TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING

Examination Control Division

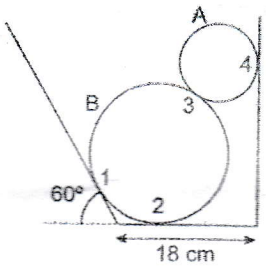
2082 Chaitra

Exam.	Regular (New Course)		
Level	BE	Full Marks	60
Programme	BCE, BAG	Pass Marks	24
Year / Part	I / I	Time	3 hrs.

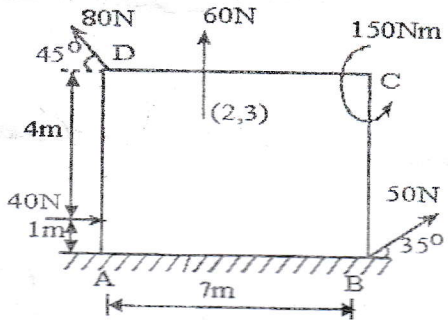
Subject: - Engineering Mechanics *(ENCE 101)*

- ✓ *Candidates are required to give their answers in their own words as far as practicable.*
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. Explain the physical meaning of equilibrium and write down the equations of static equilibrium for 2D and 3D analysis of particle and rigid body. Two cylinders A and B rest in a channel as shown in figure. The cylinder A has diameter of 10 cm and weighs 200 N whereas the cylinder B has diameter of 18 cm and weighs 500 N. Determine the contact forces. [1+3+4]

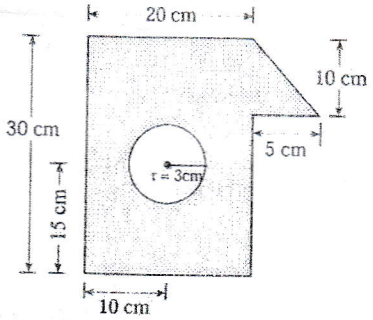


2. Define a couple and prove that "couple is a free vector". Find the magnitude, direction and line of action of resultant force of the given system of force and couple as shown in figure below. Calculate also the moment about point A. [2+3+3]

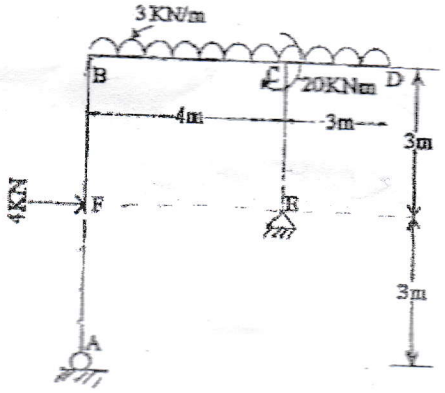


3. Define friction, angle of friction and explain about the sliding and over turning condition of a block. Illustrate all the terms with suitable diagram also. [1+2+2]

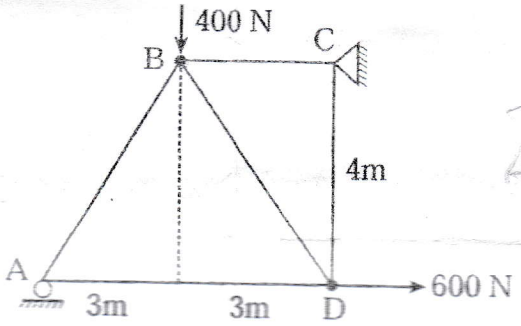
4. Define centroid, center of gravity and radius of gyration. Find the moment of inertia of the given composite shaded area about its centroidal X-X axis. [3+7]



5. Draw axial force, shear force and bending moment diagram of the given frame loaded as shown in figure below. Indicate also the salient features if any. [10]

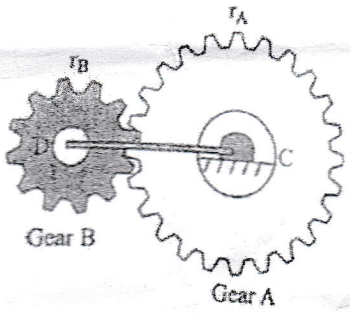


6. How can we check the determinacy and stability of the given structures (beam, frame and truss)? Explain with suitable example. Determine the force developed in all the members of the given truss loaded as shown in figure. [3+4]



