SRM VALLIAMMAI ENGINEERING COLLEGE

(An Autonomous Institution)

SRM Nagar, Kattankulathur – 603 203

DEPARTMENT OF MECHANICAL ENGINEERING

QUESTION BANK

III SEMESTER

1909301 – ENGINEERING MECHANICS

Regulation – 2019

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SRM VALLIAMMAI ENGINEERING COLLEGE

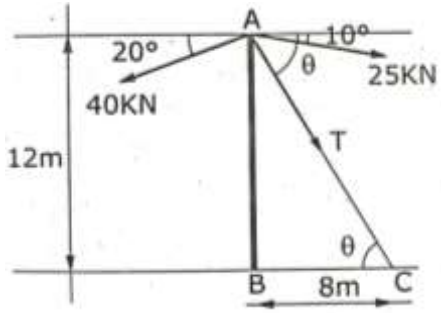
SRM Nagar, Kattankulathur – 603 203

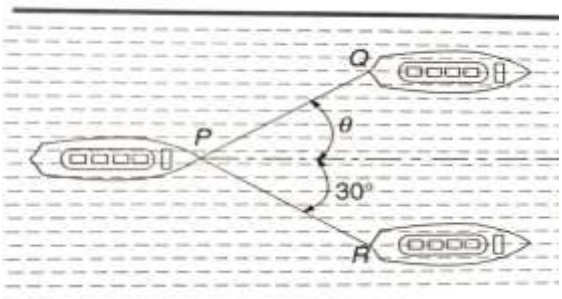
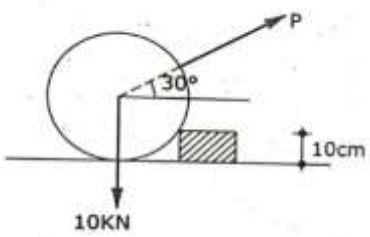
QUESTION BANK

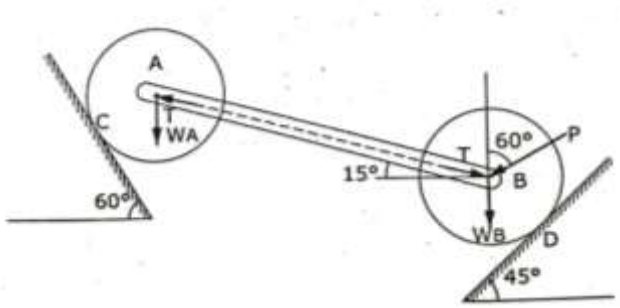
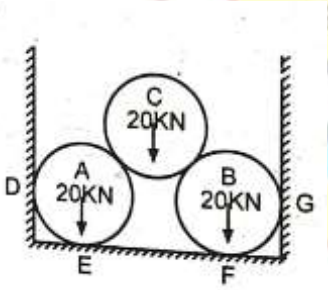
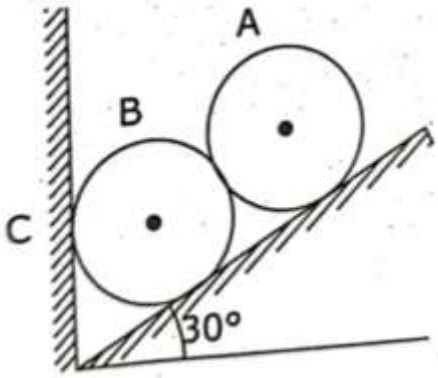
SUBJECT/SUBJECT CODE : ENGINEERING MECHANICS /1909301
SEM/YEAR :III SEM/II YEAR

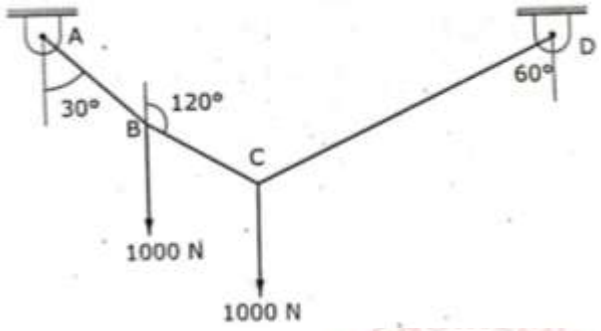
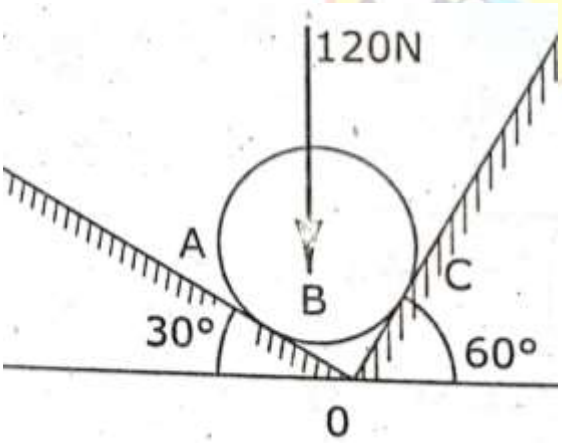
UNIT I: BASICS AND STATICS			
Introduction – Units and Dimensions – Laws of Mechanics – Lami's theorem, Parallelogram and triangular Law of forces – Vectorial representation of forces –Coplanar Forces – rectangular components – Equilibrium of a particle – Forces in space – Equilibrium of a particle in space – Equivalent systems of forces – Principle of transmissibility			
PART - A (2Marks)			
S.No	**QUESTIONS**	**LEVEL**	**COMPETENCE**
1.	Define Engineering Mechanics.	BT1	Remember
2.	Define Force.	BT1	Remember
3.	State law of parallelogram of vectors.	BT1	Remember
4.	State the principle of transmissibility of force.	BT1	Remember
5.	Define space and time.	BT1	Remember
6.	State triangular law of forces.	BT1	Remember
7.	State Lami's theorem.	BT1	Remember
8.	What is free body diagram?	BT2	Understand
9.	State the principle of resolution.	BT1	Remember
10.	What is the difference between the resultant force and equilibrant force?	BT2	Understand
11.	State the necessary and sufficient condition for static equilibrium of a particle in two dimensions.	BT1	Remember
12.	What are the characteristics of a force?	BT1	Remember
13.	Define particle.	BT2	Understand
14.	Define the term "Vector" quantity.	BT2	Understand
15.	What is the significance of parallelogram law in statics of particles?	BT2	Understand

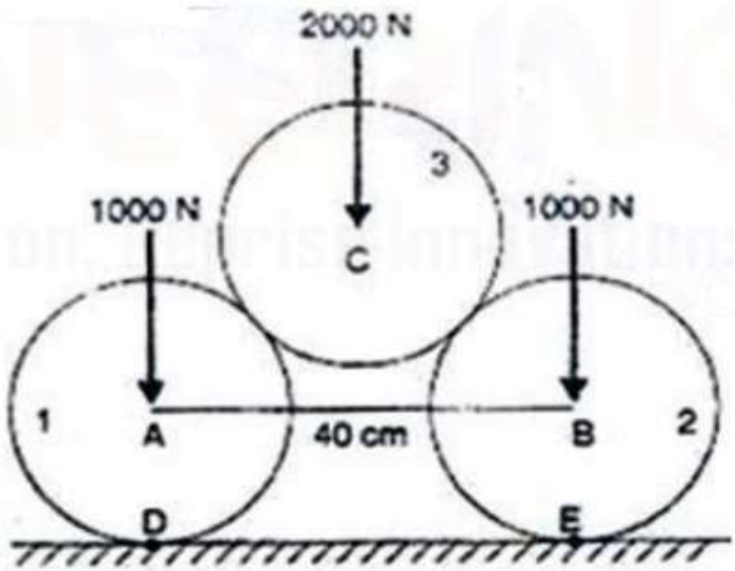
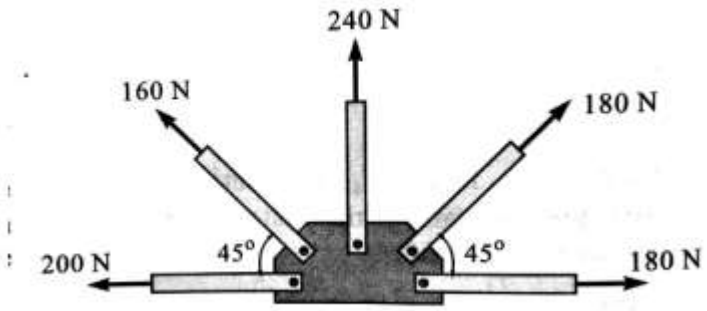
16.	Define equilibrium.	BT2	Understand
17.	State Newton's third law.	BT1	Remember
18.	Define unit vector.	BT2	Understand
19.	State newton's Second law of Gravitation.	BT2	Understand
20.	What is a scalar quantity?	BT1	Remember
21.	What is a vector quantity?	BT2	Understand
22.	State Newton's First law.	BT2	Understand
23.	State Newton's Second law.	BT2	Understand
24.	Define Concurrent forces.	BT2	Understand
25.	What is gravity?	BT2	Understand

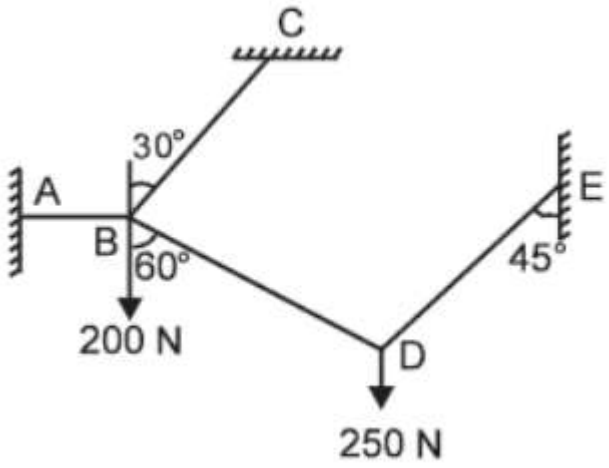
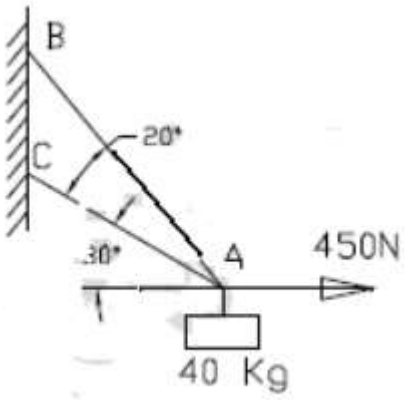
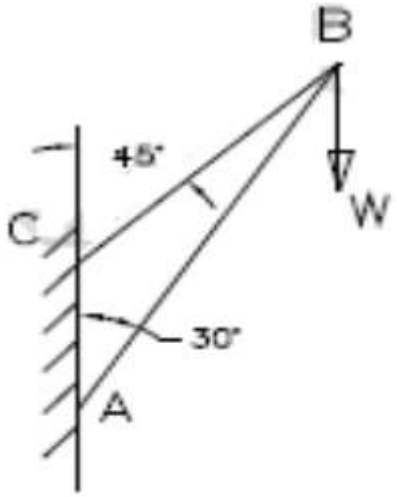
PART - B (13 Marks)				
S.No	**QUESTIONS**	**Marks**	**Level**	**Competence**
1	The following forces act a point (i) 200 N inclined at 30° towards the North of East. (ii) 250 N towards North (iii) 300 N towards North West (iv) 350 N inclined at 40° towards South of West. Find the resultant of the force system.	13	BT3	Apply
2	Two cables which have known tensions are attached to the top of a tower AB. A third cable AC is used as a guide wire as shown in the figure below. Determine the tension in AC if the resultant of the forces exerted at A by the three cables acts vertically downwards. 	13	BT3	Apply
3	Forces of 2 N, 3 N , 4 N ,5 N and 6 N are acting at one of the angular points of regular hexagon towards the other angular points taken in order. Find the resultant and its direction.	13	BT3	Apply

