

TAHOSSA KINONDONI, ILALA & TEMEKE REGIONS

REGIONAL FORM FIVE ANNUAL EXAMINATIONS

131

PHYSICS

Time: 3 Hours

Year: 2021

Instructions

1. This paper consists of sections A and B with a total of **ten (10)** questions
2. Answer **all** questions in section A and any **two (2)** questions from section B
3. Section A carries **seventy (70)** marks and section B carries **thirty (30)** marks.
4. Marks for each question or part thereof are indicated
5. Mathematical tables and non-programmable calculators may be used.
6. Cellular phones and any unauthorized materials are **not** allowed in the examination room.
7. Write your **Examination Number** on every pages of your answer booklet(s) provided.
8. The following information may be useful.
 - (a) Acceleration due to gravity, $g = 9.8\text{m/s}^2$
 - (b) Radius of the Earth, $(R_E) = 6400\text{km}$
 - (c) Speed of light $= 3 \times 10^8\text{m/s}$
 - (d) Density of water $= 1000\text{kg/m}^3$
 - (e) Young modulus (E) of material of a wire was $2 \times 10^{11}\text{N/m}^2$
 - (f) $\frac{1}{4\pi\epsilon_0} = 9 \times 10^9 \text{C}^2\text{N}^{-1}\text{M}^{-2}$

OPPO

SECTION A (70 Marks)

Answer **all** questions in this section

1. (a) (i) Why do we use square brackets around M, L and T? (1 marks)
- (ii) Write down dimensional formula of capacitance (c) and give two quantities which have dimensional formula $[ML^2T^{-1}]$ (03 marks)
- (iii) State the principle under which the principle of homogeneity of dimension was based. (01 mark)
- (b) Which of the following measurements is most accurate and which is most precise
- (i) 4.00mm (ii) 4.00cm (iii) 4.00m (iv) 40.00m (04 marks)
- (c) What is the physical significance of error bar? (01 mark)
2. (a) (i) How do you say that, mass is a measure of inertia? (01 mark)
- (ii) Explain why a person get injured when drops on hard surface than on sponge surface? (01 mark)
- (b) (i) Explain briefly mechanism of a jet propulsion (02 marks)
- (ii) An object is projected so that it just clears two obstacles, each 25m high, which are situated 160m from each other, if the time of passing between the obstacles is 2.5sec. Calculate the full range of projectile and the initial velocity of the object. (06 marks)
3. (a) (i) Write down three applications of banking of the road (03 marks)
- (ii) What are two advantages of banking of the road? (01 marks)
- (b) (i) An insect is released from rest at the top of smooth bowling ball such that it slides over the ball. Prove that it will lose its footing with the ball at an angle of about 48° with the vertical. (03 marks)
- (ii) Can a torque be balanced by a single force? Explain (03 marks)
4. (a) (i) A girl is sitting on a swing. Another girl sits by her side. What will be the effect on the periodic time of the swing? (02 marks)
- (ii) Can a pendulum watch give correct time in an artificial satellite? Explain (02 marks)

(b) (i) State the two (2) conditions for a body to execute SHM (01 marks)

(ii) A particle moving in a straight line has velocity v given by $v^2 = \alpha - \beta y^2$, where α and β are constants and y is its distance from a fixed point in the line. Show that the motion of particle is SHM. Find its time period and amplitude. (05 marks)

- ✓ 5. (a) (i) Calculate the effect of rotation of the earth per day on the weight of the body at a place of latitude 45° (03 marks)
- (ii) Explain why any opposition to the forward motion of a satellite may cause it to burn? (02 marks)
- (iii) Sketch a graph to show the variation of kinetic energy and potential energy at a distance from the centre of the earth (Use separate graph) (02 marks)

(b) A solid cylinder of mass m and radius (r) rolls without slipping down an inclined plane at an angle of θ with horizontal. Show that the acceleration a of a cylinder down the plane is given by

$$a = \frac{g \sin \theta}{1 + \frac{I}{mr^2}} \quad (03 \text{ marks})$$

✓ 6. (a) (i) Explain seebeck effect as applied to thermocouple (02 marks)

(ii) The electrical resistance R in ohm of a certain thermometer varies with temperature, T according to the equation

$$R_T = R_0[1 + 5 \times 10^{-4}(T - T_0)]$$

The resistance R is 101.6Ω at the tripple point of pure water and 165.5Ω at the normal melting point of lead (600.5k). Determine the temperature T when resistance is 123.4Ω . (03 marks)

- (b) (i) Why is it preferred to have small heat capacity of a thermometer bulb? (02 marks)
- (ii) The sun radiates maximum energy at the wavelength of 4753\AA . If the temperature of the sun is 6076k , determine the temperature of a star for which maximum energy is emitted at 9300\AA (03 marks)

7. (a) What do you understand by the following terms:-

- (i) Perfectly elastic body (01 mark)
- (ii) Coefficient of elasticity (01 marks)
- (iii) Safety factor (01 marks)

- (b) Give reasons for the following phenomena:-
- (i) The temperature of a wire raises when it is bend back and forth. Why? (01 mark)
 - (ii) Why a spring balance does not give correct measurement when it has been used for a long time? (01 marks)
- (c) A uniform wire of unstretched length 2.49m is attached to two points A and B which are 2m apart and in the same horizontal line. When 6kg mass is attached to the midpoint C of the wire the equilibrium position of C is 0.75m below the line AB. Find the
- (i) Strain in the wire (02 $\frac{1}{2}$ marks)
 - (ii) Stress in the wire (02 $\frac{1}{2}$ marks)

SECTION B: (30 Marks)

Answer any **two (2)** questions from this section.

