Total Pages—7

B. Tech

BEG 1002

Second Semester Examination, 2004

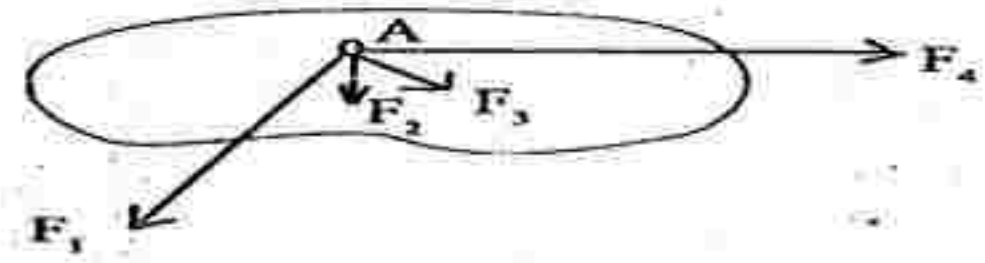### Mechanics-I

Full Marks : 70

Time : 3 hours

Answer Q. No. 1 which is compulsory and
any five questions from the
remaining seven questions

The figures in the right-hand margin indicate marks

1. Answer the following : 2 × 10

    (*a*) Indicate as to how the resultant of the
    following force system acting on a body at
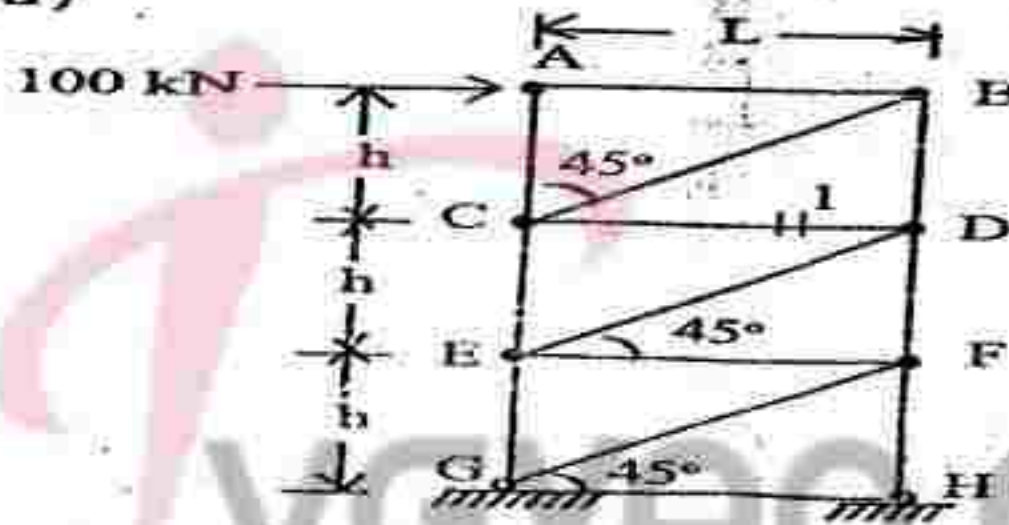   A can be determined in magnitude and
    direction

(b) If the X-component of a force is 50 kN and Y-component of it is 100 kN, then what is the magnitude and direction of the force ?

(c) What is a Plane frame ?

(d)

Write down the equation for the force S_1 acting in the member 1 (CD) by the method of section and hence determine S_1, given the loading of the frame as 100 kN at A.

(e) Distinguish between Static equilibrium and Dynamic equilibrium of Forces in a plane.

(f) Explain the theory of Transmissibility of force.

(g) For the case of elastic impact, two laws of conservation hold good. What are they ?

(h) The general displacement-time equation for the rectilinear motion of a particle with constant acceleration f is given by :

$$x = x_0 + \dot{x}_0 t + (1/2) f t^2$$

What do the terms x_0 and $\dot{x}_0$ signify ?

(i) What is impact ? Explain.

