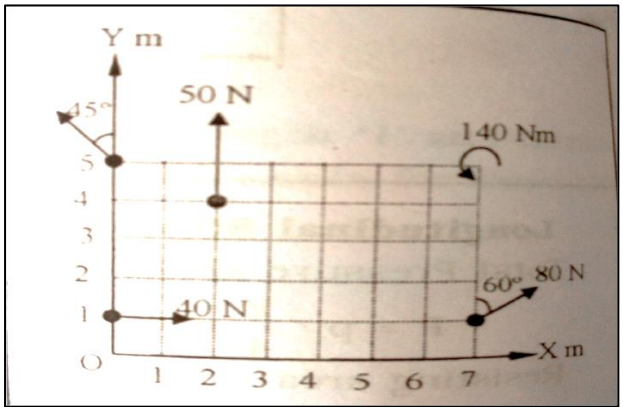
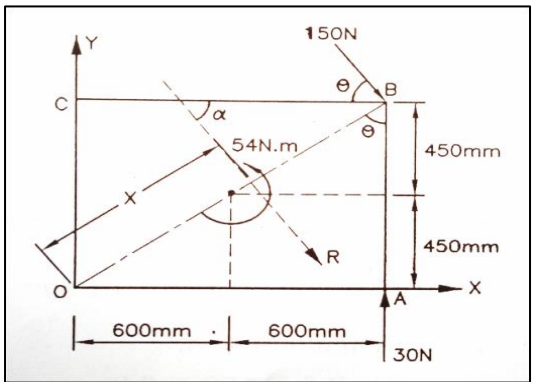
MECHANICS OFSOLIDS

QUESTION BANK:1

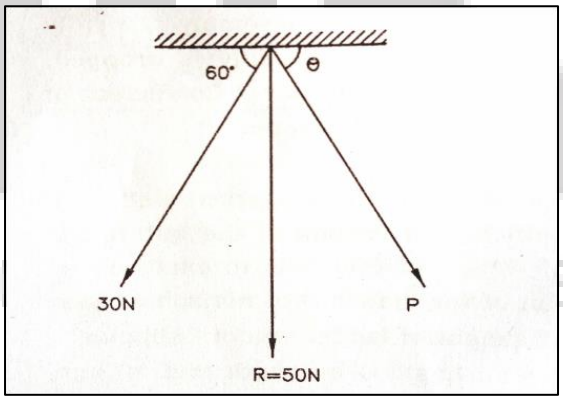
1. What do you mean by mechanics? Classify mechanics.
2. What is the difference between:
   a. Statics and Dynamics
   b. Kinetics and Kinematics
   c. Scalar and Vector Quantities
   d. Fundamental and Derived Units
3. Derive equation for magnitude and direction of resultant for a system of two coplanar concurrent forces using law of parallelogram of forces.
4. Explain with figure, law of triangles of forces.
5. Explain Law of Transmissibility of Forces.
6. Explain Law of Polygon of Forces.
7. State and explain the following Law.
   a. Newton's 1^{st} law of motion.
   b. Newton's 2^{nd} law of motion.
   c. Newton's 3^{rd} law of motion.
   d. Newton's gravitational law of attraction
8. Reduce the following S.I. units to Units indiacted.
   100Mpa to kN/mm^2
   10^9 kg to Gg
   2000 µm to mm
   20 Gg to kN (Take 1 Kg = 10N)
   $2x10^5$ Mpa to kN/m^2
   10^{-9} Gg to Kg
   10^5 N.m to kJ
9. A system of four forces shown in figure has resultant 50N along X-axis .Determine magnitude & inclination of unknown force P.



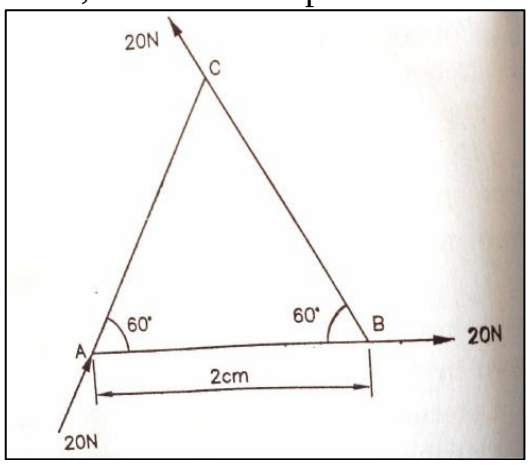
10. For the system of forces on a lamina OABC is shown in figure. Find magnitude& direction of the resultant force. Also locate the resultant either showing perpendicular distance from point 'O'.



