11 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division

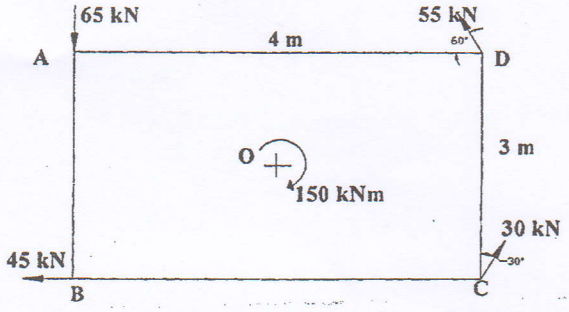
2075 Ashwin

Exam.	Back		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT, BAME, BIE, B. Agri, B. Arch.	Pass Marks	32
Year / Part	I / I	Time	3 hrs.

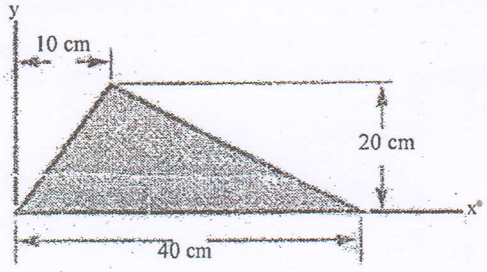
Subject: - Applied Mechanics *(CE401)*

- ✓ 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.*

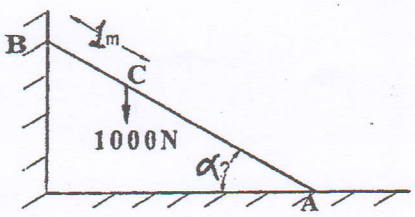
1. **Define rigid** body. Explain about the principles of Mechanics? [1+2]
2. **It is very** important to draw free body diagram for the analysis of problem in statics, **Explain.** Describe about the equations of static equilibrium for 2-D and 3-D analysis of a **particle and** a rigid body. [3+3]
3. **State principle** of transmissibility with its limitations. Explain, couple is a free vector. [2+2]
4. **Determine** the magnitude; direction and position with respect to center 'O' of the resultant **of the forces** acting on the resultant plate ABCD as shown in the figure below. [8]



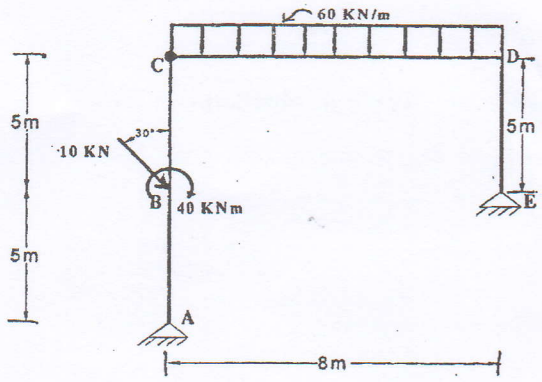
5. **Define** centroid, centre of gravity and axis of symmetry. Find I_{xx} and I_{yy} for the given **triangle about** it's centroidal axes. [3+9]



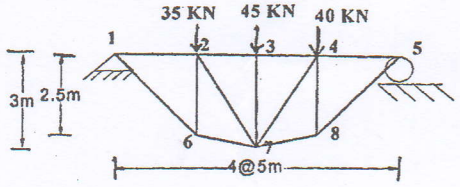
6. A ladder shown in figure is 4m long and is supported by a horizontal floor and a vertical wall. The co-efficient of friction at the wall is 0.3 and at the floor is 0.45. The weight of the **ladder** is 300N. The ladder supports a vertical load of 1000N at C. Determine the reactions at A, B and C and compute the least value of α at which ladder may be placed **without slipping** to right. [5]



7. Draw AFD, SFD and BMD for the following structure. Also show salient features, if any. [13]



8. Determine the member forces in the members 26,23,27,67,37. How can we check the determinancy and stability of the plane truss? Explain with examples. [5+4]



9. Define average and instantaneous velocity. Two cars A and E travel along the same straight route. At any time t their distance x_a and x_e from the starting point are given by: [2+8]

$x_a = 2.5t+1.2t^2$

$x_e = 3t^2-0.25t^3$

Where t in seconds and x_a and x_e are in meters.

a) Which car is ahead just after they leave the straight point?
b) At what time are the cars at the same point?
c) At what time is the distance between A and E neither increasing nor decreasing?
d) At what time do A and E have the same acceleration?

10. The resultant of the force applied on a 3kg particle is given by the relation; $\vec{F} = \left(12t\,\hat{i} - 24t^2\,\hat{j} - 40t^3\,\hat{k}\right)$N. The particle is initially at origin at rest. Determine the y-component of acceleration, velocity and position at the instant of 3 sec. What do you mean by dynamic equilibrium for a particle? [7+3]

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11 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division

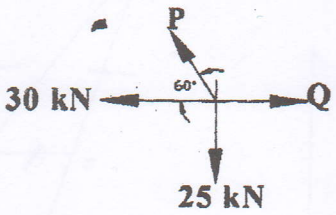
2074 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT, BAME, BIE, B.Agri, B. Arch.	Pass Marks	32
Year / Part	I / I	Time	3 hrs.

