UACE Physics paper 1 set 2 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.

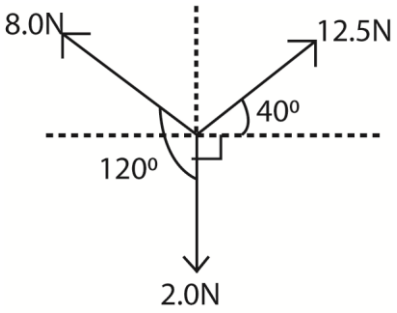
Non programmable scientific calculators may be used.

Assume where necessary

Acceleration due to gravity, g	$9.81ms^{-2}$
Electron charge, e	$1.6 x10^{-19}C$
Electron mass	$9.11 \times 10^{-31}kg$
Mass of the earth	$5.97 \times 10^{24}kg$
Plank's constant, h	$6.6 \times 10^{-34}Js$
Stefan's-Boltzmann's constant, σ	$5.67 \times 10^{-8}Wm^{-2}K^{-1}$
Radius of the earth	6.4 x 106m
Radius of the sun	$7 \times 10^{8}m$
Radius of the earth's orbit about the sun	$1.5 \times 10^{11}m$
Speed of light in the vacuum, c	$3.0 \times 108ms^{-1}$
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	$6.67 \times 10^{-11}Nm^{2}Kg^{-2}$
Avogadro's number, N_A	$6.02 \times 10^{23}mol^{-1}$
Surface tension of water	$7.0 \times 10^{-2}Nm^{-1}$
Density of water	$1000kgm^{-3}$
Gas constant, R	$8.31Jmol^{-1}K^{-1}$
Charge to mass ratio, e/m	$1.8 \times 10^{11}Ckg^{-1}$
The constant, $\frac{1}{4\pi\varepsilon_0}$	$9.0 \times 10^{9}F^{-1}m$
Faraday's constant, F	$9.65 \times 10^{4}Cmol^{-1}$

SECTION A

1. (a) What is meant by relative velocity? (01mark)
   (b) A ship is heading due to north at a speed of $30ms^{-1}$. Water in the lake s moving in the north-east direction at an average speed of 5kmh-1. Calculate
   (i) relative velocity of the ship (04 marks)
   (ii) distance off course the ship will be after 40 minutes. (02marks)
   (c) (i) Explain why a passenger in a car jerks forward when the brakes are suddenly applied. (03marks)
   (ii) Use Newton's second law to define the Newton. (04marks)
   (d) Three forces of 8.0N, 12.5N and 2.0Nact on a body of mass 0.7kg as shown below



   Calculate the acceleration of the body
2. (a) what is meant by the centre of the mass? (01mark)
   (b) Explain why a long spanner is preferred to a short on n undoing a tight bolt. (03marks)
   (c) A uniform ladder of length 10m and weight 400N, leans against a smooth wall and its foot rests on rough ground. The ladder makes an angle of 60^0 with the horizontal. If the ladder just slips when a person of weight 800N climbs 6m up the ladder, calculate the
   (i) reaction on the wall and the ground (05marks)
   (ii) distance another person of weight 600N can climb up the ladder so that the same reaction are exerted as in (c)(i). (02marks)
   (d) (i) State the principle of conservation of energy. (01mark)
   (ii) How does the principle in (d)(i) apply to a child sliding down an incline? (02marks)
   (e) A pump with power output of 147.1W can raise 2kg of water per second through a height of 5m and delver it into a tank. Calculate the speed with which the water is delivered into the tank. (03marks)
   (f) Explain the effect of a **couple** on a rigid body. (03marks)
3. (a) What is meant by a
   (i) Brittle material (01mark)
   (ii) Ductile material (01marks)

   (b) Give one example of each of the materials in (a) (01mark)

   (c) Explain why bicycle frame are hollow (02mark)

   (d) (i) Sketch a labelled graph of stress against strain for a ductile material (02marks)

   (ii) Explain the main features of the graph in (d)(i) (04marks)

   (e) Derive the expression for the energy stored per unit volume in a rod of length, L, Young's Modulus, Y, when stretched through distance, e. (04marks)

(f) A load of 5kg is placed on top of a vertical brass rod of radius 10mm and length 50cm. if

(i) decrease in length (03marks)

(ii) energy stored in the rod. (02marks)

4. (a) Define the following:
   (i) Angular velocity
   (ii) Period

   (b) An object moves in a circular path of radius, r, with a constant velocity, V. Derive an expression for its acceleration. (04marks)

   (c) (i) State two factors on which the rate of flow of a fluid through a tube depends. (02marks)

   (ii) Describe an experiment to measure the coefficient of viscosity of a liquid using Ponselle's formula

   (d) Find the time take for an oil drop of diameter 6.0×10^{-3}mm to fall through a distance of 4.0 cm in air of coefficient of viscosity 1.8×10^{-5}Pa.