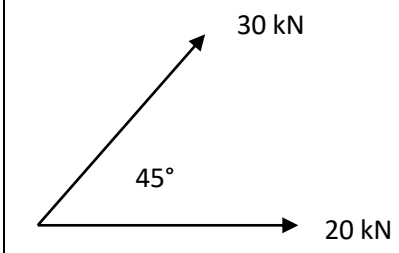
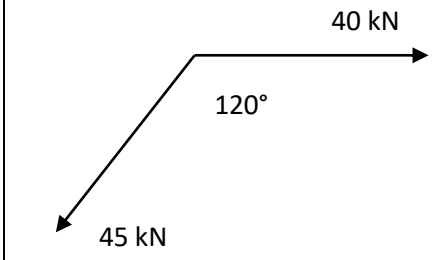
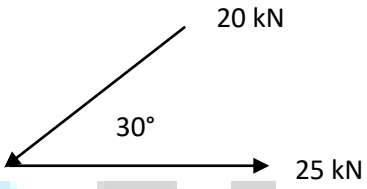
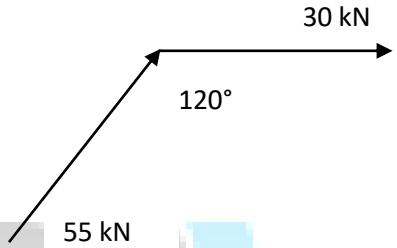
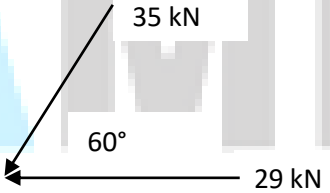
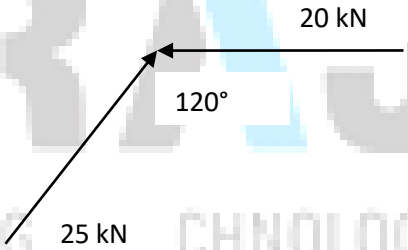
11. Resultant forces of a system of two forces is directed vertically downwards .The magnitude of the resultant force R is 50N. One of the force of the system has magnitude of 30N & is inclined at an angle of 60° with horizontal as shown in figure. Determine the magnitude P and direction Θ of the second force.



12. Three forces are acting on an equilateral triangular plate as shown in figure .Determine the magnitude, direction and position of the resultant force.

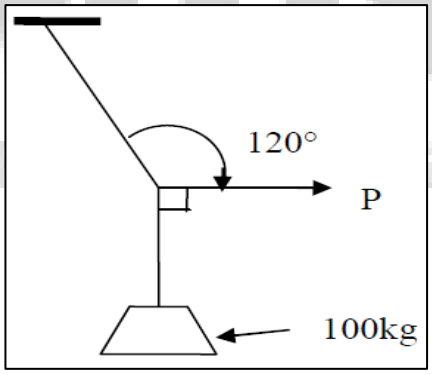


13. Find Magnitude and direction for following system of two forces using law of parallelogram of forces analytically and using law of triangle of forces graphically. Observe that the values of magnitude and direction must be same with a minor difference of not more than 2 to 3 percent.