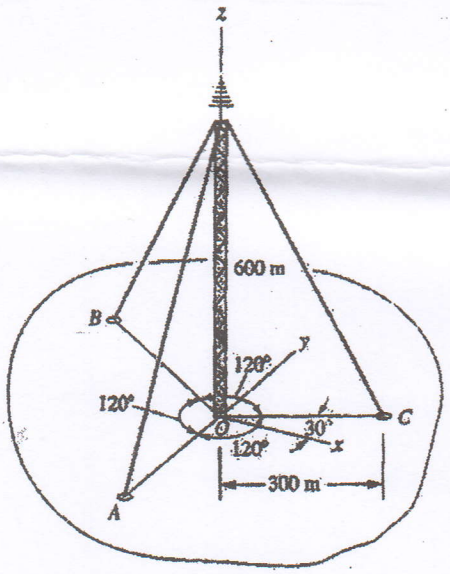
Subject: - Applied Mechanics *(CE401)*

- ✓ 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.*

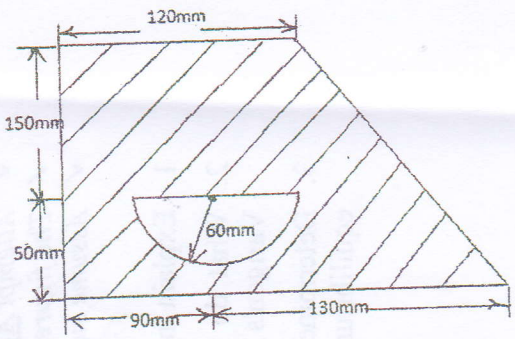
1. Explain in brief about fundamental concepts and principles of mechanics. [3]
2. What do you understand by Free Body Diagram? Explain with sketches. Also state Varigon's Theorem and prove it. [4+4]
3. Determine the values of the unknown forces P and Q for the system of forces to be in equilibrium. [4]



4. Three gay wires are used in the support system for a television transmission tower that is 600m tall. Wire A and B are tightened to a tension of 60KN, whereas wire C has only 30 KN of tension. What is the moment of wire forces about the base O of the tower? The Y axis is collinear with AO. [7]

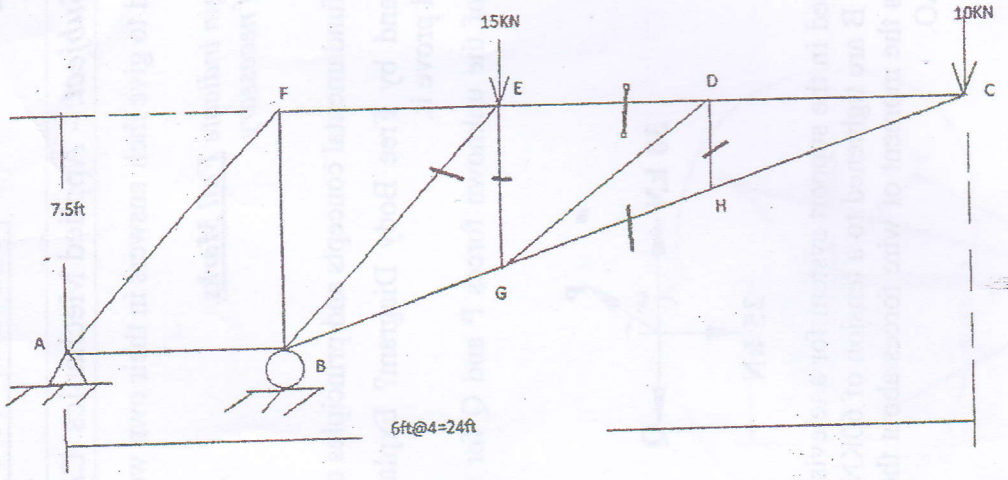


5. State and proof parallel axis theorem for moment if inertia. Determine moment if inertia about centroidal axes of the plane figure shown in below. [4+8]

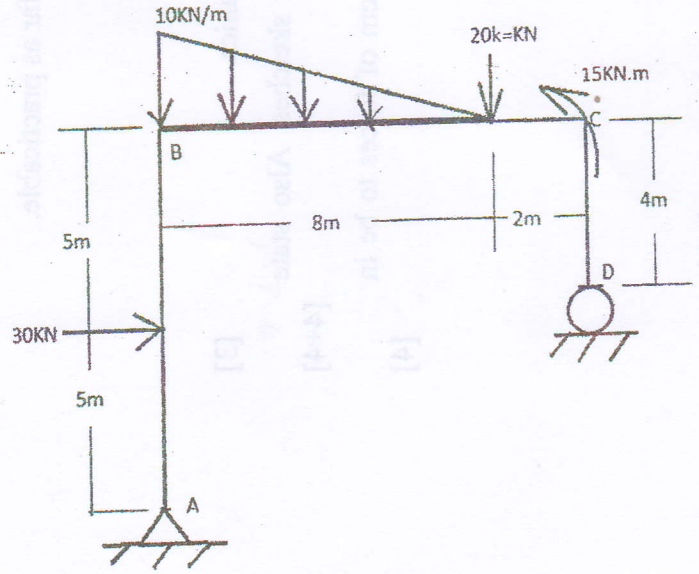


6. Define limiting friction, angle of friction and coefficient of the static and dynamic friction. [4]

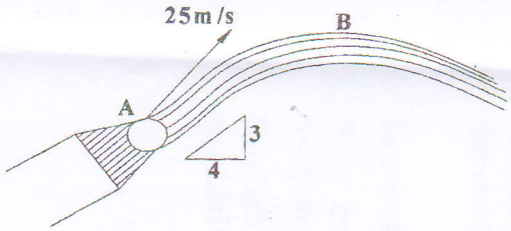
7. Find the member forces of indicated members of the truss shown in figure below. Write down the assumptions of perfect truss. [5+4]



