P510/1
PHYSICS
PAPER 1
JULY/AUG. 2010
2½ HOURS

JOINT MOCK EXAMINATIONS 2010

UGANDA ADVANCED CERTIFICATE OF EDUCATION

P510/1 PHYSICS

PAPER 1

2 HOURS 30 MINUTES

INSTRUCTIONS TO CANDIDATES:

- *Attempt five questions including at least one, but not more than two from each of the Sections A, B, and C.*
- *Mathematical tables and squared papers will be provided.*
- *Non-programmable scientific electronic calculators may be used.*
- *Assume where necessary:*

Acceleration due to gravity, g	$= 9.81ms^{-2}$
Electron charge, e	$= 1.6 \times 10^{-19}C$
Electron mass	$= 9.11 \times 10^{-31}Kg$
Mass of earth	$= 5.97 \times 10^{24}Kg$
Planck's constant, h	$= 6.6 \times 10^{-34}Js$
Wien's displacement constant	$= 2.9 \times 10^{-3}mK$
Radius of the earth	$= 6.4 \times 10^{6}m$
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 a vacuum, c	$= 3.0 \times 10^{8}ms^{-1}$
Specific heat capacity of water	$= 4200Jkg^{-1}K^{-1}$
Universal gravitational constant G	$= 6.67 \times 10^{-11}Nm^{2}Kg^{-2}$
Avogadros number, N_A	$= 6.02 \times 10^{23}mol^{-1}$
Density of water	$= 1000Kgm^{-3}$
Gas constant, R	$= 8.31Jmol^{-1}K$
Charge to mass ratio, e/m	$= 1.8 \times 10^{11}C\ Kg^{-1}$
Stefan-Boltzmann's constant	$= 5.67 \times 10^{-8}Wm^{-2}K^{-4}$
1 atomic mass unit	$= 931MeV$

1 (a) Define the terms:

(i) Inertia of a body (l mark)

(ii) Gravitational field strength. (l mark)

(b) Briefly distinguish between conservative and non-conservative forces. Give two examples of each. (3 marks)

(c) Weightless spring X can be compressed by 2 cm by a force of 200 N. The same spring is placed at the bottom of a frictionless inclined plane which makes an angle of 45° with the horizontal as shown m in figure 1 below:

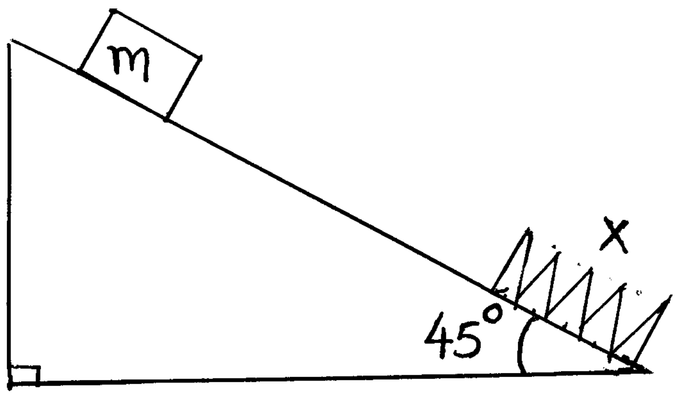

Fig.1

A 2kg mass m is released from rest at the top of the incline and is brought to rest momentarily after compressing the spring by 3.0cm.Find;

(i) the elastic potential energy stored in the spring. (2 marks)

(ii) the distance through which the mass slides before it reaches the spring. (3 marks)

(iii) the time taken by the mass to reach the spring. (3 marks)

(d) (i) Explain what is meant by uniform acceleration. (2marks)

(ii) A train of length 75.0m is moving with a constant acceleration on straight rails. The front part of the train passes a point P with a speed of 8 ms^{-1} If the end of the train passes this point 6.0s later, determine the speed of the train in this time. (5marks)

2. (a) Define

(i) Weightlessness (1 mark)

(ii) Parking orbit (1 mark)

(b) A body of mass **m** is released from above at a distance **r** from the centre of the earth of mass **M** and radius **R**. Show that the velocity of the body when it strikes surface of the earth is given by

$$= R\sqrt{2g(\tfrac{1}{R} - \tfrac{1}{r})}$$

(4marks)

(c) A car of mass 3000kg travels at 108kmh^{-1} around an unbanked circular track of radius 200m.