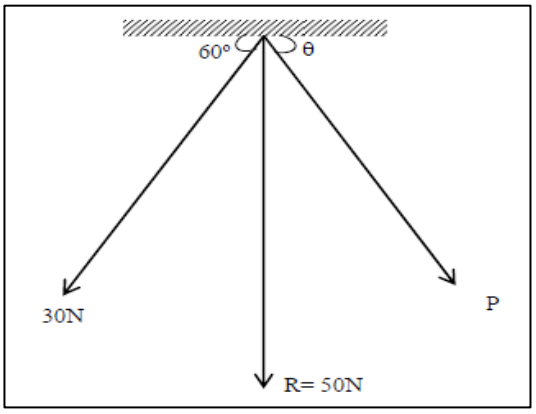
1		4	
2		5	
3		6	

QUESTION BANK:2

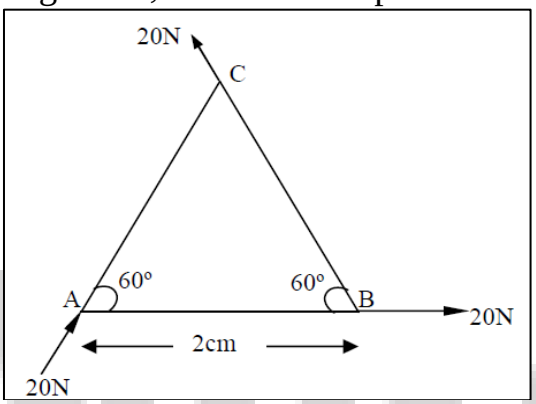
1. Two forces *P* and *Q* are acting at a point in a plane. The angle between the forces is 'α'. Prove that the resultant (R) of the two forces is given by $R = \sqrt{P^2 + Q^2 + 2PQcos\alpha}$
2. Explain with sketch the following system of forces:
   (1) Co planar forces (2) collinear forces (3) concurrent forces (4) Like parallel forces (5) coplanar –concurrent forces (6) unlike parallel forces
3. Define the moments. List examples of moment.
4. Differentiate Moment of force and moment of couple.
5. State the varignon's theorem. Prove that the resultant of two like parallel forces F_1 and F_2 is $F_1 + F_2$. Also prove that the resultant divides the line of joining the points of action of F_1 and F_2 internally in the inverse ratio of the forces.
6. Prove that a given force F applied to a body at any point A can always replace by an equal force applied at another point B together with a couple.
7. Explain the "Equivalent couples" with neat sketches.
8. State and explain the condition of equilibrium.
9. What is Free Body Diagram? What is the importance of Free Body Diagram?
10. Find the magnitude of the force P, required to keep the 100 kg mass in the position by strings as shown in the fig.



11. Resultant force of a system of two forces is directed vertically downwards. The magnitude of resultant force R is 50 N One of the force of the system has magnitude of 30 N and is inclined at an angle of 60º with horizontal as shown in Fig. Determine the magnitude P and direction of the second force.

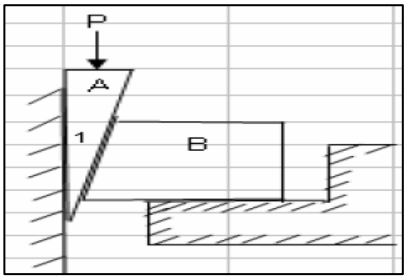


12. Three forces are acting on a weightless equilateral triangular plate as shown in Fig. Determine the magnitude, direction and position of the resultant force.



QUESTION BANK: 3

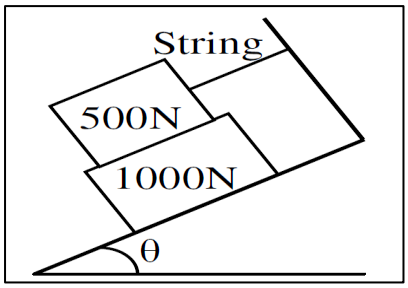
1. A 15^0wedge 'A' is pushed to move block 'B' weighing 1200 N as shown in figure. Determine the minimum force 'P' required to move the block if the coefficient of friction for all contact surfaces is 0.25. Neglect the self-weight wedge.



2. A ladder 6 m long, rests on horizontal ground and leans against a smooth vertical wall making an angle of 200 with the wall. Its weight is 1000 N and it ison the point of sliding when a man weighing 500 N stands on it at a distance of2.2 m from the foot of the ladder. Calculate the coefficient of friction.

3. A ladder is supported by a horizontal floor and a vertical wall. The weight of ladder is 200N. The coefficient of friction at the wall is 0.2 and at the floor is0.4. A man of weight of 600N is to climb on it. Determine the minimum inclination of the ladder with horizontal floor so that the man can climb the full height of ladder without slipping.