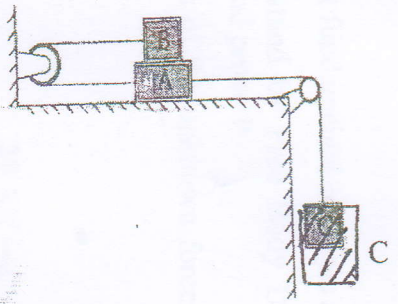
8. Draw axial forces, shear force and bending moment diagram and indicate the salient features if any for the given frame loaded as shown in figure below. [13]



9. Derive the relationship for normal and tangential components of acceleration for a particle moving in a curvilinear path. A nozzle discharge a stream of water in direction as shown in figure below with an initial velocity of 25m/sec. Determine the radius of curvature of the stream (i) as it leaves the nozzel (ii) at the maximum height of the stream. [4+6]



10. Determine the acceleration of block "A" for the system, if the system starts from rest. Coefficient of friction between block "A" and table is 0.25 and that between blocks "A" and "B" is 0.35. Where weight of block A, B and C are 100 N, 50 N and 500 N respectively. [10]



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21 TRIBHUVAN UNIVERSITY

INSTITUTE OF ENGINEERING

Examination Control Division

2074 Ashwin

Exam.	Back		
Level	BE	Full Marks	80
Programme	BEL, BEX, BAME, BCT, BIE, B.Agri., B.Arch.	Pass Marks	32
Year / Part	I / I	Time	3 hrs.

Subject: - Applied Mechanics *(CE401)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
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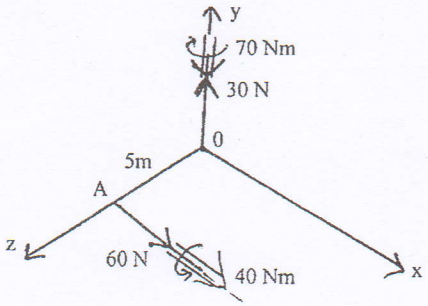
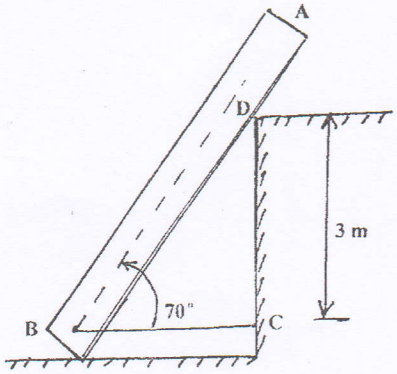
- ✓ *Assume suitable data if necessary.*

1. Define Equilibrium and its essence. What are the equations of static equilibrium for 2D and 3D analysis of particle and Rigid Body? [6]
2. Replace the two wrenches as shown in figure below by a single equivalent wrench and determine the point where its axis intersects the XZ plane. [8]

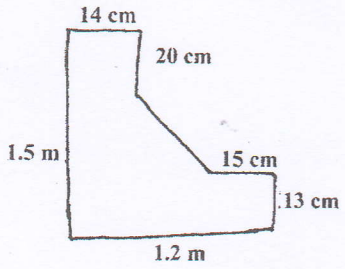


3. Determine the tension in the cable BC which holds a part AB of length 4m length from sliding. The past has a mass of 10 kg. Assume all the contact surfaces are smooth. [6]



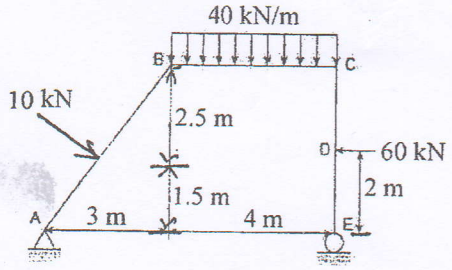
4. Illustrates the conditions of no friction, no motion, impending motion and motion with necessary sketches. How can you assure condition of sliding or overturning of the block? [3+2]

5. Determine moment of inertia about centroidal XX and XY axes of the plane figure shown in figure below. Define centroid, centre of gravity and axes of symmetry. [9+3]

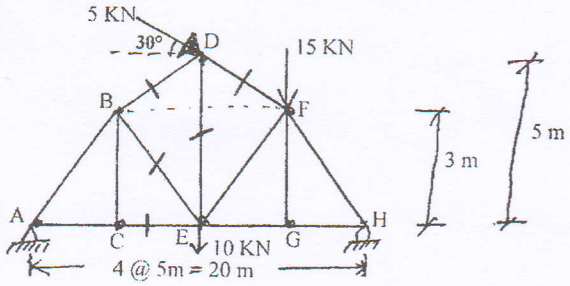


6. a) How can you check the determinacy and stability of the frame? Explain with examples. [3]

   b) Calculate and draw the axial force, shear force and bending moment diagram; with its salient features for the given frame. [12]



7. Find the member force in the indicated members of the truss shown below. [8]



8. Explain about relative motion of particle with example. A projectile is fired from position A with an initial velocity of 200 m/sec at a target B on right located 500m above from the position A. The horizontal distance between A and B is 3000 m. Determine the firing angle neglecting air resistance. [2+8]

9. The resultant external force acting on a 2 kg particle in space is $\vec{F} = \left(12t\,\hat{i} - 24t^2\,\hat{j} - 40t^3\,\hat{k}\right)$ N, where t is the time measured in seconds. The particle is at rest at the origin when t = 0. Determine the acceleration component a_y, the velocity component V_y, and the coordinate y of the particle at the instant of 4 sec. What do you mean by principle of impulse and momentum? [8+2]

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21 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division

2073 Shrawan

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT, BAME, BIE, B. Agri. B. Arch.	Pass Marks	32
Year / Part	I / I	Time	3 hrs.

