) (i) What is meant by the terms streamline flow and turbulent flow? (2 marks)

(ii) Describe an experiment to illustrate the two types of flow. (5 marks)

(b) (i) Define the coefficient of viscosity and hence deduce its dimensions. (4 marks)

(ii) Water of negligible viscosity flows steadily through a pipe of varying cross- sectional area. At a point A of cross-sectional area 10.0cm2, the velocity is 0.2ms-1.

What is the pressure difference between A and B if the cross-sectional area of point B is 2.5cm2? (4 marks)

(c) (i) State Bernoulli’s principle. (1 mark)

(ii) Explain why we should blow over a piece of paper not under it to keep it horizontal.

(4 marks)

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SECTION B

5. (a) Define the following quantities.

(i) Thermometric property (1 mark)

(ii) Fixed point (1 mark)

(b) (i) Describe the steps taken to set up a celcius scale of temperature for a platinum resistance thermometer. (4 marks)

(ii) State two advantages and two disadvantages of a resistance thermometer. (2 marks)

(c) Describe with aid of a diagram, how a constant-volume gas thermometer is used to measure temperature. (6 marks)

(d) The resistance R of the wire of an electrical resistance thermometer at a temperature toC is given by R=Ro(1+

Where Rois the value of R at 0oC and is a constant of the wire. The resistance at the triple point of water is 101.6Ω and that at 600.5K IS 165.5Ω. What is the temperature when the resistance is 123.4Ω?

(6 marks)

6. (a) (i) Define specific latent heat of vaporization of a liquid. (1m ark)

(ii) With the aid of a labeled diagram, describe an experiment to measure the specif latent heat of vaporization of a liquid using an electrical method. (7 marks)

(b) (i) What is the boiling point of a liquid? (1 mark)

(ii) Explain the effect of reducing external pressure on boiling point of a liquid.

(3 marks)

(c) What is meant by saturated and unsaturated vapour? (2 marks)

(d) (i) Define the saturated vapour pressure of a liquid. (1m ark)

(ii) A closed vessel contains a mixture of air and alcohol vapour in contact with liquid alcohol. The pressure in the vessel at 20oC is 1.7 x 104Nm-2 when the mixture is heated to 78oC, the normal boiling point of alcohol the pressure in the vessel becomes 1.14 x 105Nm-2. Determine the S.V.P of alcohol at 20oC, assuming that the vapour remains saturated and the atmospheric pressure is 1.01 x 105Nm-2. (5 marks)

7. (a) (i) What is a black body? (1 mark)

(ii) Give two examples of a black body. (1 mark)

(iii) Explain with the aid of a diagram how a black body is approximated. (4 marks)

(b) (i) State the laws of black body radiation. (2m arks)

(ii) The total power output of the sun is 4.4 x 1026W. If the density of the sun is

1.4 x 103Kgm-3 and its mass is 2.0 x 1030kg, calculate the surface temperature of the sun. (5marks)

(c) (i) What is coefficient of thermal conductivity? (1mark)

(ii) Describe Searle’s method of determination of coefficient of thermal conductivity.

(6 marks)

SECTION C

8. (a) State Bohr’s postulates of the atom. (3 marks)

(b) Explain the occurrence of the emission line spectrum. (3 marks)

(c) Explain the main observations in Rutherford’s alpha particles scattering experiment. (6 marks)

(d) Explain why the experiment was carried in a vacuum. (3 marks)

(e) An alpha particle is projected with an energy of 4MeV directly towards a gold nucleus.

(i) Calculate the distance of its closest approach given that the atomic number of gold is 79. (4 mark)

(ii) State the significance of the value of the least distance of approach. (1m ark)

9. (a) (i) What is meant by X-rays and cathode rays? (2 marks)

(ii) With the aid of a labeled diagram describe the structure and mode of a operation of an X-ray tube. (5 marks)

(b) Explain how soft and hard x-rays are produced. (3 marks)

(c) (i) Sketch a graph of intensity against wavelength for the spectra produced in an X-ray tube. (1 mark)

(ii) Use the graph to explain the occurrence of the cut-off wavelength, continuous and the line spectra. (5 marks)

(d) The potential difference between the cathode and the anode of an X-ray tube is

5.0 x 10+4V. If only 0.4% of the kinetic energy of the electrons, is converted into X-rays and the rest is dissipated as heat in the target at a rate of 600W, find the ;

(i) current that flows (2marks)

(ii) speed of the electrons striking the target. (2 marks)

10. (a) (i) With the aid of a well labeled diagram, describe the structure and mode of operation of a cathode ray oscilloscope. (6 marks)

(ii) Give two uses of a C.R.O. (1 marks)

(b) Ultraviolet radiation falls on Zinc plate placed on the cape of a neutral electroscope.

(i) State what is observed. (1 mark)

(ii) Explain the observation in (b)(i) above. (3 marks)

(c) State the laws of photoelectric emission. (4 marks)

(d) Sodium has a work function of 2.0eV and is illuminated by radiation of wavelength 150nm.

(i) Calculate the maximum speed of the emitted electrons. (3 marks)

(ii) Find the threshold frequency. (2 marks)

END