(j) Explain how the force at the interface of the two blocks, shown in the figure below, can be determined.

P $\longrightarrow$

W_1

W_2

Smooth Surface

Smooth Surface
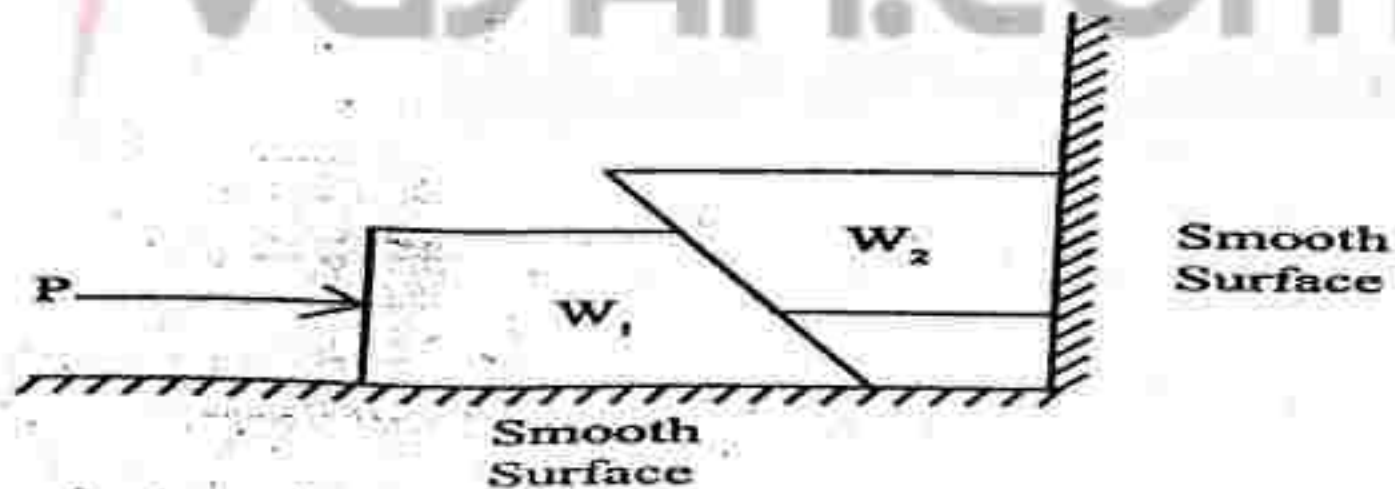
2.   (a) What are the principles by which one can determine the members of truss which do not carry any load ?   3

   (b) The truss, shown in *Fig. 1*, is hinged at the end A and roller supported at D. Determine the forces and their nature in all the members AB, BF and BE.   7
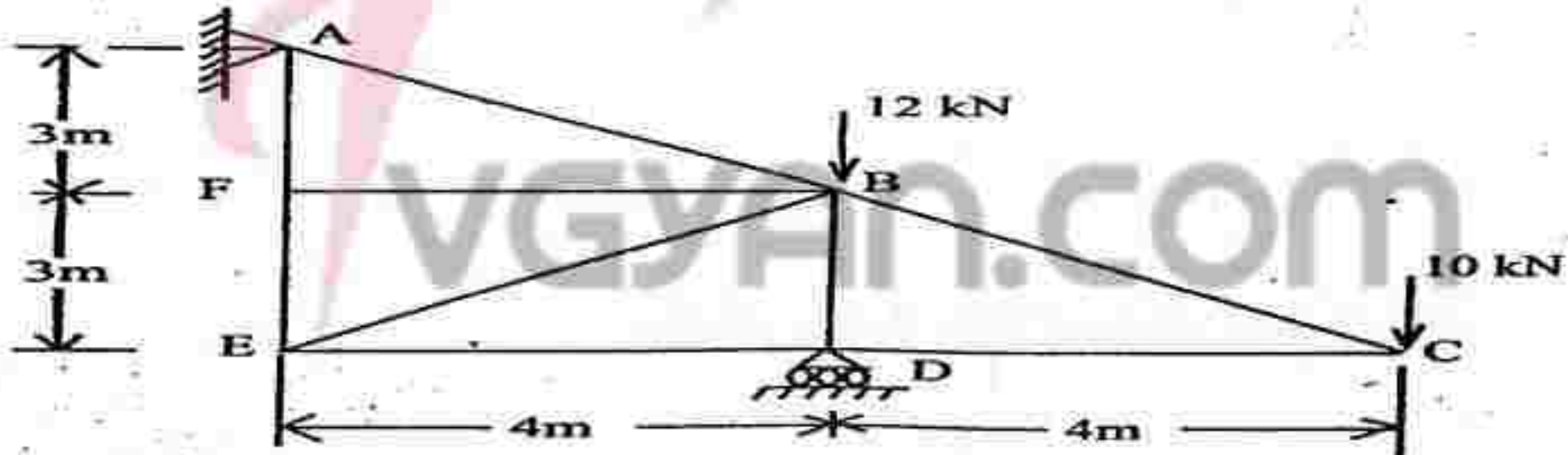

