



DEDAN KIMATHI UNIVERSITY OF TECHNOLOGY
SCHOOL OF ENGINEERING
ORDINARY EXAMINATIONS FOR ACADEMIC YEAR 2016/2017

SPH 2170/SPH 2173 PHYSIC I & PHYSICS FOR ENGINEERS I
YEAR ONE SEM I

For {Mechanical , Mechatronic , Civil(Bsc&Btech)and
Electrical and Electronics (Bsc&Btech} and GIS, GEGIS,

INSTRUCTIONS

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

Constants

Answer question **One** and any other **two** questions.

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 ice = 2100 J/kgk .
8. Latent heat of fusion Ice = $3.6 \times 10^5 \text{ J/kg}$
9. Latent heat of vaporization of water = $2.26 \times 10^6 \text{ J/kg}$.
10. $\sigma = 5.6699 \times 10^{-8} \text{ W/m}^2 \text{ k}^4$

Question One (30 marks)

(a) Define the following terms

- (i) Displacement.(1 mark)
- (ii) heat. (1 mark)
- (iii) plasticity.(1 mark)

- (b) Two force ($400N, 50^\circ$) and ($400N, 210^\circ$) acts at a point. Calculate the resultant force. (3 marks)
- (c) State the laws of refraction. (2 marks)
- (d) The acceleration of a particle from a fixed point O along the X- axis is given by $a = (2t + 1)ms^{-2}$. Determine the velocity and displacement equation of the particle given that $V=5 ms^{-1}$ and the displacement $X= 20$ at $t = 0 sec$. (4 marks).
- (e) A person wants to have a bath in water at $50^\circ C$ how much water at $90^\circ c$ should he add to 20kg of water at $25^\circ C$ to achieve the desired temperature. (3 marks)
- (f) State three applications of total internal reflection. (3 marks)
- (g) The operating temperature of tungsten filament in a lamp is 2450K and its emissivity is 0.3. Find the surface area of the filament of a 40 watts lamp. (3 marks)
- (h) A light bulb is placed 3m in front of a diverging lens of focal length 0.5m .Find the position and magnification of the image formed. (4 marks)
- (i) State Newton's second law of motion. (2 marks)
- (j) State three modes of heat transfer.(3 marks)

Question Two (20 marks)

- a) State four assumptions that can be made when studying fluid flow. (4 marks)
- b) State three factor that affects the critical velocity of a fluid flowing in a tube.(3 marks)
- c) Using dimensional analysis find the dimension of work. (3marks)
- d) A force of 3000N is suspended from a wire whose outstretched length is 4m .Its found to stretch the wire to 4.06m. The un-stretch area of the wire, which can be assumed to be constant, is $0.4mm^2$. Determine Young's modulus of elasticity of the wire. (4 marks)
- e) Water enters a house though a pipe 3.0mm in inside diameter at an absolute pressure of $4.5 \times 10^6 pa$. The pipe leading to the third floor bathroom is 12m above is 1.8mm in inside diameter. If the velocity of the inlet pipe is $8m/s$, calculate
- (i) flow velocity in the bathroom. (2 marks)
- (ii) pressure of the water in the bathroom.(4 marks)

Question Three (20 marks)

- a) Define the following terms.
- (i) S.H.M. (1 mark)
- (ii) Wavelength (1 mark)

- (iii) Rigid body. (1 mark)
- b) State
- (i) Principle of conservation of energy.(1 mark)
 - (ii) Principle of conservation of linear momentum. (1 mark)
- c) Show that if the force on a particle is constant in the x- direction ,then its velocity is given by $V_x = V_{0x} + a_x t$. (3 marks)
- d) A block of mass M is initially at rest on a friction less surface at the origin. At $t = 0$ a decreasing force of $F = F_0 e^{-\lambda t}$ acts on it. Determine the equation of its velocity and displacement at any time. (5 marks)
- e) The force on a body is proportional to displacement. A force of 8N causes a displacement of 4mm.If a mass of 4kg is attached at the end of the spring and pulled a displacement of 8mm and released, determine
- (i) the spring constant. (3 marks)
 - (ii) period and frequency of the oscillation.(4 marks)

Question Four (20 marks)

- a) State
- i) Boyles law.(1 mark)
 - ii) Pressure law.(1 mark)
- b) A cylinder is fitted with a movable piston contains 100cm^3 of a gas at 47°C and at 170 kpa. It is heated to 120°C . If the pressure is reduced to 102 kpa by moving out the piston, determine the new volume of the gas. (4 marks)
- c) A metal cup mass of 300g containing 0.5kg of water at a temperature of 28°C . A 0.7kg block of same metal that makes the cup at a temperature of 150°C is dropped into the cup and the temperature is observed to increase to 38°C . Neglecting the heat losses to the surrounding, determine the specific heat capacity of metal. (6marks)
- d) State and explain briefly the three modes of heat transfer. (3 Marks)
- e) How much heat is required to convert 120g of ice at -7°C to steam at 100°C assuming no heat losses to the surrounding? (4 marks)

Question Five (20 marks)

- a) State two main eye defects. (2 marks)
- b) Draw a ray diagram to show how a converging lens is used as a simple microscope. (3 marks)

- c) Using ray diagram method find the image formed by concave mirror if its place 20cm from a mirror whose focal length is 15cm.State the image characteristics. (5 marks)
- d) The equation of a certain traveling transverse wave is given by $y = 5 \sin 4\pi\left(\frac{t}{0.04} + \frac{x}{.025}\right)$ where x and y are in meter and t in seconds. Determine:
- (i) The frequency of the wave. (3 marks)
 - (ii) The speed of the propagation. (3 marks)
- e) Two slits are spaced 0.2mm apart and a screen is at a distance of 1m,the third bright fringe is found to be displaced 7.5mm from the central fringe. Determine the wavelength of the light used. (3 marks)