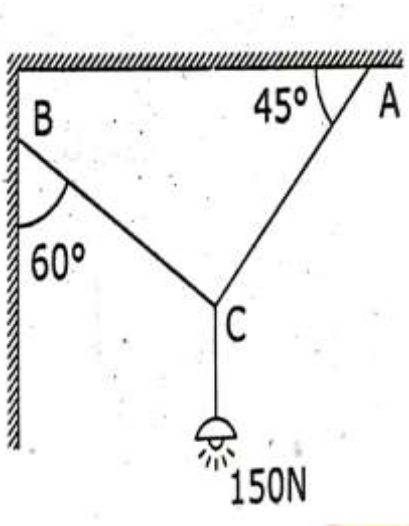
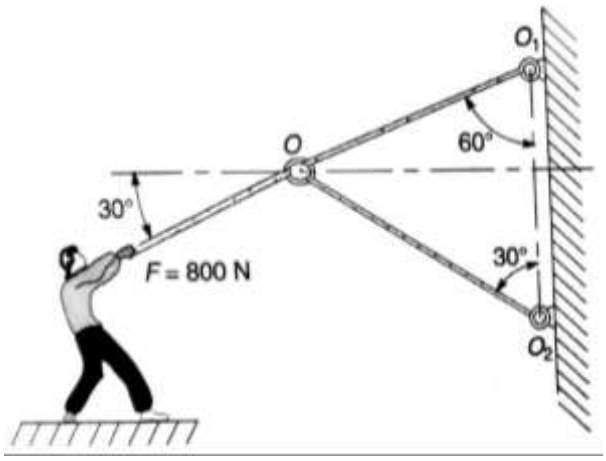
4	A disabled ship P is being pulled by two tugboats as shown in the figure. The resultant of the forces exerted by the two tugboats is 30 kN which is directed along the axis of the ship. Find (i) the required tensions in each of the ropes for Θ = 30° (ii) the value of Θ such that the tension in the rope PQ is minimum. 	13	BT4	Analyze
5	State and derive the expression for magnitude and direction of the resultant using the Parallelogram law of forces.	13	BT1	Remember
6	(i) Two concurrent forces acts at an angle of 30°. The resultant force is 15 N and one of the forces is 10 N. Find the other force. (ii) find the magnitude of the two forces such that if they act at right angles, their resultant is $\sqrt{10}$ N. But if they act at 60°, their resultant is $\sqrt{13}$ N.	13	BT3	Apply
7	(i) A cylindrical roller has a weight of 10 kN and it is being pulled by a force which is inclined at 30° with the horizontal as shown in the figure. While moving it comes across an obstacle 10 cm high. Calculate the force required to cross the obstacle, if the diameter of the roller is 1 m. 	13	BT3	Apply

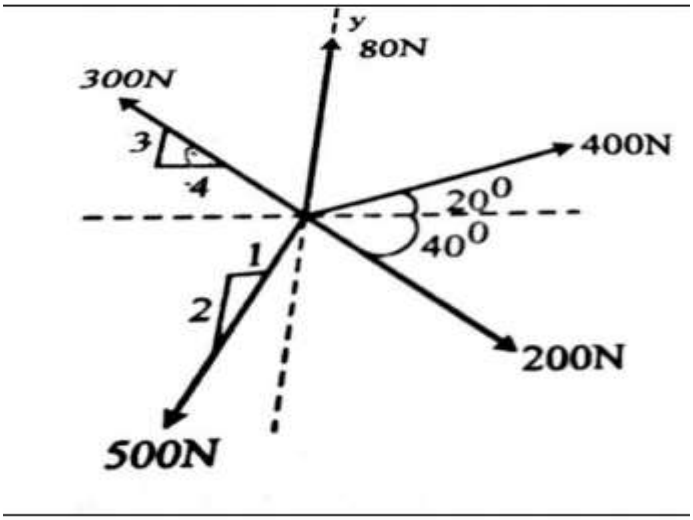
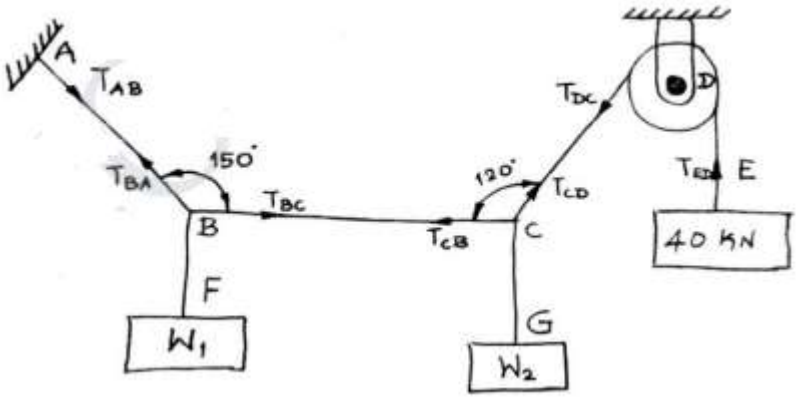
8	The figure below shows cylinders, A of weight 100 N and B of weight 50 N, resting on smooth inclined planes. They are connected by a bar of negligible weight hinged to each cylinder at their geometric centres by smooth pins. Find the force P, as shown, that holds the system in the given position. 	13	BT3	Apply
9	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 in the figure. Calculate the reactions at the point of contact between the pipes and between the channel and the pipes. Take the width of the channel as 160 cm. 	13	BT5	Evaluate
10	Two identical rollers, each of weight 50 N, are supported by an inclined plane and vertical walls as shown in the figure. Find the reactions at the points of supports A, B and C. Assume all the surfaces to be smooth. 	13	BT5	Evaluate

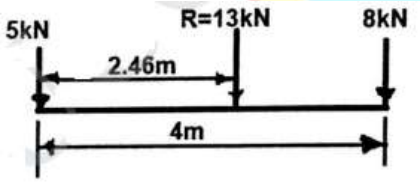
11	A string ABCD, attached to two fixed points A and D has two equal weights of 1000 N attached to it at B and C. The weights rest with the portions AB and CD inclined at the angle of 30° and 60° respectively, to the vertical as shown in the figure. Find the tensions in the portions AB, BC and CD of the string, if the inclination of the portion BC with the vertical is 120°. 	13	BT5	Evaluate
12	A ball of weight 120 N rests in a right angled groove as shown in the figure. The sides of the groove are inclined at an angle of 30° and 60° to the horizontal. If all the surfaces are smooth, then determine the reactions R_A and R_C at the point of contact. 	13	BT4	Analyze
13	A string of length 310mm has its extremities attached to two fixed points situated 250mm apart in a horizontal line. If the string can bear any tension up to 36N, find the greatest load that can be supported at a point of the string distance 240mm from one extremity.	13	BT3	Apply
14	Two smooth circular cylinders each of weight 1000 N and radius 15 cm are connected at their centers by a string AB of length 40 cm and rest upon a horizontal plane, supporting above them a third cylinder of	13	BT3	Apply

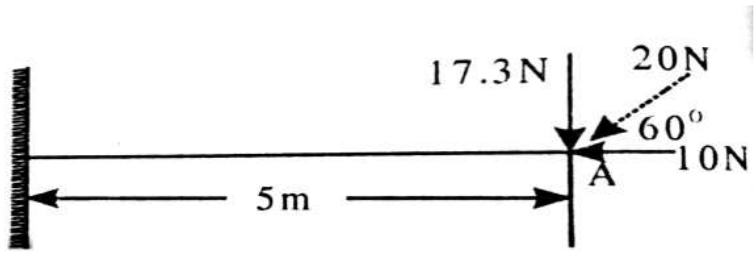
	weight 2000 N and radius 15 cm as shown in Figure. Predict the force S in the string AB and reactions on the floor at the points of contact D and E. 			
15	A gusset plate of roof truss is subjected to forces as shown in Fig.2. Determine the magnitude of the resultant force and its orientation measured counter clockwise from the positive x-axis. 	13	BT3	Apply
16	A system of connected flexible cable shown in Fig.3 is supporting two vertical forces 200 N and 250 N at points B and D. Determine the forces in various segments of the cable.	13	BT3	Apply

				
17	Determine the tension in cables AB & AC to hold 40 Kg load shown in fig. 	13	BT3	Apply
18	A crane shown in figure is required to lift a load of W=10 KN. Find the forces in the members AB and CB 	13	BT3	Apply

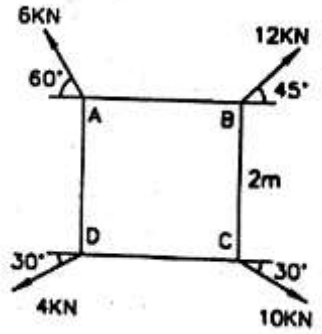
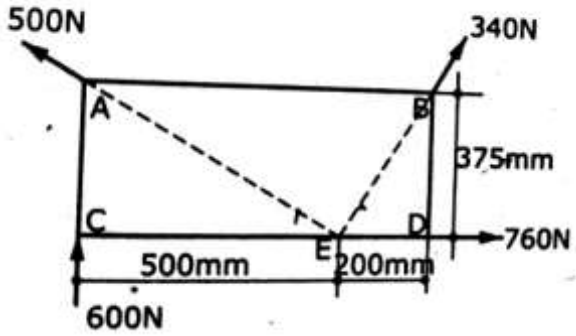
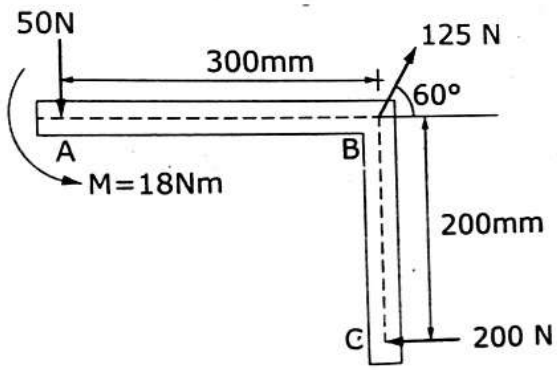
	PART-C (15 Marks)			
1	Five forces are acting on a particle. The magnitude of forces are 300 N, 600 N, 700 N, 900 N and P and their respective angles made with the horizontal are 0°, 60°, 135°, 210° and 270°. If the vertical component of all forces is -1000 N, find the value of P. Also calculate the magnitude and the direction of the resultant, assuming that the first force acts towards the point, while all the remaining forces act away from the point.	15	BT6	Create
2	A electric light fixture weighing 150 N hangs from a point C, by two strings AC and BC as shown in the figure. Determine the forces in the strings AC and BC. 	15	BT6	Create
3	Two cables are tied together at the point O and loaded as shown in the figure. Determine the tensions in OO_1 and OO_2. 	15	BT5	Evaluate

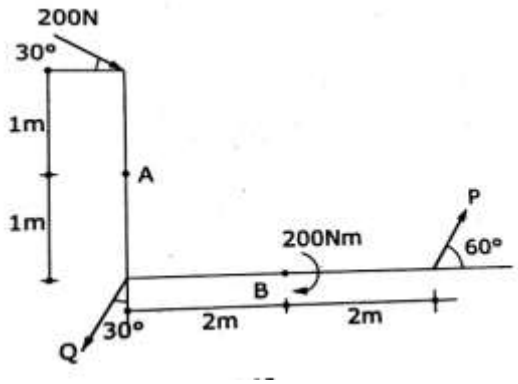
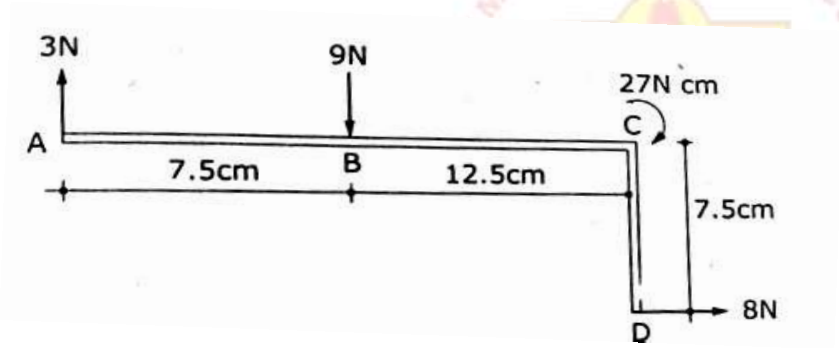
4	Determine the resultant of system of forces acting as shown in Fig.  	15	BT3	Apply
5.	ABCDE is a light string whose end A is fixed. The weights W_1 and W_2 are attached to the string at B&C and the string passes round a small smooth wheel at D carrying a weight 40kN at the free end E. In the position of equilibrium, BC is horizontal and AB and CD make angles 150° and 120° with horizontal. Find (i) the tensions in AB BC and DE of the given string (ii) magnitudes of W_1 and W_2.  	15	BT6	Create

