P510/1
Physics
Paper 1
July 2019
2 ½ hours

MOCK EXAMINATIONS 2019

UGANDA ADVANCED CERTIFICATE OF EDUCTION

PHYSICS

PAPER 1

2 HOURS 30 MINUTES

Instructions to candidates:

- Answer **five** questions, including at least **one**, but **not** more than **two** from each of the sections **A, B** and **C**
- Non programmable scientific electronic calculators may be used.
- Assume where necessary:

Acceleration due to gravity	**g** = 9.81 ms^{-2}
Electronic charge	**e** = 1.6 x 10^{-19} C
Mass of the earth	**R** = 5.97 x 10^{24}kg
Plank's constant	**h** = 6.6 x 10^{-34}Js
Stefan's Boltzman's constant	σ = 5.67 x 10^{-8} $wm^{-2}K^{-4}$
Radius of the earth	= 6.4 x 10^{6}m
Speed of light in a vacuum,	**C** = 3.0 x $10^{8}ms^{-1}$
Universal gravitational constant	**G** = 6.67 10^{-4} Nm^2 Kg^{-2}
Avogadro's number	N_A = 6.02 x 10^{23} mol^{-1}
Gas constant	**R** = 8.31 x $Jmol^{-1}$ K^{-1}
Charge to mass ratio,	e/m = 1.8 x 10^{11} Ckg^{-1}
The constant $\frac{1}{4\pi\varepsilon}$	$= 9.0 \times 10^{9} F^{-1} m$

Density of water = 1000 Kgm^{-3}

SECTION A

1. (a) (i) Define Young's modulus of a material. (1 mark)
   (ii) Distinguish between tensile strain and tensile stress (2 marks)

   (b)Explain the physical processes that occur during work hardening of a material. (3 marks)

   (c) A piece of copper wire has twice the radius of a piece of steel wire. Young's modulus for steel is twice that for copper. One end of the copper wire is joined to one end of a steel wire so that both can be subjected to the same longitudinal force. Calculate the percentage strain in steel that produces a strain of 1% on the copper wire. (6 marks)

   (d) Explain briefly why a glass cup full of hot water may break. (4 marks)

   (e) Show that the energy stored in a rod of length, **L** when extended by **e** is $\frac{1}{2}\ \frac{Ee^2}{L^2}$ per unit volume, where E is Young's modulus of the rod.

2. (a) (i) State Kepler's laws of planetary motion (3 marks)
   (ii) Use Newton's law of gravitation to derive Kepler's third law of Universal gravitation. (3 marks)

   (b) A satellite orbits the earth at a parking orbit. If the mass of the satellite is 1.2×10^3kg;
   (i) Calculate the mechanical energy of a satellite (6 marks)
   (ii) Explain what happens to the satellite in b (i) above when its mechanical energy reduces (3 marks)

(c) Define angular velocity (1 mark)

(d) Explain why a car moves faster on a banked road than the an unbanked road of the same radius of curvature. (4 marks)

3. (a) (i) Define angle of contact of a liquid (1 mark)

(ii) Give two factors on which angle of contact of a liquid depends (1 mark)

(b) Describe an experiment to determine the surface tension of a liquid by capillary rise method. (6 marks)

(c) Two lengths of capillary tubing of diameters 0.2 mm and 1.0mm respectively are joined to make a U-tube in which mercury is placed as shown in figure 1.

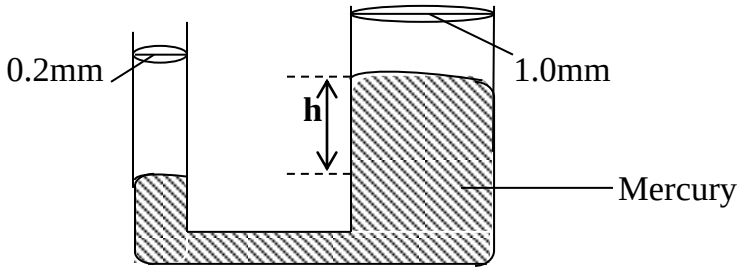


Figure 1

Calculate the value of **h** if the angle of contact of mercury is 140^{c}, its surface tension is $0.46Nm^{-1}$

(Density of mercury is $13600kgm^{-3}$) (4 marks)

(d) Write an equation for pressure variation based on Bernoulli's principle and define all symbols used (3 marks)

(e) explain the origin of a dynamic lift force on aerofoil wings at take-off (5 marks)

4. (a) (i) Define simple harmonic motion (1 mark)

(ii) State four characteristics of simple harmonic motion (4 marks)

(b)A volume **V** of air is contained at atmospheric pressure, **P** in a cylindrical vessel of cross-sectional area, **A** by a frictionless air tight piston of mass, **M**. Show that on

slightly forcing down the piston and releasing it, the piston oscillates with simple harmonic motion of period. $T = \frac{2\pi}{A}\sqrt{\frac{MV}{P}}$

(c) A particle performing simple harmonic motion has a total energy of 1.024J and a period of 2π seconds. When the time of oscillation is $\frac{\pi}{4}$ seconds, its displacement from equilibrium position is $(8\sqrt{2})$cm. Calculate:

(i) Amplitude of oscillation (3 marks)

(ii) Mass of the particle (3 marks)

(d) (i) Distinguish between free oscillation and damped oscillation (2 marks)

(ii) Sketch a graph of variation of energy against displacement for a freely oscillating particle (2 marks)

SECTION B:

5. (a) (i) state Wien's displacement law of black body radiation. (1 mark)

