P510/1
PHYSICS
PAPER 1
JULY/AUGUST 2017
2 ½ HOURS

RESOURCEFUL MOCK EXAMINATIONS 2017
Uganda Advanced Certificate of Education
Physics
Paper 1
2 Hours 30 Minutes

INSTRUCTIONS TO CANDIDATES:

- *This paper consists of three sections* **A**,**B** *and* **C**
- *Answer five questions including at least one , out not more than two from each of the sections.*
- *Answers to each question should be written on the answer sheets provided*
- *Poor numbering and untidy work will lead to loss of marks*
- *Non-programmable scientific calculators may be used.*

Assume where necessary:

Acceleration due to gravity,	*g*	=	$9.81ms^{-2}$
Speed of light in a vacuum,	*c*	=	$3.0x10^{8}$
Electron charge,	*e*	=	$1.6\ x10^{-19ms-1}$
Electron mass		=	$9.1x10^{-31}kg$
Planck'sconstant,	*h*	=	$6.63x10^{-34}Js$
Permeability of free space,	μ_0	=	$4.0x10^{-7}\ Hm^{-1}$
The constant $\frac{1}{4\pi\varepsilon_0}$		=	$9.0x10^{9}F^{-1}m$
Once electron volt,	*(eV)*	=	$1.6x10^{-10}J$
Avogadro's number,	*NA*	=	$6.02x10^{23}mol^{-1}$
Stefan's - Boltzmann's constant, σ		=	$5.67x10^{8}Wm^{-2}K^{-4}$
Radius of the earth,		=	$6.4 \times 10^{6}m$
Radius of the sun		=	$7 \times 10^{8}m$
Thermal conductivity of copper		=	$390Wm^{-1}K^{-1}$
Specific heat capacity of water		=	$4200JKg^{-1}K^{-1}$
Density of water		=	$1000Kgm^{-3}$
Gas constant,	R	=	$8.31Jmol^{-1}K^{-1}$

Charge to mass ratio, e/m = $1.8 \times 10^{11} CKg^{-1}$

SECTION A

1. (a) (i) State the principle of conservation of mechanical energy . *(01mark)*

(ii) Show that a stone thrown vertically upwards obeys the principle in (i) through its upward motion. *(04marks)*

(b) (i) A wind turbine made of a bladde of radius r, is driven by a wind of speed, **V**, if $\sigma$is the density of air, derive an expression for the maximum power, p, which can be developed by the turbine in terms of σ , **r** and **V**. *(03marks)*

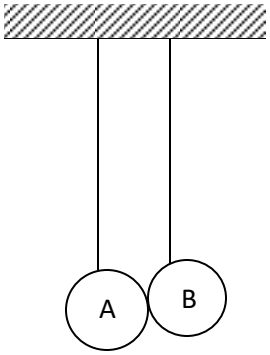
(ii) Explain why the power attained is less than the maximum value in b(i) above. *(02marks)*

(c) State the conditions under which the following will be conserved in a collision between two bodies.

(i) Linear momentum *(01mark)*

(ii) Kinetic energy *(01mark)*

(d) Two pendula of equal length L, have bobs A and B of masses 3m and M respectively. The pendula are hung with bobs in contact as shown in the figure below.



The bob **A** is displaced such that the string makes an angle **θ** with the vertical and released. If A makes a perfectly inelastic collision with **B**, find the height to which B rises. *(08marks)*

2. (a) (i) State Newton's law of universal gravitation. *(01mark)*

(ii) Show that this law is consistent with Kepler's third law. *(03marks)*

(iii) Two alternative units for gravitational field strength are Nkg^{-1} and ms^{-1}. Use the method of dimensions to show that the two units are equivalent. *(03marks)*

(b) (i) Derive an expression for the speed of a body moving uniformly circular path. *(03marks)*

(ii) Explain why a force is necessary to maintain a body moving with a constant speed in a circular path. *(02marks)*

(c) A small mass attached to a string suspended form a fixed point moves in a circular path at a constant speed in a horizontal plane.

(i) Draw a diagram showing the forces acting on the mass. *(01mark)*

(ii) Derive an equation showing how the angle of the string depends on the speed of the mass and the radius of the circular path. *(03marks)*

(d) (i) Define **moment of a force**. *(01mark)*

(ii) A wheel of radius 0.60m is pivoted at its centre. A tangential force of 4.0N acts on the wheel so that the wheel rotates with uniform velocity. Find the work done by the force to turn the wheel through 10 revolutions. *(05marks)*

3. (a) (i) Show that the weight of fluid displaced by an object is equal to the upthrust on the object. *(05marks)*

(ii) A piece of metal of mass $2.60 \times 10^{-3}kg$ and density $8.4x10^{3}kg^{-3}$ is attached to a block of wax of mass 1.0×10^{-2} kg and density $9.2 \times 10^{2}kgm^{-3}$. When the system is placed in a liquid, it floats with wax just submerge. Find the density of the liquid. *(04marks)*

(b) Explain the;

(i) Terms laminar flow and turbulent flow. *(04marks)*

(ii) Effects of temperature on the viscosity of liquids and gases. *(03marks)*

(c) (i) Distinguish between static pressure and dynamic pressure. *(02marks)*

(ii) A pitot-static tube fitted with a pressure gauge is used to measure the speed of a boat at sea. Given that the speed of the bat does not exceed $10ms^{-1}$ and the density of sea water is 1050 $kgms^{-1}$. Calculate the maximum pressure on the gauge. *(02marks)*

4. (a) What is meant by the following terms?

