FE l sem - I (Rev.)    14/12/12
Engg. mechanics- I

(REVISED COURSE)                    **KR-3411**

                                    (3 Hours)                      **[Total Marks : 80**

- Question number 1 is compulsory.
- Attempt any *three* questions from remaining five questions.
- Figure to the right of the question paper indicate full marks.
- Assume acceleration due gravity value g=9.81m/s$^2$
- Assume suitable data wherever necessary
- Answers to sub-questions should be grouped together.
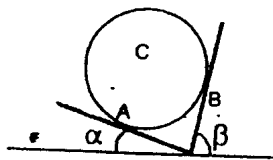
1. Solve
   a) Find resultant of the force system.

[04]
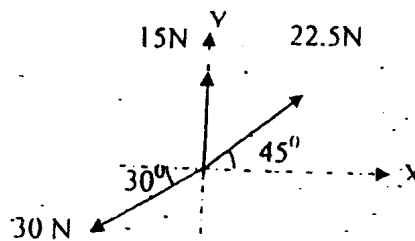


   b) A smooth circular cylinder of weight W and radius R rests in a V shape groove whose
      sides are inclined at angles $\alpha$ and $\beta$ to the horizontal as shown. Find the reactions $R_A$ and
      $R_B$ at the points of contact.                                    [04]



alpha = 20 degree
beta = 60 degree

   c) For the block shown in figure, find the minimum value of P, which will just disturb the
      equilibrium of the system.
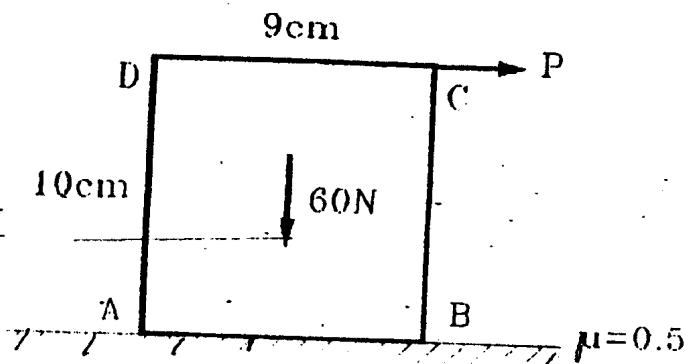


   d) A particle moving in the +ve x direction has an acceleration. a = 100 - 4v$^2$ m/s$^2$
      Determine the time interval and displacement of a particle when speed changes from
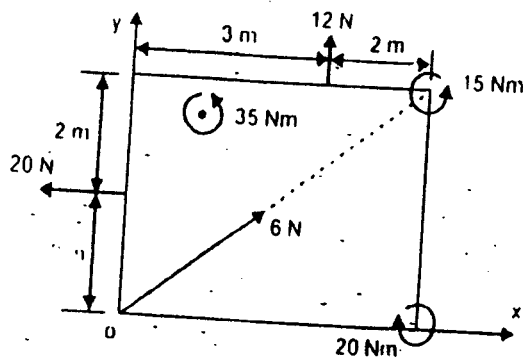      1m/s to 3m/s.

[04]

**[ TURN OVER**

e) A vertical lift of total mass 750kg acquires an upward velocity of 3m/s over a distance of 4m moving with constant acceleration starting from rest. Calculate the tension in the cable.

[04]

2. Solve

a) Replace the system of forces and couples by a single force and locate the point on the x-axis through which he line of action of the resultant passes.

[6]



Missing length = 2 m

(b) Two identical rollers each of weight 500N and radius r are kept on a right angle frame ABC having negligible weight. Assuming smooth surfaces, find the reactions induced at all contact surfaces.

[8]
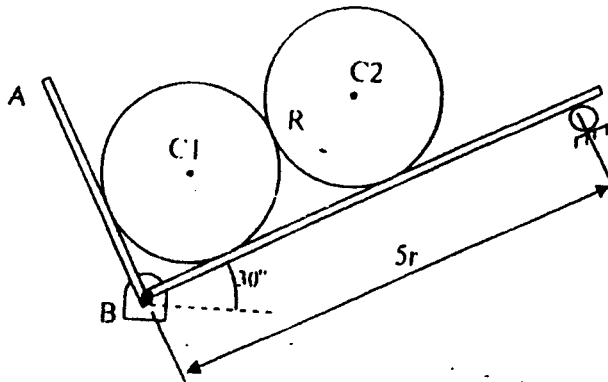


(c) A body of mass 2kg is projected upwards from the surface of the ground at t=0 with velocity 20m/s. At the same time another body of mass 2 kg is dropped along the same line from a height of 25m. If they collide elastically, find the velocities of body A and B just after collision.