   [The density of oil and air are 8.0×10^{3}kgm^{-3} and 1kgm^{-3} respectively]

SECTION B

5. (a) Define the following quantities:
   (i) Thermometric property (01mark)
   (ii) Specific heat capacity (01mark)

   (b) (i) state two examples of commonly used thermometric properties. (01mark)

   (ii) Describe briefly how to determine the lower and upper fixed points for an uncalibrated liquid-in-glass thermometer (04marks)

   (c) (i) Describe with the aid of a diagram, an experiment to determine the specific heat capacity of a liquid using the continuous flow method. (07marks)

   (ii) State two advantages of the continuous flow method over the method of mixtures. (01mark)

   (iii) State two disadvantages of the method in (c)(i) (01mark)

   (d) The brake lining of the wheel of a car of mass 800kg have total mass of 4.8kg and are made of a material of specific heat capacity 1200Jkg^{-1}K^{-1}. If the car is at 15ms^{-1} and is brought to rest by applying the brakes, calculate the maximum possible temperature rise of the brake lining. (04marks)

6. (a) (i) What is meant by conduction of heat? (01mark)
   (ii) Explain why mercury conducts heat better than water. (03marks)
   (iii) Explain the occurrence of land and sea breezes. (06marks)
   (b) A copper sphere of radius 7cm and density 900kgm^{-3}, is heated to a temperature of 127^{0}C and then transferred to an evacuated enclosure whose walls are at a temperature of 27^{0}C. Calculate

(i) net rate of loss of heat by the copper sphere

(ii) temperature of copper sphere after 5minutes

(c) Explain why heating system based on the circulation of steam are more efficient than those based on circulation of boiling water. (02marks)

7. (a) (i) what is meant by a black body? (02marks)

(ii) Give two examples of a black body. (01mark)

(b) With aid of graphs describe how radiation emitted by a black body varies with wavelength for two temperatures.

(c) (i) Define thermal conductivity. (01mark)

(ii) Describe an experiment to determine thermal conductivity of glass. (07marks)

(d) Radiation from the sun falls normally on a blackened roof measuring 20m x 50m. If half of the solar energy is lost in passing through the earth's atmosphere, calculate the energy incident on the roof per minute. [Temperature of the sun's surface = 6000K; radius of the sun = 7.5 x 10^8m, distance of the sun from the earth = 1.5 x 10^{11}m]

SECTION C

(ii)

8. (a) Define the following

(i) Binding energy (01marks)

(ii) Unified Atomic Energy (01marks)

(b) Explain how energy is released in a nuclear fusion process. (03marks)

(c) Explain what is observed in a discharge tube when the pressure is gradually reduced to low values? (05marks)

(d) With the aid of a diagram, describe the operation of Bainbridge mass spectrometer in the determination of charge to mass ratio. (07marks)

(e) An ion of mass 2.6 x 10^{-26} kg moving at a speed of 4 x 10^4ms^{-1} enter a region of uniform magnetic field of flux density 0.05T. Calculate the radius of the circle described by the ion.

9. (a)(i) State three differences between X-rays and cathode rays. (03marks)

(ii)Describe using a labelled diagram, the mode of operation of an X-ray tube (06marks)

(iii) What is the difference between soft and hard X-rays (01mark)

(b) (i) What is the main distinction between work function and ionization energy? (02marks)

(ii) An electron of charge, e, enters at right angles into a uniform magnetic field of flux density B and rotates at frequency, f, n a circle of radius, r.

Show that the frequency, f, is given by; f = $\frac{Be}{2\pi m}$. (03marks)

(c) An X-ray beam is produced when electrons are accelerated through 50kV are stopped by the target of an X-ray tube. When the beam falls on a set of parallel atomic plates of a certain metal at glancing angle of 16^0, a first order diffraction maximum occurs. Calculate the atomic spacing of the planes. (05marks)

10. (a) State two differences between alpha and beta particles

(b) Describe with the aid of a diagram, the structure and mode of operation of an ionization chamber. (06marks)

(c)(i) Explain the application of carbon-14 in carbon dating. (03marks)

(ii) A sample of dad wood was found to have activity of 20units due to carbon-14 isotope whose half-life is 5600 years. If activity of wood just cut is 47.8 units, estimate the age of the sample. (03marks)

(d) The photoelectric work function of potassium is 2.25eV. Light having a wavelength of 360mm falls on a potassium metal.

(i) Calculate the stopping potential (04marks)

(ii) Calculate the speed of the most energetic electron emitted by the metal (02marks)

Compiled by Dr. Bbosa Science