UACE Physics paper 1 set6 Time 2½ marks

Instructions the candidates:

Answer **five** questions, including at least **one**, but **not more than two** from each sections **A, Band C**.

Any additional question(s) answered will not be marked.

Non programmable scientific calculators may be used.

Assume where necessary

Acceleration due to gravity, g	$9.81ms^{-2}$
Electron charge, e	$1.6 x10^{-19}C$
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	$5.67 x 10^{-8}Wm^{-2}K^{-1}$
Radius of the earth	6.4 x 106m
Radius of the sun	$7 x 10^{8}m$
Radius of the earth's orbit about the sun	$1.5 x 10^{11}m$
Speed of light in the vacuum, c	$3.0 x 108ms^{-1}$
Thermal conductivity of copper	$390Wm^{-1}K^{-1}$
Thermal conductivity of aluminium	$210Wm^{-1}K^{-1}$
Specific heat capacity of water	$4.200Jkg^{-1}K^{-1}$
Universal gravitational constant	$6.67 x 10^{-11}Nm^{2}Kg^{-2}$
Avogadro's number, N_A	$6.02 x 10^{23}mol^{-1}$
Surface tension of water	$7.0 x 10^{-2}Nm^{-1}$
Density of water	$1000kgm^{-3}$
Gas constant, R	$8.31Jmol^{-1}K^{-1}$
Charge to mass ratio, e/m	$1.8 x 10^{11}Ckg^{-1}$
The constant, $\frac{1}{4\pi\varepsilon_0}$	$9.0 x 10^{9}F^{-1}m$
Faraday's constant, F	$9.65 x 10^{4}Cmol^{-1}$

SECTION A

1. (a)(i) What is projectile motion? (01 marks)
   (ii) A bomb is dropped from an aeroplane when it is directly above a target at a height of 1402.5m. The aeroplane is moving horizontally with a speed 0f 500kmh^{-1}. Determine whether the bomb will hit the target. (05marks)
   (b) (i) Define angular velocity. (01mark)
   (ii) a satellite is revolving around the earth in a circular orbit at an altitude of 6 x 105m where the acceleration due to gravity is 9.4 ms^{-2}. Assuming that the earth is spherical, calculate the period of the satellite. (03marks)
   (c) (i) State Newton's laws of motion (03marks)
   (ii) Explain how a rocket is kept in motion. (04marks)
   (i) Explain why passengers in a bus are thrown backwards when the bus suddenly start moving (03marks)

2. (a) (i) What is meant by Young's modulus? (03marks)
   (ii) State Hooke's law (01mark)
   (iii) Derive an expression for energy released in a unit volume a stretched wire in terms of stress and strain. (04marks)
   (b) A steel wire of length 0.6m and cross-section area 1.5 x 10^{-6}m^2 is attached at B to a copper wire BC of length 0.39m and cross section area 3.0 x 10^{-6}m^2. The combination is suspended vertically from a fixed point at A and supports a weight of 250N at C. find the extension in each of the wires, given that Young's Modulus for steel is 2.0 x 10^{11}Nm^{-2} and that of copper is 1.3 x 10^{11}Nm^{-2}. (05marks)
   (c) With the aid of a labelled diagram, describe an experiment to determine the Young's Modulus of a steel wire (07marks)
   (d) Explain the term plastic deformation in metals (02marks)
3. (a) Define work and energy (02marks)
   (b) Explain whether a person carrying a bucket of water does any work on the bucket while walking on a levelled road. (03marks)
   (c) A pump discharges water through a nozzle of diameter 4.5cm with speed of 62ms^{-1} into a tank 16m above the intake.
   (i) Calculate the work done per second by the pump in raising the water if the pump is ideal. (04marks)
   (ii) Find the power wasted if the efficiency of the pump is 73% (02marks)
   (iii) Account for the power loss in (c)(ii) (02marks)

   (d) (i) State work-energy theorem. (01mark)

   (ii) Prove the work-energy theorem for a body moving with constant acceleration. (03marks)

   (e) Explain briefly what is meant by internal energy of a substance. (03marks)

4. (a) Define coefficient of viscosity and state its units. (02marks)
   (b) Explain the origin of viscosity in air and account for the effect of temperature on it. (05marks)
   (c) Describe, stating the necessary precautions an experiment to measure the coefficient of viscosity of a liquid using Stroke's law. (07marks)

(d) A steel ball bearing of diameter 8.0mm falls steadily through oil and covers a vertical height of 20.0cm in 0.56s. If the density of steel is7800kgm^{-3} and that of oil is 900kgm^{-3}, calculate the

(i) up thrust on the ball (03marks)

(ii) viscosity of the oil (03marks)

SECTION B

5. (a) (i) State two differences between saturated and unsaturated vapours. (02marks)