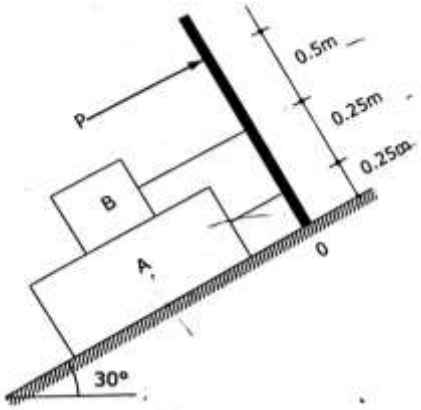
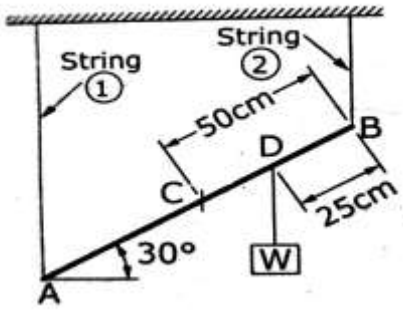
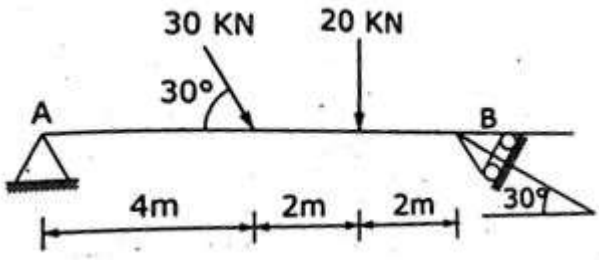
UNIT II EQUILIBRIUM OF RIGID BODIES			
Free body diagram – Types of supports – Action and reaction forces –stable equilibrium – Moments and Couples – Moment of a force about a point and about an axis – Varignon's theorem – Single equivalent force -Equilibrium of Rigid bodies in two dimensions – Equilibrium of Rigid bodies in three dimensions			
PART - A (2Marks)			
S.No	**QUESTIONS**	**LEVEL**	**COMPETENCE**
1.	State the principle of moments.	BT2	Understand
2.	State the necessary and sufficient conditions for equilibrium of rigid bodies in two dimensions.	BT1	Remember
3.	The position vector and force are 2i – 3j + 4k and 120i – 260j + 320k. Find the moment of the force about the origin. And also find the scalar quantity of the moment.	BT1	Remember
4.	Define the term couple.	BT1	Remember
5.	What are the characteristics of a couple?	BT2	Understand
6.	Represent a (i) Horizontal roller support and (ii) Inclined roller support showing its direction of the reaction.	BT3	Apply
7.	Find the magnitude and position of the resultant of two forces 5kN and 8kN both acting vertically upwards and separated by 4m. 	BT1	Remember
8.	Define moment of a force?	BT2	Understand
9.	For what condition the moment of a force will be zero.	BT1	Remember
10.	What is the difference between a moment and a couple?	BT3	Apply
11.	What is difference between a fixed vector and free vector?	BT1	Remember
12.	With the help of a simple illustration, define free body diagram.	BT5	Evaluate
13.	Find the moment of the force of 15N acting along the positive direction of X-axis about the point A (2, 3).	BT1	Remember
14.	Sketch the idealized, graphical and reaction of a cantilever support at a point.	BT2	Understand

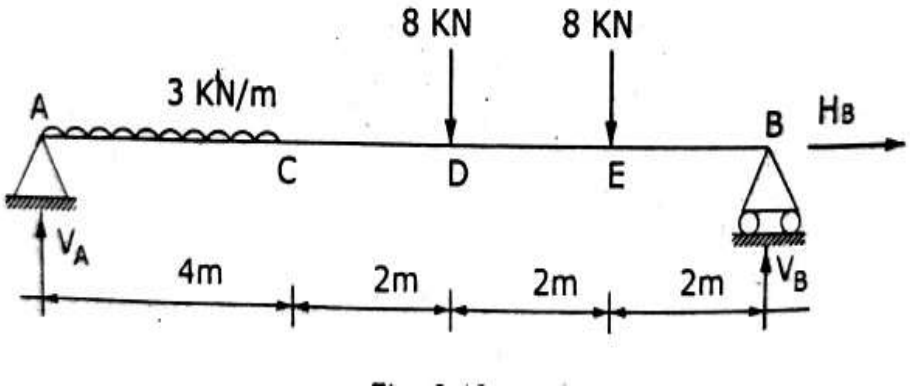
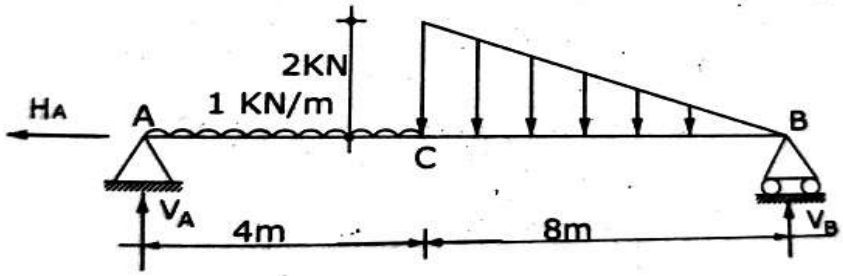
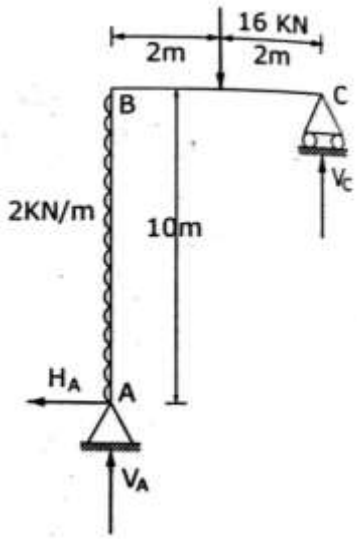
15.	State the requirements for equilibrium of a body acted upon by a parallel force system?	BT1	Remember
16.	What are the necessary and sufficient conditions for the equilibrium of a rigid body in three dimensions?	BT1	Remember
17.	What are the common types of supports used in two dimensions?	BT1	Remember
18.	Find the moment of 20 N force about the point 'O' as shown in Fig. 	BT1	Remember
19.	What are the common types of supports used in three dimensions?	BT1	Remember
20.	Mention some applications of cantilever beam.	BT1	Remember
21.	What are the common types of loads?	BT1	Remember
22.	What is statically determinate structure?	BT1	Remember
23.	What are the reaction at a fixed support of plane beam that are possible?	BT1	Remember
24.	State necessary and sufficient conditions for equilibrium of rigid bodies in two dimensions?	BT1	Remember
25.	When is moment of force maximum about a point?	BT1	Remember

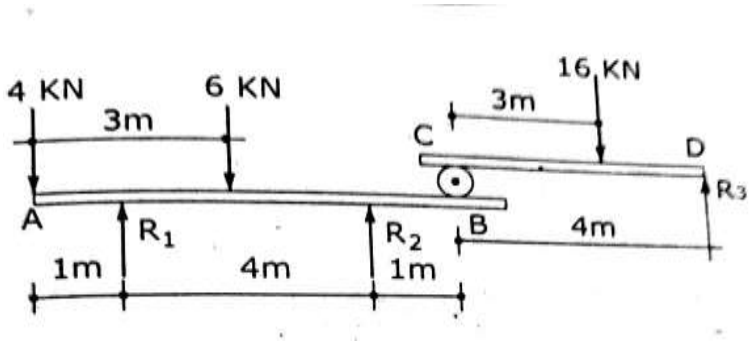
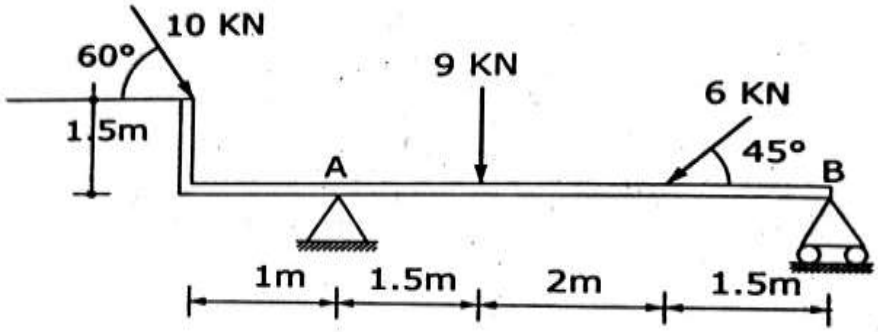
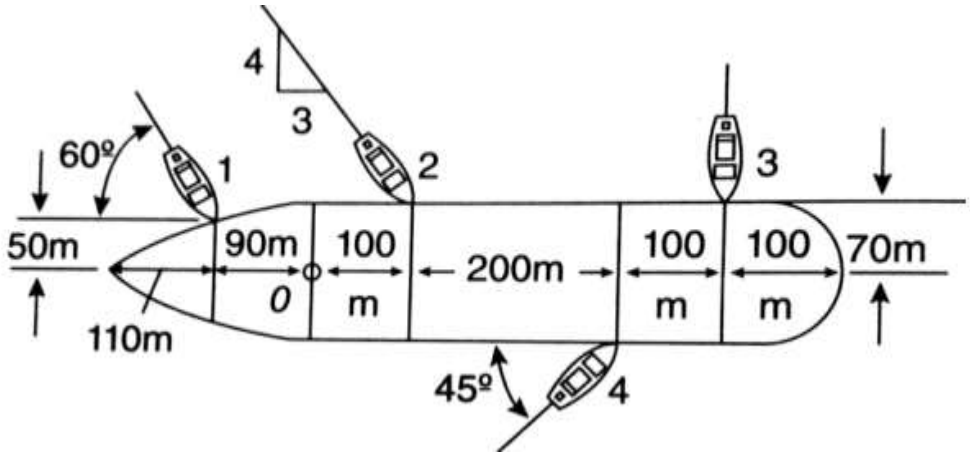
	PART - B (13 Marks)			
S.No	**QUESTIONS**	**Marks**	**Level**	**Competence**
1	Four forces of magnitude and direction acting on a square ABCD of side 2 m are shown in the figure. Calculate the resultant in magnitude and direction and also locate its point of application with respect to the sides AB and AD.	13	BT5	Evaluate

