DEDAN KIMATHI UNIVERSITY OF TECHNOLOGY

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,

ACADEMIC YEAR 2016/2017

INSTRUCTIONS

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

Constants

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

Some Useful Contents:

1. C = $3x10^8 m/s$
2. g = $10m/s^2$
3. Density of water = $1g/cm^3$
4. Specific heat capacity of water = 4200J/kgk
5. Atmospheric pressure = 101.3kpa
6. Universal gas constant 8.314 J/mol.k.
7. Specific heat capacity of ice = 2100J/kgk.
8. Latent heat of fusion Ice = $3.6x10^5 J/kg$
9. Latent heat of vaporization of water = $2.26x10^6\ J/kg$.
10. $\sigma = 5.6699x10^{-8} w/m^2k^4$

Question One (30 marks)

(a) Define the following terms

(i) Displacement.(1 mark)

(ii) heat. (1 mark)

(iii) plasticity.(1 mark)

(b) Two force ($400N, 50°$) and ($400N, 210°$) 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 50^0C how much water at 90^0c should he add to 20kg of water at 25^0C 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 $4.5x10^6pa$.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 fiction less surface at the origin. At t = 0 a decreasing force of $F = F_O e^{-\lambda t}$ 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 47^0C and at 170 kpa. It is heated to 120^0c. 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 $y = 5 \sin 4\pi(\frac{t}{0.04} + \frac{x}{.025})$ 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)