4. What should be the value of _ in figure which will make the motion of1000N block down the plane to impend? The coefficient of friction for allcontact surfaces is 1/3.

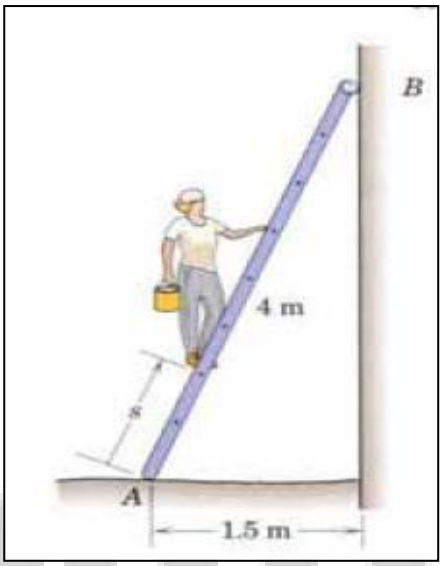


5. A body of weight 500N is pulled up an inclined plane, by a force of 350N. The inclination of the plane is 30º to the horizontal and the force is applied parallel to the plane. Determine the coefficient of friction.

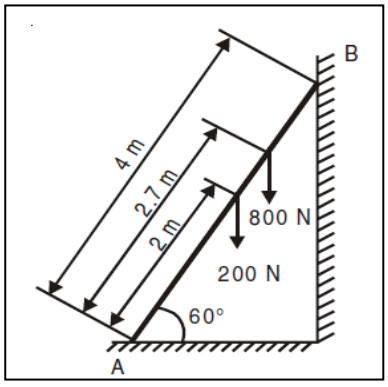
6. A pull of 180 N applied upward at 30° to a rough horizontal plane was required to

just move a body resting on the plane while a push of 220 N applied along the same line of action was required to just move the same body downwards. Determine the weight of the body and the coefficient of friction.

7. Determine the distance x to which the 90 kg painter can climb without causing the 4-m ladder to slip at its lower ends A. The top of the 15kg ladder has a small roller, and at the ground the coefficient of static friction is 0.25. The mass center of the painter is directly above her feet.

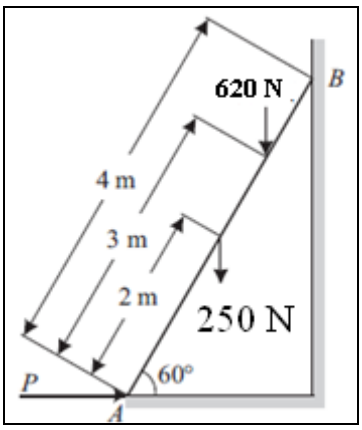


8. A 4 m ladder weighing 200 N is placed against a vertical wall as shown in Fig. 4.2 as a man weighing 800 N, reaches a point 2.7 m from *A*, the ladder is about to slip. Assuming that the Coefficient of friction between the ladder and the wall is 0.2, determine the coefficient of friction between the ladder and the floor.



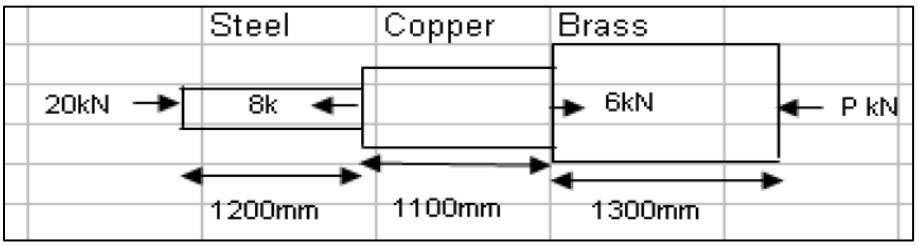
9. A ladder of length 4 m, weighing 250 N is placed against a vertical wall as shown in Fig. 4.3. The coefficient of friction between the wall and the ladder is 0.25 and that between floor and the ladder is 0.39. The ladder, in addition to its own weight, has to support a man weighing 620 N at a distance of 3 m from A. Calculate the minimum

horizontal force to be applied at A to prevent slipping.

