535/2
PHYSICS
Paper 2
Oct./Nov. 2023
2¼ hours

UGANDA NATIONAL EXAMINATIONS BOARD

Uganda Certificate of Education

PHYSICS

Paper 2

2 hours 15 minutes

INSTRUCTIONS TO CANDIDATES:

Answer any **five** *questions.*

Any additional question(s) answered will **not** *be marked.*

Mathematical tables and silent non-programmable scientific calculators may be used.

These values of physical quantities may be useful to you:

Acceleration due to gravity	=	$10\ ms^{-2}$.
Specific heat capacity of water	=	$4200\ Jkg^{-1}K^{-1}$.
Specific heat capacity of copper	=	$400\ Jkg^{-1}\ K^{-1}$.
Specific latent heat of fusion of water	=	$340000\ Jkg^{-1}$.
Speed of sound in air	=	$330\ ms^{-1}$.
Velocity of electromagnetic waves	=	$3.0 \times 10^{8}\ ms^{-1}$.

1. (a) (i) What is meant by the **centre of gravity** of a body? *(01 mark)*

(ii) State **two** ways in which the stability of a bus can be increased during its manufacture. *(02 marks)*

(b) (i) What is meant by a **couple** in mechanics? *(01 mark)*

(ii) State **two** conditions necessary for a body to be in equilibrium. *(02 marks)*

(c) Describe an experiment to verify the principle of moments. *(04 marks)*

(d) A block of mass 0.5 kg is pulled from rest on a rough horizontal bench by a steady force P, against a constant frictional force of 2 N. It moves 10 m in 2 s. Find;

(i) its speed. *(02 marks)*

(ii) its acceleration. *(02 marks)*

(iii) the value of P. *(02 marks)*

2. (a) (i) What is meant by **parallax** and **virtual image**? *(02 marks)*

(ii) An object is placed in front of a plane mirror. Describe an experiment to locate the position of its image. *(05 marks)*

(b) Why are prisms preferred to plane mirrors for use as reflectors in optical instruments? *(02 marks)*

(c) What is meant by **critical angle**? *(01 mark)*

(d) A ray of light is incident at an angle of 38° from a liquid of refractive index 1.43.

(i) Find the angle of refraction in air. *(03 marks)*

(ii) Find the angle of incidence in the liquid for the light to graze the boundary with air. *(03 marks)*

3. (a) Define the following:

(i) Momentum. *(01 mark)*

(ii) Potential energy. *(01 mark)*

(b) State the S.I unit for each of the quantities defined in (a). *(01 mark)*

(c) When a piece of stone falls from a short height onto an orange fruit, the orange may not be damaged. Explain why the orange fruit crushes when the height of fall of the stone is significantly increased. *(05 marks)*

(d) A car of mass 900 kg travelling at 72 km h^{-1} is brought to rest in 80 m by applying the brakes. Calculate its;

(i) initial momentum. (*03 marks*)
(ii) average braking force. (*03 marks*)
(iii) initial kinetic energy. (*02 marks*)

4. (a) What is meant by the following:

(i) Insulators? (*01 mark*)
(ii) Conductors? (*01 mark*)

(b) Explain how two bodies can get charged by friction. (*03 marks*)

(c) State the fundamental law of electrostatics. (*01 mark*)

(d) State and explain what is observed when;

(i) a negatively charged rod is brought near the metal cap of a negatively charged gold-leaf electroscope. (*03 marks*)
(ii) a negatively charged rod is brought near a fine stream of water flowing out of a tap. (*02 marks*)

(e) Sketch the electric field pattern between a positively charged point and a metal plate. (*03 marks*)

(f) State any **four** applications of electrostatics. (*02 marks*)

5. (a) What is meant by the following as applied to heat:

(i) Conduction? (*01 mark*)
(ii) Convection? (*01 mark*)

(b) Explain how conduction and convection are minimised in a vacuum flask. (*03 marks*)

(c) Describe how a domestic hot water system works. (*05 marks*)

(d) A hot water tap delivers water to a bath tab at 80 °C at a rate of 10 kg min^{-1} and a cold water tap delivers water to the same tab at 20 °C at the rate of 20 kg min^{-1}. If the taps closed after 2 minutes and ice at 0 °C is then added until the temperature of water in the tab is 32 °C, find the;

(i) temperature of water in the tab before adding ice. (*02 marks*)
(ii) amount of ice added. (*04 marks*)

(*Specific latent heat of ice* = 340,000 J kg^{-1}; *Specific heat capacity of water* = 4200 J kg^{-1} K^{-1})

6. (a) What is meant by;

(i) radioactivity? (*01 mark*)

(ii) half-life? (*01 mark*)

(b) The half-life of Uranium is 24 days. Calculate the mass of Uranium which remains after 120 days if the initial mass is 64 g. (*03 marks*)

(c) (i) What are **cathode rays**? (*01 mark*)

(ii) With the aid of a labelled diagram describe how X–rays are produced in an X–ray tube. (*06 marks*)

(iii) State **four** differences between cathode rays and X–rays. (*04 marks*)

7. (a) (i) What is meant by **compressions** and **rarefactions** as applied to sound waves? (*02 marks*)

(ii) Sound waves of frequency 620 Hz travel through air at a speed of 330 ms^{-1}. Calculate the wavelength of the waves. (*03 marks*)

(b) (i) Describe an experiment to determine the speed of sound in air. (*05 marks*)

(ii) State the precautions taken to reduce the errors in the experiment. (*01 mark*)

(c) In an experiment, the length of a stretched wire is varied until it vibrates in unison with each of several tuning forks taken in turn keeping the tension in the wire constant throughout.

Describe how the variation in length affects the frequency of vibration of the wire. (*02 marks*)

(d) A ship sends out an ultra sound to the bottom of an ocean and receives an echo after 20 s. If the wavelength of the ultra sound in water is 0.1 m and the frequency of the transmitter is 50 kHz, calculate the depth of the ocean. (*03 marks*)

8. (a) What is meant by a **neutral point** as applied to a magnetic field? (*01 mark*)

(b) Sketch a diagram to show the magnetic field pattern around a bar magnet placed in the earth's magnetic field, with its North pole pointing in the magnetic South direction. (*02 marks*)

(c) (i) Explain what is meant by **magnetic saturation**. (*02 marks*)

(ii) Using the domain theory explain why a permanent magnet may lose its magnetism by hammering. (*03 marks*)

(d) Draw a labelled diagram to show the structure of a simple d.c motor and describe how it works. (*06 marks*)

(e) State any **two** adjustments that can be made on the simple d.c motor to make it a practical one. (*02 marks*)

END