P510/1
PHYSICS
PAPER 1
JULY 2022
2 ½ HOURS

(MEPSA) RESOURCEFUL ASSESSMENT 2022

Uganda advanced certificate of education

MOCK EXAMINATIONS

PHYSICS

Paper 1

Time: 2hrs 30min

INSTRUCTIONS:

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

Assume where necessary;

Acceleration due to gravity, g	=	9.81 ms^{-2}
Specific heat capacity of water	=	4,200$Jkg^{-1}K^{-1}$
Gas constant, R	=	8.31$Jmol^{-1}K^{-1}$
Avogadro's number N_A	=	6.02 x 10^{23} mol^{-1}
Density of water	=	1000kgm^{-3}
Planck's constant, h	=	6.6 x 10^{-34}Js
Electronic charge e	=	1.6 x 10^{-19}C

Turn over

SECTION A

1. a) Distinguish between *fundamental* and *derived quantities* and give one example of each. (3marks)

   b) The velocity, of sound traveling along a rod made of a material of Young's modulus, Y, and density, ρ, is given by $V = \sqrt{\frac{Y}{\rho}}$.

   Show that the formula is dimensionally consistent. (4marks)

   (c) i) Define linear momentum and impulse. (2marks)
   ii) state the law of conservation of linear momentum. (1mark)

   iii) Show that the law in (c) (ii) above follows from Newton's laws of motion. (5marks)

   (d) A car of mass 1000kg travelling at uniform velocity of $20ms^{-1}$, collides perfectly inelastically with a stationary car of mass 1500kg. Calculate the loss in kinetic energy of the car as a result of the collision. (5marks)

2. a) i) Define the terms velocity and displacement. (2 marks)
   ii) Sketch the graph of velocity against time for an object thrown vertically upwards. (2 marks)

b) Coplanar forces act on a particle of mass 2 kg as shown in figure 1.

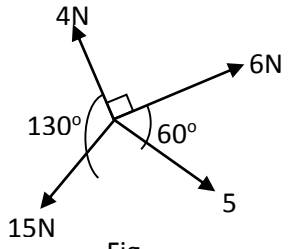

Fig.

Find the distance moved by the particle in 3 seconds from rest. (6 marks)

c) i) What is meant by saying that a body is moving with velocity ***v*** relative to the other? (01 mark)

ii) A pilot who can fly at 500 kmh^{-1} wishes to fly from airport **A** to airport **B**, which is 3,000 km North-East of **A**. wind blows from west to east at 150 kmh^{-1}. Find the direction in which he should fly and the time he will take to reach airport **B**. (6marks)

d) Distinguish between conservative and non conservative forces and give one example of each. (3 marks)

3. a) Define **angular velocity** (1marks)
   (b) A car whose center of gravity is **h** meters above the ground and its width is **2a** meters, moves round a horizontal circular track of radius **R** with velocity **V.**

(i) Draw a sketch diagram to show the forces acting on the car. (2marks)

(ii) Derive an expression showing the velocity for which the car can move safely round the track without overturning (5marks)

(iii) Explain why the car would move at a higher velocity if the track was banked than on the un banked one of the same radius of curvature. (4marks)

(c) A small bob of mass 0.5 kg is tied on an inextensible string of length 0.8 m. The bob is whirled in a horizontal circle of radius 0.3 m forming a conical pendulum.

(i) Draw a diagram to show the forces acting on the bob. (2marks)

(ii) Calculate the frequency of motion of the bob. (3marks)

d) Explain why a body moving with a constant speed in a circular track accelerates. (3marks)

4. (a (i) What are *co-planar forces*? (1 mark)

(ii) State the conditions under which a rigid body is in equilibrium under the action of co-planar forces. (2marks)

(b) The foot of a uniform ladder in on a rough horizontal ground and the top rests against a smooth vertical wall. The weight of the ladder in 400 N and a man weighing 800 N stands on the ladder one-quarter of its length from the bottom. If the inclination of the ladder to the horizontal is 30°, find the total force on the ground. (5 marks)

(c) (i) State the work – energy theorem. (1 mark)

(ii) Explain why a goal keeper draws his hands backward while catching a fast moving ball. (4 marks)

(d) (i) Define *limiting friction.* (1 mark)

(ii) Describe how you would determine coefficient of limiting friction. (3 marks)

(iii) Explain the origin of frictional force between two surfaces in contact. (3 marks)

SECTION B

5. (a) (i) What is meant by **internal energy** of a substance? (1mark)

(ii) Define **specific latent** heat of a substance. (1mark)

(b) (i) With use of a diagram, describe an experiment to determine the specific heat capacity of a good conducting solid by the electrical method. (6marks)

(ii) State two factors that make the value of specific heat capacity obtained in (i) above inaccurate. (2marks)

(c) State **Newton's law** of cooing. (1mark)

(d) An electric heater rated 500 W is used to heat a metal of mass 2.0 kg initially at room temperature of 25° C, its temperature rises steadily up to 80° C and remains constant.

