1904/103
PHYSICS TECHNIQUES I
June/July 2019
Time: 3 hours

THE KENYA NATIONAL EXAMINATIONS COUNCIL

CRAFT CERTIFICATE IN SCIENCE LABORATORY TECHNOLOGY

MODULE I

PHYSICS TECHNIQUES I

3 hours

INSTRUCTIONS TO CANDIDATES

You should have the following for this examination:
Answer booklet;
Scientific calculator (battery operated).
*The paper consists of **TWO** sections; **A** and **B**.*
*Answer **ALL** questions in Section **A** and any **TWO** questions from Section **B**.*
*Each question in section **A** carries **4** marks while each question in section **B** carried **20** marks.*
Maximum marks for each part of the question are indicated.
Candidates should answer the questions in English.

This paper consists of 5 printed pages.

Candidates should check the question paper to ascertain that all the pages are printed as indicated and that no questions are missing.

SECTION A: (60 marks)

Answer ALL the questions in this section.

1. (a) Differentiate between basic physical quantity and derived physical quantity, giving an example in each case. (2 marks)

   (b) Convert 0.05 cm^3 to SI unit. (2 marks)

2. A box of 6 cm square base contains water to a height of 7 cm. When a stone of mass 200 g is completely immersed in the water, the water level rises to a height of 9 cm. Determine:

   (a) the volume of the stone. (2 marks)

   (b) the density of the stone. (2 marks)

3. (a) Differentiate between molecules of ice and molecules of water. (2 marks)

   (b) Explain why air bubble bursts as soon as it emerges from the surface of water. (2 marks)

4. Explain the Brownian motion. (4 marks)

5. In an experiment using a density bottle, the following results were obtained:

   Mass of the bottle = 30 g
   Mass of the bottle and water = 58 g
   Mass of the bottle and liquid x = 62 g

   Calculate the relative density of the liquid x. (4 marks)

6. (a) State the Archimede's principle. (2 marks)

   (b) A body of mass 4 kg weighs 30 N in a liquid. Determine the upthrust on the body due to the liquid. (2 marks)

7. Prove that pressure, P, at a given point in a liquid is given by the formula:

   $P = \rho gh$

   where ρ = density of the liquid
   g = gravitational force
   h = height of the liquid

   (4 marks)

8. With the aid of a labelled diagram, outline a test to determine if a mercury barometer is faulty. (4 marks)

9. Define the following terms:

   (a) moment of a force. (2 marks)

   (b) principle of moments. (2 marks)

10. (a) State Newton's Third law of motion. (1 mark)

    (b) A pick-up truck of mass 2000 kg moving at a velocity of 40 ms^{-1} along a straight road is brought to rest in a distance of 25 metres. Calculate the average retarding force. (3 marks)

11. (a) Define "uniform circular motion". (2 marks)

    (b) An automobile of mass 1,200 kg moving at uniform speed of 10 ms^{-1} makes a circular turn of radius 30 metres.
    Calculate the centripetal force acting on it. (2 marks)

12. (a) Define temperature and it's SI unit. (2 marks)

    (b) Give any **two** reasons why mercury is preferred to water for use in thermometers. (2 marks)

13. A 3.0 kW kettle containing 1.5 kg of water at 100°C is left switched on. Calculate the time it will take to boil off all the water.

    (Take: Specific latent heat of vaporization of water as 2.26×10^6 j kg^{-1}) (4 marks)

14. (a) A river whose real depth is 16 metres appear to be 12 metre deep. Calculate the refractive index of the water in the river. (2 marks)

    (b) Calculate the critical angle for glass of refractive index 1.5. (2 marks)

15. An object is placed 16 cm infront of a converging lens of focal length 12 cm. Determine:

    (a) the image distance;
    (b) the magnification;
    (c) nature of the image formed. (4 marks)

SECTION B: (40 marks)

*Answer any **TWO** questions from this section.*

16. (a) (i) With the aid of labelled diagram, describe how the specific heat capacity of a good conductor is determined by electrical method.

(ii) State any three possible source of errors in 16 (a)(i) above.

(12 marks)

(b) Use an object and ray diagrams to illustrate:

(i) the principal focus of a concave mirror;

(ii) the focal length of a concave mirror;

(iii) radius of curvature.

(4 marks)

(c) A spherical mirror with a focal length of 20 cm forms a magnified image four times the size of the object on a screen.

(i) With a reason, state the kind of mirror used.

(ii) Determine the object distance from the mirror.

(4 marks)

17. (a) An object of mass 1.5 kg is heated in an oven to the temperature of 135°C. It is then quickly transferred into copper calorimeter of mass 0.015 kg containing 200 g of water. The mixture is well stirred and the final temperature is noted to be 30°C. If the initial temperature of water and the calorimeter was 10°C, Determine the specific heat capacity of the object.

(Take the Specific heat capacities of copper and water as 400 j $kg^{-1}K^{-1}$ and 4200 j $kg^{-1}K^{-1}$ respectively).

(8 marks)

(b) Draw a ray diagram to show how a concave mirror is used in shaving. (5 marks)

(c) (i) List any **three** factors that affect stability of a body. (3 marks)

(ii) Identify **one** application of stability. (1 mark)

(d) Given ${}_a\eta_g = 1.5$ where a and g represent refractive index of air and glass respectively. Determine ${}_g\eta_a$. (3 marks)

18. (a) Differentiate between stable and unstable equilibrium. (4 marks)

(b) State the law of conservation of linear momentum. (2 marks)

(c) A body of mass 2 kg moving at 0.25 ms^{-1} collides with a second body of mass 1.5 kg and moving the opposite direction at 0.4 ms^{-1}. If the bodies stick and move together after collision, determine:

(i) the total momentum before collision.

(ii) common velocity after collision.

(7 marks)

(d) An alloy is made by mixing 80 cm^3 of copper of density 8.9 gcm^{-3} with 120 cm^3 of aluminium of density 2.7 gcm^{-3}. Determine the density of alloy in kgm^{-3}.

(7 marks)

19. (a) List any **three** properties of a hydraulic fluid. (3 marks)

(b) A solid block of mass 20 kg has dimensions 2 m by 1 m by 0.5 m.
Determine:

(i) maximum pressure;

(ii) minimum pressure;

it exerts when resting on a flat surface.

(6 marks)

(c) Two springs of negligible weights with spring constants of 50 Nm^{-1} and 100 Nm^{-1} respectively are connected end to end and suspended from a fixed point.
Determine:

(i) the total extension when a mass of 2.0 kg is hung from the lower end

(ii) the combined spring constant.

(7 marks)

(d) A gas container has a pressure of 2.5×10^5 pa at a temperature of 25°C. Assuming that there is no change in volume, determine the pressure of the gas when the temperature is lowered to -10°C. (4 marks)

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