Registration No. : | | | | | | | | | | |

Total number of printed pages – 7

B. Tech
BE 2104

First Semester Back Examination – 2014

MECHANICS

BRANCH(S) : AEIE, AERO, AUTO, BIOMED, BIOTECH, CHEM, CIVIL, CSE, EC, EEE, EIE, ELECTRICAL, ENV, ETC, FASHION, FAT, IEE, IT, MANUFACT, MANUTECH, MECH, MINERAL, MINING, MME, PLASTIC, TEXTILE

QUESTION CODE : L 355

Full Marks – 70

Time : 3 Hours

*Answer Question No. **1** which is compulsory and any **five** from the rest.*
The figures in the right-hand margin indicate marks.

1. Answer the following questions : 2×10

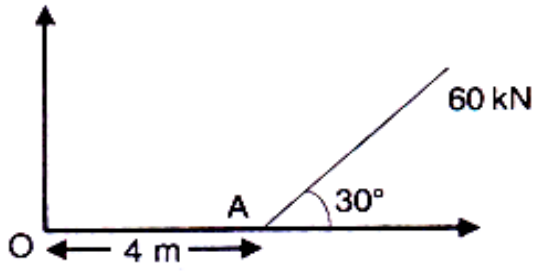
(a) A simply supported beam AB of beam span is loaded with a uniformly varying load whose intensity varies from zero at one end to 100 KN/m at the other end. Find the reactions at the supports at A and B.

(b) Sketch the free body diagram of a ladder of weight 'W' leaning against a wall. Both wall and floor are rough.

(c) A particle is starting from rest moves in a straight line whose equation of motion is $S = 2t^2 - 3t - 1$. What will be the velocity and acceleration of the particle after 5 seconds ?

P.T.O.

(d) A force of 60 KN is acting at appoint 'A' as shown in the figure. Determine the moment of this force about 'O'.



(e) What are the various type of support ? Show the reactions at hinged support and also at the fixed support.

(f) How does D' Alemberts principle differ from Newton's law ? Explain.

(g) A man of weight W=1KN holds one end of a rope that passes over a pulley vertically above his head and to the other end of which is attached a weight Q = 614N. Find the force with which the man's feet press against the floor.

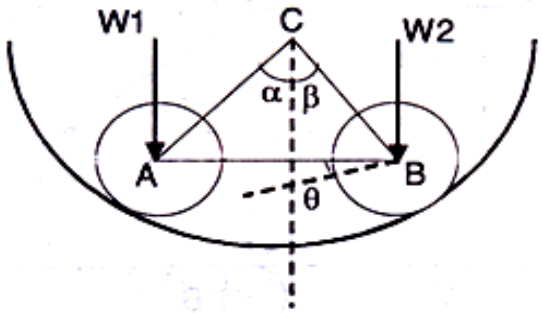
(h) What do you mean by equilibrium of three forces ? How can they be in equilibrium ?

(i) What Is the effect of force and moment in a body ?

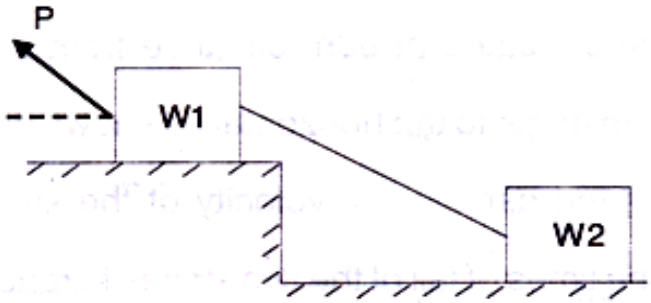
(j) What do you mean by limiting force of friction ? Explain.

2. A rigid bar AB with balls of weights W_1 = 75 N and W_2 = 125 N at ends is supported inside a circular ring as shown in the figure. Radius of the ring and rod AB are such that radii AC and BC make right angles at the centre of the ring C.