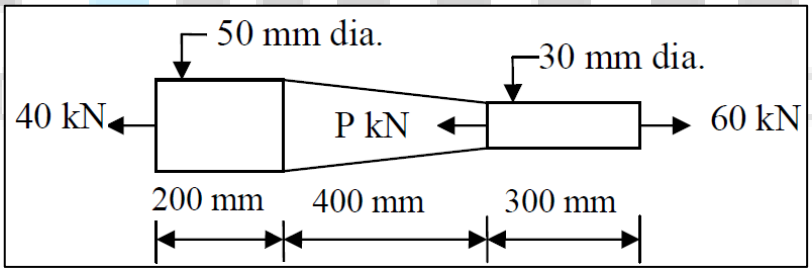


QUESTION BANK: 4

1) Explain the terms compressive strain, shear strain, volumetric strain
A stepped bar made of steel, copper and brass is under axial force as shown in following figure and is in equilibrium. The diameter of steel is 12mm, diameter of copper is 16mm and the diameter of brass is 20mm.Determine (i) Magnitude of unknown force P (ii) stresses in each material and (iii) Total change in length of the bar. Take Esteel= 200GPa, Ecopper=100GPa and Ebrass= 80GPa.

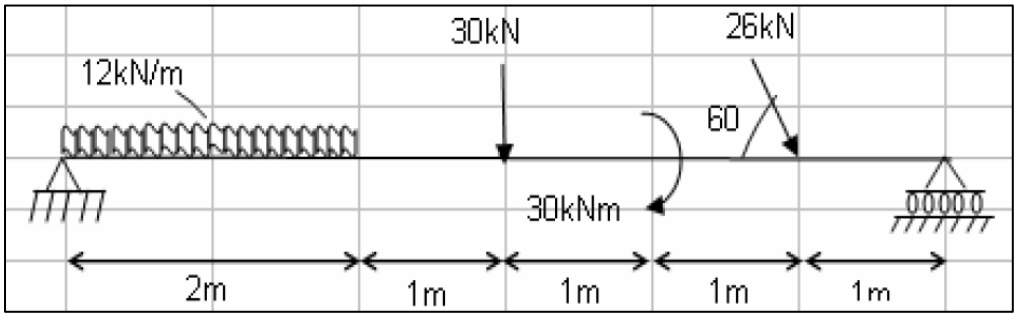


2) An assembly of steel bars as shown in the fig. is in equilibrium. Find force P and the net elongation of the assembly. Take Es= 2 x 105 MPa.

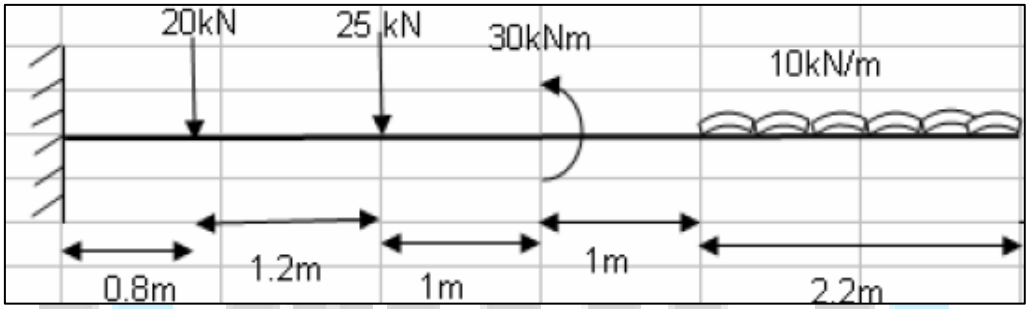


3) At a point in a strained material two mutually perpendicular tensile stresses of 420 N/mm^2 and 280 N/mm^2 are acting. There is also a clockwise shear stress of 200 N/mm^2. Determine the values of principal stresses and location of principal plane.

4) Determine support reactions for following beam.



5) Draw shear force and bending moment diagram for the beam shown in figure.

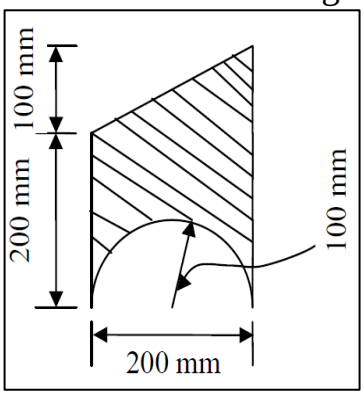


6) Prove that the maximum shear stress in a circular section of a beam is 4/3 times of average shear stress.

