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Answer ALL Questions

PART A - (10 x 1 = 10 Marks)

1. The resultant of two forces P and Q acting at an angle θ is
   (a) $\sqrt{P^2 + Q^2 + 2PQ \sin \theta}$
   (b) $\sqrt{P^2 + Q^2 - 2PQ \cos \theta}$
   (c) $\sqrt{P^2 + Q^2 + 2PQ \cos \theta}$
   (d) $\sqrt{P^2 + Q^2 + 2PQ \tan \theta}$

2. The forces, which meet at one point and their lines of action also lie on the same plane, are known as
   (a) Coplanar concurrent forces
   (b) Coplanar non-concurrent forces
   (c) Non – coplanar concurrent forces
   (d) Non-coplanar non-concurrent forces

3. How many reaction forces in the fixed support?
   (a) 1   (b) 2   (c) 3   (d) 4

4. Three forces acting on a rigid body are represented in magnitude, direction and line of action by the three sides of a triangle taken in order. The forces are equivalent to a couple whose moment is equal to
   (a) Area of triangle
   (b) Twice the area of triangle
   (c) Half the area of triangle
   (d) None of these

5. The centre of gravity of a quarter-circle lies at a distance of .... from the base measured along the horizontal radius
   (a) $\frac{3\pi}{4r}$ (b) $\frac{4r}{3\pi}$ (c) $\frac{3r}{8}$ (d) $\frac{8}{3r}$

6. Moment of inertia is the
   (a) Second moment of force
   (b) Second moment of area
   (c) Second moment of mass
   (d) Second moment of weight

7. The first and second differentiation of an equation of displacement in terms of time, with respect to time, the equation so obtained will give in the order of

   (a) displacement and velocity
   (b) displacement and acceleration
   (c) acceleration and velocity
   (d) velocity and acceleration

8. The maximum height of a projectile on a horizontal range is

   (a) $\dfrac{u^2 \sin 2\alpha}{2g}$
   (b) $\dfrac{u^2 \sin \alpha}{2g}$
   (c) $\dfrac{u^2 \sin^2 2\alpha}{2g}$
   (d) $\dfrac{u^2 \sin^2 \alpha}{2g}$

9. The force of friction always acts in a direction opposite to that

   (a) In which the body tends to move
   (b) In which the body is moving
   (c) Both (a) and (b)
   (d) None of the (a) and (b)

10. The bodies which rebound after impact are called

    (a) inelastic bodies
    (b) elastic bodies
    (c) neither elastic or inelastic bodies
    (d) None of these

PART - B (5 x 2 =10 Marks)

11. State parallelogram law of forces.

12. Explain Varignon's theorem.

13. Define radius of gyration

14. What is Impulse of force?

15. Explain limiting friction.

PART - C (5 x 16 = 80 Marks)

16. (a) Two smooth sphere each of radius 100 *mm* and weight 100 *N*, rest in a horizontal channel having vertical walls, the distance between the walls being 360 *mm*. Find the reactions at the points of contacts *A, B, C* and *D* as shown in Figure. 1. (16)


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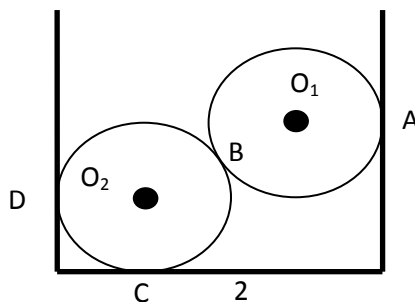
(b) Particle 'O' is acted on by the following forces Determine the resultant force.