Fig. 1

3.   (a) State the conditions of equilibrium for a system of coplanar forces.   2

(b) Two cylinders A and B rest in a box as shown in Fig. 2. A has a diameter of 300 mm and weighs 1200 N. B has a diameter of 200 mm and weighs 360 N. The box is 450 mm wide at the bottom. Assume that all surfaces are smooth. Find the reactions at the supporting surfaces.   8
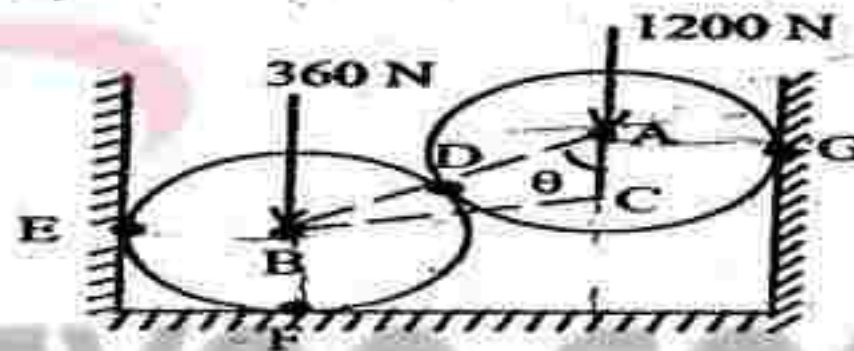

Fig. 2

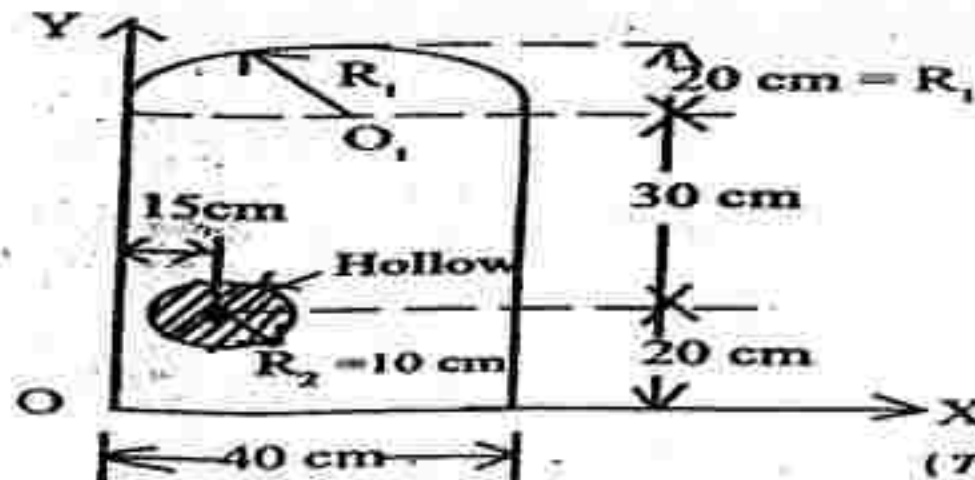4. Locate the centroid of the given composite area shown in Fig. 3   10