Subject: - Applied Mechanics *(CE401)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
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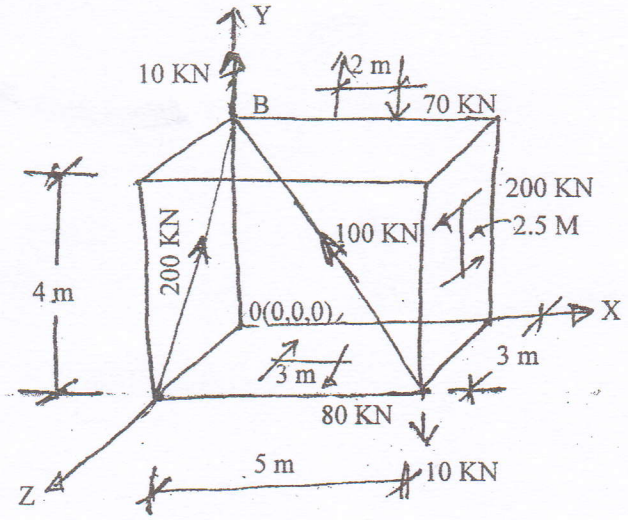
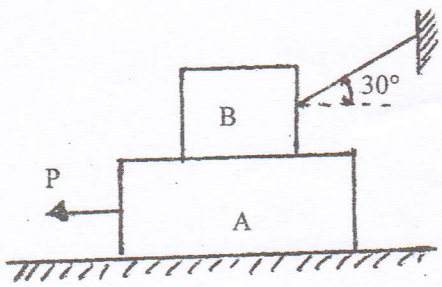
- ✓ *Assume suitable data if necessary.*

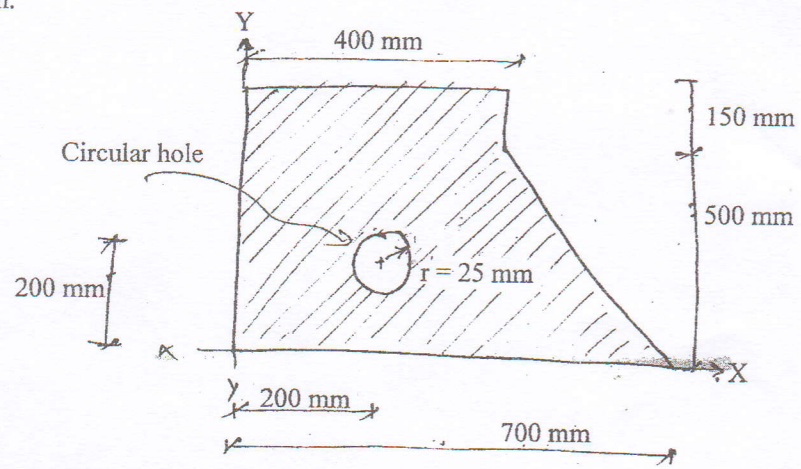
1. What do you understand by a Rigid Body? Why it is necessary to assume a body as 'perfectly rigid' for your present study? [3]
2. Write down the concept of rigid bodies and deformable bodies. What is Free Body Diagram and why it is used during analysis of structure? [8]
3. Determine the resultant force and moment of the following system about the point 'O' as shown in figure below. [10]



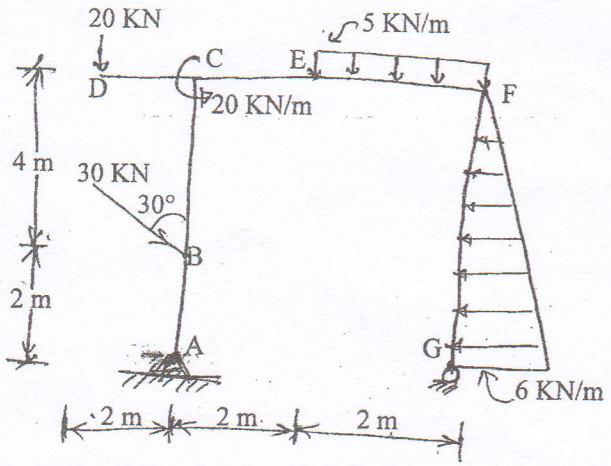
4. Two blocks A and B of 40 N and 20 N respectively are in equilibrium position as shown in figure below. Calculate the force P required to move block A. Take $\mu = 0.3$ for all surface. [5]



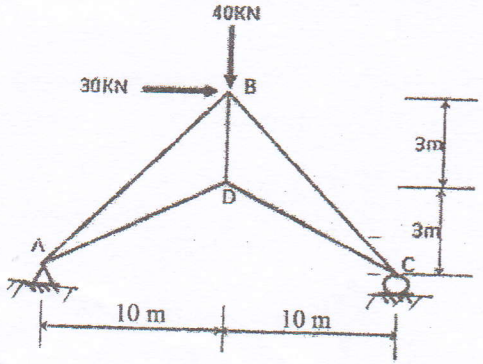
5. Calculate the moment of inertia of the composite area as shown in figure about it's centrorial axes. Define centroid, center of gravity, axis of symmetry and radius of gyration. [8+4]



6. Draw AFD, SFD and BMD for the given frame and loading. Indicate salient points, if any. [14]



7. Write down the ideal assumptions of Truss. Calculate the member forces in all members of the truss loaded as shown in figure below by using suitable method. [2+6]



8. Define the uniformly rectilinear motion and the uniformly accelerated rectilinear motion. A projectile is fired with an initial velocity of 244m/s at a target B located 610m above the gun A and at a horizontal distance of 3658m. Neglect air resistance, determine the value of the firing angle α. [2+8]
9. The motion of a 1000 gm block B in a horizontal plane is defined by radius, $r = 2(1+\cos 2\pi t)$ and $\theta = 2\pi t$ where 'r' is expressed in meters and t in seconds. Determine the radial and transverse components of the force exerted on the block B at 0.8 sec. Explain about principle of impulse and momentum. [8+2]

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21 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division

2072 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT, BAME, BIE, B. Agri. B. Arch.	Pass Marks	32
Year / Part	I / I	Time	3 hrs.

