

**University of Mumbai**

Program: \_First Year (All Branches) Engineering - SEM-I

Curriculum Scheme: Rev 2019

Engineering Mechanics

**Question Bank**

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<b>Q1.</b>	<b>Choose the correct option for following questions. All the Questions are compulsory and carry equal marks [20]</b>
1.	Equilibrium of a rigid body in static refers to_____.
Option A:	Balance of forces in static condition
Option B:	Balance of forces and moments in static condition
Option C:	Balance of energy of body
Option D:	Balance of inertia force and inertia moments
2.	Resultant of the forces $F_1= 30i +20j$ and $F_2= -20i +10j$ is _____.
Option A:	31.62 N acting along $71.56^\circ$ to the x-axis
Option B:	31.62 N acting along $18.56^\circ$ to the x-axis
Option C:	3100 N acting along $71.56^\circ$ to the x-axis
Option D:	31.62 N acting along $18.43^\circ$ to the x-axis
3.	Pushing or pulling of a vehicle with same magnitude of force along the same line of action is called as _____.
Option A:	Equilibrium
Option B:	Principle of transmissibility
Option C:	Newtons III law
Option D:	Newtons II law
4.	If the resultant of the two equal forces is equal to either of them, then angle between the forces is_____.
Option A:	$30^\circ$
Option B:	$60^\circ$
Option C:	$90^\circ$
Option D:	$120^\circ$
5.	Ratio of limiting friction and normal reaction is _____.
Option A:	Coefficient of friction
Option B:	Angle of friction
Option C:	Sliding friction
Option D:	Coefficient of restitution
6.	A 2 m long ladder rests against a wall and makes an angle $30^\circ$ with the horizontal. At the instant of slipping, the instantaneous center of rotation will be_____.

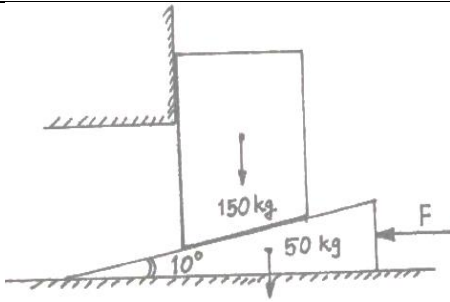
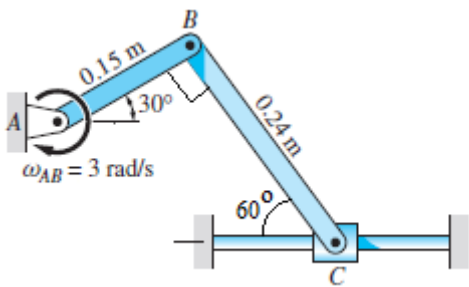
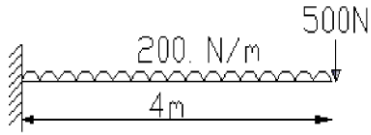
Option A:	1.0 m from wall and 1.732 m above the floor
Option B:	1.732 m from wall and 4 m above the floor
Option C:	1.732 m from wall and 2 m above the floor
Option D:	1.732 m from wall and 3 m above the floor
7.	A particle experiences constant acceleration for 25 s after starting from rest. If it travels a distance of $S_1$ in the first 15 s and distance $S_2$ in the next 10 s then,
Option A:	$S_1 = 1.78 S_2$
Option B:	$S_2 = 1.78 S_1$
Option C:	$S_1 = S_2$
Option D:	$S_2 = \frac{S_1}{0.78}$
8.	If stone is projected vertically up, its time of flight is _____.
Option A:	Inversely proportion to its mass
Option B:	Proportional to its initial velocity
Option C:	Proportional to its mass
Option D:	Inversely proportional to its initial velocity
9.	Velocity-time curve for the body projected vertically upwards is a _____.
Option A:	Straight line inclined to the time axis
Option B:	parabola
Option C:	ellipse
Option D:	curve
10.	The area under the speed -time graph gives the _____.
Option A:	Distance travelled by the particle
Option B:	Velocity of the particle
Option C:	Acceleration of the particle
Option D:	Momentum of particle
11.	The algebraic sum of the resolved parts of a number of forces in a given direction is equal to the resolved part of their resultant in the same direction. This is as per the principle of
Option A:	Forces
Option B:	Balance of forces
Option C:	Resolution of forces
Option D:	Transmissibility of forces
12.	Two parallel equal forces acting in the opposite direction
Option A:	balance each other
Option B:	constitute a moment
Option C:	constitute a force couple system
Option D:	constitute a moment of the couple
13.	Varignon's theorem is used to find _____
Option A:	direction of resultant force