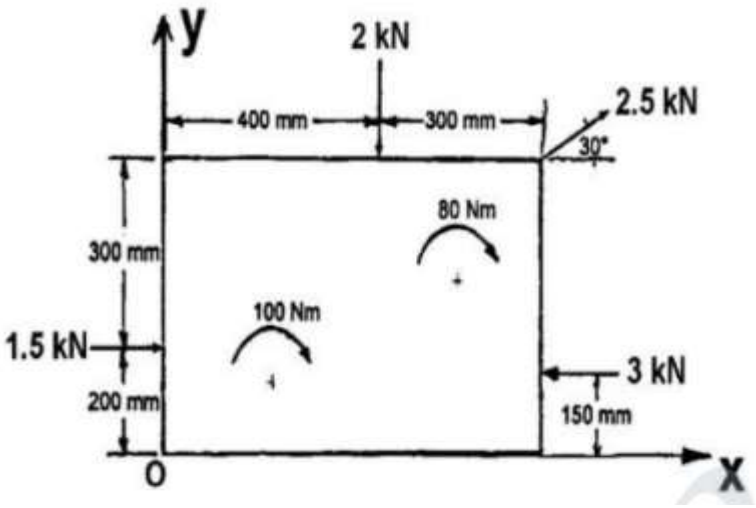
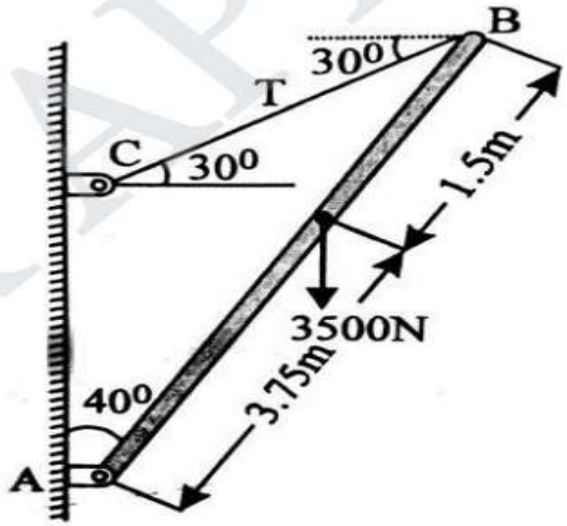
				
2	Four forces act on a 700 mm X 375 mm plate as shown in the figure. (a) Find the resultant of these forces. (b) Locate the two points where the line of action of the resultant intersects the edge of the plate. 	13	BT3	Apply
3	The three forces and a couple of magnitude, M = 18 Nm are applied to an angled bracket as shown in the figure. Find (i) Find the resultant of this system of forces. (ii) Locate the points where the line of action of the resultant intersects line AB and line BC. 	13	BT3	Apply

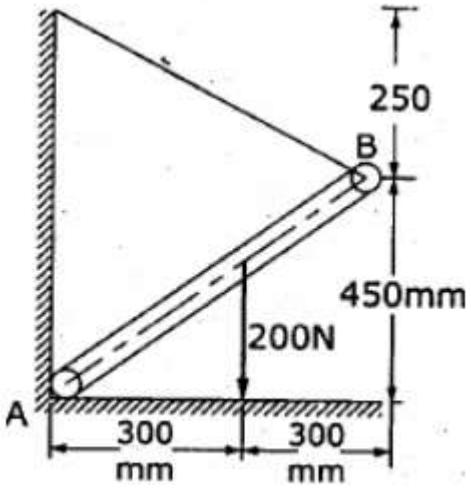
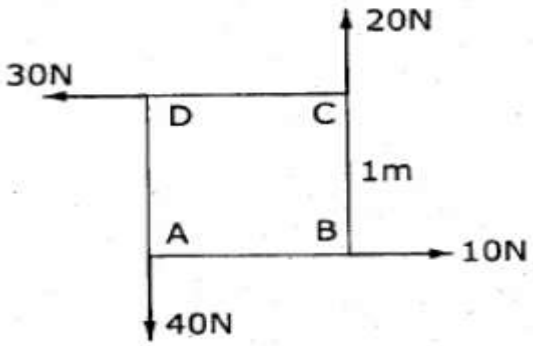
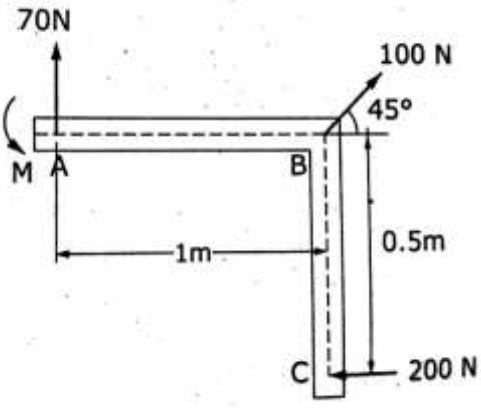
4	For the system of forces shown in the figure, determine the magnitude of P and Q such that the resultant of the system passes through A and B. 	13	BT5	Evaluate
5	For the figure shown in figure. Find (i) Find the resultant of the system. (ii) Find the points of the intersection of its line line of action with AC and CD. (iii) The 27 N-cm couple applied at C is removed and replaced by a couple of unknown Magnitude M. determine the value of M if the resultant force is to pass through C. 	13	BT4	Analyze

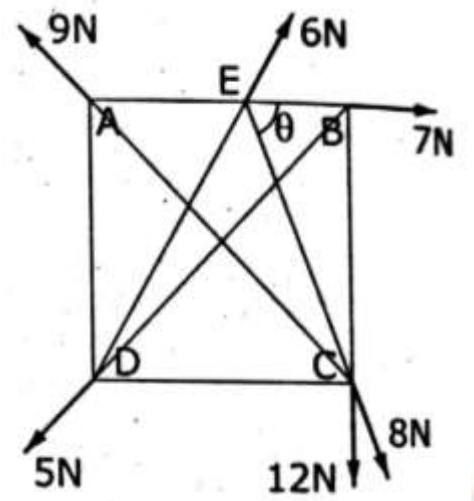
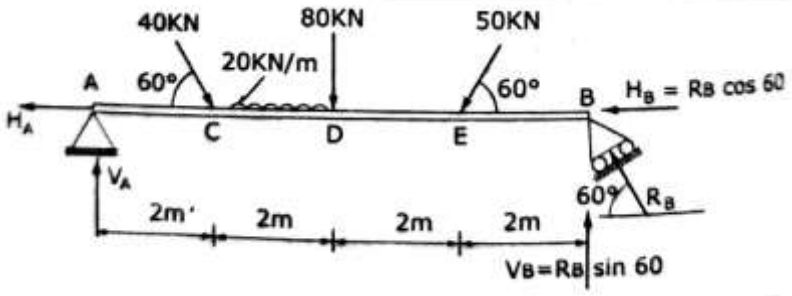
6	Blocks A and B of the weight 200 N and 100 N respectively, rest on a 30° inclined plane and are attached to the post which is held perpendicular to the plane by a force P, parallel to the plane as shown in the figure. Assume that all surfaces are smooth and that the cords are parallel to the plane. Determine the value of P. Also find the normal reaction of the blocks A and B. 	13	BT4	Analyze
7	A uniform meter rod AB, assumed rigid of the mass 0.5 kg is suspended from its ends in an inclined position and a mass of 1 kg is suspended from a point D, as shown in the figure. Determine the tension in each strings. Where the suspended mass should be placed in order to get equal tension in the strings. 	13	BT3	Apply
8	Find the support reactions of the beam as shown in the figure. 	13	BT5	Evaluate

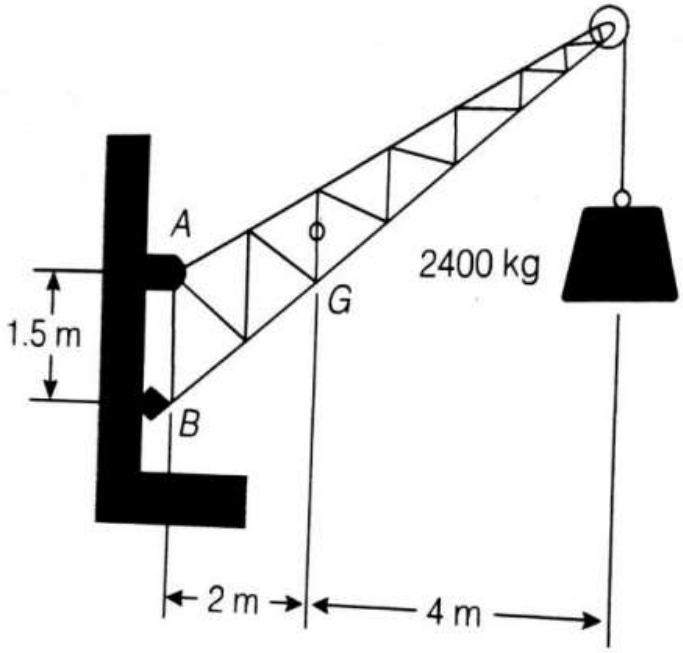
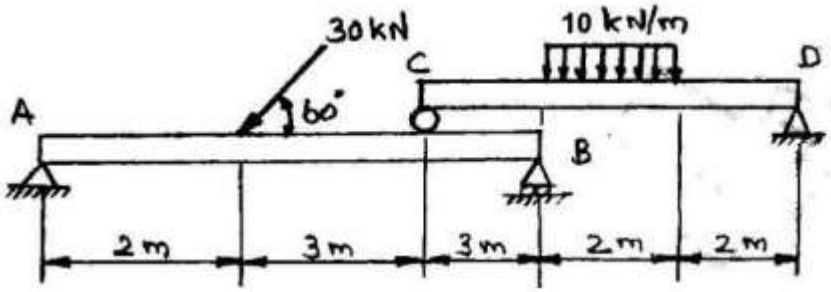
9	A beam AB of span 10 m span is loaded as shown in the figure. Determine the reactions at A and B. 	13	BT4	Analyze
10	Calculate the support reactions of a simply supported beam as shown in the figure. 	13	BT4	Analyze
11	A bent up beam ABC is shown in the figure. It is hinged at A and supported on rollers at C. If there is an uniform wind pressure of 2 kN/m on the vertical side AB and a central point load of 16 kN at middle of BC, calculate the reactions offered by the supports. 	13	BT3	Apply

12	Calculate the reactions R1, R2 and R3 for the beams AB and CD supported as shown in the figure. There being a hinge connecting B and C. 	13	BT3	Apply
13	A beam AB is simply supported and carries loads as shown in the figure. Calculate the reactions at A and B. 	13	BT4	Analyze
14	Four tug boats are used to bring a large ship to its pier. Each tug boat exerts a 5000 N force in the direction as shown in Fig. Determine the equivalent force - couple system at point 'O' and the point on hull where a single more powerful tug boat should push to produce the same effect as the original four boats. 	13	BT3	Apply

15.	A force couple system acting on a rectangular plate is shown in figure below.  (i) Fine the equivalent force couple system at the origin O. (ii) Find the single resultant force and its location on X - axis	13	BT4	Analyze
16.	A load of 3500 N is acting on the boom, which is held by a cable BC as shown in figure below the weight of the boom can be neglected.  (i) Sketch the free body diagram of the boom (ii) Determine the tension in cable BC (iii)Find the magnitude and direction of the reaction at A.	13	BT4	Analyze
17.	A cable BD and the corner of wall and floor surface as shown in fig support a rod AB of weight 200N. Find the reaction at A and tension in the cord.	13	BT4	Analyze

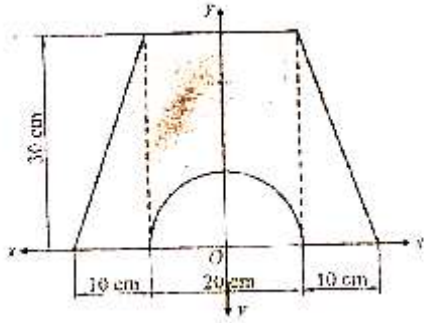
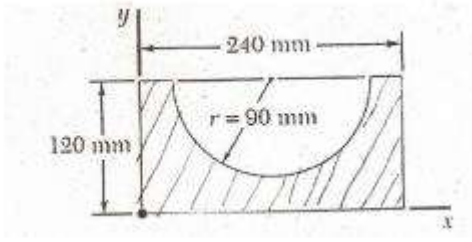
				