Subject: - Applied Mechanics *(CE401)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
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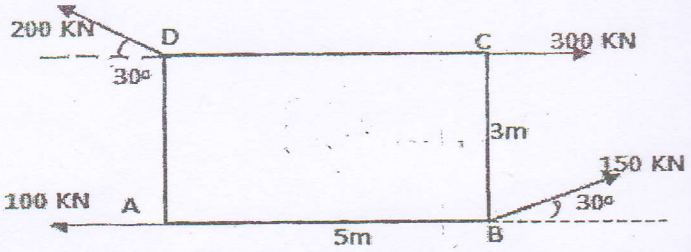
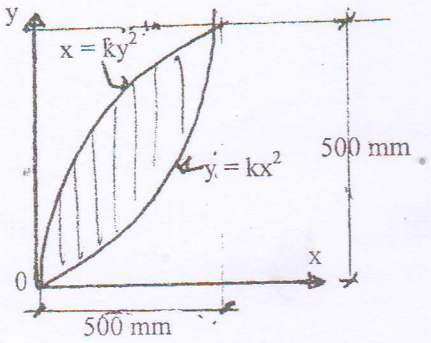
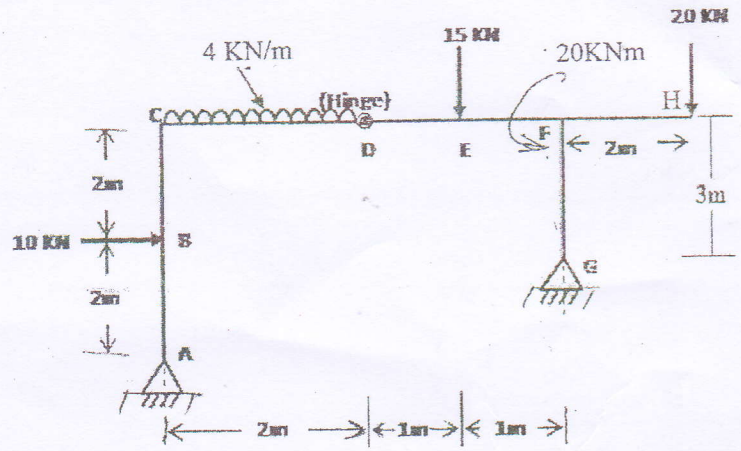
1. Describe about the fundamental principle of applied mechanics. [3]
2. Write down the steps to be considered while drawing a free body diagram. Illustrate equilibrium condition of particle and rigid body in two and three dimensional analysis. [8]
3. Find the magnitude, direction and Position of resultant force of the following system as shown in figure. [10]



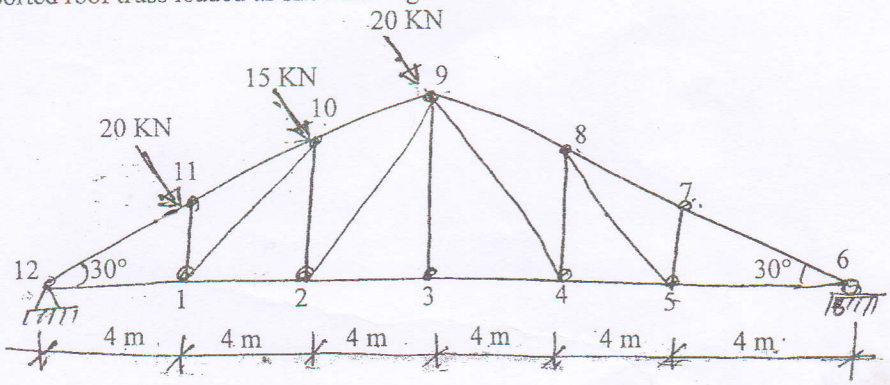
4. Describe the condition illustrating No friction, No motion, Impending motion and motion with proper sketches. How can we assure condition of sliding and over turning of a block? Explain with suitable figure. [3+2]
5. State and prove parallel axes theorem for moment of inertia. Determine centroid of the given plane in figure below. [4+8]



6. Draw the Axial Force, Shear Force and Bending Moment diagram for the given frame shown in figure below. Also show the salient features. [14]



7. Find the member force of members 1-11, 1-10, 1-2 ,2-10 and 10-11 of the simply supported roof truss loaded as shown in figure below. [8]

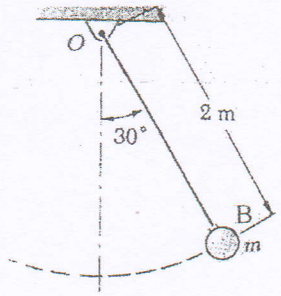


8. A ball is tossed with velocity of 10 m/s directed vertically upward from a window located 20 m above the ground. Knowing that the acceleration of the ball is constant and equal to 9.81 m/s^2 downward, determine: [8+2]

   i) The velocity 'v' and the elevation 'y' of the ball above the ground at any time 't'.
   ii) The highest elevation reached by the ball and the corresponding value of 't'.
   iii) The time when the ball will hit the ground and the corresponding velocity.

   What do you mean by dependent motion? Explain with example.

