

# UNEB UACE PHYSICS PAPER 1 2016

## SECTION A

1. a) i) Define dimensions of a physical quantity.

ii) In the gas equation

$$\left(p + \frac{a}{V^2}\right)(V - b) = RT$$

where  $p$  = pressure,  $V$  = volume,  $T$  = absolute temperature and  $R$  = gas constant, what are the dimensions of the constants  $a$  and  $b$ ?

b) A particle is projected from a point on horizontal plane with a velocity,  $u$  at an angle,  $\theta$ , above the horizontal. Show that the maximum horizontal range  $R_{\max}$  is given by

$$R_{\max} = \frac{u^2}{g}$$

where,  $g$ , is acceleration due to gravity.

c) i) Define **elastic limit** of a material.

ii) Describe an experiment to determine Young's Modulus of steel wire.

d) Explain why tyres of a vehicle travelling on a hard surfaced road may burst.

2. a) i) What is meant by **efficiency of a machine**?

ii) Describe an experiment to determine Young's Modulus of a steel wire.

b) i) Define the impulse and momentum

ii) An engine pumps water such that the velocity of the water leaving the nozzle is  $15\text{ms}^{-1}$ . If there water jet is directed perpendicularly onto a wall and comes to a stop at the wall, calculate the pressure exerted on the wall.

c) i) Define **inertia**.

ii) Explain why a body placed on a rough plane will slide when the angle of inclination is increased.

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

ii) Briefly explain the three states of equilibrium.

3a) i) What is meant by a conservative force?

ii) Give two examples of conservative force.

b) Explain the following

i) Damped oscillations

ii) Forced oscillations

c) i) State Newton's law of gravitation.

ii) Show that Newton's law of gravitation is consistent with Kepler's third law.

- d) If the earth takes 365 days to make one revolution around the sun, calculate the mass of the sun.
- e) Explain briefly how satellites are used in world-wide radio or television communication
4. a) i) What is meant by fluid element and a flow line as applied to fluid flow?  
 ii) Explain why some fluids flow more easily than others.
- b) i) State **Bernoulli's Principle**  
 ii) Explain how a Pitot-static tube works
- c) Air flowing over the upper surface of an air craft's wings causes a lift force of  $6.4 \times 10^3$  N. The air flows under the wings at a speed of  $120 \text{ms}^{-1}$  over an area of the upper surface of the air craft's wings.

(Assume density of air =  $1.2 \text{kgm}^{-3}$ )

- d) i) What is meant by surface tension and angle of contact of a liquid?  
 ii) A water drop of radius 0.5cm is broken up into other drops of water each of radius 1 mm. Assuming isothermal conditions, find the total work done to break up the water drop.

## SECTION B

5. a) i) Define **specific latent heat of fusion**.  
 ii) State the effect of impurities on melting point.
- b) Explain why there is no change in temperature when a substance is melting.
- c) With the aid of a labeled diagram, describe the continuous flow method of measuring the specific heat capacity of a liquid.
- d) In an experiment to determine the specific latent heat of fusion of ice a heating coil is placed in a filter funnel and surrounded by lumps of ice. The following two sets of readings were obtained.

V(V)	4.0	6.0
I (A)	2.0	3.0
Mass of water $m$ (g) collected in 500s.	14.9	29.8

Calculate the;

- i) specific latent heat of fusion of ice.  
 ii) energy gained in the course of obtaining the first set of readings.
- e) Why are two sets of readings necessary in (d) above.
- 6.a) i) State **Dalton's law of partial pressures**.  
 ii) Using the expression  $p = \frac{1}{3} \rho c^2$ , where  $p$  is the pressure of a gas of density  $\rho$  and mean square speed  $c^2$ , derive Dalton's law of partial pressures for two gases.
- b) i) What is meant by **isothermal** process and **adiabatic** process.  
 ii) Explain why adiabatic expansion of a gas causes cooling.
- c) A gas at a temperature of  $17^\circ\text{C}$  and pressure  $1.0 \times 10^5 \text{Pa}$  is compressed isothermally to half its original volume. It is then allowed to expand adiabatically to its original volume.
- i) Sketch on a P – V curve the above processes.  
 ii) If the specific heat capacity at constant pressure is  $2100 \text{Jmol}^{-1} \text{K}^{-1}$  and at constant volume is  $1500 \text{Jmol}^{-1} \text{K}^{-1}$ , find the final temperature of the gas.