(ii) Sketch a graph of relative intensity against wave length for two temperatures and explain the features (3 marks)

(b) A blackened metal sphere is found to cool at a rate of 1.2°c per minute when its temperature is 127°C and external temperature is 27°C. Calculate the rate at which a sphere made from the same material and is three times its radius cools when at 327°C if the surrounding temperature remains constant. (7 marks)

(c) (i) Define Thermal conductivity (1 mark)

(ii) Explain the mechanism of heat transfer in metals (3 marks)

(d) Describe an experiment to determine the thermal conductivity of a good conductor of heat. (5 marks)

6. (a) (i) State Zeroth's law of thermodynamics (1 mark)

(ii) Explain how Zeroth's law applies to mercury – in – glass Thermometer when used to measure body temperature (4 marks)

(b) (i) Define a thermometric property (1 mark)
(ii) Give two qualities of a good thermometric property (2 marks)

(c) Define the term adiabatic change (1 mark)
(d) A quantity of oxygen is compressed isothermally until its pressure is doubled. It is then allowed to expand adiabatically until its original volume is restored. If the pressure at the end of isothermal compression is 640mmHg.
(i) Sketch P – V curves for the above changes on the same axes (2 marks)
(ii) Determine the final pressure ($\propto = 1.40$) (3 marks)

(e) Explain the conditions for isothermal and adiabatic changes to occur (6 marks)

7. (a) (i) Distinguish between saturated vapour and unsaturated vapour (2 marks)
(ii) Explain how a liquid can be made to boil faster on a high altitude. (4 marks)

(b) Describe an experiment to determine the saturated vapour pressure (S.V.P) at a given temperature. (6 marks)

(c) A horizontal tube of uniform bore, closed at one end has some air trapped by a small quantity of water. If the length of the endorsed air column is 20cm at 12^{o}C, Calculate the length of the air column when the temperature is raised to 38^{o}C keeping he external pressure constant at 75.0cmHg. (6 marks)
(S.V.P of water vapour at 12^{o}C and 38^{o}C are 10.5mmHg and 49.5mmHg respectively)

(d) Sketch on the same axes graphs of pressure against volume for a real gas below and above its critical temperature. (2 marks)

SECTION C:

8. (a) (i) Define Cathode rays (1 mark)
(ii) State three properties of cathode rays (3 marks)

(iii) Explain how a sign of charge on cathode rays can be determined using a magnetic field (4 marks)

(b) describe the structure and the principle of operation of a cathode ray oscilloscope (6 marks)

(c) A particle of mass, **m** carrying a charge, **q** moves with a velocity, **u** in a direction perpendicular to a uniform magnetic field of intensity 1.2 x 110^{-3} Wbm^{-2} and describes an area of radius 38cm. A uniform electric field of intensity 9.6 x 10^4 Vm^{-1} acts to oppose the magnetic effect and a particle moves out in a straight line. Calculate the:

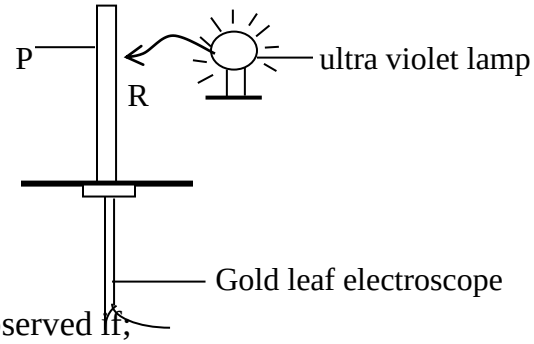
(i) value of u (3 marks)

(ii) value of $\frac{q}{m}$ (3 marks)

9. (a) State the experimental observations of photoelectric emission. (4 marks)

(b) Explain briefly why photoelectric effect is a reverse of x-ray production (2 marks)

(c) Figure 2 shows a well-cleaned zinc plate; ***P*** connected to gold leaf electroscope, ***G***. Radiation, ***R*** is incident on ***P*** from an Ultraviolet lamp in a dark room.



Explain what is observed if;

(i) P is negatively charged (3 marks)

(ii) P is positively charged (2 marks)

(d) The maximum kinetic energy of the electrons emitted from A metallic surface is 1.6 x 10^{-19}J. When the wavelength of the incident radiation is 0.4μm. Calculate the threshold wavelength for the metal (4 marks)

(e) (i) Sketch **I–V** characteristics of the vacuum diode at two different filament currents and explain its main features. (4 marks)

(ii) State one application of a vacuum diode. (1 mark)

10. (a) (i) Define isotopes (1 mark)

(ii) Explain briefly how isotopes can be distinguished (4 marks)

(b)(i) Define the term binding energy per – nucleon (1 mark)

(ii) Explain briefly why neutrons are preferred in inducing nuclear fission (2 marks)

(c) Determine the energy in MeV that must be given to 2mg of lead nucleus $^{206}_{86}Pb$ to make it break up to form mercury nucleus $^{202}_{80}Hg$ and α particle $^{4}_{2}\boldsymbol{He}$

Mass of lead = 206.034u, mass of mercury = 202.035u, mass of α particle = 4.004u, 1u = 930.5MeV)

(d) Describe the x-ray diffraction by crystals and derive Bragg's law. (5 marks)

(e) Electrons moving with a speed of 7.24 x $10^6 ms^{-1}$ strike crystals and first order diffraction maximum occur where the glancing angle is 28^o48^1, calculate the spacing between the atomic planes. (3 marks)

END