7. Define impact and explain about different types of impact with diagram. A projectile is aimed at a mark on the horizontal plane through the point of projection and falls 7 m short when the inclination is 20° and overshoots the mark by 14 m when the angle of projection is 45°. Calculate the distance of the target and the required angle of projection. [2+4]

8. Explain D'Alembert's principle for plane motion of rigid body. Gear A of the system shown in figure rotates with $\omega_A = 180$ rpm (ccw) and the connecting arm CD rotates with $\omega_{CD} = 60$ rpm (cw). Determine ω_B of the gear B. Take $r_A = 200$mm and $r_B = 100$mm. [2+4]



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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2082 Kartik

Exam.	Back (New Course)		
Level	BE	Full Marks	60
Programme	BCE, BAG	Pass Marks	24
Year / Part	I / I	Time	3 hrs.

Subject: - Engineering Mechanics *(ENCE 101)*

- ✓ *Candidates are required to give their answers in their own words as far as practicable.*
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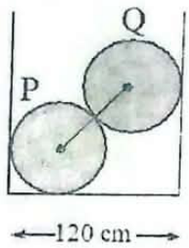
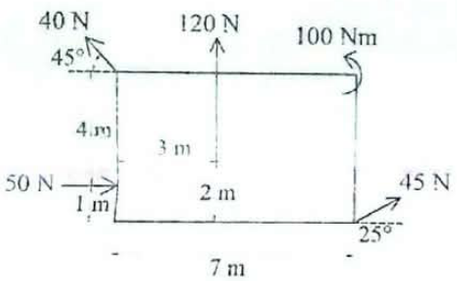
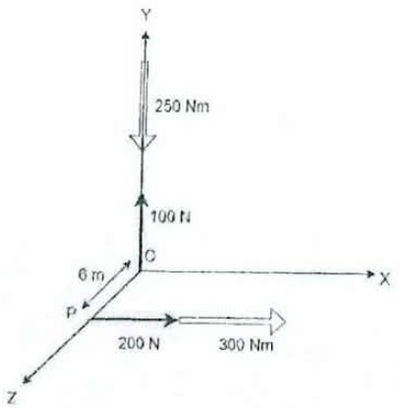
1. Two cylinders P and Q of weight $1200\ N$ and $1800\ N$ and radius $40\ cm$ and $50\ cm$ respectively are placed in a trench as shown in figure. Find the reactions at the contact points. Assume that contract surfaces are smooth. [5]



2. a) For given rectangular plate (7m x 5 m) is subjected to various system of forces and moment as shown in figure. Determine magnitude, direction, and position of the resultant force. [4]

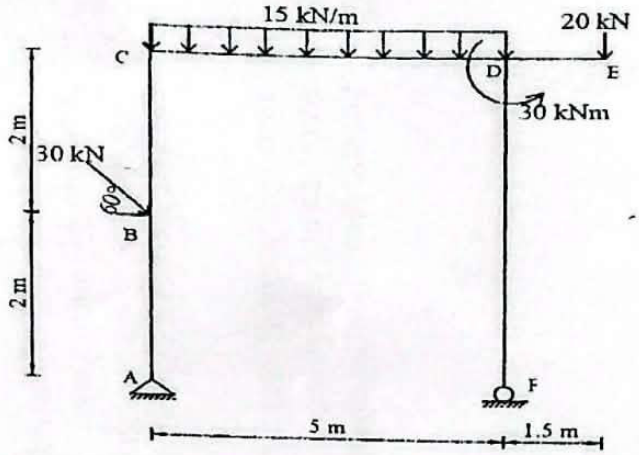


b) Replace the two wrenches as shown in the figure by a single equivalent wrench. Also indicate its line of action. [5]