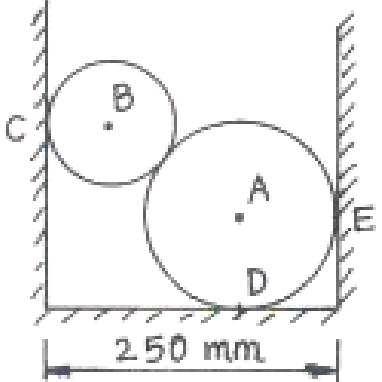

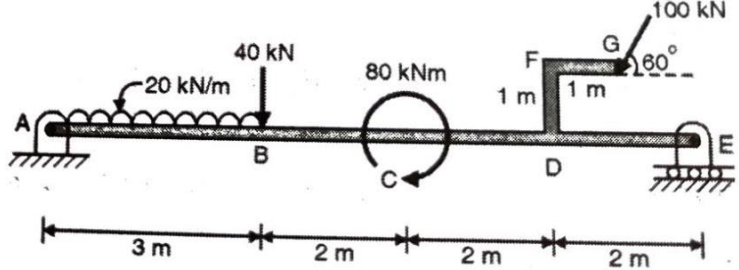
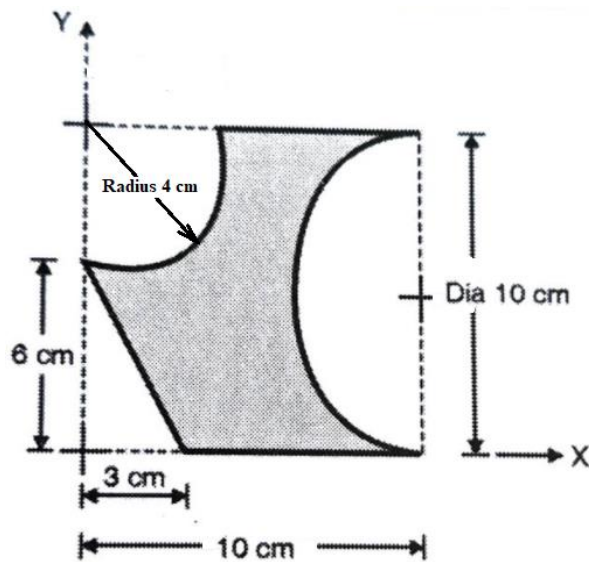
Option B:	location of resultant force
Option C:	magnitude of resultant force
Option D:	nature of resultant force
14.	If an object is dropped from the top of a building and it reaches the ground at $t = 4$ s , then the height of the building is (ignoring air resistance) ( $g = 9.8 \text{ m/s}^2$ )
Option A:	77.3 m
Option B:	80.5 m
Option C:	79.2 m
Option D:	78.4 m
15.	During a test, 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 when $t = 3$ sec.
Option A:	Position = 70 m
Option B:	Position = 80 m
Option C:	Position = 90 m
Option D:	Position = 100 m
16.	Forces of magnitudes 100N, 200N and 300 N act along the slides BC, CA, AB of an equilateral triangle of side 20 mm. what is the moment of the resultant about A.
Option A:	$600\sqrt{3}$ N
Option B:	$1000\sqrt{3}$ N
Option C:	$2000\sqrt{3}$ N
Option D:	$3000\sqrt{3}$ N
17.	A particle moves along a straight line such that distance (x) traversed in t seconds is given by $x = t^2 (t - 4)$ , the acceleration of the particle will be given by the equation
Option A:	$3t^2 - t$
Option B:	$3t^2 + 2t$
Option C:	$6t - 8$
Option D:	$6t - 4$
18.	D' Alembert's principle is used for
Option A:	Reducing the problem of kinetics to equivalent statics problem
Option B:	solving kinematic problems
Option C:	Stability of floating bodies
Option D:	Designing safe structures
19.	A projectile is fired at an angle $\theta$ to the vertical. Its horizontal range will be maximum when $\theta$ is
Option A:	$0^\circ$
Option B:	$30^\circ$
Option C:	$45^\circ$
Option D:	$60^\circ$
20.	What is the C.G of an isosceles triangle of base 20 cm and side 40?
Option A:	12.90 cm
Option B:	13.28 cm