(i) What is the minimum coefficient of sliding friction between the road and the car tyres that will permit the car to negotiate the curve without sliding? (3 marks)

(ii) At what angle would the road have to be banked if there were to be no frictional force between the tyres and the road surface? (2 marks)

(d) Define:

(i) Describe the energy changes which take place in swinging pendulum bob (3 marks)

(ii) Explain with the aid of a sketch diagram why the oscillations of a simple pendulum eventually die out. (3 marks)

(iii) Give two examples that demonstrate resonance in daily life. (3 marks)

3. (a) (i) Define coefficient of viscosity and determine its dimensions. (4marks)

(ii) The viscous force on a steel ball bearing of radius r falling with speed V, in a liquid of coefficient of viscosity η is given by $F = K\eta rV$ where K is a constant. Find the dimensions of K. (4marks)

(b) A metal sphere of radius 2.0 x 10^{-3}m and mass 3.0 x10^{-4} kg falls under gravity centrally down a wide tube filled with another liquid of coefficient of viscosity 1Nsm^{-1} at 35^{0}C. The density of the liquid is 700kgm^{-3}. The sphere attains a terminal velocity of 0.4 ms-1. The tube is emptied and filled with another liquid of coefficient of viscosity η_2 and density 900kgm^{-3} at the same temperature. When the metal sphere falls centrally down the tube, it is found to attain a terminal velocity of 0.25ms^{-1}. Determine at 350C the ratio $\eta_1 : \eta_2$ (6 marks)

(c) In an experiment to determine Young's modulus, a wire suspended at its upper end was stretched by suspending masses from its lower end. The unstretched length of the wire was 2.17m and its diameter 0.71mm.

Load/kg	0.0	2.0	4.0	6.0	8.0	10.0	12.0	14.0	16.1
Scale reading/mm	2.8	3.8	4.5	5.1	5.7	6.3	6.9	7.5	8.1

Plot a suitable graph to determine Young's modulus for the material of the wire. (6marks)

4 (a) (i) State the conditions necessary for projectile motion to occur. (3 marks)

(ii) A stone is projected from the top of a cliff 60 m above sea level at an angle of elevation 38° with speed $40ms^{-1}$. At the same instant another stone is projected horizontally from the same point 1m the same vertical plane at $30ms^{-1}$. What is the horizontal distance between the points at which they strike the water level? (7 marks)

(b) (i) State the principle of moments. (1 mark)
(ii). Give two applications of the principle of moments. (2 marks)

(c) (i) State the laws of static friction (3 marks)
(ii) Describe how you can measure the coefficient of friction between two solid surfaces in contact. (4 marks)

SECTION B

5. (a) (i) Define the terms specific heat capacity and specific latent heat. (2marks)

(ii) Explain why specific latent heat of vaporization is always higher than specific latent heat of fusion. (3 marks)

(b) (i) Describe a simple electrical method for determination of the specific latent heat of vaporisation of a liquid. (6 marks)
(ii) Why is a cooling correction not necessary for this method? (2 marks)

(c) When electrical energy is supplied at a rate of 12.0W to a boiling liquid, 0.0lkg of liquid evaporated in 30 minutes. On reducing the electrical power to 7.0W, 0.005kg of liquid evaporated in the same time. Calculate:
(i) The specific latent heat of vaporisation of the liquid. (5 marks)
(ii) The power loss to the surroundings. (2 marks)

6. (a) (i) State Dalton's law of partial pressures. (1 mark)
(ii) A volume V_I of gas at a temperature T_1 and pressure P is enclosed as shown in figure 2 below. It is then connected to another sphere of volume $O.5V_I$ by a tube with a stop cork. The second sphere is initially evacuated and the stop cork is closed.

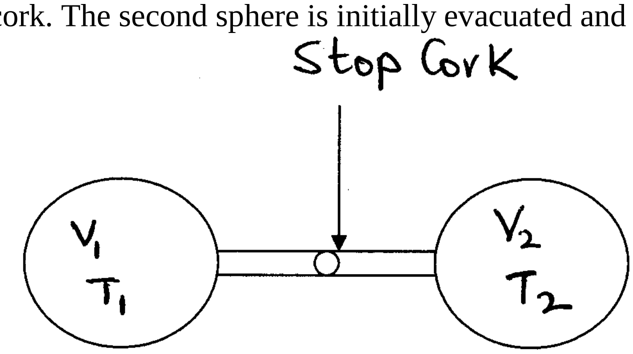

Fig.2

If the cork is opened and the temperature of the gas in the second sphere is T_2 while the first sphere is maintained at T_I, show that the final pressure P^1 within the spheres is given by

$$P^1 = \frac{2PT_2}{2T_2 + T_1}$$

(b) (i) Distinguish between an isothermal change and an adiabatic change. (2 marks)

(ii) Describe how an adiabatic change can be achieved in practice. (2 marks)

c) A gas having a temperature of 27°C, volume 3 x 10^{-4} m^3 and a pressure of 80cmHg expands isothermally to double its volume. The gas is then compressed adiabatically to half its volume.