3. Solve

[6]

a) Find centroid of the shaded area.

[08]
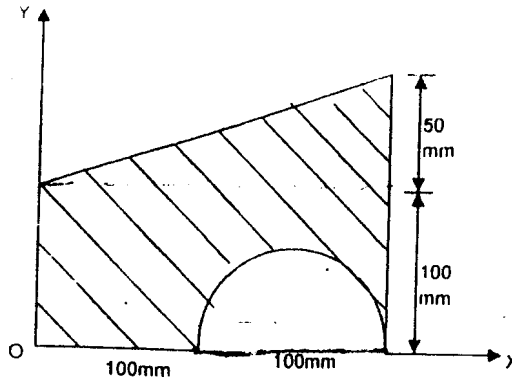
b) A rectangular parallelepiped carries 4 forces as shown in the figure. Reduce the force system to a resultant force applied at the origin and a moment around origin. OA=5m, OB=2m. OC=4m.
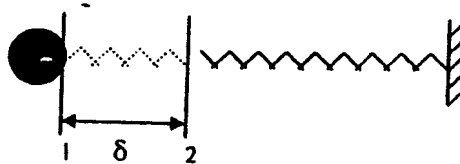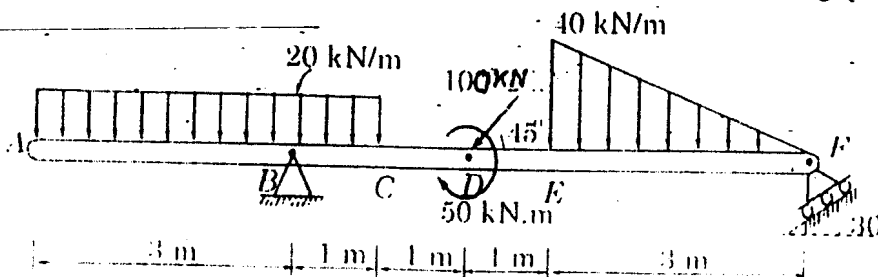
[06]
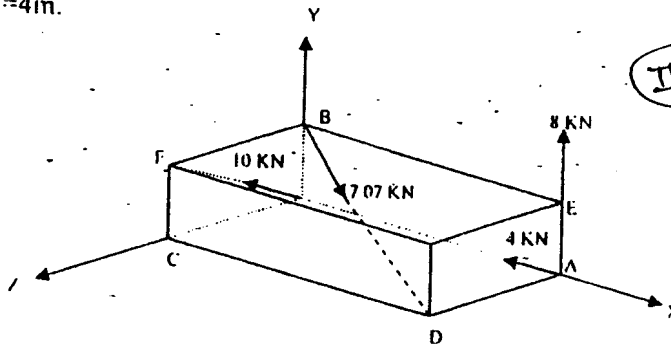
force along BD
is-7·07kN
7·07 KN



c) A spring of stiffness k is placed horizontally and a ball of mass m strikes the spring with a velocity v. find the maximum compression of the spring.    Take m = 5kg. k = 500N/m, v = 3m/s.
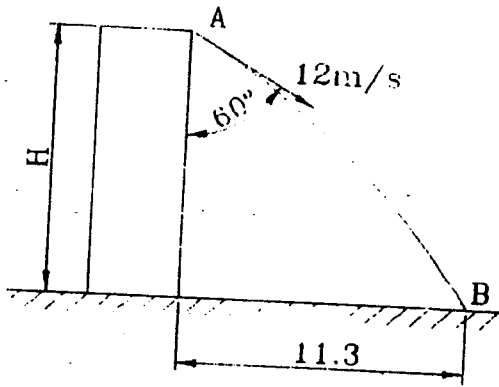
[06]



4. Solve

a. Find the support reactions for the beam loaded and supported as shown in fig. [08]

b) A ball thrown with speed of 12 m/s at an angle of 60° with a building strikes the ground 11.3 m horizontally from the foot of the building as shown. Determine the height of the building [06].