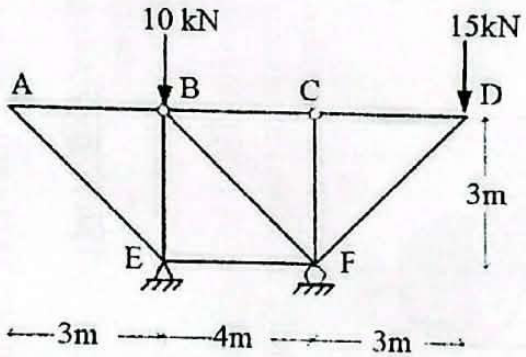


3. What is limiting friction? A ladder 6 m long has a mass of 30 kg. The ladder is placed against a vertical wall so that it makes an angle of 60° with the ground. How far up the ladder can a 80 kg man climb before the ladder is on the verge of slipping? The angle of friction at all contact surfaces is 15°. [1+3]

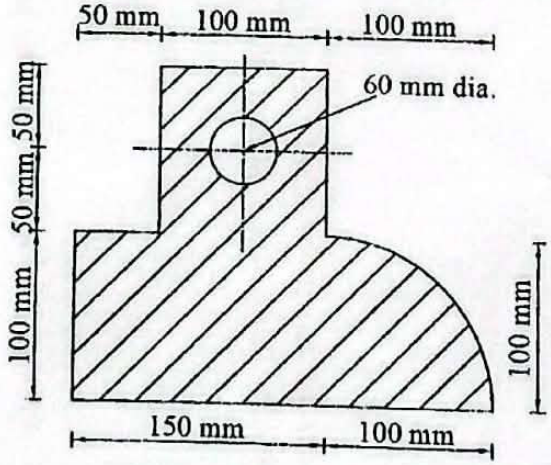
4. Draw AFD, SFD and BMD of the given loaded frame as shown in figure. Also, indicate salient points if any. [10]



5. For the given pin-jointed truss, determine forces in members BC, BF, EF,AE and DF. [5]



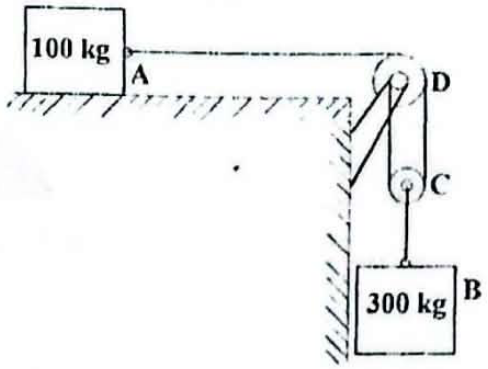
6. Determine the moment of inertia about centroidal axes of the composite area as shown. [7]



7. a) The motion of a particle is defined by the position vector $\vec{r} = 5t^2\hat{\imath} + 3t^3\hat{\jmath} + 15t^4\hat{k}$ where $\vec{r}$ in meters and t in second. At the instant t = 5 second, find the tangential and normal components of acceleration. [4]

   b) The acceleration of the particle motion in straight line is defined by the relation $a = -2m/s^2$. Initially, if the velocity is 8 m/s and position is 3 m, determine the position and velocity at the instant of 8 second. [4]

8. The two blocks are shown starting from rest. The horizontal plane and the pulley are frictionless, and the pulley are assumed to be of negligible mass. Determine the acceleration of each block and the tension in the cord. ($m_1 = 100\ kg,\ m_2 = 300\ kg$). [6]



9. Define and describe translation, rotation and general plane motion. [2×3]

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2081 Chaitra

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Year / Part	I / I	Time	3 hrs.