(i) Velocity gradient *(01mark)*

(ii) Coefficient of viscosity. *(01mark)*

(b) Derive an expression for the terminal velocity of a steel ball – bearing of radius, **r**, and density ρ, falling through a liquid of density σ and coefficient of viscosity] *(05marks)*

(c) (i) Define **Surface Tension** . *(01mark)*

(ii) Explain the origin of surface tension. *(03marks)*

(iii) Describe an experiment to measure the surface tension of a liquid by the capillary method. *(06marks)*

(d) Explain, with the aid of a diagram why air –flow over the wings of air craft at take- off causes a life. *(03marks)*

SECTION B

5. (a) State the assumptions made in the derivation of the expression $p = \frac{1}{3}\ \rho c\bar{2}$ for pressure of the ideal gas. *(02marks)*

(b) Use the expression in (a) above to deduce Dalton's law of partial pressures. *(03marks)*

(c) Describe an experiment to determine the saturation vapour pressure of a liquid.

(06marks)

(d) (i) What is meant by a reversible isothermal change? *(02marks)*

(ii) State the conditions for achieving a reversible isothermal change. *(02marks)*

(e) An ideal gas at 27^0C and at a pressure of 1:01 x 10^5 pa is compressed reversibly and isothermally until it volume is halved. It is then expanded reversibly and adiabatically to twice its original volume. Calculate the final pressure and temperature of the gas if $\propto = 1.40$ *(05marks)*

6. (a) What is meant by a **black body**? *(01mark)*

(b) Describe how an approximate black body can be realized in practice. *(02marks)*

(c) (i) Draw sketch graphs to show variation of relative intensity of black body radiation with wave length for three different temperatures. *(02marks)*

(ii) Describe the feature s of the sketch graphs in (c) (i) above. *(03marks)*

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

(ii) A solid copper sphere of diameter 10mm and temperature of 150k is placed in an enclosure maintained at a temperature of 290k. Calculate, stating any assumptions made; the initial rate of rise of temperature of the sphere.

(Density of copper = 8.93 x 10^3 kgm^{-3}, specific heat capacity of copper = 3.7x10^2 $Jkgk^{-1}$) *(04marks)*

(e) With the aid of a labelled diagram, describe how a thermopile can be used to detect infra – red radiations. *(07marks)*

7. (a) What is meant by;

(i) Thermometric property *(01mark)*

(ii) Triple point of water *(01mark)*

(b) (i) Describe the steps taken to establish a temperature scale. *(05marks)*

(ii) Explain why two thermometers may give different values for the same unknown temperatures. *(02marks)*

(c) (i) Describe , with the aid of a diagram, how a constant volume gas thermometer may be used to measure temperature . *(06marks)*

(ii) State three corrections that need to be made when using the thermometer in (c) (i) above. *(03 marks)*

(iii) State and explain the source of in accuries in using mercury – in – glass thermometer. *(02marks)*

SECTION C

8. (a) (i) Describe with aid of a labelled diagram the main features of a cathode ray oscilloscope (C.R.O) *(08marks)*

(ii) State two uses of a **C.R.O** *(01mark)*

(iii) The gain control of a C.R.O is se on 0.5v cm $^{-1}$ and an alternating voltage produces a vertical trace of 2.0 cm long with the time base off. Find the root mean square value of the applied voltage. *(02marks)*

(b) A beam of electrons is accelerated through a potential difference of 2000V and is directed mid – way between two horizontal plates of length 5.0cm and a separation of 2.0cm. The potential difference across the plates is 80V.

(i) Calculate the speed of the electrons as they enter the region between the plates. *(03marks)*

(ii) Explain the motion of the electrons between the plates. *(02marks)*

(iii) Find the speed of the electrons as they emerge from the region between the plates. *(04marks)*

9. (a) (i) Draw a labelled diagram of an x – ray tube. *(02marks)*

(ii) Use the diagram in (a) (i) to describe how x –rays are produced. *(03marks)*

(iii) State one industrial and one biological use of x – rays. *(01mark)*

(b) (i) Sketch a graph of intensity verses wave length of x – rays from an x – ray tube and describe its main features. *(04marks)*

(ii) Calculate the maximum frequency of x – rays emitted by a n X – ray tube operating a voltage of 34.0Kv. *(03marks)*

(c) In the measurement of electron charge by Milkan's apparatus , a potential difference of 1.6KV in applied between two horizontal difference switch off, an oil drop is observed to fall with constant velocity of $4.0 \times 10^{-4} ms^{-1}$. When the potential difference is switched on, the drop rises with a constant velocity of $8.0 \times 10^{-5} ms^{-1}$. If the mass of the oil drop is $1.0 \times 10^{-14} kg$. Find the number of electron charges on the drop.

[*Assume air resistance is proportional to the velocity of the oil drop and neglect the upthrust due to the air]* *(07marks)*

10. (a) (i) What is meant by half life of a radioactive material? *(01mark)*

(ii) Given that radioactive law, $N_t = N_o \bar{e}^{\lambda t}$, obtain the relation between λ and half life, T ½ *(02marks)*

(iii) What are **radio isotopes**? *(01mark)*

(iv) The radioisotope $^{90}_{38}\mathbf{Sr}$ decays by emission of β-particles.

The half life of the radioisotopes is 28.8 years. Determine the activity of 1 g of the isotope. *(05marks)*

(b) (i) With aid of a diagram, describe the structure and action of Geiger – muller tube. *(06marks)*

(ii) Sketch the count rate – voltage characteristic of the Geiger – muller tube and explain its main features. *(03marks)*

(iii) Identify, giving reasons, the suitable range in (b) (ii) of operation of the tube. *(02marks)*

END