

B.Tech-2nd(Sec-D, E, F, G, H, I & J)
Engineering Mechanics

Full Marks : 50

Time : $2\frac{1}{2}$ hours

Answer all questions

The figures in the right-hand margin indicate marks

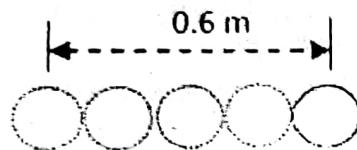
Symbols carry usual meaning

1. Answer all questions : 2×5

- (a) State & prove Varignon's theorem.**
- (b) Define coefficient of friction and limiting friction.**
- (c) What is the location of centroid of a cone height 'h' and radius 'r'?**
- (d) A ball is moving with constant velocity as shown in the given figure. A camera is**

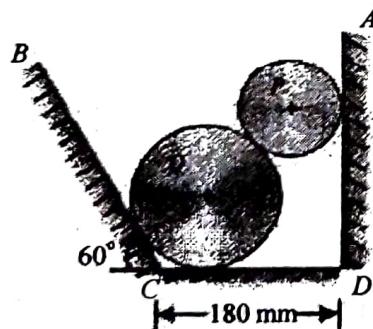
(2)

taking images of its motion at the rate of 12 images /second. What is the speed of ball ?



(e) What are impulse and momentum ?

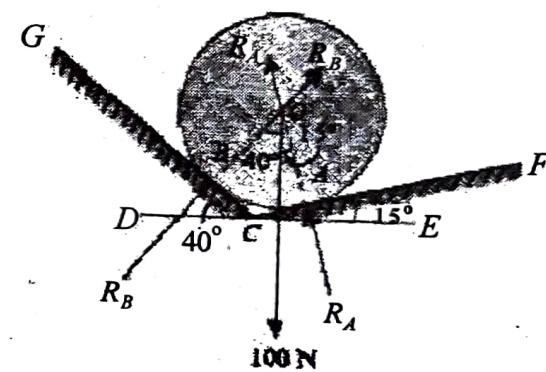
2. Two cylinders P and Q rest in a channel as shown in Figure. The cylinder P has diameter of 100 mm and weighs 200 N, whereas the cylinder Q has diameter of 180 mm and weighs 500 N. If the bottom width of the box is 180 mm, with one side vertical and the other inclined at 60° , determine the pressures at all the four points of contact. 8



(3)

Or

A smooth circular cylinder of radius 1.5 meter is lying in a triangular groove, one side of which makes 15° angle and the other 40° angle with the horizontal. Find the reactions at the surfaces of contact, if there is no friction and the cylinder weights 100 N. 8



3. A ladder 5 meters long rests on a horizontal ground and leans against a smooth vertical wall at an angle 70° with the horizontal. The weight of the ladder is 900 N and acts at its

(4)

middle. The ladder is at the point of sliding, when a man weighing 750 N stands on a rung 1.5 metre from the bottom of the ladder. Calculate the coefficient of friction between the ladder and the floor.

8

Or

A beam AB of span 5 metres is carrying a point load of 2 kN at a distance 2 metres from A. Determine the beam reactions, by using the principle of the virtual work.

8

4. Find the moment of inertia of a T-section with flange as $150 \text{ mm} \times 50 \text{ mm}$ and web as $150 \text{ mm} \times 50 \text{ mm}$ about X-X and Y-Y axes through the CG of the section.

8

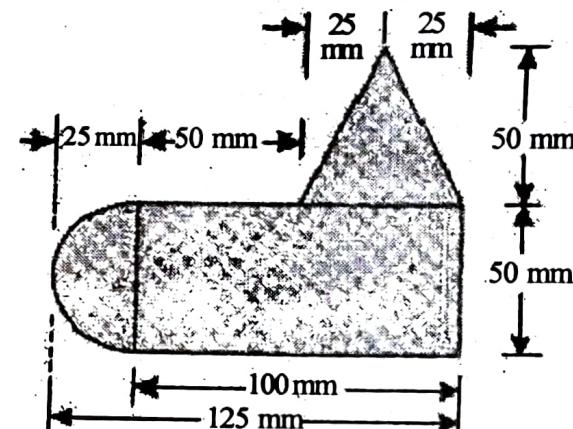
Or

(a) A uniform lamina shown in Figure consists of a rectangle, a circle and a

(5)

triangle. Determine the centre of gravity of the lamina. All dimensions are in mm.

5



(b) Using Pappus theorem, find the volume of sphere.

3

5. Two men, standing on a floating boat, run in succession, along its length, with a speed of 4.2 m/sec relative to the boat and dive off from the end. The weight of each man is 80 kg and that of the boat is 400 kg. If the boat was initially at rest, find the final velocity of the boat. Neglect water friction.

8

Or

(a) Explain the principle of conservation of momentum in oblique impact bodies. 4

(b) A ball is dropped from a height $h_0 = 1$ m on a smooth floor. Knowing that the height of the first bounce is $h_1 = 81$ cm, determine 4

(i) Coefficient of restitution, and

(ii) Expected height h_2 after the second bounce.

6. A particle is thrown with a velocity of 5 m/s at an elevation of 60° to the horizontal. Find the velocity of another particle thrown at an elevation of 45° which will have (a) equal horizontal range, (b) equal maximum height, and (c) equal time of flight. 8

Or

A wagon of mass 50 tonnes, starts from

rest and travels 30 metres down a 1% grade and strikes a post with bumper spring. If the rolling resistance of the track is 50 N/t, find the velocity with which the wagon strikes the post. Also find the amount by which the spring will be compressed, if the bumper spring compresses 1 mm per 20 kN force. 8