9. Define the linear momentum and angular momentum. Find the velocity and the acceleration of the bob in the given position. The bob of a 2 m pendulum describes an arc of a circle in a vertical plane, which is shown in figure below. If the tension in the cord is 2.5 times the weight of the bob for the position shown. [2+8]



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21 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2072 Kartik

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT, BIE, B. Agri., B.Arch.	Pass Marks	32
Year / Part	I / I	Time	3 hrs.

Subject: - Applied Mechanics *(CE401)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
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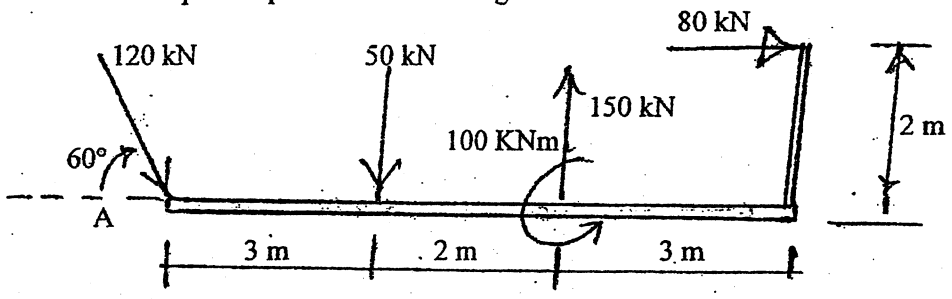
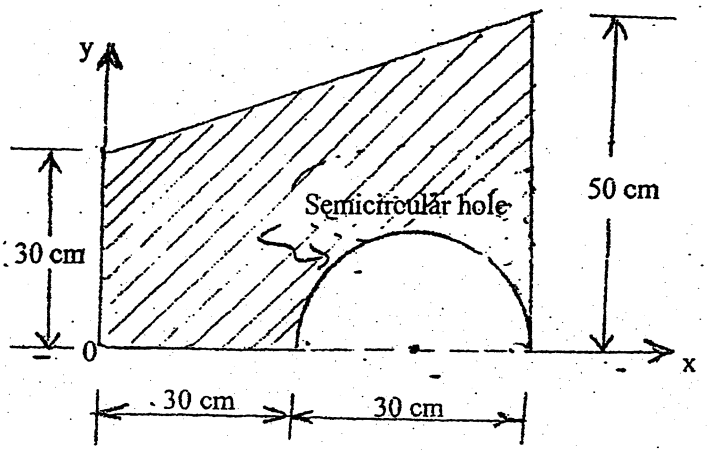
1. Explain the physical meaning of equilibrium and its application in structural engineering. [4]
2. a) Differentiate between rigid body and deformable body. Also explain the free body diagram. [2+2]
   b) Determine the magnitude, direction and position of the resultant of the system of forces with respect to point A shown in figure below. [12]

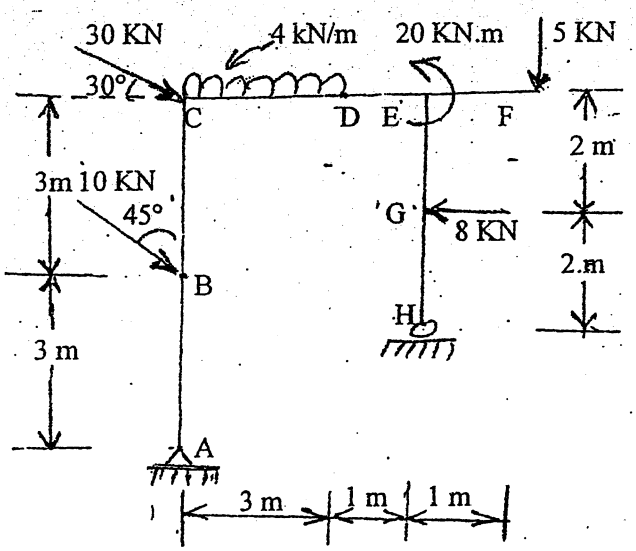


3. State and prove the parallel axis theorem for moment of inertia. Determine the moment of inertia of the given composite area as shown in figure below about it's centroidal X-X axis. [4+8]

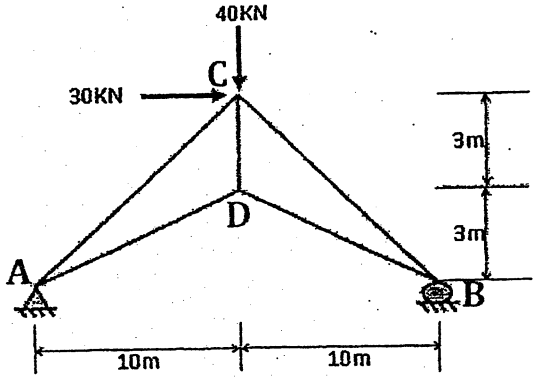


4. Define friction force and explain condition of tipping and sliding of a block. [1+3]

5. Draw AFD, SFD and BMD of the given frame loaded as shown in figure below. Indicate also the salient features if any. [14]



6. Write down the ideal assumption of truss. Calculate the force developed in all members of the truss loaded as shown in figure by using suitable methods. [2+8]



7. What do you mean by dependent motion of particles? Illustrate it with suitable example. A particle starting from origin is subjected to acceleration such that $a_x = -2m/sec^2$ and $a_y = -5\ m/sec^2$. The initial velocity is 60 m/sec directed at a slope of 30° w.r.t. horizontal. Compute the radius of curvature at the end of 3 sec. Also determine its position at the end of 3 sec. [3+7]