Subject: - Engineering Mechanics *(ENCE 101)*

- ✓ *Candidates are required to give their answers in their own words as far as practicable.*
- ✓ *Attempt **All** questions.*
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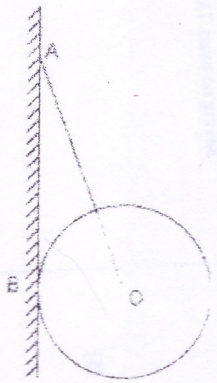
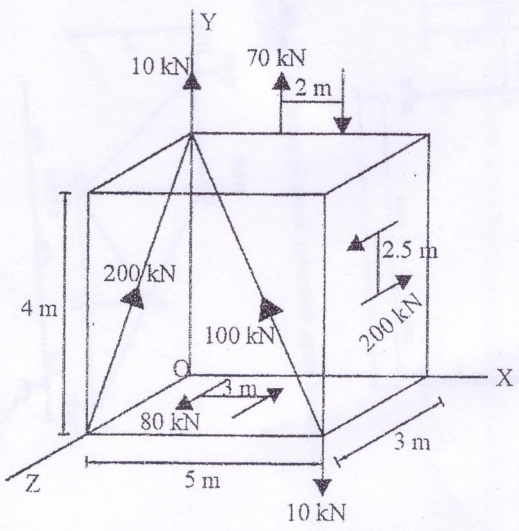
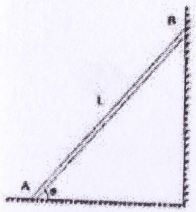
1. Define free body diagram with example. A smooth cylinder of weight 500N is supported in contact with a smooth vertical wall by a string attached to a point on its surface, the end being attached to point on the wall. If the length of the string is equal to diameter of cylinder, find tension in the string and reaction on the wall. [1.5+3.5]



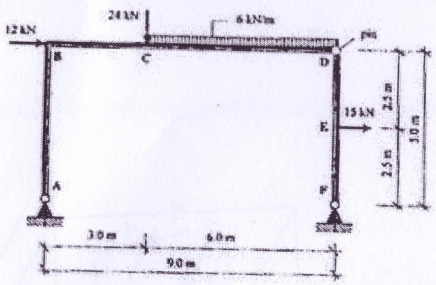
2. Determine resultant force-couple system of the following system of forces about O and obtain an equivalent wrench with line of action. [4+5]



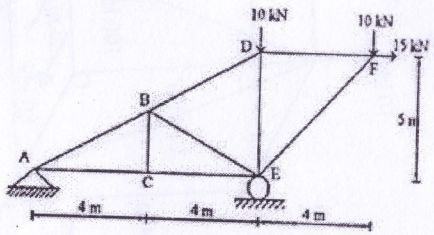
3. A ladder of weight W is placed against a wall as shown in the figure. Calculate the minimum angle of inclination of the ladder with ground so that the ladder doesn't slip under its own weight. Assume coefficient of friction for all surfaces as 0.3. [4]



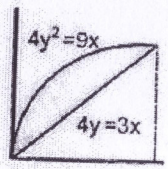
4. Draw AFD, SFD and BMD of the given loaded frame as shown in figure. Also, indicate salient points if any. [10]



5. For the given pin-jointed truss, determine forces in members BD, BE, CE, DE, DF and EF. [5]

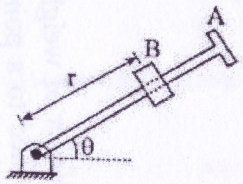


6. Determine the moment of inertia about centroidal axes of the area bounded by the curves as shown. [7]

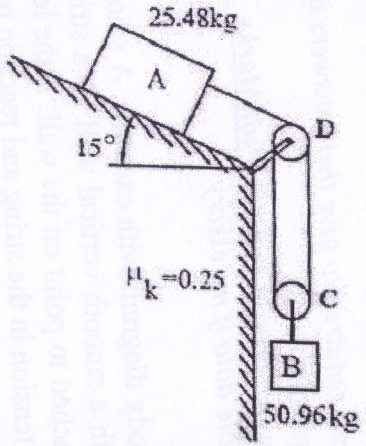


7. a) The motion of a particle is defined by the position vector $\vec{r} = 3t^2\hat{i} + 4t^3\hat{j} + 5t^4\hat{k}$ where $\vec{r}$ in meters and t in sec. At the instant t = 3 sec, find the tangential and normal components of acceleration. [4]

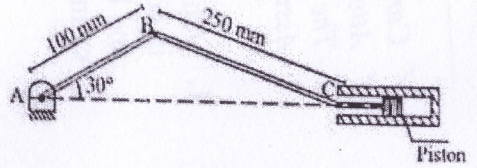
   b) The rotation of the arm 1.5 m arm OA about O is defined by the relation $\theta = 0.15t^2$, where θ is in radians and t in seconds. Collar B slides along the arm in such a way that its distance from O is $r = 1.5 - 0.12t^2$, where r is in meters and t in seconds. Calculate the magnitudes of the velocity and acceleration of the collar after the arm has rotated through 45°. [4]