      (i)   20 N inclined 30° North of East

      (ii)   25 N towards North

      (iii)   30 N towards North West

      (iv)   35 N inclined 40° to South of West, Find the resultant. (K2)   (16)

17. (a) Three smooth pipes each weighing 20 KN and of diameter 60 cm are to be placed in a rectangular channel with horizontal base as shown. Calculate the reactions at the points of contact between the pipes and between the channel and the pipes. Take width of channel as 160 cm.   (16)
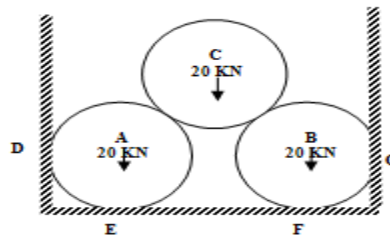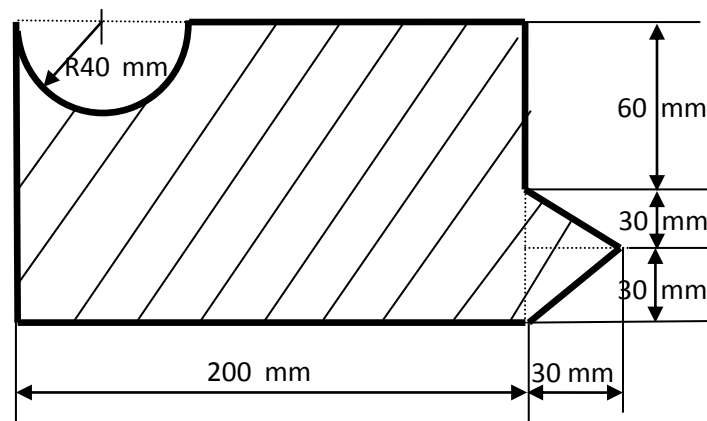

Or

(b) Find the pin reaction at *A* and the knife-edge reaction at *B*.   (16)

All Dimensions are in 'mm'
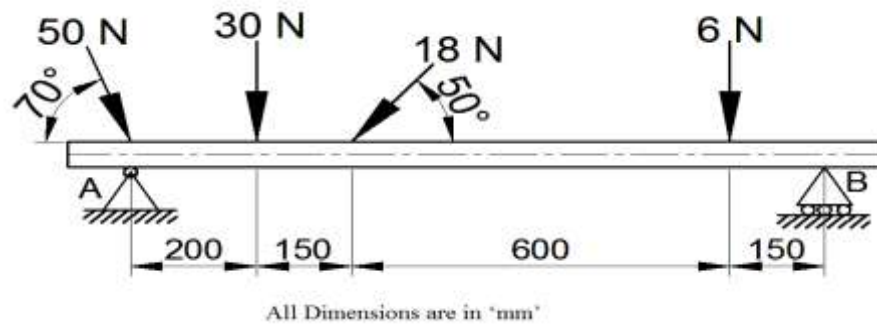
18. (a) Determine the coordinates of the centroid of the plane area shown in Figure   (16)


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Figure

Or

(b) Find the moment of inertia of a T section of flange 100 mm x 30 mm and web 20 mm x 80 mm about its centroidal axes. (16)

19. (a) A particle under constant deceleration is moving in a straight line and covers a distance of 20 *meters* in the first 2 *seconds* and 40 *meters* in the next 5 *seconds*. Calculate the distance it covers in subsequent 3 *seconds* and the total distance travelled by the particle before it comes to rest. (16)

Or

(b) A particle is projected at a velocity of 40 *m/s* at an angle of 50° to the horizontal. Find

(i) The position of the particle and the magnitude and the direction of its velocity at $t = 2$ *sec*.

(ii) The time when the particle reaches the highest point of its flight and its height at this point

(iii) The horizontal range and time of flight. (16)

20. (a) Block *A* weighing 750 *N* rests over block *B* which weighs 1250 *N* as shown in Figure. Block *A* is tied to wall with a horizontal string. If the coefficient of friction between block *A* and block B is 0.25 and between block *B* and the floor is 1/3. Calculate the value of *P* to move the block. (16)
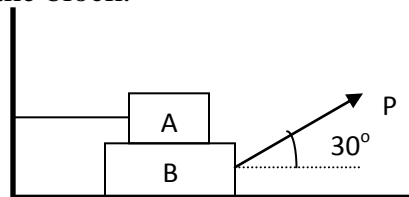
Or

(b) A right circular cylinder of weight 100 *N* and radius 200 *mm* is suspended from a cord that wound around its circumference. If the cylinder is allowed to fall freely, find the acceleration of its mass center and tension in the cord. (16)

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