8. Show that, "rate of change of angular momentum about a point is equal to moment of the force about the same point." The resultant external force acting on a 5 kg particle in space is $\vec{F} = (12t\,\hat{i} - 24t^2\,\hat{j} + 40t^3\,\hat{k})$ N, where t is seconds. The particle is initially at rest at origin. Determine the x component of acceleration, velocity and position at the instant of 5 sec. [4+6]

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21 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2071 Shawan

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
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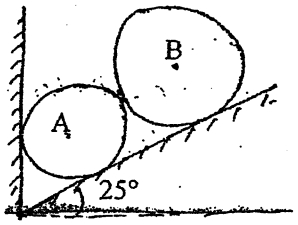
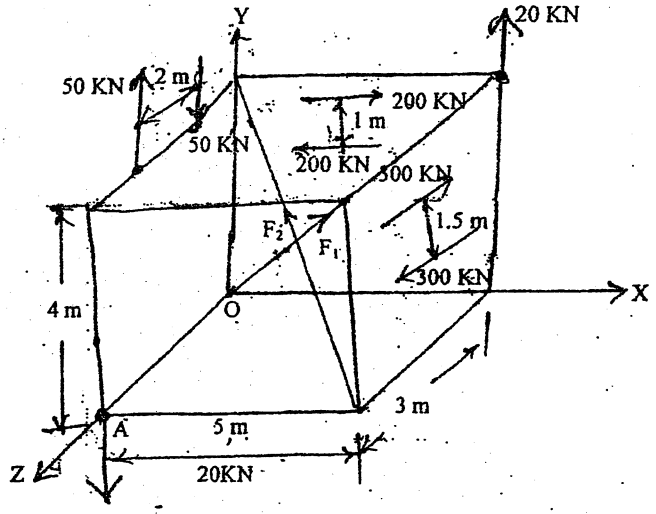
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

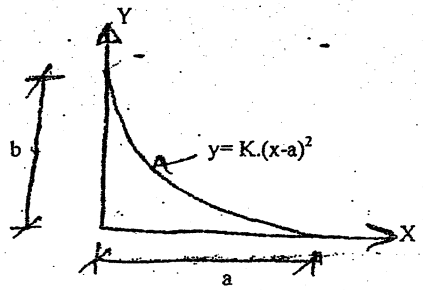
1. Why it is necessary to assume a solid body as a perfectly rigid in the Engineering study. [3]
2. What is free body diagram? The cylinder A and B rest in an inclined surface which makes an angle of 25° with horizontal as shown in figure below. Determine reaction at contact points. Take: [2+6]
   Weight of cylinder A (W_A) = 100 N
   Weight of cylinder B (W_B) = 200 N
   Diameter of cylinder A (r_A) = 60 mm
   Diameter of cylinder B (r_B) = 9



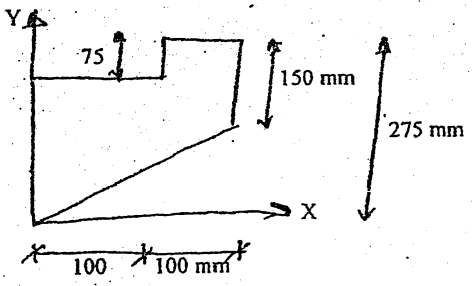
3. Find the resultant of force couple system at point 'A' as shown in figure below. Take F_1 = 100 KN, F_2 = 300 KN. Define a couple and show that couple is a free vector. [8+3]



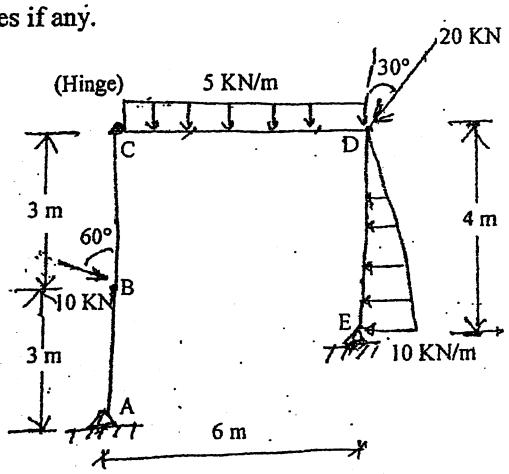
4. Determine by direct integration method, the centroid of the area shown in figure below: [5]



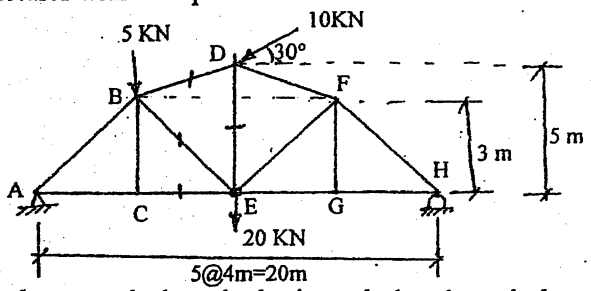
5. Calculate the moment of inertia of the composite area about Y-axis. [6]



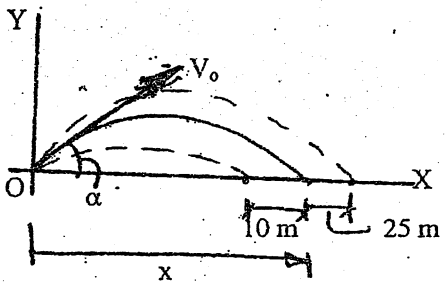
6. State laws of dry friction. How can we assume the condition of overturning and sliding of a block? Explain with suitable example. [2+3]
7. Draw axial force shear force and bending moment diagram for the given frame. Also indicate salient features if any. [14]



8. Find the member forces in CE, BE, BD and DE for the given truss. Define stability and determinacy of structures with examples. [5+3]