8. Two block shown in figure below are released from rest. The pulleys are frictionless and having no mass. Determine the acceleration of each block and tension in each cord. [6]



9. Length of crank AB is 100 mm and that of connecting rod is 250 mm as shown in figure. For the position shown in figure, determine the angular velocity of connecting rod and the velocity of the piston if the crank AB is rotating in clockwise direction at 1500 rpm. [6]



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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2081 Baishakh

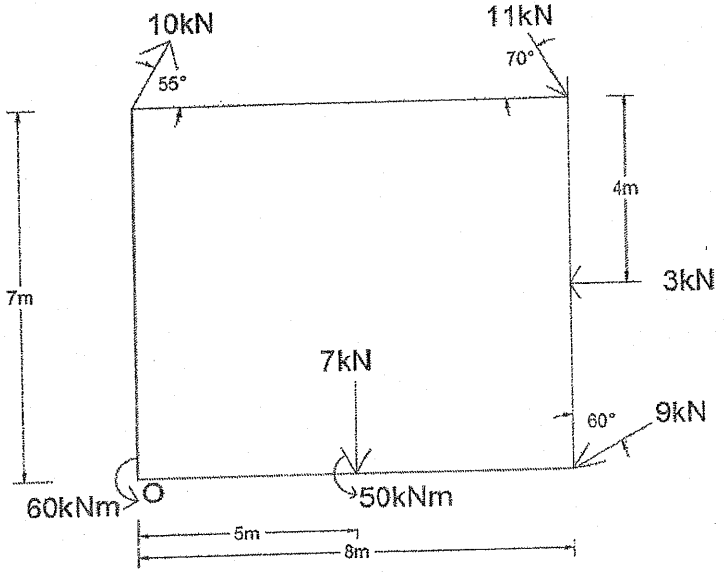
Exam.	Regular (New Course - 2080 Batch)		
Level	BE	Full Marks	60
Programme	BCE, BAG	Pass Marks	24
Year / Part	I / I	Time	3 hrs.

Subject: - Engineering Mechanics (*CE 101*)

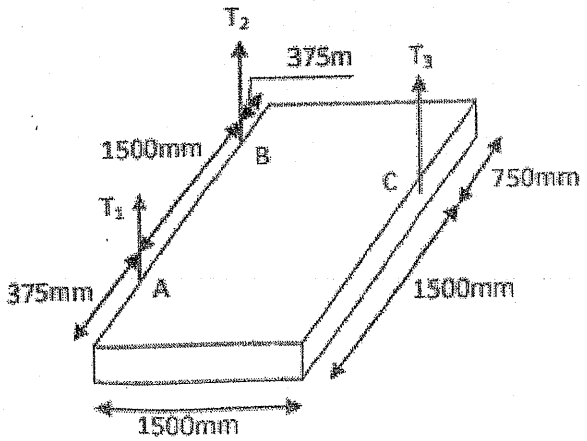
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. a) Explain the concept of particle and rigid body. What are the equations of Static Equilibrium for 2-D and 3-D analysis of particle and rigid body? [2+2]

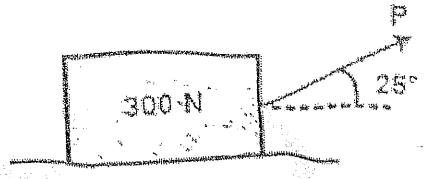
   b) Determine the magnitude, direction and position (with respect to O) of the resultant of the following forces and moments acting on the plate (7m * 8m). [5]



2. a) Three vertical wires as shown in the figure support a plate of 35 Kg. Determine the tension in each wire. [5]

