



DEDAN KIMATHI UNIVERSITY OF TECHNOLOGY

**SPH 1120/SPH 1120 PHYSIC I & PHYSICS FOR ENGINEERS I
YEAR ONE SEM I**

**FOR {CHEMICAL ENGINEERING, GEOLOGY, MECHATRONIC, CIVIL (BSC&BTECH)
AND ELECTRICAL AND ELECTRONICS (BSC&BTECH} AND GIS, GEGIS,
ACADEMIC YEAR 2020/2021**

DATE: 17TH DECEMBER, 2020

TIME: 11.00AM -1.00PM

INSTRUCTIONS: Answers question **one** and any other **two** questions.

Constants

Some Useful Contents:

1. $C = 3 \times 10^8 \text{ m/s}$
2. $g = 10 \text{ m/s}^2$
3. Density of water = 1 g/cm^3
4. Specific heat capacity of water = 4200 J/kgk
5. Atmospheric pressure = 101.3 kpa
6. Universal gas constant = 8.314 J/mol.k .
7. Specific heat capacity of copper = 390 J/kgk
8. Specific heat capacity of ice = 2100 J/kgk .
9. Latent heat of fusion lce = $3.6 \times 10^5 \text{ J/kg}$
10. Latent heat of vaporization of water = $2.26 \times 10^6 \text{ J/kg}$.
11. $\sigma = 5.6699 \times 10^{-8} \text{ w/m}^2 \text{ k}^4$
12. $G = 6.67 \times 10^{-11} \frac{\text{N.m}^2}{\text{kg}^2}$

Question One (30 marks)

- (a) Define the following terms
- (i) vector quantity. (1 mark)
 - (ii) light . (1 mark)
 - (iii) Elasticity. (1mark)
- (b) State two assumptions made when studying Bernoulli's principal.(2 marks)
- (c) Using dimensional analysis ,find the dimensions of power .(2 marks)
- (d) The displacement of a particle is given as $\mathbf{r} = (t^3 - 6t)\mathbf{i} + (5t + 2t^2)\mathbf{j}$.Determine the magnitude of the particle velocity at 3 seconds. (4 marks)
- (e) A metal rod of radius 2.4mm and length of 80cm is held to a clamp. A force of magnitude $F = 60kN$ is applied perpendicular to the end face at the other end. If the elongation is 0.3cm, determine the direct stress and longitudinal strain in the rod.(4 marks)
- (f) State and explain three modes of heat transfer.(3marks)
- (g) State three characteristics of image formed by a convex mirrors.(3 marks)
- (h) A cylinder contains 20 litres of air at $22^{\circ}C$ and 25kpa. The temperature is raised to $75^{\circ}C$, and the volume is reduced to 10litres. Calculate the final pressure of the gas in atmospheres. (4 marks)
- (i) An electromagnetic wave is transmitted at 8km .Calculate the frequency of the wave.(3 marks)
- (j) Two bodies are placed 100mm apart.If the two bodies have masses of 50kg and 80 kg,What is the net gravitational force between them.(3 marks)

Question Two (20 marks)

- (a) Define the following terms
- (i) Simple harmonic motion .(1 mark)
 - (ii) Angular speed .(1 mark)
 - (iii)Period. (1mark)
- (b) Show that a particle projected at an angle to the horizontal axis traces a parabolic curve.(4 marks)

- (c) A particle moves in the x-y plane such that its coordinate as a function of time is given as $x = A \cos(\omega t)$ and $y = A \sin(\omega t)$ where A and ω are constants. Show that the speed of the particle is a constant. **(4 marks)**
- (d) Two forces $(400N, 90^\circ)$ and $(450N, 160^\circ)$ at a point. Determine the resultant force. **(3 marks)**
- (e) A particle moves with S.H.M which is governed by the equation $x = 12\pi \sin(120\pi t + 2.5)$. Determine the particles frequency and period. **(4 marks)**
- (f) A car negotiates a corner at an angular speed of 45 rad/sec . determine its linear speed if the radius of the circle is 4 m . **(2 marks)**

Question Three (20 marks)

- (a) Define the following terms
- (i) Heat **.(1 mark)**
 - (ii) temperature. **(1 mark)**
- (b) Explain how ice skating is possible **.(2 marks)**
- (c) Calculate the heat required by 3 kg of ice at -5°C to water at 50°C . **(4 marks)**
- (d) A cylinder fitted with a movable piston contains 800 cm^3 of gas at 87°C and at 150 kpa . it is heated to 307°C . If the pressure is reduced to 110 kpa by moving the piston out, calculate the new volume of the gas. **(4 marks)**
- (e) A thin rectangular steel plate 60 cm by 40 cm is heated in a fire to a temperature of 220 degrees Celsius. Taking that its emissivity is unity, determine the total rate of radiation of the heat energy. **(3 marks)**
- (f) State three factors that determine the rate of heat conduction. **(3 marks)**
- (g) Explain why ice floats on water yet its solidified water. **(2 mark)**

Question Four (20 marks)

- (a) State
- (i) Archimedes` principle **.(1mark)**
 - (ii) Law of floatation. **(1mark)**
- (b) State four applications of Bernoulli`s principle. **(4 marks)**
- (c) State and explain two factors that affect the critical velocity of a fluid in circular tubes. **(4 marks)**

- (d) Calculate the gauge pressure that a machine must produce in order to suck some mud whose density is 2500kg/m^3 from a trench up a tube by a height of 8.2m. **(3 mark)**
- (e) A water pipe having a 4.0 cm in inside diameter carries water into a basement of a house at a speed of 1.5m/s and a pressure of 190kpa. If the pipe tapers to 2.5cm in inside diameter and rises to a second floor 15m above the input point, calculate
- The speed of water in the second floor. **(3 marks)**
 - The abs. pressure of the water at second floor. **(4 marks)**

Question Five (20 marks)

- State three applications of convex lenses. **(3marks)**
- State three applications of total internal reflection. **(3 marks)**
- A concave mirror has a focal length of 20 cm. If an object is placed 16 cm from the lens, draw ray diagram to locate the image and write two characteristics of the image formed. **(4 marks)**
- Determine the critical angle of a material whose $n = 1.42$. **(3 marks)**
- State three characteristics of image formed by plane mirrors. **(3 marks)**
- An electromagnetic wave is transmitted at 700 nanometers. Calculate the frequency of the wave. **(3 marks)**