(i) Represent these changes on a P-V diagram. (2 marks)

(ii) Calculate the final pressure and temperature of the gas. (6 marks)

(iii) State whether work has been done on or by the gas. (Take ¥ = 1.4) (2 marks)

7. (a) (i) State four factors which control the rate of cooling of a body. (2 marks)

(ii) Describe how a cooling correction can be determined for a bad conductor when obtaining its specific heat capacity. (5 marks)

(iii) Explain why a cooling correction is not necessary when using continuous flow method. (2 marks)

(b) What is meant by (i) temperature gradient. (1mark)

(ii) thermal conductivity of a material (1 mark)

(c) (i) Explain why metals are better conductors of heat than glass. (4 marks)

(ii) A wall of a building consists of two brick layers each of thickness10.0cm and between them there is a layer of air 2.0cm thick. Find the rate of heat flow through 1.0m^2 of the wall if the inner and outer temperatures of the building are 25°C and 15°C respectively. (Thermal conductivities of brick and air are respectively 6.7 $Wm^{-1}K^{-1}$ and 0.024 $Wm^{-1}K^{-1}$). (5 marks)

SECTION C

8. (a) Distinguish between X-rays and Cathode rays. (3 marks)

(b) Explain how you can use a Cathode Ray Oscilloscope to measure the root mean square value of a sinusoidal voltage. (3 marks)

(c) An electron of energy 10 keV enters mid-way between two horizontal metal plates each of length 5.0cm and separated by a distance of 2.0cm. A potential difference of 20 V is applied across the plates .A fluorescent screen is placed 20 cm beyond the plates. Calculate the vertical deflection of the electrons on the screen. (6 marks)

(d) (i) Define atomic number and atomic mass. (2 marks)

(ii) Describe how a Bainbridge mass spectrometer can be used to measure the charge to mass ratio of ions. (6 marks)

9. (a) (i) Write down the equation for the kinetic energy of electrons emitted from a metal surface. (1 mark)

(ii) Explain how your equation above accounts for the emission of electrons from metal surfaces illuminated by radiation. (4 marks)

(b). Describe an experiment to determine the work-function of a metal. (6 marks)

(c) (i) Explain the production of a line spectrum in an X-ray tube. (3 marks)

(ii) Electrons of energy 83keV are stopped by the target of an X-ray tube. Calculate the cut-off wavelength of X-rays produced. (3 marks)

(d) A monochromatic beam of X-rays of wavelength $2.0x10^{-10}$ m is incident on a set of cubic planes in a crystal of potassium chloride. First order diffraction maxima are observed at a glancing angle of 18.5^0. What is the inter-planar spacing of the potassium chloride? (3 marks)

10. (a) Define Activity of radioactive material. (1 mark)

(b) (i) Draw the Current-Voltage characteristic for a Geiger-Muller tube and identify, giving reasons, the part of the characteristic over which the tube is normally operated. (4marks)

(ii) Explain the importance of an inert gas, and a quenching agent in a Geiger-Muller tube. (3 marks)

(c) A steel piston ring contains 15.0g of radioactive iron $^{54}_{26}Fe$ of activity of 3.7×10^5 disintegrations per second. After 100 days of continuous use the crank- case oil was found to have a total activity of 1.23×10^3 disintegrations per second.

i) *Find*

(i) the half-life of $^{54}_{26}Fe$; (4 marks)

(ii) the average mass of iron worn off the ring per day assuming that all the metal removed accumulates in the oil. (2 marks)

(ii) Ionized atoms of Chlorine-35 and Chlorine-37 are passed into the deflection chamber of a mass spectrometer with the same velocity of 2.0×10^4 ms^{-1}. If the flux density of the deflecting chamber is 0.32T, calculate the difference in the radii of the paths of the ions. (5 marks)

END