18.	Four forces act on a square of side 1m as shown in fig. Reduce the force system into an equivalent force-couple system at A. 	13	BT4	Analyze
	PART-C (15 Marks)			
1	Three forces and a couple M acting on an angled bracket is shown in the figure. Find the moment of the couple if the line of action of the resultant force is to pass through (i) point A (ii) point C. 	15	BT6	Create

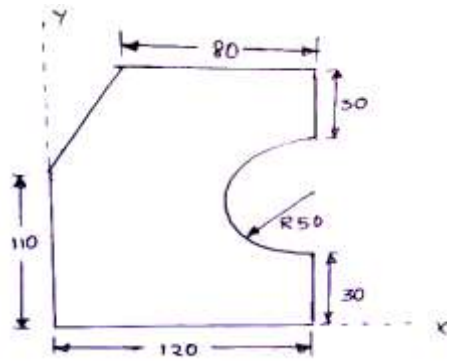
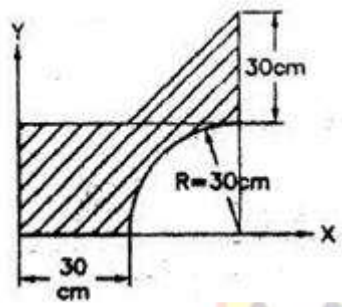
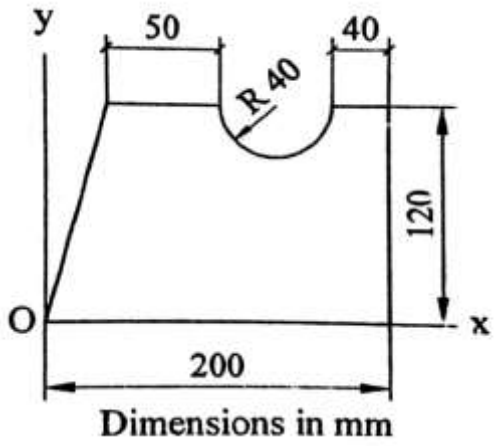
2	ABCD is a square and E is the middle point of AB. Forces of 7,8,12,5,9 and 6 N act a point in the directions AB, EC, BC, BD, CA and De respectively. Find the magnitude and direction of the single force which will keep the particle at rest.  	15	BT5	Evaluate
3	Find the reactions at the supports A and B of the beam shown in the figure.  	15	BT4	Analyze
4	A Fixed crane shown in Fig. has a mass of 1000kg and it is used to lift a 2400 kg weight. It is held in a place by a pin at A and a rocker at B. The centre of gravity of the crane is located at G. Determine the components of the reactions at A and B.	15	BT5	Evaluate

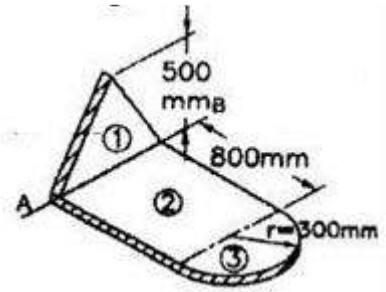
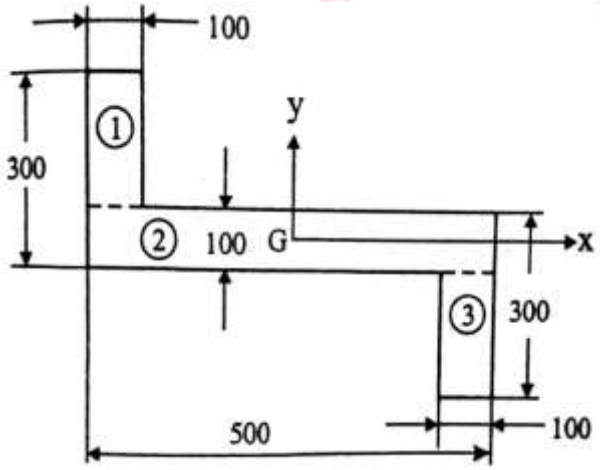
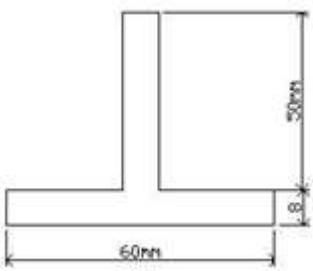
				
5	Two beams AB and CD are shown in figure. A and D are hinged supports. B and C are roller supports. (i) Sketch the free body diagram of the beam AB and determine the reactions at the support A and B. (ii) Sketch the free body diagram of beam AB and determine the reactions at the supports C and D. 	15	BT5	Evaluate

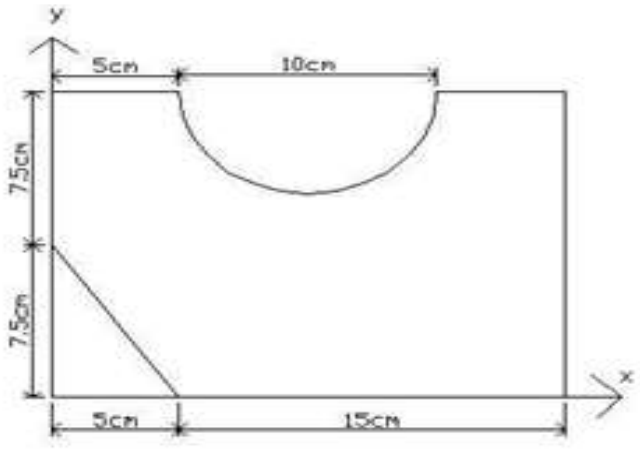
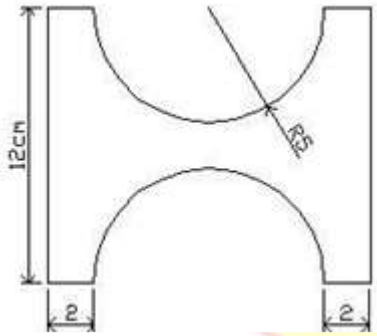
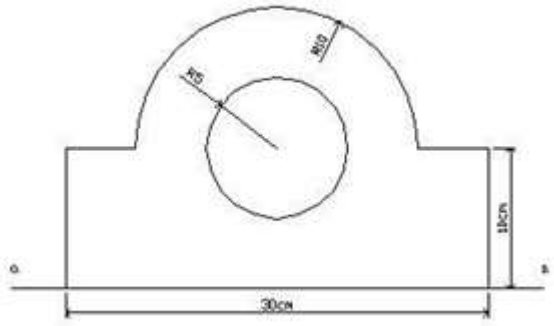
UNIT III – PROPERTIES OF SURFACES AND SOLIDS			
Centroids of areas, composite areas, determination of moment of inertia of plane figures by integration, polar moment of inertia-radius of gyration - Parallel axis theorem and perpendicular axis theorem – Centre of mass –- mass moment of inertia of simple solids.			
PART - A (2Marks)			
S.No	**QUESTIONS**	**LEVEL**	**COMPETENCE**
1.	What is meant by centre of gravity?	BT1	Remember
2.	What is meant by centroid?	BT1	Remember
3.	What is centre of mass?	BT1	Remember
4.	What do reference axes mean?	BT2	Understand
5.	What is meant by centroidal axis?	BT2	Understand
6.	What is parallel axes theorem for moment of inertia?	BT2	Understand
7.	What is perpendicular axes theorem for moment of inertia?	BT1	Remember
8.	What is product of inertia?	BT1	Remember
9.	What is principal moment of inertia?	BT2	Understand
10.	What is mass moment of inertia?	BT2	Understand
11.	Define Radius of Gyration.	BT1	Remember
12.	State Pappus theorem.	BT5	Evaluate
13.	State Guldinus theorem	BT3	Apply
14.	Write the formula for centre of gravity of composite solid figures.	BT2	Understand
15.	When will the product of inertia of an become zero?	BT1	Remember
16.	Define first moment of an area about an axis.	BT2	Understand
17.	What do you mean by polar moment of inertia?	BT2	Understand
18.	When will the centroid and centre of mass coincides?	BT2	Understand
19.	Express the centroidal coordinates of a quadrant of the circle.	BT2	Understand
20.	How will you locate the principal axes of inertia?	BT3	Apply

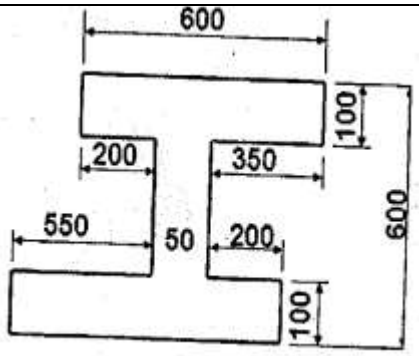
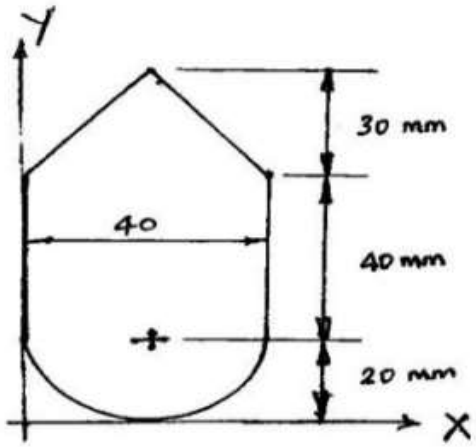
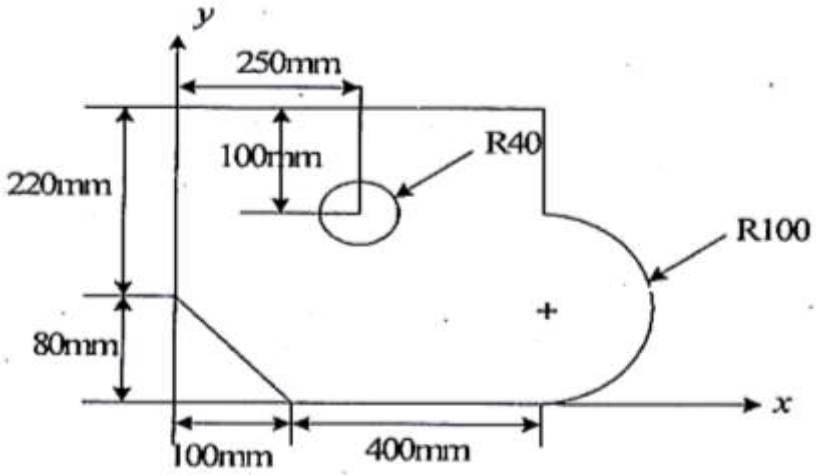
21.	What are the various methods to find centre of gravity?	BT2	Understand
22.	What is section modulus?	BT2	Understand
23.	State the relationship between the second moment of area and mass moment of inertia for a thin uniform plate.	BT2	Understand
24.	What are the theorems that deal with moment of inertia?	BT2	Understand
25.	What are major and minor principal axes?	BT2	Understand