Neglecting friction and weight of AB, ascertain equilibrium configuration defined by angle$[(\alpha-\beta)/2]$ that AB makes with horizontal. Find the contact reaction at A and B, and axial force in rod AB. 10



3. (a) Two blocks of weights W_1 and W_2 connected with a string are at rest as shown in the figure. If the angle of friction of each block be ϕ, find the magnitude and direction of least force 'P' necessary for upper block that will induce sliding. 6

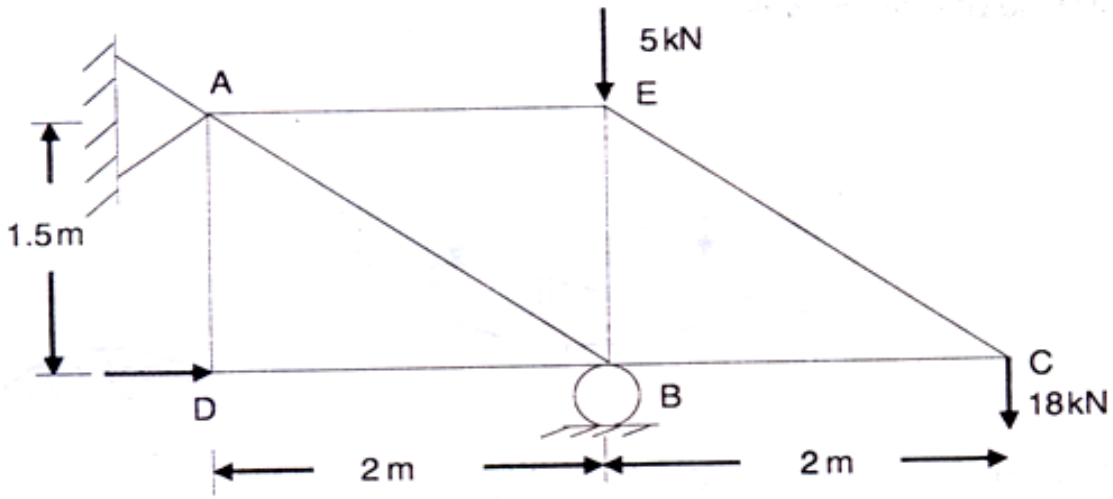


(b) A particle is projected vertically upwards is seen at 'P' after t_1 seconds. If it takes t_2 seconds more from this point 'P' to the point of projection, prove that,

(i) The height of 'P' above the point of projection $= \frac{1}{2} g t_1 t_2$

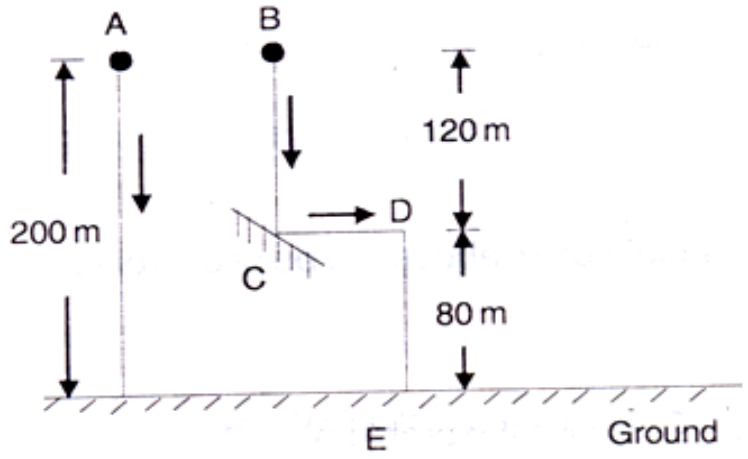
(ii) The maximum height attained $\frac{1}{2} g \left[\frac{t_1 - t_2}{2}\right]^2$ 4

4. (a) A truss of span 9 m is loaded as shown in figure. Find the forces in the members of the truss. 8