Fig. 3

5. (a) State and explain the Principle of conservation of Energy.   2

   (b) Two blocks A and B weighing 1500 N and 2500 N respectively are initially at rest. They are connected by string passing over a smooth pulley as shown in Fig. 4. Determine the tension in string and acceleration of each block. The force of friction between two surfaces between the inclined plane and blocks are negligible.   8
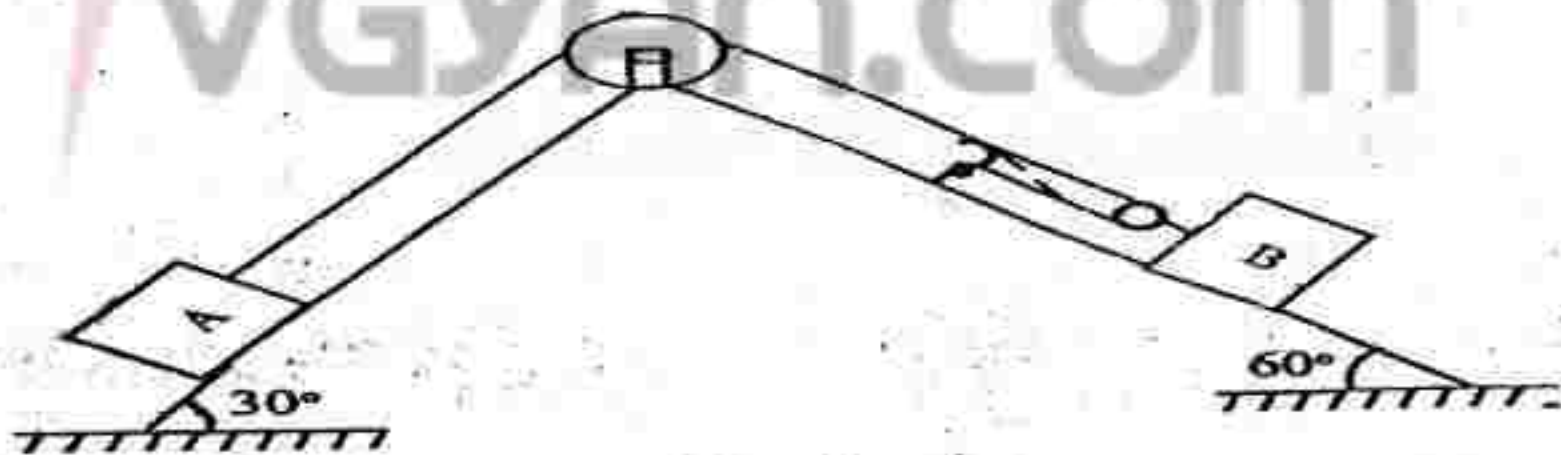

Fig. 4

6. Track repairs are going on a 2 km length of a railway track. The maximum speed of the train is 90 kmph. The speed over the repair track is 36 kmph. If the train on approaching the repair track decelerates uniformly from the full speed of 90 kmph to 36 kmph over a distance of 200 metres and after covering the repair track accelerates uniformly to full speed of 90 kmph from 36 kmph over a distance of 1600 metres, find the time lost due to reduction of speed in the repair track. 10

7. A bullet of mass 30 grams fired with a velocity of 1200 metres per sec., strikes a wooden block weighing 98 N at its centre, the block being suspended by a vertical string from a point 6 metres above the centre of the block. If after striking the bullet remains embedded in the centre of the block, find the angle by which the string will swing from the vertical. 10

8. A baseball is thrown with a speed of 30 m/sec at some angle of elevation. Using the principle of work and energy, and neglecting the resistance of air, determine the speed of the ball when it reaches its maximum height of 16 metres above the horizontal plane that passes through the starting point. 10

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