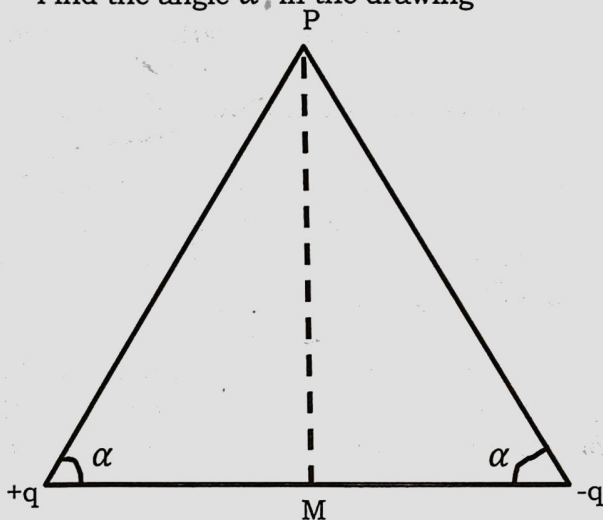
8. (a) (i) Why are longitudinal waves called pressure waves? (01 marks)
- (ii) Transverse waves are not produced in liquid and gases. Why? (02 marks)
- (b) Monochromatic light of wavelength 400nm is in air enters a glass plate of refractive index 1.5. Calculate
- (i) The speed of light in glass (01 $\frac{1}{2}$ marks)
 - (ii) The frequency of light (01 marks)
 - (iii) The wavelength of light in glass (01 $\frac{1}{2}$ marks)
- (c) (i) State the Maulus law (01 mark)
- (ii) What percentage of incident light is transmitted if the angle between the polarizer and analyser is 30° (03 marks)
- (d) The light of the H (calcium) line of the spectrum is deviated through an angle of 45°12' by a certain prism, when observed in light of a distant nebula the deviation is 44°15'. Calculate the velocity of the nebula in the light of sight, assume that the deviation to be inversely proportional to the wavelength of the light over the range of values to be considered (04 marks)
9. (a) Explain the following phenomenon based on surface tension
- (i) A small quantity of liquid assume spherical shape. Why? (01 marks)

- (ii) A drop of oil placed on the surface of water spreads out but a drop of water placed on oil contracts. Why? (01 marks)
- (iii) Oil is sprinkled on sea waves to calm them. Why? (01 marks)
- (b) (i) Write Stoke's equation, defining clearly the meaning of all symbols used. (02 marks)
- (ii) State two assumptions used to develop the equation (b) (i) (02 marks)
- (iii) There is a conical pipe of radii of its two ends as 0.2m and 0.02m with 20N/m^2 as the pressure difference along its length. A liquid of density 1000kg/m^3 is flowing through the pipe. Calculate the rate of flow of liquid through the pipe. (04 marks)
- (c) A body is released from rest on the surface of water filled to a height of 2m in a big cylinder. Assuming there is no viscous force, calculate the time taken by the body to reach the bottom of the cylinder. The relative density of a body is 6. (04 marks)
10. (a) (i) Two equal positive point charges Q are placed at a distance $2L$ apart in vacuum. A third positive test charge $+q_0$ is placed midway between two charges. If the central charge is slightly displaced by an amount x such that $x \ll L$, show that the central charge performs Simple harmonic motion with time period $T = 2\pi L \sqrt{\frac{\pi\epsilon_0 LM}{Qq_0}}$ (03 marks)
- (ii) By using Gauss's law, show that electric field intensity, E due to infinitely long straight uniformly charged wire is given by $E = \frac{\lambda}{2\pi\epsilon_0 r}$ Where each symbol carries usual meaning. (02 marks)
- (b) Sketch a graph to show variation of electric field intensity with distance from the centre of the:-
- (i) Uniformly charged spherical shell (01 $\frac{1}{2}$ marks)
- (ii) Non conducting charged solid sphere (01 $\frac{1}{2}$ marks)
- (c) (i) two point charges of the same magnitude but opposite signs are fixed to either end of the base of an Isosceles triangle as the drawing shows below.

The electric field at the midpoint 'M' between the charges has magnitude E_m . The field directly above the midpoint P has a magnitude E_p . The ratio of these two field magnitude is $\frac{E_m}{E_p} = 9$

Find the angle α in the drawing

(03 $\frac{1}{2}$ marks)



- (ii) Three charges $+2\mu\text{C}$, $+4\mu\text{C}$ and $-6\mu\text{C}$ are placed respectively at the corners A, B and C of an equilateral triangle ABC of sides 10cm. Calculate the electric field intensity E at the midpoint D of the line AB. (03 $\frac{1}{2}$ marks)