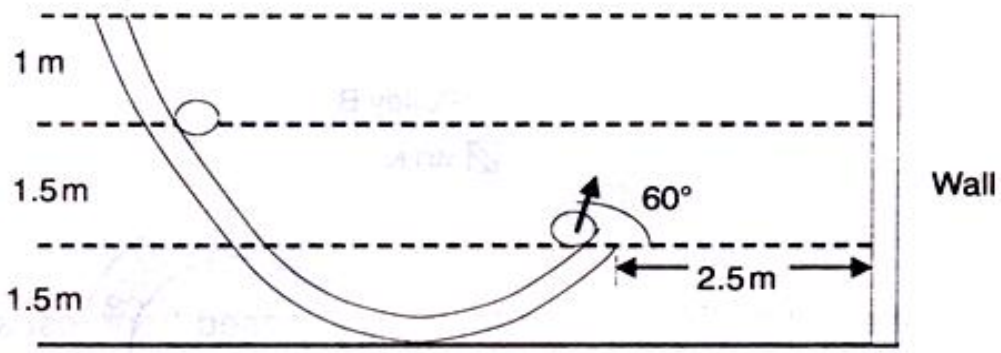
(b) Explain rigid truss, over rigid truss and deficit truss along with diagrams. 2

5. (a) Two stones are dropped simultaneously from rest from two points both 200m above the ground. One of the stone during its downward motion hits affixed inclines plane located at 80m distance from the ground. The plane is inclined at an angle to the horizontal as shown in the figure. As a result of this impact, the direction of velocity of the stone becomes horizontal. Compare the times of fall of the two stones to reach the ground. 5



(b) A ball weighing 10N starts from the position as shown in Figure and slides down a frictionless chute under its own weight. After leaving the chute where will the ball hit the wall ?

Also calculate the time interval between the instant of leaving chute and hitting the wall. 5



6. A stone is projected upwards from the top of a 30 m high building with a velocity of 30 m / sec at an angle of 35° with horizontal. Calculate 10

(i) The greatest height reached by the stone above the ground.

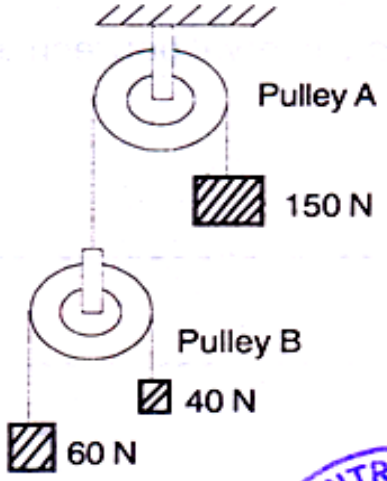
(ii) The horizontal distance from the point of projection to the point where the stone strikes the ground.

(iii) The velocity with which it strikes the ground, and

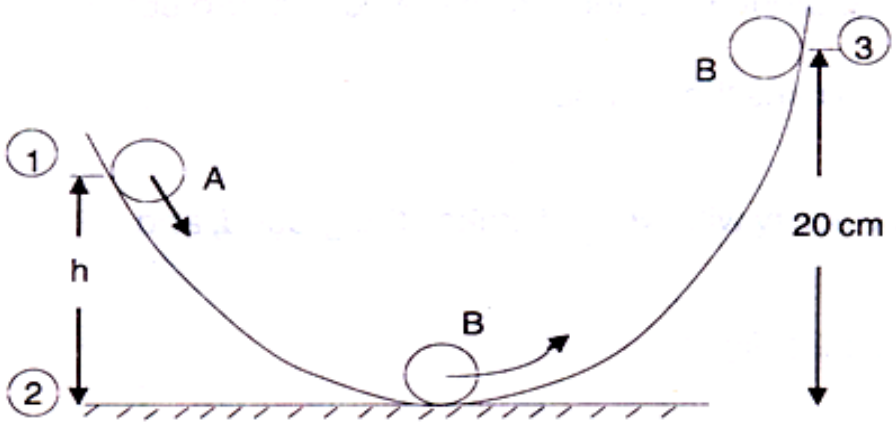
(iv) The time of flight

(Draw the figure and solve the problem)

7. A system of weights connected by strings passing over pulleys A and B as shown in the figure. Find the accelerations of the 3 weights assuming weightless strings and ideal conditions for pulleys. 10



8. (a) A spherical ball A of mass M when released from rest slides down the surface of a smooth bowl and strikes another spherical ball B of mass M/4 resting out the bottom of the bowl, as shown in the figure. Determine the height 'h' from which the ball A should release so that after the impact the ball B just leaves the bowl. The coefficient of restitution may be assumed to be 0.8. 6



(b) Determine the centroid of the areas between parabola $x^2 = ay$ and the straight line $y = x$, as shown in the figure. 4