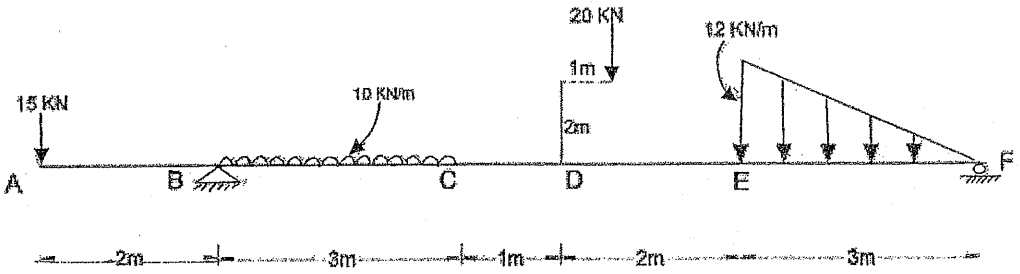


   b) Define angle of friction. A body weighing 300N is lying on a rough horizontal plane having coefficient of static friction as 0.35. Find the magnitude of force P which can move the body at an angle of 25 degrees. [1+3]

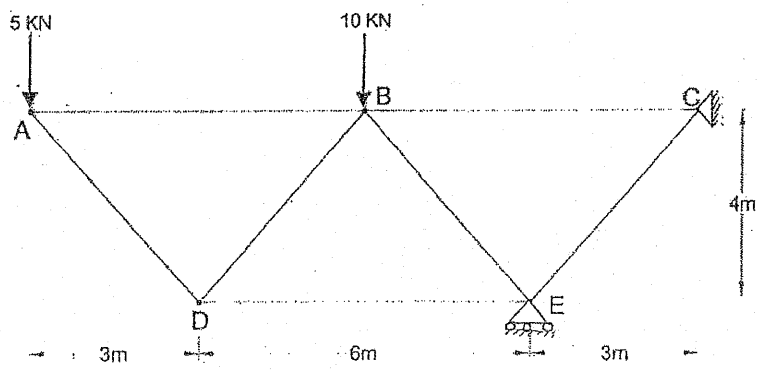


3. a) How can we check the determinacy and stability of a frame structure? Explain with suitable example. [3]

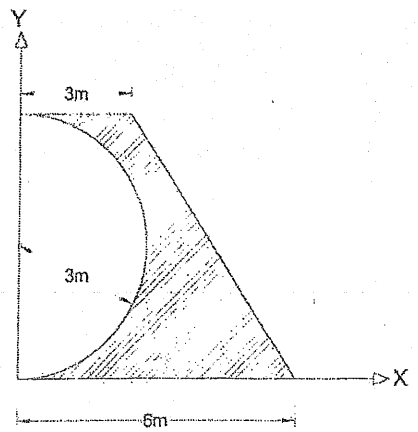
b) Draw axial force, shear force and bending moment for the beam loaded as shown. Indicate salient features if any. [10]



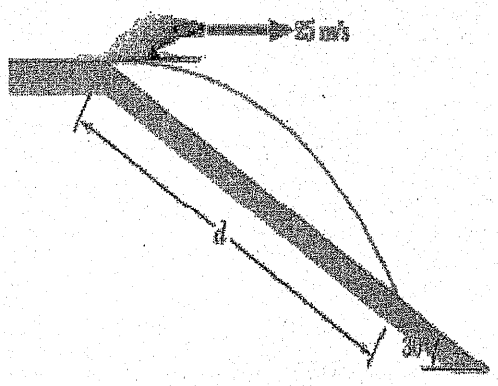
4. a) Explain with diagram the general conditions in which zero force member arises in a truss. Find the force in all the members of the truss shown. [2+4]



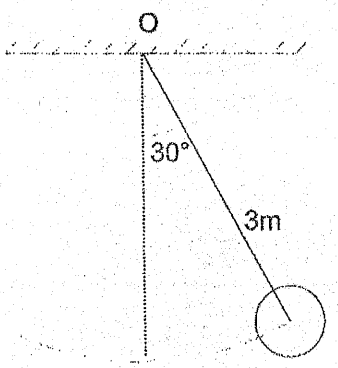
b) "Location of center of gravity/centroid is independent of choice of reference point/axis" Explain the statement. Calculate moment of inertia about centroidal y-axis of the composite shaded area shown below. [1+4]



5. a) How does kinematics differ from kinetics for a particle moving along its path? A ski jumper starts with a horizontal take-off velocity of 25 m/s and lands on a straight landing hill inclined at 30°. Determine (i) the time between take-off and landing, (ii) the length d of the jump, (iii) the maximum vertical distance between the jumper and the landing hill. [1+5]