- d) i) What is meant by a **saturated vapour**?
- ii) Explain briefly the effect of altitude on the boiling point of a liquid.
7. a) i) Define a black body.
- ii) Sketch and explain graphs of intensity versus wavelength for three different temperatures of a black body.
- b) Describe with the aid of a labeled diagram how an optical radiation pyrometer is used to measure temperature.
- c) i) State **Prevost's theory** of heat exchanges.
- ii) A metal sphere of radius 1.5cm is suspended within an evacuated enclosure whose walls are at 320K. The emissivity of the metal is 0.40. Find the power input required to maintain the sphere at a temperature of 320K, if heat conduction along the supports is negligible.
- d) A metal boiler is 1.5cm thick. Find the difference in temperature between the inner and outer surfaces if 40kg of water evaporate from the boiler per metre squared per hour.
- (*Latent heat of vaporization of water = 2268kJkg<sup>-1</sup>, Thermal conductivity of the metal of the boiler = 63Wm<sup>-1</sup>K<sup>-1</sup>*).

### SECTION C

8. a) i) Distinguish between **mass defect** and **binding energy** of an atomic nucleus.
- ii) Sketch a graph of nuclear binding energy per nucleon versus mass number for naturally occurring isotopes and use it to distinguish between nuclear fission and fusion.
- b) Describe with the aid of labeled diagram, Millikan's oil drop experiment to determine charge on an oil drop.
- c) i) Explain briefly diffraction of X-rays by crystals and derive **Bragg's law**.
- ii) A second order diffraction image is obtained by reflection of X-rays at atomic planes of a crystal for a glancing angle of  $11^{\circ} 24'$ . Calculate the atomic spacing of the planes if the wavelength of X-rays is  $4.0 \times 10^{-11}$  m.
9. a) State **Bohr's model** of an atom.
- b) An electron of mass  $m$  and charge  $-e$ , is considered to move in circular orbit about a proton.
- i) Write down the expression for the electric force on the electron.
- ii) Derive an expression for the total energy of the electron given that the angular momentum of the electron is equal to  $\frac{nh}{2\pi}$  where  $n$  is an integer and  $h$  is Planck's constant.
- c) With the aid of a labeled diagram, describe the operation of a diffusion type cloud chamber.
- d) The energy levels of an atom have values
- $E_1 = 21.4$  eV
- $E_2 = -4.87$  eV
- $E_3 = -2.77$  eV
- $E_4 = -0.81$  eV
- $E = 0.00$  eV
- i) Calculate the wavelength of radiation emitted when an electron makes a transition from  $E_3$  and  $E_2$ .
- ii) State the region of the electromagnetic spectrum where the radiation lies.
10. a) Describe how positive rays are produced.
- b) Describe how a Bainbridge spectrometer can be used to detect isotopes.

c) i) What is a time base as applied to a Cathode Ray Oscilloscope?

ii) Draw a sketch graph showing the variation of time-base voltage with time.

d) An alternating p.d to the Y-plates of an oscilloscope produces five complete waves on a 10cm length of the screen when the time base setting is  $10\text{mscm}^{-1}$ . Find the frequency of the alternating voltage.

e) i) Explain the motion of an electron projected perpendicularly into a uniform magnetic field.

ii) An electron accelerated from rest

by a p.d of 100V, enters perpendicularly into a uniform electric field of intensity  $105\text{Vm}^{-1}$ . Find the magnetic flux density,  $\mathbf{B}$  which must be applied perpendicularly to the electric field so that the electron passes undeflected through the fields.

**END**