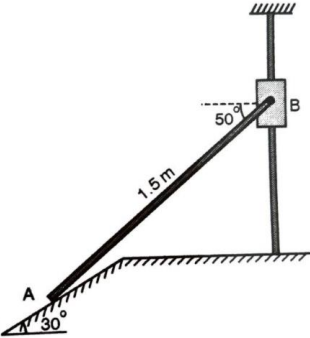
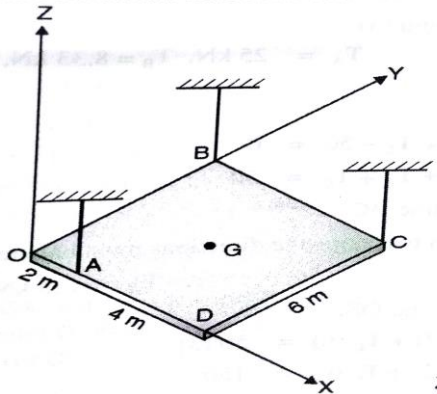
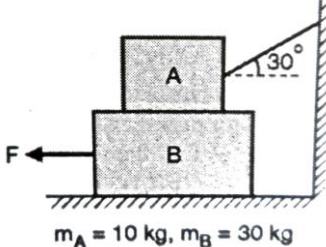
Option C:	19.36 cm
Option D:	38.72 cm

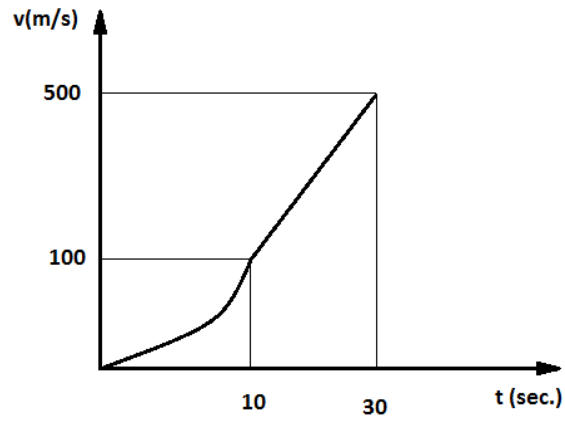
### Descriptive Section

1.	<p>A concurrent system of forces is shown in the <b>Error! Reference source not found.</b> Find the resultant passing through the origin</p>	<p style="text-align: center;">Figure 1</p>
2.	<p>Find the centroid of the shaded areas of the are as shown in figure 2</p>	<p style="text-align: center;">Figure 1</p>
3.	<p>A heavy roller with radius 14 cm and weighing 2000 N is pulled to the right by a pulling force T acting at an angle 30° with respect to horizontal as shown in figure 3. A 6 cm step stops the rolling motion of the roller. Find the magnitude of force T, to just start the motion of the roller. Also find the reaction at A.</p>	<p style="text-align: center;">Figure 3</p>
4.	<p>The horizontal position of the 500 kg rectangular block of concrete, shown in Figure 4, is adjusted by the 5° wedge under the action of the force P. If the coefficient of static friction for all the surfaces in contact is 0.4, determine the force P required to move the block to the right.</p>	<p style="text-align: center;">Figure 4</p>
5.	<p>Two objects A and B are dropped from above a tower of height h at different time interval and reach the ground in time <math>t_1</math> and <math>t_2</math> seconds, respectively. Find the ratio of <math>t_1</math> and <math>t_2</math> if object A travels 50 m in its last second of flight, while object B travel 70m in its last second of flight?</p>	
6.	<p>A particle starts from rest from origin and its acceleration is given by</p>	