(ii) Sketch graphs of vapour against temperature for an ideal gas and for saturated water vapour originally at 0^0C (03marks)

(b) The specific heat capacity of oxygen at constant volume is 719Jkg^{-1}K^{-1} and its density at standard temperature and pressure is 1.429kgm^{-3}. Calculate the specific heat capacity of oxygen at constant pressure (04marks)

(c) (i) With the aid of a labelled diagram, describe an experiment to determine standard saturated vapour pressure of water. (05marks)

(ii) State how the experiment set up in (c) (i) may be modified to determine a saturated vapour pressure of above atmospheric pressure (01marks)

(d)(i) Define ideal gas (01mark)

(ii) State and explain the conditions under which real gases behave as ideal gases. (04marks)

6. (a) (i) What is a black body?(01marks)

(ii) Explain with the aid of a diagram how black body can be approximated. (03marks)

(iii) With the aid of sketch graphs explain the silent features of the spectral distribution of black body radiation (04 marks)

(b) Give four properties of ultraviolet radiation. (02marks)

(c) Describe an experiment to compare the energy radiated by two surfaces at different temperatures (04marks)

(d) (i) State Stefan's law. (01mark)

(ii) The earth receives energy from the earth from the sun at the rate of 1.4 x 10^3Wm^{-2}. If the ratio of the earth's orbit to the sun's radius is 216, calculate the surface temperature of the sum. (05marks)

7. (a) Define specific latent heat of vaporization. (01mark)

(b) With the aid of labelled diagram, describe an experiment to measure the specific latent heat of vaporization of a liquid using an electrical method. (07marks)

(c) Explain the effect of pressure on the boiling point of a liquid. (02marks)

(d) A liquid of specific heat capacity 2.8 x 10^3Jkg^{-1}K^{-1} and specific latent heat of vaporization 9.00 x 10^5Jkg is contained in a flask of heat capacity 800JK^{-1} at a temperature of 32^0C. An electric heater rated 1kW is immersed in 2.5kg of the liquid and switched on for 12

minutes, calculate the amount of liquid that boiled off, given that the boiling point of the liquid is 80^0C. (06marks)

(e) (i) Two thermometers are used to measure the temperature of a body. Explain why the temperatures may be different. (02marks)

(ii) A platinum resistance thermometer has a resistance of 5.42Ω at the triple point of water. Calculate the resistance at a temperature of 50.0^0C. (02marks)

SECTION C

8. (a) State Rutherford's model of the atom. (02marks)

(b) Explain how Bohr's model of the atom addresses the two main failures of Rutherford's model. (07marks)

(c) With the aid of a labelled diagram, describe how cathode rays are produced. (05marks)

(d) (i) What is binding energy of a nucleus? (01mark)

(ii) Calculate the energy in MeV released by fusing four protons to form an alpha particle and two beta particles.

Mass of beta particle = 0.000549u

Mass of hydrogen atom = 1.007825u

Mass of helium atom = 4.002664u

[1u = 931MeV] (05marks)

9. (a) What is photo electric emission? (01mark)

(b)(i) Describe an experiment to demonstrate photo electric effect. (04marks)

(ii) When a clean surface of a metal in a vacuum is irradiated with light of wave length 5.5×10^{-7}m, electrons just emerge from the surface. However when light of wavelength 5×10^{-7}m is incident on the metal surface, electrons are emitted each with energy 3.62×10^{-20}J. Find Plank's constant. (04marks)

(c) (i) With the aid of a labelled diagram, describe an X-ray tube and how X-rays are produced. (05marks)

(ii) Describe how the intensity and quality of X-rays is controlled in an X-ray tube. (02marks)

(d) An X-ray tune operates at 1.5 x 10-3V and the current through it is 1.0 x 10-3A.

Find the

(i) number of electrons crossing the tube per second. (02marks)
(ii) kinetic energy gained by electron traversing the tube (02marks)

10. (a)(i) What is specific charge? (01mark)

(ii) State the **unit** of specific charge (01mark)

(iii) Describe with the aid of a diagram how the specific charge of positive ions can be determined using a mass spectrometer. (06marks)

(b) A beam of strongly ionized carbon atoms passes undeflected through a region of crossed magnetic and electric field of 0.10T and $1.0 \times 10^{4} NC^{-1}$ respectively. When it enters a region of uniform magnetic field, it is deflected through an arc of radius 0.75m. Calculate the magnetic flux density of this magnetic field. (Mass of carbon atom = 2.0×10^{-26}kg) (05marks)

(c) (i) Draw a graph to illustrate the variation of ionization current and p.d across an ionization chamber and explain its features. (03marks)

(ii) Explain how ionization chamber can be used to detect ionization radiation (04marks)

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