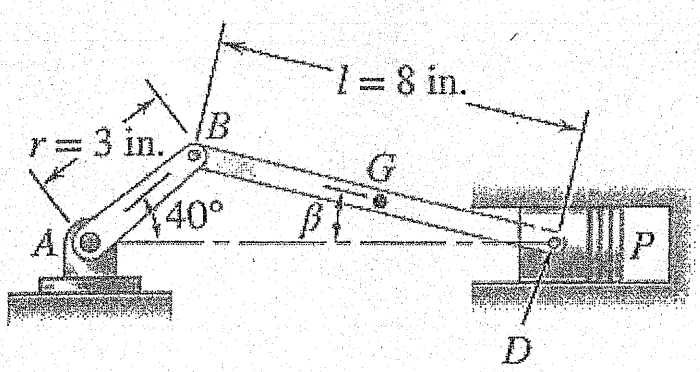


b) Derive work-energy principle for a particle. The bob of a 3 m pendulum describes an arc of a circle in a vertical plane. If the tension in the chord is 2 times the weight of the bob for the position when it is displaced through an angle of 30 degree from its mean position, find the velocity and acceleration of the bob for this situation? [2+4]



6. a) Explain D' Alembert's principle for plane motion of rigid body. [2]

b) In the engine system shown, the crank AB has a constant clockwise angular velocity of 2000 rpm. For the crank position shown in figure below, determine, (i) the angular velocity of the connecting rod BD, (ii) the velocity of the piston P. [4]



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TRIBHUVAN UNIVERSITY
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Examination Control Division
2081 Kartik

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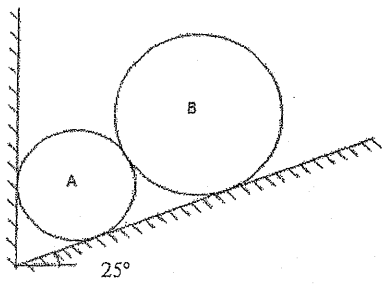
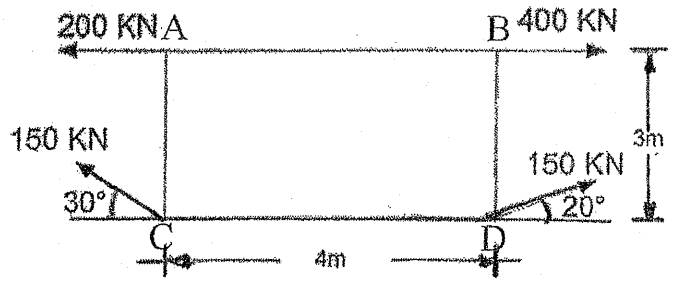
1. a) Define free body diagram. "Solid body is considered as perfectly rigid body in Engineering Mechanics" Justify the statement. [2+2]

   b) The cylinder A and B rest in an inclined surface which makes an angle of 25° with horizontal as shown in figure below. Determine reaction at the contact points. [6]

   Take:
   Weight of cylinder A (W_A) = 200 N
   Weight of cylinder B (W_B) = 400 N
   Diameter of cylinder A (d_A) = 100 mm
   Diameter of cylinder B (d_B)= 150 mm



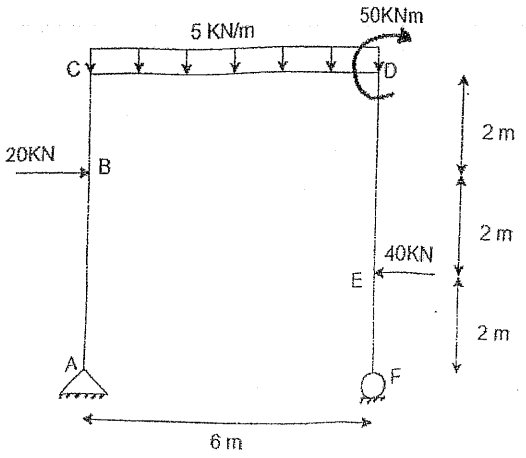
2. a) Find the magnitude, direction, and position of resultant force of the following system as shown in the Plate ABCD. [4]