(i) Explain why the temperature remains constant. (3marks)

(ii) If the heater was used for 3 minutes and 18 seconds, estimate the specific heat capacity of the metal. (3marks)

(e) Calculate the work done against the atmosphere when 1 kg of water turns into vapor at atmospheric pressure of 1.01×10^5 Pa. [Density of water vapor = 0.598 kgm^{-3}] (3marks)

6. (a) Define molar heat capacity of a gas,

(i) at constant pressure C_p (1mark)

(ii) at constant volume C_v (1mark)

(b)(i) Derive an expression relating Cp and C_v as defined in (a) above. (4marks)

(ii) Define an adiabatic and an Isothermal change. (2marks)

(iii) State the conditions for a reversible adiabatic change. (2marks)

(c) An ideal gas at 27° C and at a pressure of 1.01 x 10^5 Pa is compressed reversibly and isothermally until its volume is halved. It is then expanded reversibly and adiabatically to twice its original volume.

(i) Draw a P-V diagram for the above processes. (1mark)

(ii) Calculate the final pressure and temperature of the gas if $\gamma = 1.4$ (5marks)

(d) (i) State Dalton's law of partial pressures. (1mark)

(ii) A vessel of volume 500 cm^3 containing air at a pressure of 8.0 x 10^4 Pa is connected by a very narrow tube fitted with a tap to a vessel of volume 700 cm^3 containing air at a pressure of 2.0 x 10^5 Pa What is the resulting pressure in the vessel when the tap is opened? (3marks)

7. (a)(i) Define specific latent heat of vaporisation. (1 mark)

(ii) With the aid of a well labelled diagram, describe the accurate method of determining the specific latent heat of vaporisation of water. (6 marks)

(b) A car engine has four cylinders. At a certain speed, a piston in a cylinder executes twenty-four power strokes per minute. To keep the temperature of the engine constant, water circulates round the engine at a rate of 200g per second and its temperature rises by 10.0 Ks^{-1}. Calculate;

(i) The heat generated by each power stroke. (3 marks)

(ii) The power input the car engine if its efficiency is 0.75. (3 marks)

(c) (i) Define the following terms **fixed point**, **thermometric property** and **triple point of water** (3 marks)

(ii) The resistance of a platinum resistance thermometer is $5.2\,\Omega$ at the triple point of water and $9.1\,\Omega$ at an unknown temperature θ. Find the value of θ. (3 marks)

(iii) State one advantage and one disadvantage of a liquid in glass thermometer. (1 mark)

SECTION C

8. a) Define;
(i) Half-life (1mark)
(ii) Decay constant (1mark)

b) (i) Given the radioactive law $N_t = N_0 e^{-\lambda t}$, obtain the relation between λ and half life $t_{\frac{1}{2}}$ (2marks)

(ii) The radioisotope $^{90}_{38}Sr$ decays by emission of $\beta - particles$. The half life of the radio – isotope is 28.8 years.
Determine the activity of 1g of the isotope. (5marks)

c) With aid of a labeled diagram, describe the action of an ionization chamber in detecting radiation. (6marks)

d) Explain two medical uses of radio isotopes. (5 marks)

9. a) Define the following;
i) Work function (1 mark)
ii) Stopping potential (1 mark)

b) State the laws of photoelectric emission. (4 marks)

c) i) With the aid of a labeled diagram, describe how X – rays are produced in an X-ray tube. (5 marks)
ii) Derive Bragg's law X-ray diffraction. (4 marks)

d) An Alpha particle of mass 6.65 x 10^{-27} kg travelling at 2.0x10^{7} ms^{-1} head on towards a gold atom of atomic number 79 is repelled back. Calculate the distance of closest approach between the alpha particle and the nucleus. (3 marks)

10. a) Define the following;
i) specific charge (1 mark)
ii) Faraday's constant (1 mark)

b) Explain the motion of an electron beam in a region of uniform magnetic field. (3 marks)

c) i) With the aid of a labeled diagram, describe how to determine the charge on an oil drop by Millikan's oil drop experiment. (6 marks)
ii) Explain why in experiment in (i) above the temperature of the enclosure is kept constant. (2 marks)
iii) Distinguish between Cathode rays and positive rays. (2 marks)

d) The deflecting plates in a Thomson's set up are 5cm long and 1.5cm apart. The plates are maintained at a p.d of 240V. Electrons accelerated to energy 2KeV enter from one edge of the plates midway in the direction parallel to the plates. Calculate the vertical deflection on a screen placed 30cm away from the other end of the plates. (5 marks)

END