KENYATTA UNIVERSITY

UNIVERSITY EXAMINATIONS 2011/2012

FIRST SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE (MECHANICAL ENGINEERING)

EMM 105: PHYSIC FOR ENGINEERS

DATE: Monday 19th December 2011 **TIME:** 8.00a.m – 10.00a.m

INSTRUCTIONS

ANSWER ANY THREE (3) questions
All questions carry 20 equal marks each
Use neat and clear diagrams

Q1. a) Define the terms, as used in mechanics:-

i) Mechanics
ii) Statics
iii) Machine
iv) Particle
v) Rigid body

(5 mks)

b) Determine the reactions of the beam loaded as shown in figure Q. 1 (b) **(5 mks)**

c) i) A smooth sphere weighs 200N and rests as shown in figure Q.1 (c) determine the reaction at the supports

(3 mks)

ii) Determine the minimum value of force P required just to start the wheel over the step 300 mm high. The diameter of the wheel is 1.2m and its weight is 800N. Also find the direction of P.

(7 mks)

Q.2 a) Define the following:-

i) Kinematics
ii) Kinetics
iii) Dynamics
iv) Newton's 1st law
v) Newton's 2nd law

(5 mks)

b) From first principles, show that the centroid of a semi-circular thin sheet of metal is at a distance $\frac{4R}{3\pi}$ from its diametral axis given that R is its radius. **(5 mks)**

c) A projectile is fired from the edge of a 160m high cliff with an initial velocity of 200m/sec at an angle of elevation of 35^0 with the horizontal. Neglecting air resistance find:-

i) The horizontal distance from the gun to the point where the projectile strikes the ground. **(5 mks)**

ii) The greatest elevation above the ground reached by the projective. **(5 mks)**

Q.3 a) Define the following terms used in connection with the flow of a liquid:-

i) Uniform flow

ii) Steady flow

iii) Turbulent flow

iv) Viscous or streamline or laminar flow

v) Discharge` **(5 mks)**

b) i) Write the Bernoulli's equation for unit mass and again for unit weight **(2 mks)**

ii) Water at an altitude of 36m above sea level has a velocity of 18mls and a pressure of 350 KN/m^2 calculate the total energy per Newton of this water reckoned above sea level. **(3mks)**

c) Oil flows through a pipeline which contracts from 450mm diameter at A to 300 mm diameter at B and then forks, one branch being 150 mm diameter discharging at C and the other branch 225 mm diameter discharging at D. If the velocity at A is 1.8 mls and the velocity at D is 3.6 mls, what will be:-

i) The discharges at C and D? **(5 mks)**

ii) The velocities at B and C? **(5 mks)**

Q4. a) i) State the first law of thermodynamics **(1 mks)**

ii) Write the equation for a non flow process in the 1^{st} law **(1 mk)**

iii) Write the steady flow energy equation **(1 mk)**

b) State i) Boyle's law **(2 mks)**

ii) Charles' law **(2 mks)**

iii) Avogadro's hypothesis **(2 mks)**

c) A certain gas has a volume of 0.l m^3 and is compressed from a pressure of 120 KN/m^2 and

temperature 25^0C to a pressure of 12 bar according to the law $PV^{1.2}$ = constant. Determine:-

i) The work transferred during compression **(5 mks)**
ii) The change in internal energy **(3 mks)**
iii) The heat transferred during compression **(3 mks)**

Take C_v = 0.72 KJ/kgK and R = 0.285 Kj/kg K

Q.5 a) (i) Write the Fourier's Law of heat conduction and write down the expression of the Law stating what the symbols denote. **(2 mks)**

iii) For a one dimensional steady-state heat condition through a composite wall of two layers derive the expression for the rate of heat flow through the wall. **(3 mks)**

b) A Furnace Wall consists of 125 mm wide refractory brick and 125mm wide insulating firebrick separated by an air gap. The outside wall is covered with 12mm thickness of plaster. The inner surface of the wall is at 100^0C and the room temperature is 25^2C.