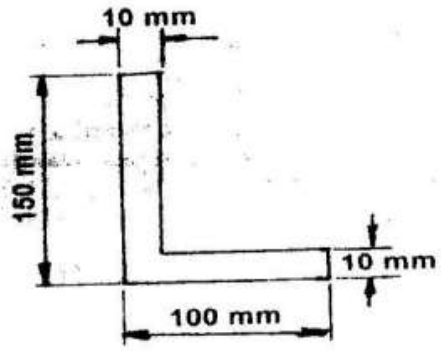
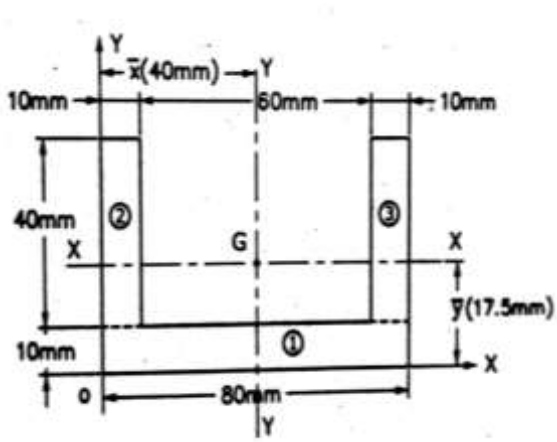
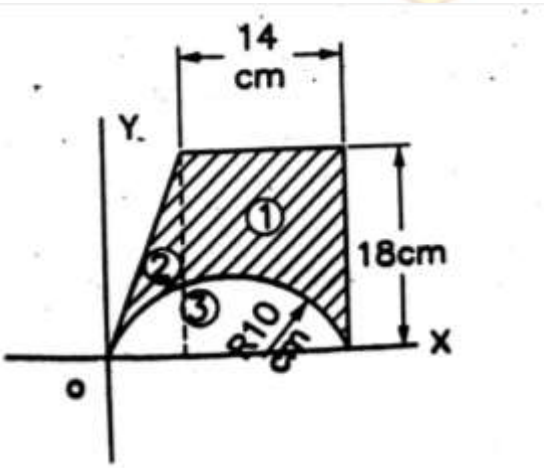
PART - B (13 Marks)				
S.No	**QUESTIONS**	**Marks**	**Level**	**Competence**
1	Find the moment of inertia of shaded area as shown in figure about Ixx axis and Iyy axis. 	13	BT5	Evaluate
2	Determine the moment of inertia of the shaded area as shown in figure with respect to the x axis 	13	BT5	Evaluate
3	A solid hemisphere of density 2ρ is attached centrally to a solid cylinder of density ρ. Find the height of the cylindrical portion to have the CG of the solid combination on the axis of symmetry at the junction between the hemisphere and the cylinder. Take the cylinder diameter as 100mm.	13	BT5	Evaluate

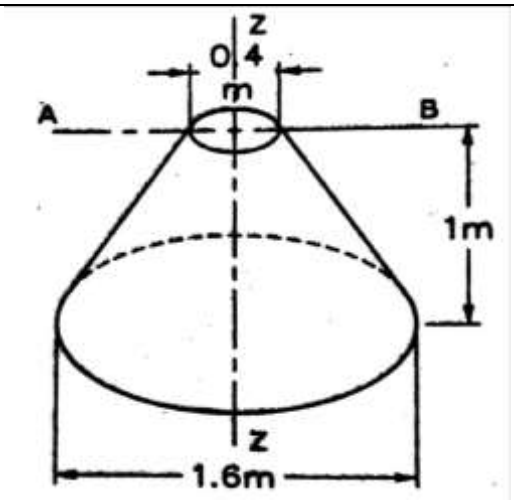
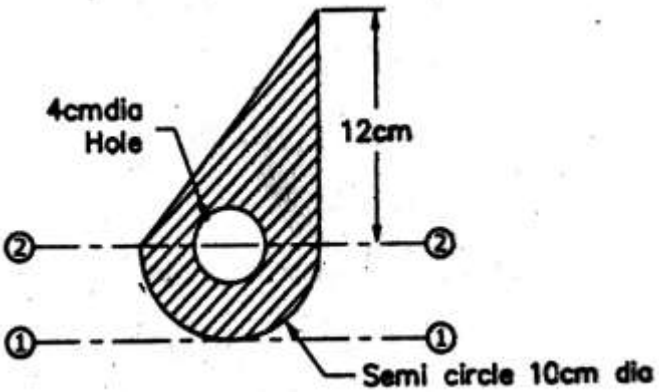
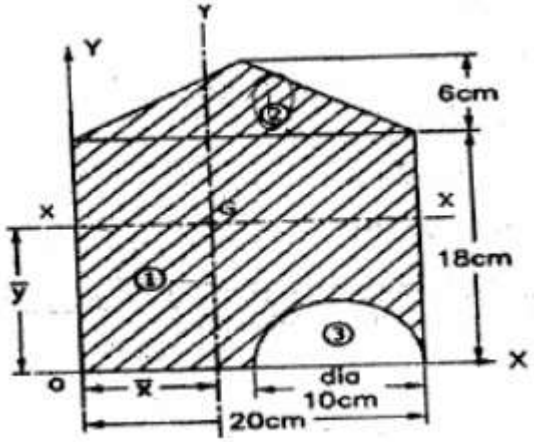
4	Locate the centroid of the area shown in figure below. The dimensions are in mm. 	13	BT4	Analyze
5	Determine the co-ordinates of centroid of the shaded area shown in figure. 	13	BT5	Evaluate
6	A Cylinder of height of 10 cm and radius of base 4 cm is placed under sphere of radius 4 cm such that they have a common vertical axis. If both of them are made of the same material, find the centre of gravity of the combined unit.	13	BT5	Evaluate
7	Find the moment of inertia of the section shown in the figure about the centroidal axes. 	13	BT3	Apply

8	Find the mass moment of inertia of the plate shown in fig with respect to the axis AB. Thickness of the plate is 5mm and density of the material is 6500kg/m^3. 	13	BT4	Analyze
9	Derive the expression for mass moment of inertia of prism along three axes.	13	BT3	Apply
10	Calculate Moment of Inertia about the co-ordinate axes of plane area shown in fig. Also find Polar Moment of Inertia. All the dimensions are in 'mm'. 	13	BT5	Evaluate
11	Determine the principal moments of inertia and find location of principal axes of surface shown in figure 	13	BT5	Evaluate
12	Determine the Moment of Inertia and radius of gyration of surface about x	13	BT4	Analyze

	axis shown in fig. Also find MOI about centroidal x axis. 			
13	Illustrate the Mass moment of inertia of plane area about centroidal axes shown in fig. 	13	BT5	Evaluate
14	Explain second moment of area about the centroidal XX axis and a-a axis of the surface shown in fig. 	13	BT5	Evaluate
15.	For the section shown in figure below, locate the horizontal and vertical centroidal axis.	13	BT5	Evaluate

				
16.	Figure shows a composite area. Find the moment of inertia (Second moment of area) about both the centroidal axes. 	13	BT5	Evaluate
17.	Locate the centroid of the plane area shown in figure below. 	13	BT5	Evaluate
18	An area in the form of L section is shown in figure below. Find the moment of inertia Ixx, Iyy and Ixy about its centroidal axes. Also determine the principal moments of inertia.	13		

				
	PART-C (15 Marks)			
1	Find the moment of inertia of the section shown below. 	15	BT5	Evaluate
2	Calculate the principal moments of inertia of the section shown in the figure. 	15	BT4	Analyze
3	Calculate the mass moment of inertia of the frustum of cone shown in the figure about the AB and ZZ axes. Assume the density is 2500 kg/m^3	15	BT6	Create

				
4	For the section shown in the figure. Determine the moment of inertia values about the (1) – (1) and (2) – (2) axes. 	15	BT5	Evaluate
5.	Find the moment of inertia of the section shown in figure about its horizontal centroidal axis 	15	BT5	Evaluate

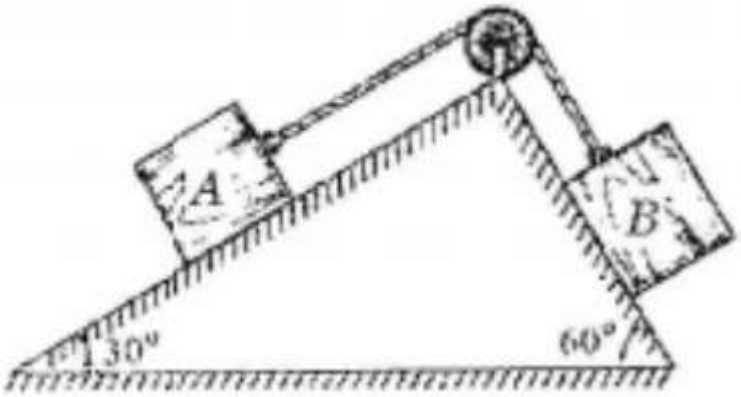
UNIT IV - FRICTION

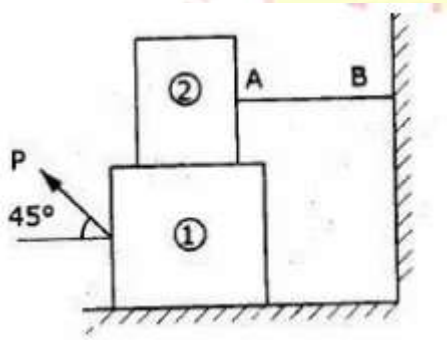
Frictional Force - Laws of Coulomb friction - Cone of friction - Angle of repose - relation between cone of friction and angle of repose - limiting friction - Rolling resistance - Simple contact friction - Screw – Wedge – Ladder - Belt friction.

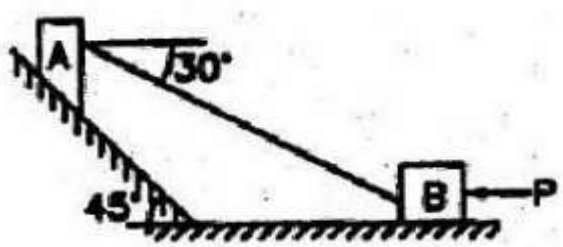
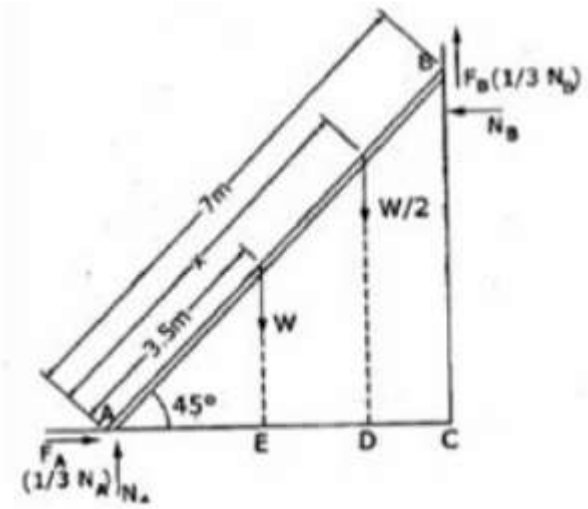
PART -

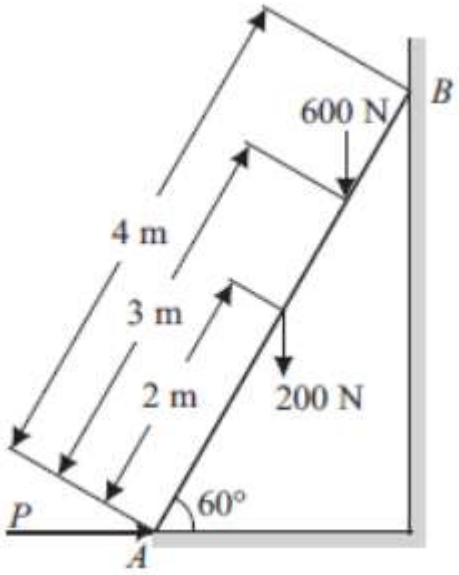
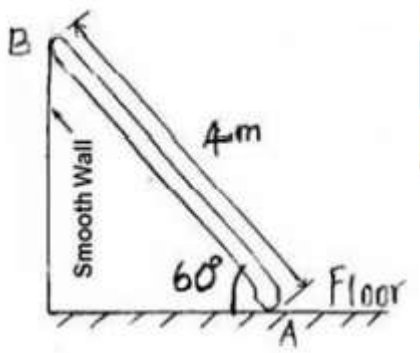
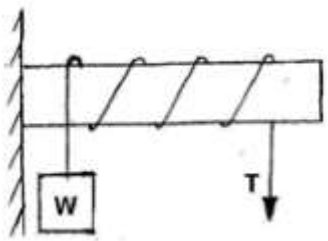
S.No	QUESTION	LEVEL	COMPETENCE
1.	Define friction.	BT1	Remember
2.	Classify the type of friction.	BT1	Remember
3.	Define limiting friction.	BT2	Understand
4.	Define co-efficient of static friction.	BT1	Remember
5.	State Coulomb's laws of dry friction.	BT1	Remember
6.	What is impending motion?	BT2	Understand
7.	Define angle of repose.	BT1	Remember
8.	Define cone of friction.	BT1	Remember
9.	What is co-efficient of Rolling resistance?	BT1	Remember
10.	Define rolling resistance.	BT2	Understand
11.	Analyze the coefficient of friction and express its relationship with angle of friction.	BT2	Understand
12.	Define ladder friction.	BT2	Understand
13.	Compare and contrast Ladder friction and Wedge friction.	BT2	Understand
14.	Compare Co-efficient of friction and angle of friction	BT2	Understand
15.	Define frictional force and its direction.	BT1	Remember
16.	State any two important law of dry friction.	BT1	Remember
17.	Why is static coefficient of friction μ, always greater than kinetic coefficient of friction μ_k.	BT2	Understand
18.	State the equilibrium conditions to be satisfied by a ladder at just start of sliding?	BT1	Remember
19.	Define the belt friction and write the relation between ratio of tensions and coefficient of belt friction.	BT1	Remember
20.	Define wedge and wedge friction.	BT1	Remember
21.	Give the expression to calculate coefficient of friction in V-belt.	BT2	Understand

