EMBU UNIVERSITY COLLEGE

(A Constituent College of the University of Nairobi)

2015/2016 ACADEMIC YEAR

FIRST SEMESTER EXAMINATION

FIRST YEAR EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE
AND BACHELOR OF EDUCATION SCIENCE

SPH 101: MECHANICS I

DATE: DECEMBER 7, 2015   TIME: 8:30-10:30

INSTRUCTIONS:

Answer Question ONE and ANY Other TWO Questions.

$g = 9.8 m/s^2$ density of water $= 1000 kgs/m^3$

QUESTION ONE

a) You are provided with $\vec{a} = 3.0\hat{\imath} - 4.0\hat{\jmath}$ and $\vec{b} = -2.0\hat{\imath} + 3.0\hat{k}$. Find $\vec{a}.\vec{b}$.   (3 marks)

b) Giving examples differentiate between a vector and a scalar quantity.   (4 marks)

c) The position of a particle on the x-axis is given by $x = 5 - 81t + t^3$. Find t.

(3 marks)

d) Differentiate between gauge pressure and absolute pressure.   (2 marks)

e) A particle of mass m moves vertically along y-axis. Gravitational force Fg acts on it as it moves from point y_i to y_f. Find its change in gravitational potential energy.

(4 marks)

f) A block of wood of mass 450 g hangs from a cord. A bullet of mass 0.0095 kg was fired into the block coming quickly to rest. They both swung a vertical distance of 4.7 cm before the

pendulum came momentarily to rest at the end of the arch. Find the speed of the bullet prior to the collision. (4 marks)

g) A rocket is shot and is observed 210 km away in a direction making an angle of 52^0 East of due North. Find how far East and North the rocket is from the point of shooting at the time of observation. (3 marks)

h) A ball is thrown upwards with a velocity of 12 ms^{-1}. Find the time it takes to reach the maximum height. (3 marks)

i) A diver expands his lungs at a depth L and forgets to exhale during his ascent to the surface such that at the surface the difference between external pressure on him and air pressure is 9.3 k Pa. Find the depth on which he starts to ascend.

(4 marks)

QUESTION TWO

a) A liquid of density 791kgm^{-3} flows smoothly through a horizontal pipe that has different cross sectional areas from A1 = 1.20 x 10^{-3}m^2 to A2 = A1/2. The pressure difference between the wide and narrow sections of the pipe is 4120pa. Find the volume flow rate Rv of the liquid. (8 marks)

b) A body accelerates from rest at a constant rate α for some time, after which it decelerates at a constant rate β to come to rest. If the total time lapse is t seconds. Find:
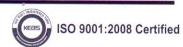   i) Maximum velocity reached. (6 marks)
   ii) Total distance travelled. (6 marks)

QUESTION THREE

a) A rocket travelling in a horizontal straight line at 10km/s explodes and breaks up into two parts of mass 1 ton and 0.2 tons respectively. Both parts travel in the same direction as before but measurements show that the lighter section is moving 1000m/s faster than the heavier part. Calculate the velocity of each section.

(9 marks)

b) Show that the gravitational force Fg acts at the same point as the center of mass of body

i.e.

$$X_{coG} = X_{coM}$$ (11 marks)

QUESTION FOUR

A rectangular block of density $\rho=800kg/m^3$ floats in a fluid of density $\rho_f=1200kg/m^3$. The block has a height H=6.0cm and is submerged up to a height h in the fluid. Find:

    a) The depth by which the block is submerged (15 marks)

    b) If the block is held fully submerged and then released, what is the magnitude of its acceleration? (5 marks)

QUESTION FIVE

Consider a uniform disk of mass M=2.5 kg and radius R=20 cm mounted on a fixed horizontal axle. A block of mass m=1.2 kg hangs from a massless cord that is wrapped round the rim of the disc.

    i) Tension in the cord (10 marks)

    ii) Find the acceleration of the disc. (10 marks)

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