Calculate:-

I) The rate at which heat is lost per m^2 of wall surface and **(2 mks)**
II) Each interface temperature and **(6 mks)**
III) The temperature of the outside surface of the wall **(2 mks)**

Take:- the heat transfer coefficient from the outside wall surface to the air in the room as $17W/m^2K$ and the resistance to the heat flow of the air gap as 0.16K/W
The thermal conductivity of refractory brick, insulating firebrick and plaster are 1.6, 0.3 and 0.14 W/mK respectively

c) Explain, briefly:-

i) Convective heat transfer **(1 mk)**
ii) The phenomena, using a sketch, when radiation heat energy strikes a surface **(2 mks)**
iii) Radiation shape factor **(2 mks)**

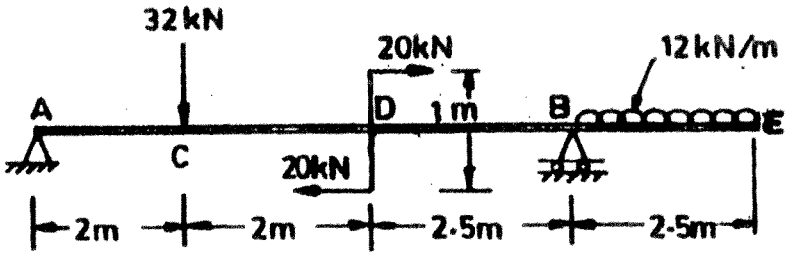

FIG. Q1 (b)

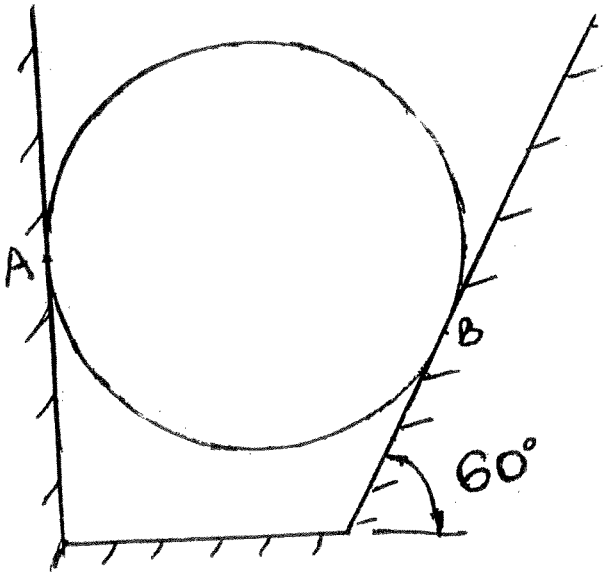

FIG. Q 1(C) (i)

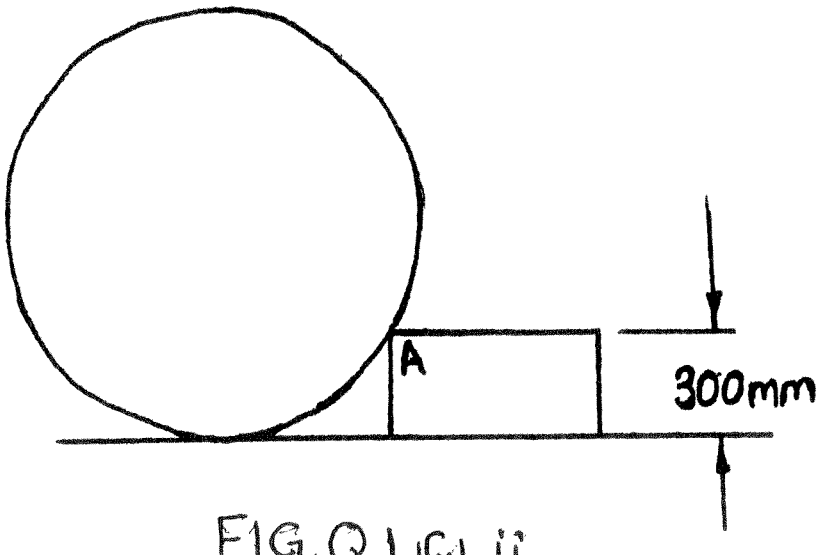

FIG. Q 1 (C) (ii)