| Time: 9.00 to 10.30 am	03/10/2019	Marks: 30

Instructions:

(i) Figures to the right indicate full marks for the question.
(ii) Make use of sketches/diagrams wherever possible.
(iii) Assume missing data suitably and mention the same clearly.

**Q1.** **Attempt any two:-** [10]

a) A disable automobile is pulled by means of two ropes as shown in figure. The resultant of the forces in the ropes AB and AC is 25kN. Pulls in ropes AB and AC are so adjusted that the automobile moves in the direction of the axis. Determine (i) the tensions in tow ropes AC and AB, when $\alpha = 45^0$ and (ii) the value of α such that the tension in the rope AC is minimum. Find the tension P and corresponding Q minimum.
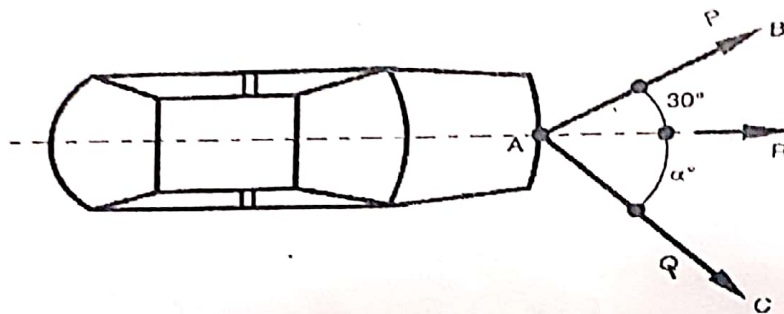
b) Three identical cylinders are piled up in a rectangular channel as shown in figure.
   (a) Determine reactions at 6 contact points
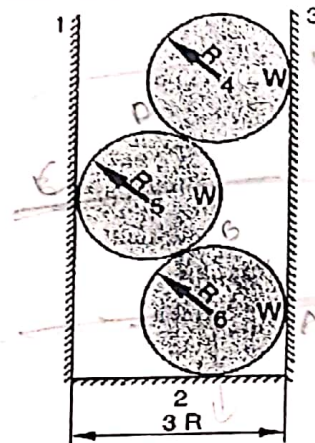
c) Two beams ABC and CD are pinned together at C as shown in figure below. Beam CD carries uniformly load w kN/m, which produces reactions at B as 60 kN. Determine w and find reactions at A and B.


w kN/m

A   B   C   D

4 m   2   4 m
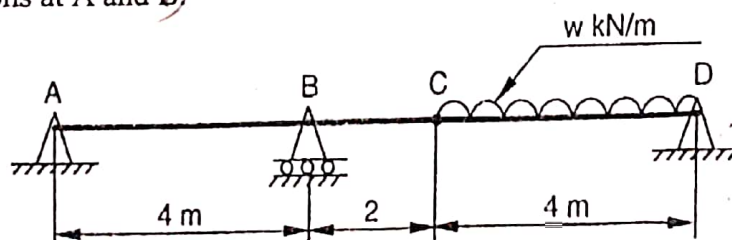
Q2.a) Forces 32kN, 24kN, 24kN, and 120 kN are concurrent at origin and are respectively [04] directed through the points whose coordinates are A (2,1,6), B (4, -2, 5), C(-3, -2, 1) and D (5, 1, -2). Determine the resultant of the system.

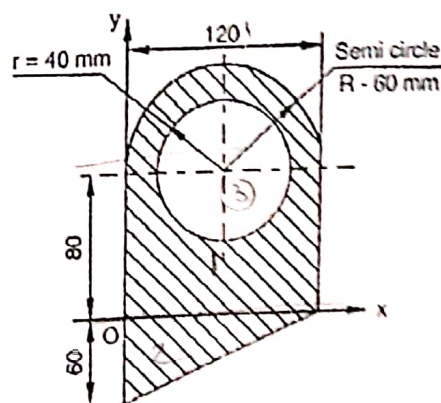**b)** Replace the force system shown in figure below by a force couple system at C. [06]
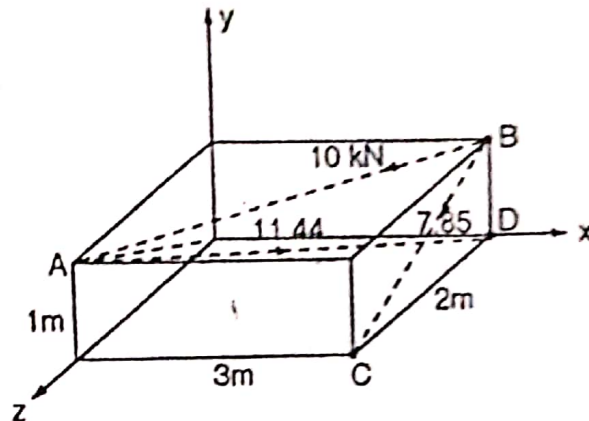
OR

b) Five vertical forces are acting on a horizontal plate as shown in figure. Find the resultant [06] of the forces and point of application w.r.t origin.
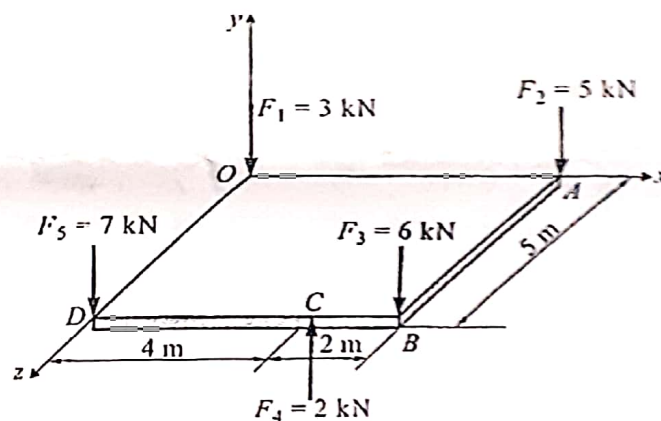
Q3.a) Determine the location of the centroid of the plane area shown shaded in sketch below: [05]

b) Determine the moment of inertia of plane area about AB axis as shown in figure, [05] without using parallel axis theorem.
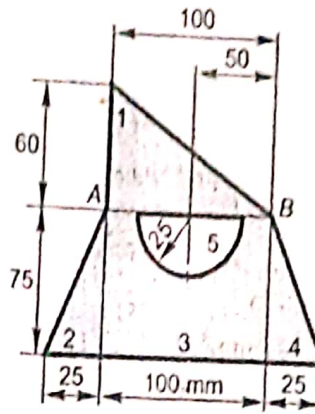
OR

c) Find the moment of inertia of given shaded area about centroidal x axis. Refer Figure [05] below.