c) In a crank and connecting rod mechanism, the length of crank and the connecting rod are 300mm and 1200mm respectively. The crank is rotating at 180 rpm. Find the velocity of piston, when the crank is at an angle of 45° with the horizontal. [06]
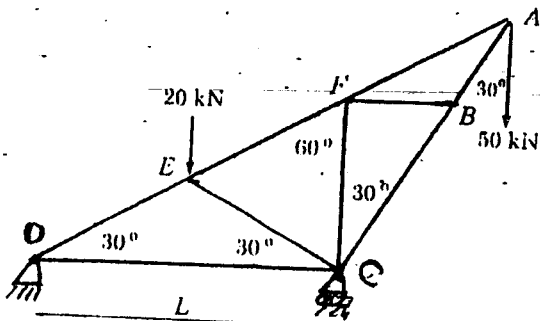
→ Direction of rotation of crank is clockwise
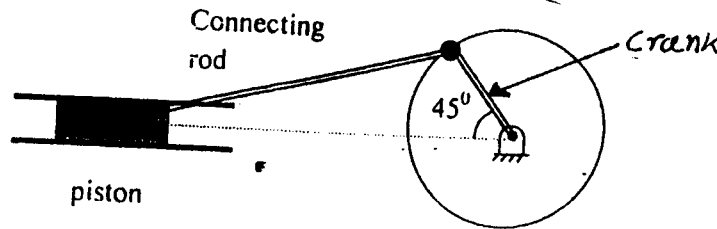


5.Solve

(a) Referring to the truss shown in fig. find

(i) Reactions at D and C (ii) Zero force members (iii) ) Forces in members FE, and DC by method of sections and (iv) Forces in other members by method of joints [08]

Hint: Hing support is D and Roller support is C

b) A point moves along a path $y = x^2/3$ with a constant speed of 8m/s. What are the x and y components of its velocity when x=3? What is the acceleration of the point at this instant?

[06]

c) At the position shown in figure, the crank AB has Angular velocity of 3rad/sec clockwise. Find the velocity of slider C and the point D at the instant shown. AB=100mm. [06]
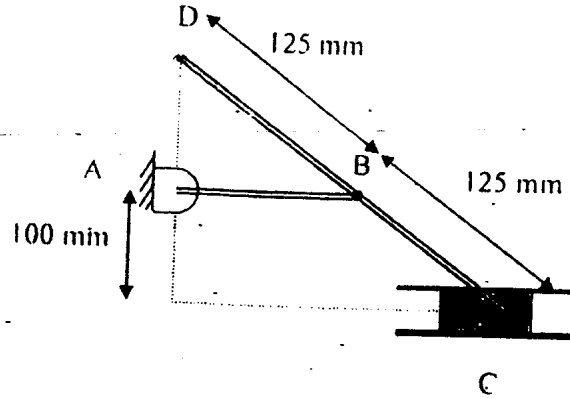


6. Solve

a) Force $F = 80i + 50j - 60k$ passes through a point A (6, 2, 6). Compute its moment about a point B (8, 1, 4).

[04]

b) Assuming the values for $\mu$=0.25 at the floor and 0.3 at the wall and 0.2 between the blocks, find the minimum value of horizontal force P applied to the lower block that will hold the system in equilibrium.

[8]
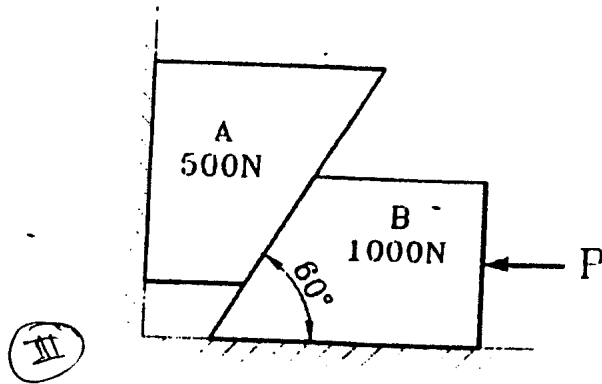


start from Rest & moves

c) The car moves in a straight line such that for a short time its velocity is defined by $v = (9t^2 + 2t)$ m/s. Where t is in seconds. Determine its position and acceleration when t = 3sec.

[04]

d) Three $m_1$, $m_2$ & $m_3$ of masses 1.5Kg, 2Kg & 1Kg respectively are placed on a rough surface with $\mu$ = 0.20, as shown. If a force F is applied to accelerate the blocks at 3m/s², what will be the force that 1.5Kg block exerts on 2Kg block? [04]