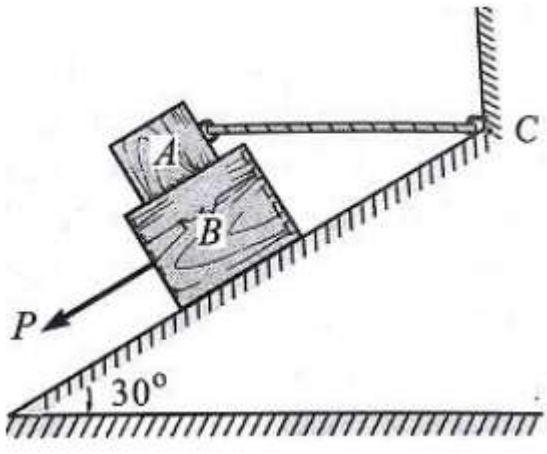
22.	Define friction and classify its types.	BT2	Understand
23.	Define screw friction.	BT2	Understand
24.	What is meant by fluid friction?	BT2	Understand
25.	What are two types of dynamics friction?	BT2	Understand

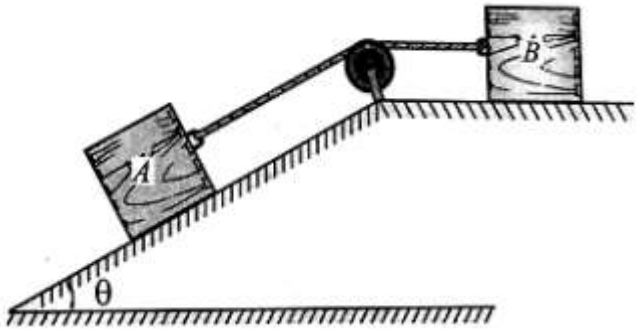
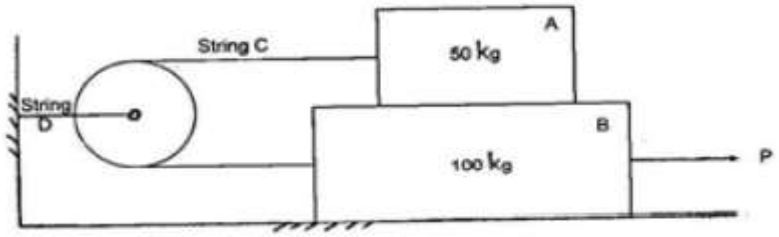
	PART - B (13 Marks)			
S.No	**QUESTIONS**	**Marks**	**Level**	**Competence**
1	Two rough planes are joined together. One of them is horizontal and the other is inclined at 45^{o} to the horizontal. A 100 kg block is on the inclined plane and is connected to a 60 kg block on the horizontal plane through a cable passing over a smooth pulley at the junction of the planes. A dragging force of A is applied on 60 kg block at an angle of Θ to the horizontal. Find the magnitude of the force and the value of Θ for the motion is about to start. Assume $\mu = 0.25$	13	BT5	Evaluate
2	Two blocks A and B are placed on inclined planes as shown. The block A weighs 1000N. Determine minimum weight of the block B for maintaining the equilibrium of the system. Assume that the blocks are connected by an inextensible string passing over a frictionless pulley. Coefficient of friction μ_A between the block A and the plane is 0.25. Assume the same value for μ_B. 	13	BT5	Evaluate
3	A ladder 3m long and weighing 200N is resting on the horizontal floor and leaning against a vertical wall making 30° with the floor. The friction coefficients at the ground and wall contact surfaces are 0.35 and 0.25	13	BT5	Evaluate

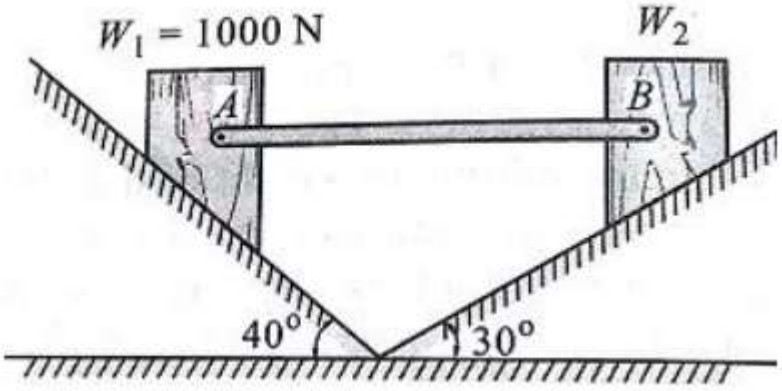
	respectively. It has to support a weight of 100N at the top. To prevent slipping a string is tied to the foot of the ladder and attached to the wall in the horizontal position. Determine the minimum tension required in the string for this condition. Find also the minimum angle with the floor at which the above ladder with the weight at the top could be placed without slipping in the absence of string.			
4	A body, resting on a rough horizontal plane, required a pull of 180 N inclined at 30° to the plane just to move it. It was found that a push of 220 N inclined at 30° to the plane just moved the body. Determine the weight of the body and the coefficient of friction.	13	BT3	Apply
5	Block (2) rests on block (1) and is attached by a horizontal rope AB to the wall as shown in fig. What force P is necessary to cause motion of block (1) to impend? The co-efficient of friction between the blocks is ¼ and between the floor and block (1) is 1/3. Mass of blocks (1) and (2) are 14kg and 9 kg respectively. 	13	BT5	Evaluate
6	Block A weighing 1000 N rests on a rough inclined plane whose inclination to the horizontal is 45°. It is connected to another block B, weighing 3000 N rests on a rough horizontal plane by a weightless rigid bar inclined at an angle of 30° to the horizontal as shown in fig. Find the horizontal force required to be applied to the block B just to move the block A in upward direction. Assume angle of friction as 15° at all surfaces where there is sliding.	13	BT5	Evaluate

				
7	A 7m long ladder rests against a vertical wall, with which it makes an angle of 45° and on a floor. If a man whose weight is one half that of the ladder climbs it, at what distance along the ladder will he be, when the ladder is about to slip? Take coefficient of friction between the ladder and the wall is 1/3 and that between the ladder and the floor is ½. 	13	BT5	Evaluate
8	An effort of 200 N is required just to move a certain body up an inclined plane of angle 15°, the force is acting parallel to the plane. If the angle of inclination of the plane is made 20°, the effort required being again parallel to the plane, is found to be 230 N. Predict the weight of the body and coefficient of friction.	13	BT3	Apply
9	A ladder of length 4 m, weighing 200 N is placed against a vertical wall as shown in Fig.10. The coefficient of friction between the wall and the ladder is 0.2 and that between floor and the ladder is 0.3. The ladder, in addition to its own weight, has to support a man weighing 600 N at a distance of 3m from A. Calculate the minimum horizontal force to be applied at A to	13	BT3	Apply

	prevent slipping.  			
10	A ladder of weight 1000 N and length 4 m rests as shown in figure. If a 750 N weight is applied at a distance of 3 m from the top of ladder, it is at the point of sliding. Determine the coefficient of friction between ladder and the floor.  	13	BT5	Evaluate
11	A rope is wrapped 3 times around the rod as shown in the fig. Design the force required at the free end of the rope to stope the load w=20KN.Takeμ=0.3  	13	BT3	Apply
12	A cylinder of radius 80 mm rolls down on an inclined plane at an angle of	13	BT3	Apply

	2° with the horizontal. Determine the co-efficient of rolling resistance of the cylinder.			
13	A screw jack has a pitch of 12 mm with a mean radius of thread equal to 22.5 mm. a lever 600 mm long is used to raise a load of 1800 kg. if the co-efficient of friction is 0.10, what force is necessary when applied normal to the lever at its free end?	13	BT3	Apply
14	A body of weight 16 N rests on a rough inclined plane at an angle of 30◦ to the horizontal. If a force of 2N acting up the plane is just sufficient to prevent the body from slipping downwards, find the force in the same direction which will make the body on the point of moving upwards.	13	BT3	Apply
15	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 middle. The ladder is at the point of sliding, when a man weighing 750N stands on a rung 1.5 meter from the bottom of the ladder. Calculate the coefficient of friction between the ladder and the floor.	13	BT5	Evaluate
16	Block A of mass 30 kg rests on block B of mass 40 kg as shown in Fig. Block A is restrained from moving by a horizontal rope tied at point C, what force P applied to the plane inclined at 30o with horizontal is necessary to start block B down the plane. Take coefficient of friction for all surfaces as 0.35. 	13	BT3	Apply
17	Find the value of 'Θ' if the block 'A' and 'B' shown in Fig. have impending motion. Given block A = 20 kg, block B = 20 kg, $\mu_A = \mu_B = 0.25$	13	BT3	Apply

				
18	Find the least force required to drag a body of weight 'W' placed on a rough inclined plane having inclination 'α' to the horizontal. The force is applied to the body in such a way that it makes an angle 'Θ' to the inclined plane and the body is on the point of motion up the plane.	13	BT3	Apply
	PART-C (15 Marks)			
1	Two blocks A and B of mass 50 kg and 100 kg respectively are connected by a string C which passes through a frictionless pulley connected with the fixed wall by another string D as shown in figure. Find the force P required to pull the lock B. Also find the tension in the string D. Take coefficient of friction at all contact surfaces as 0.3. 	15	BT5	Evaluate
2	A uniform ladder of weight 1000 N and of length 4m rests on horizontal ground and leans against a smooth vertical wall. The ladder makes an angle of 60◦ with horizontal. When a mean of weight 750 N stands on the ladder at a distance 3m from the top of the ladder, the ladder is at the point of sliding. Determine the co-efficient of friction between the ladder and the floor.	15	BT5	Evaluate
3	In a screw jack, the pitch of the square threaded screw is 5.5 mm and the mean diameter is 70 mm. the force exerted in turning the screw is applied at the end of a lever 210 mm long measured from the axis of the screw. If the co-efficient of friction of the screw jack is 0.07. calculate the force required	15	BT6	Create

	at the end of the lever to (i) raise a weight of 30kN (ii) lower the same wight.			
4	An effort of 200N is required just to move a certain body up an inclined plane of angle 15◦, the force is acting parallel to the plane. If the angle of inclination of the plane is made 20◦, the effort required being again parallel to the plane, if found to be 230 N. Find the wight of the body and the coefficient of friction.	15	BT3	Apply
5	Two blocks W_1 and W_2 resting on two inclined planes are connected by a horizontal bar AB as shown in Fig. If W_1 is equals 1000 N, determine the maximum value of W_2 for which the equilibrium can exists. The angle of limiting friction is 20°at all rubbing faces. 	15	BT3	Apply

UNIT V - KINEMATICS AND KINETICS OF RIGID BODIES

Displacements, Velocity and acceleration, their relationship – Relative motion – Curvilinear motion - Newton's laws of motion – Work Energy Equation– Impulse and Momentum – Impact of elastic bodies.

