DEDAN KIMATHI UNIVERSITY OF TECHNOLOGY

UNIVERSITY EXAMINATION 2014/2015

FIRST YEAR FIRST SEMESTER EXAMINATION FOR THE DEGREE IN BACHELOR OF SCIENCE IN CIVIL ENGINEERING, MECHATRONIC ENGINEERING, ELECTRICAL & ELECTRONICS ENGINEERING, GEOMATIC ENGINEERING & GEOSPATIAL INFORMATION SYSTEMS AND BACHELOR OF SCIENCE IN GEOSPATIAL INFORMATION SCIENCE

SPH 2170 PHYSICS I

DATE: 12TH FEBRUARY 2015 TIME: 8.30AM – 10.30AM

Some useful constants

(1) g =9.8m/s^2
(2) Specific heat capacity of water = 4200 J/kgK
(3) Specific heat capacity of copper = 400J/kgK
(4) Density of water = 1000kg/m^3
(5) R=8.314J/mol.K
(6) 1atm.=101.3 Kpa.
(7) σ= 5.6699x 10^{-8} Wm^{-2} K^{-4}

Answer question one and any other two questions

QUESTION ONE(30 marks)

(a) Define the following terms.

(i) instantaneous velocity (0.5 mark)
(ii) Vector (0.5 mark)
(iii) angular speed (0.5 mark)
(iv) focal point (0.5 mark)
(v) scalar (0.5 mark)
(vi) light (0.5 mark)

(b) The displacement equation of a particle is given as $x = (10t^2 - 8t - 3)$m

(i) Find the equation governing the velocity and acceleration of motion of the particle at any time t. (3marks)

(ii) Calculate the average acceleration between t = 2seconds and t = 6 seconds. (3 marks)

(c) State the two conditions necessary for total internal reflection to occur. (2marks)

(d) An object is placed 15 cm in front of a convex mirror whose focal length is 18 cm, calculate the image distance. (3 marks)

(e) A mass of 150 kg is suspended from a wire whose length is 2m.The wire length increases to 2.02 m.If the diameter of the wire is 1.5mm, compute the Young`s modulus of the wire. (4marks)

(f) An empty lorry of 10 tonnes is moving at 2m/s along a level track and collides with a loaded lorry of mass 20 tonnes at rest with brakes released .If the two couple together determine their common speed after collision. (3marks)

(g) State and explain two factors that affect the rate of conduction of heat. (4 marks)

(h) State two conditions necessary for beat to occurs. (2marks)

(i) The volume of a gas in a tube changed from 120 cm^3 to 180cm^3.If its original temperature was 123^0C, calculate its final temperature in degrees Celsius. (3 marks)

QUESTION TWO(20marks)

(a) Define the following terms

(i) Simple harmonic motion. (1 mark)
(ii) Amplitude . (1 mark)
(iii) Frequency. (1 mark)

(b) A body of mass 5kg moves with S.H.M of amplitude of 3m and a period of ten seconds. Determine

(i) The frequency of the motion. (1 marks)

(ii) The force on the body at t = 2seconds. (5 marks)

(c) State four applications of total internal reflection (2 marks)

(d) The equation of a transverse wave in a string is given by $y = 4\pi \cos\left\{12.5\pi t - \frac{x}{0.25}\right\}$where y and x are in meters and t in seconds. Determine

(i) the frequency of the wave. (2marks)

(ii) the velocity of propagation . (2 marks)

(iii) the value of y when t = 2 and x =40. (2 marks)

(e) State three types of waves. (3 marks)

QUESTION THREE (20 marks).

(a) Define the following terms.

(i) temperature (1 mark)

(ii) radiation (1 mark)

(iii) elasticity (1 mark)

(b) A copper cup of mass 0.3kg initially at 40^{o}C is filled with 0.2 kg of water at 130^{o}C. Determine the final temperature of the water and the copper cup after attaining thermal equilibrium assuming no heat loss. (4 marks)

(c) A rectangular block steel plate 40 cm by 60 cm by 90cm is heated in fire to a temperature of 100 degree Celsius. Taking emissivity to be unity, determine the total rate of radiation of the heat energy.

(3marks)

(d) Sketch the temperature time graph of ice as its heated slowly to steam. (3marks)

(e) (i)Derive the Bernoulli's equation of a incompressible fluid and define as the symbols used. (4marks)

(ii) Water at a speed of 12m/s is pumped through a pipe of 14cm in diameter to a smaller tap whose diameter is 5cm. Determine the speed of delivery of water from the tap. (3 marks)

QUESTION FOUR (20marks).

(a) Draw the ray diagram of a simple microscope. (2 marks)

(b) A converging lens has a focal length of 50cm.Determine the object distance if the image formed is 30 cm from the lens. (3 marks)

(c) A diffraction grating with 4 x 10^{6} lines per centimeter produces the third image at a diffraction angle of 35^{0} . Calculate the wavelength of the light used. (3 marks)

(d) A photo man focuses his camera on a group of people standing 4 meters from the lens. If the lens has a focal length of 2cm, calculate the image distance and linear magnification of the image.(4 marks)

(e) Show that if two waves with same amplitude and frequency interfere then the output of the superposed waves is twice the amplitude of one of the waves. (5 marks)

(f) An object is placed at a distance of 15cm in front of a concave mirror forms an image at a distance of 4cm behind. By formula method find the focal length of the mirror. (3 marks)

QUESTION FIVE (20 marks).

(a) State

(i). Newton`s second law of motion. (1 mark)

(ii). Hooke`s law. (1 mark)

(iii). Pascal principle. (1 mark)

(iv). Principle of conservation of energy. (1 mark)

(b))Three forces (200N,20^0) (400N,90^0) and (300N,$300^{0)}$ acts at a point ,determine the resultant of the three forces. (4marks)

(c) Using dimensional analysis, find the dimensions of kinetic energy. (3marks)

(d) The coordinates of a particle moving in the x – y plane is given as a function of time as $x = (t^3 + 6t)$ meters $y = (3t^3 + 8t)$ meters. Calculate

(i) the particle distance from the origin at t = 2 seconds. (3marks)

(ii) the particle speed at t = 5 seconds. (3 marks)

(iii) the particle acceleration at t= 2 seconds in the y direction. (3 marks)