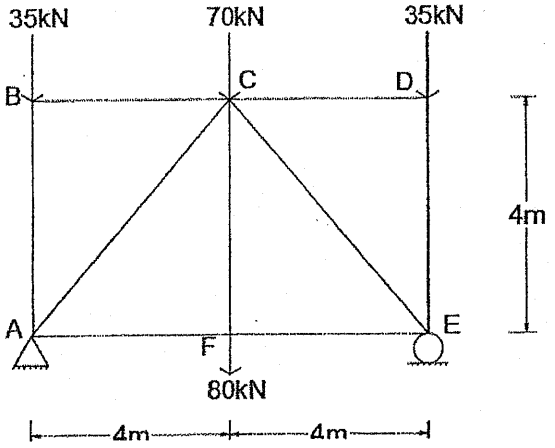
   b) How can you assure the condition of tipping or sliding of a block? Explain with suitable diagram. [3]

3. a) Derive an expression to show that area under the shear force curve between any two points is equal to change in bending moment between those two points. [3]

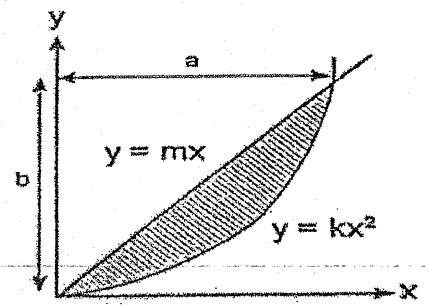
   b) Draw axial force, shear force and bending moment diagram for the frame shown. Indicate salient points, if any. [12]



4. a) Explain the applicability of method of joint and section for the analysis of plane truss. Determine the force developed in all the members of the truss loaded as shown in figure below. [1+4]

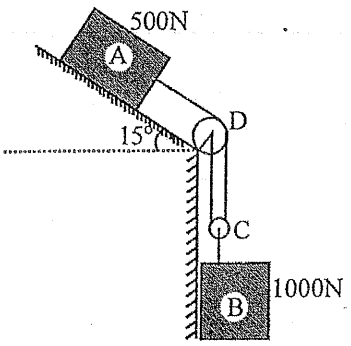


b) What are the basic differences between center of gravity and centroid? Determine the moment of inertia of the shaded area using method of integration about a horizontal axis which is b/2 distance from base. [1+4]



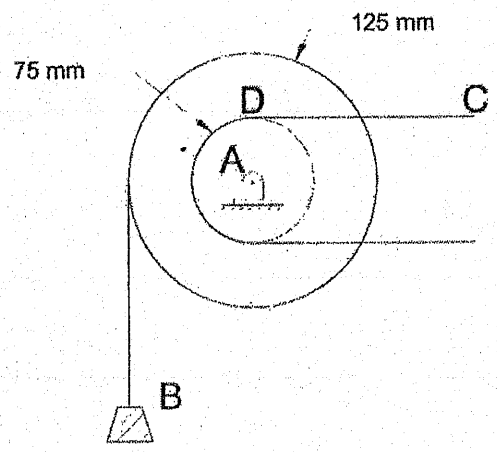
5. a) Derive an expression for radial and transverse component of velocity and acceleration for a particle moving along a curved path. The motion of a particle is defined by the relation x = t2-10t+30, where x is expressed in meter and t in second. Determine the position and total distance travelled when t = 8sec. [3+3]

b) Differentiate between conservative and non-conservative forces with examples. Two block A and B having respective weights 500N and 1000N starts from rest. The pulley is friction less and practically mass less. The kinetic coefficient of friction between the block A and the inclined surface is 0.35. Determine the acceleration of each block and tension in the cord. [1+5]



6. a) Derive an expression for kinetic energy in plane motion of rigid body. [2]

b) Load B is connected to a double pulley by one of the two inextensible cables as shown in fig. The motion of the pulley is controlled by cable C, which has a constant acceleration of 225 mm/sec2 and an initial velocity of 300mm/sec, both directed to the right. Determine (i) the number of revolutions executed by the pulley in 2 sec (ii) the velocity and change in position of the load B after 2sec. [4]



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