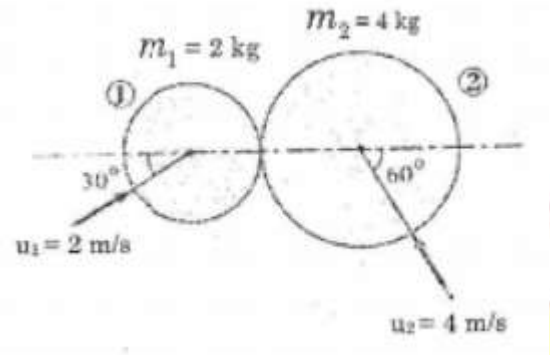
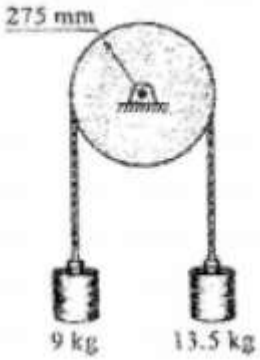
PART - A (2Marks)

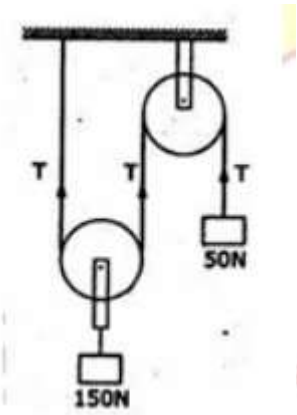
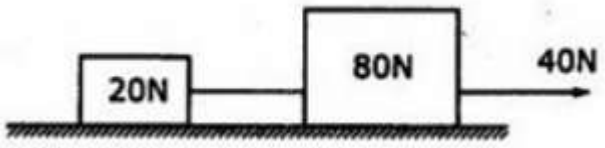
S.No	QUESTIONS	LEV	COMPETENCE
1.	Define D'Alembert's principle	BT1	Remember
2.	Discuss about the equations of motion of a particle under gravitation.	BT2	Understand
3.	Differentiate linear and angular momentum.	BT3	Apply
4.	Give the dynamic equilibrium conditions.	BT1	Remember
5.	A car accelerates uniformly from a speed of 30 kmph in 5 seconds. Determine the acceleration of the car and the distance travelled by the car during 5 seconds.	BT2	Understand
6.	State the law of conservation of momentum	BT1	Remember
7.	A car starts from rest with a constant acceleration of $4m/sec^2$. Determine the distance travelled in the 7^{th} second.	BT2	Understand
8.	Solve the following: A stone is projected in space at an angle of 45° to horizontal at an initial velocity of 10 m/sec. Find the range of the projectile.	BT2	Understand
9.	What is work energy principle.	BT1	Remember
10.	Illustrate the impulse momentum equation?	BT1	Remember
11.	Distinguish between kinetics and kinematics.	BT2	Understand
12.	Distinguish between impulse and impulsive force.	BT2	Understand
13.	Analyze the impulse momentum equation.	BT2	Understand
14.	Compare and contrast the rectilinear and curvilinear motion.	BT2	Understand
15.	Define inertia force.	BT1	Remember
16.	What differences exist between impulse and momentum?	BT1	Remember
17.	Compare and contrast the impact and elastic impact.	BT3	Apply
18.	Define Co-efficient of restitution.	BT1	Remember
19.	State Newton's law of collision of elastic bodies.	BT2	Understand
20.	Define range of projectile.	BT1	Remember
21.	A point P moves along a straight line according to the equation $x= 4t^3+2t+5$, where x is in meters and t is in secs. Determine the velocity and acceleration at t=3 secs.	BT2	Understand

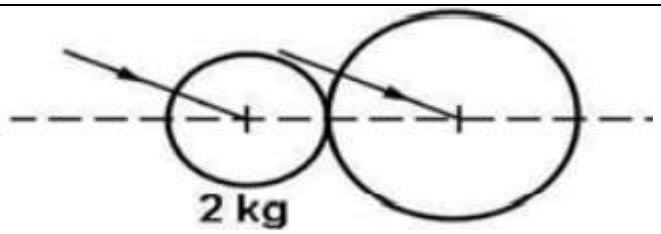
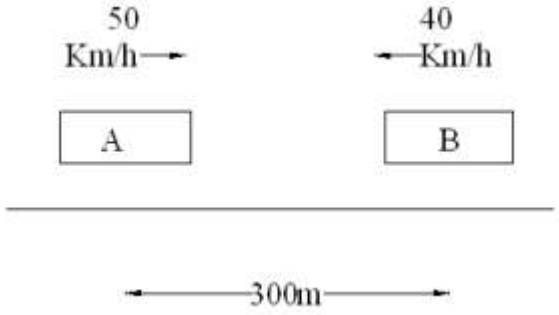
22.	The particle moving with $S= 9t^3 + 2t + 2$. Find velocity and acceleration when time t=6sec.	BT2	Understand
23.	How do you define the moment of the particle?	BT2	Understand
24.	Define Law of conservation of momentum.	BT2	Understand
25.	Define law of conservation of angular momentum.	BT2	Understand

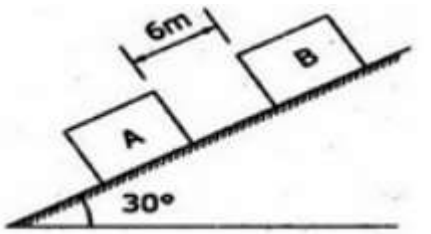
PART - B (13 Marks)

S.No	QUESTIONS	Marks	Level	Competence
1	A body moving with uniform acceleration observed to travel 33m in 8th second and 53m in 13 second of its travel. calculate the velocity at start and uniform acceleration	13	BT3	Apply
2	Two stones A and B are projected from the same point at inclinations of 45^O and 30^O respectively to the horizontal. Find the ratio of the velocities of projection of A and B if the maximum height reached by them is the same	13	BT3	Apply
3	Water drips from a tap fitted to a barrel at the rate of four drops per second. Find the vertical separation between two consecutive drops after the lower drop has attained a velocity of 3m/s	13	BT3	Apply
4	A train is traveling from A to D along the track. Its initial velocity at A is zero. The train takes 5 min to cover the distance AB, 2250 m length and 2.5 minutes to cover, the distance BC, 3000 m in length, on reaching the station C, the brakes are applied and the train stops 2250 m beyond, at D (i) Find the retardation on CD, (ii) the time it takes the train to get from A to D, and (iii) its average speed for the whole distance.	13	BT3	Apply
5	The position of the particle is given by the relation $S=1.5t^3-9t^2-22.5t+60$, where S is expressed in meters and t in seconds. Determine (i) the time at which the velocity will be zero (ii) the position and distance travelled by the particle at that time (iii) the acceleration of the particle at that time and (iv) the distance travelled by the particle from t = 5s to t = 7s.	13	BT3	Apply

6	A body A is projected vertically upwards from the top of a tower with a velocity of 40 m/s, the tower being 180m high. After t sec, another body B is allowed to fall from the same point. Both the bodies reach the ground simultaneously. Calculate t and the velocities of A and B on reaching the ground	13	BT3	Apply
7	Two smooth spheres 1 and 2 having a mass of 2 kg and 4 kg respectively collide with initial velocities as shown in figure. If the coefficient of restitution for the spheres is e=0.8, determine the velocities of each sphere after collision. 	13	BT3	Apply
8	Two bodies of 9 kg and 13.5 kg are suspended on two ends of a string passing over a pulley of radius 275 mm and mass moment of inertia = 16.5kg m2 as shown. Determine the tensions in the strings and the angular acceleration of the pulley. 	13	BT3	Apply
9	A particle is projected with a initial velocity of 12m/s at an angle M with the horizontal. After sometime, the position of the particle is observed by its x and y distances of 6m and 4m respectively from the point of projection. Find the angle of projection.	13	BT5	Evaluate
10	A cricket ball hit at a height of 1.5m from the ground by a batsman with a	13	BT3	Apply

	velocity of 20 m/s, at an angle of 30◦ to the horizontal was caught by field man at a height of 50 cm from the ground. Find out the distance between the two players.			
11	Two blocks of weight 150 N and 50 N are connected by a string and passing over a frictionless pulley as shown in figure. Predict the acceleration of blocks A and B and the tension in the string.  	13	BT5	Evaluate
12	Two weights 80 N and 20 N are connected by a thread and move along a rough horizontal plane under the action of a force 40 N, applied to the first weight of 80 N as shown in figure. The coefficient of friction between the sliding surfaces of the wrights and the plane is 0.3. Design the acceleration of the weights and the tension in the thread using work-energy equation.  	13	BT3	Apply
13	A ball of mass 2 kg, moving with a velocity of 3 m/s, impinges on a ball of mass 4 kg moving with a velocity of 1 m/s. The velocities of the two balls are parallel and inclined at 30◦ to the line of joining their centers at the instant of impact. If the coefficient of restitution is 0.5, Explain I. Direction, in which the 4 kg ball will move after impact; (5) II. Velocity of the 4 kg ball after impact; (2) III. Direction, in which the 2 kg ball will move after impact; (4) IV. Velocity of the 2 kg ball after impact. (2)	13	BT5	Evaluate

				
14	A ball of mass 500 grams, moving with a velocity of 1m/s impinges on a ball of mass 1kg, moving with a velocity of 0.75 m/s. at the time of impact, the velocities of the balls are parallel and inclined at 60◦ to the line joining their centers. Determine the velocities and directions of the balls after impact. Take, e=0.6.	13	BT5	Evaluate
15.	A weight of 10N resting on an inclined plane that makes an angle of 30° with horizontal is connected by a string passing over a frictionless pulley at the upper end of the plane. On the free end of the string a weight of 20N is connected. If the coefficient of friction between the plane and 10N weight is 0.2 calculate the time taken by the hanging weight to descend by 1m. Adopt work-energy method.	13	BT3	Apply
16.	A bullet of mass 20g is fired into a body of mass 10Kg, which is suspended by a string 0.8m long. Due to this impact, the body swings through an angle of 30°. Find the velocity of the bullet.	13	BT3	Apply
17.	A ball is thrown vertically upward from a point located 20m above the ground. The maximum height reached by the ball is 30m from the ground. Determine the initial velocity of the ball at 20m above the ground and the velocity with which the ball strikes the ground.	13	BT3	Apply
18.	Two vehicles approach each other in opposite lanes of a straight horizontal roadway as shown in fig. Find the time and positions at which the vehicles meet if both continue to move with constant speed. 	13	BT3	Apply

	PART-C (15 Marks)			
1	A ball is dropped from a height of 10m on a fixed steel platform. Determine the height to which the ball rebounds on the first, second and third bounces. The co-efficient of restitution between the ball and the plate is 0.9.	15	BT3	Apply
2	Two Blocks A and B of weight 100 N and 200 N respectively are initially at rest on a 30° inclined plane as shown in figure. The distance between the blocks is 6 m. The co-efficient of friction between the block A and the plane is 0.25 and that between the block B and the plane is 0.15. If they are released at the same time, in what time the upper block (B) reaches the Block (A). 	15	BT6	Create
3	Two bodies one of mass 30kg, moves with a velocity of 9m/s strikes on another body of mass 15kg, moving in the opposite direction with the velocity of 9m/s centrally. Find the velocity of each body after impact, if the coefficient of restitution is 0.8.	15	BT5	Evaluate
4	A ball strikes centrally on another ball of mass twice the mass of first ball but moving with a velocity 1/7 of the velocity of first ball and in the same direction. Show that, the first ball comes to rest after impact. The co-efficient of restitution between them is ¾.	15	BT5	Evaluate
5	A shot is fired with a velocity of 30m/sec from a point 15m in front of a vertical wall 6m high. Find the angle of projection with the horizontal to enable the shot to just clear the wall. Explain the double answer.	15	BT5	Evaluate

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