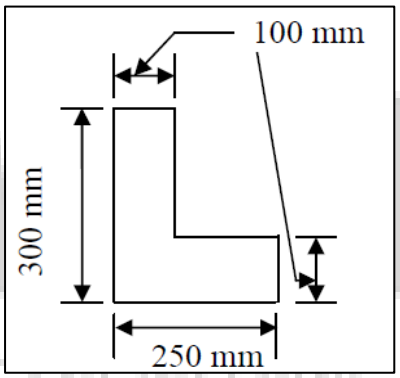
7) A mild steel simply supported beam of 3 m span has cross section 20 mm (width) x 50 mm (depth). Find the maximum uniformly distributed load that beam can carry in addition to its self-weight, if maximum bending and shear stresses are limited to 150 N/mm2 and 100 N/mm2.Self weight of beam is75N/m.

QUESTION BANK: 5

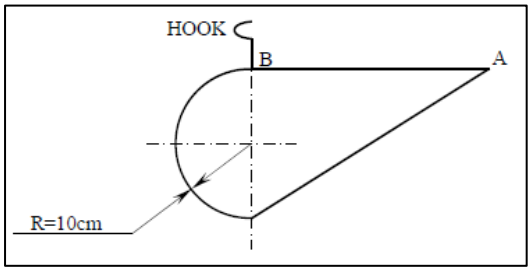
1) Derive equation of centroid for a triangular lamina from its base. Find centre of gravity of a lamina shown in the fig.



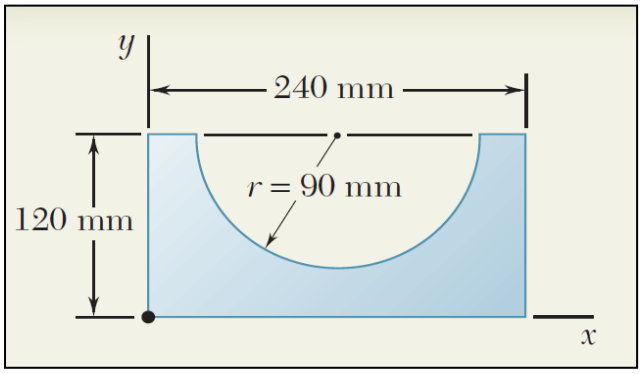
2) Find Moment of Inertia of a lamina shown in the fig.8 about horizontal centroidal axis.



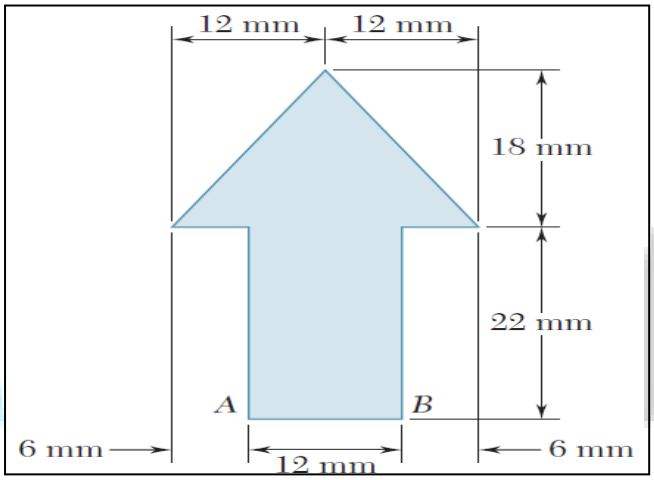
3) A lamina of uniform thickness is hung through a weightless hook at point B such that side AB remains horizontal; as shown in Fig . Determine the length AB of the lamina.



4) Determine the moment of inertia of the shaded area with respect to the *x* axis.



5) Determine the moments of inertia Ix and Iy of the area shown with respect to centroidal axes respectively parallel and perpendicular to side AB.



6) Find moment of inertia of the give lamina about the Centroid “C”. Assume the corners to be without any curvature.