	$a = \frac{k}{(x+4)^2}$ <p>Knowing that <math>v = 4 \text{ m/s}</math> when <math>x = 8 \text{ m}</math>. Find value of <math>k</math></p>	
7.	The motion of particle is defined by the relation $x = 3t^3 - 18t^2 + 26t + 8$ , where $x$ is the position expressed in meters and $t$ is the time in seconds. Determine (i) time when the velocity is zero and (ii) the position and the total distance travelled when the acceleration becomes zero.	
8.	From top of 60 m tower, a bullet is fired at an angle of $60^\circ$ with the horizontal, with a velocity of 120 m/s. Calculate height attained by bullet and the time of its interval.	
9.	A block of mass 150kg each raised by a $10^\circ$ wedge weighing 50kg under it and by applying a horizontal force at it as shown in <b>Error! Reference source not found.</b> Taking $\mu$ between all surfaces of contact as 0.3, find what minimum force should be applied to raise the block.	 <p style="text-align: center;">Figure 5</p>
10.	When the mechanism of Figure 6 is in the position shown, the angular velocity of bar $AB$ is 3 rad/s clockwise. Using instantaneous center of rotation, calculate the angular velocity of bar $BC$ and the velocity of slider $C$ for this position	 <p style="text-align: center;">Figure 6</p>
11.	Find the support reactions of the following cantilever beam loaded as shown in <b>Error! Reference source not found.</b>	 <p style="text-align: center;">Figure 7</p>
12.	A motorist is travelling on a curved road of radius 200 m at a speed of 27 km/h. Find normal and tangential component of acceleration. If he applies brakes to slow down his car uniformly to a speed of 36 km/h in 10 s, find the normal and tangential component of deceleration just after the brakes are applied.	
13.	A uniform ladder rests with one end against a vertical wall and other end on the ground, whose coefficient of friction is 0.6. If the inclination of ladder to the ground is $45^\circ$ , find the position of a man whose weight is same as ladder. The length of ladder is 8 m.	

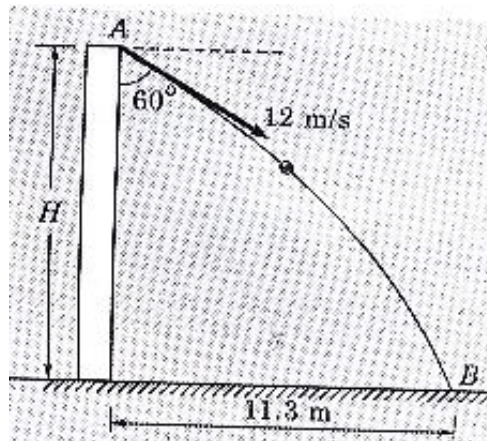
<p>14.</p>	<p>Two smooth spheres A and B weigh 200N and 100N respectively are resting against two smooth vertical walls and a smooth horizontal floor as shown in</p> <p>When the mechanism of Figure 8 is in the position shown, the angular velocity of bar AB is 3 rad/s clockwise. Using instant center of rotation, calculate the angular velocity of bar BC and the velocity of slider C for this position.</p> <p>The radius of sphere A is 100mm and Radius of sphere B is 50mm. Find the reactions from the vertical walls and horizontal floor. Also find the reaction exerted by each sphere on the other.</p>	 <p style="text-align: center;">Figure 8</p> 
<p>15.</p>	<p>Forces 32 kN, 24 kN, 24 kN, and 120 kN are concurrent, non-coplanar acting at the origin and directed through the points whose coordinates are A(2,1,6), B(4,-2,-5), C(-3,-2,1) and D(5,1,-2) respectively. Determine the resultant.</p>	
<p>16.</p>	<p>Find the reactions at the supports A &amp; B for the given beam shown in fig.</p> 	
<p>17.</p>	<p>Find the centroid of the shaded area shown in fig. with respect to given reference axes X &amp; Y.</p> 	

18.	<p>Collar B moves up with constant velocity of <math>V_B = 2 \text{ m/s}</math>. Rod AB is pinned at B. Find the angular velocity of rod AB and velocity of A.</p> 
19.	<p>A square plate of dimensions <math>6\text{m} \times 6\text{m}</math> and weighing <math>50 \text{ kN}</math> is suspended in horizontal plane using three cables. Find the tension in each cable.</p> 
20.	<p>Find the minimum force required to pull the block B towards left. Take the coefficient of friction for all contact surfaces as <math>0.3</math>.</p> 
21.	<p>A stone is dropped into the well and sound of splash is heard after 4 seconds. Assuming velocity of sound to be <math>350 \text{ m/s}</math>, find the depth of well.</p>
22.	<p>A car moves along a straight road such that its velocity is described by the graph shown in fig. For the first 10 seconds the velocity variation is parabolic and between 10 seconds and 30 seconds the variation is linear construct s-t and a-t graphs.</p>



23.

A ball thrown with a speed of 12m/s at an angle of  $60^\circ$  with a building strikes the ground 11.3m horizontally from the foot of the building as shown in fig. Determine the height of the building and the velocity of ball with which it strikes the ground.



For given system find resultant and its point of application with respect to point A.