9. A projectile is aimed at a marked on the horizontal plan through the point of projection and falls 10 shorts when the angle of projection is 15° while overshoots the mark by 25 m when the inclination is 40°. Calculate the distance of the target and required angle of projection, if the velocity remains constant. Neglecting air resistance. Define dependent motion of particle with example. [8+2]



10. Define the dynamic equilibrium. Determine the velocity and acceleration of the particle, if it moves along a curved path defined by $r = 5\theta$ and $\theta = t^2/3$, where r is in meters and t is in seconds. Given that the instant angle is $\theta = \pi/2$. [2+8]

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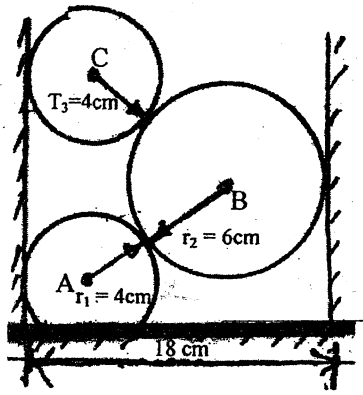
21 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2070 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT, BIE B.Agri, B.Arch	Pass Marks	32
Year / Part	I / I	Time	3 hrs.

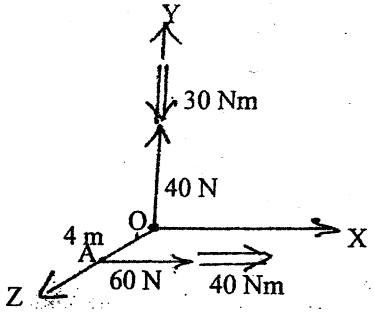
Subject: - Applied Mechanics *(CE401)*

- ✓ 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.*

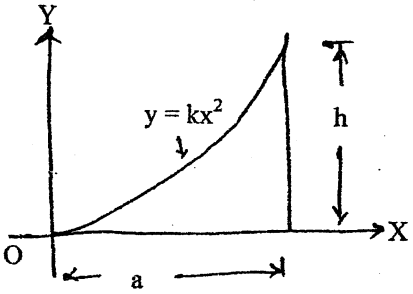
1. Describe the scope and importance of applied mechanics in engineering study. Define free body diagram with examples. [2+2]
2. Determine the reactions at the contact points, if three cylinders are piled in a rectangular ditch as shown in figure. Given that the weight of the cylinders are: $W_A = 2$ KN [8]
   $W_B = 5$ KN
   $W_C = 3$ KN



3. How can you reduce a force into a force and couple? Obtain the resultant of the two pairs of wrench shown in the figure. Indicate it's line of action. [3+8]

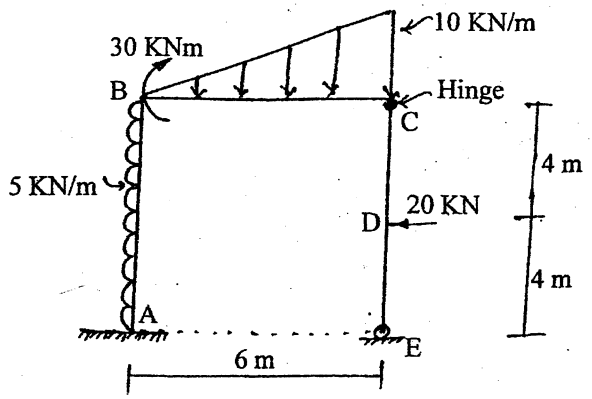


4. Determine centroid of the given plane figure. State and prove parallel axes theorem for moment of inertia. Define centroid and center of gravity. [7+3+2]

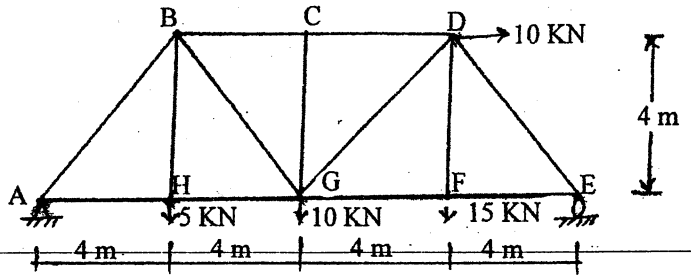


5. Define the angle of friction and also write the laws of static friction. [4]

6. Draw axial force, shear force and bending moment diagram for the loaded frame as shown in figure below. Also indicate the salient featutes if any. [13]

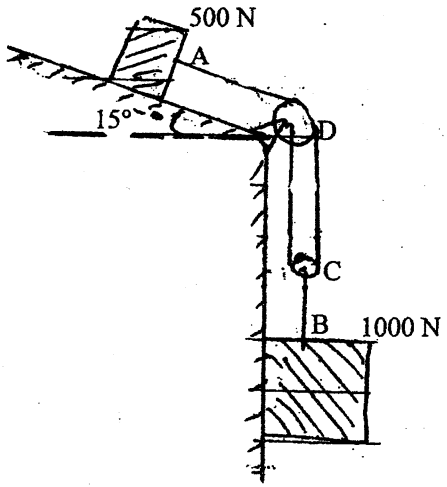


7. Determine the total degree of internal, external indeterminacy of given truss. Also determine the member forces in members BC, BG, HG and GD. [2+6]



8. The acceleration of a partial is given by a relation $a = v^3$. It is known that at time t = 0, position is -2m and velocity is 2m/sec. Find the displacement, position, velocity and acceleration at instant of ½ sec. What do you mean by projectile and obtain the equations for projectile motion. [7+3]

9. What do you mean by impulse momentum principle? Two blocks A and B having respective weights 500 N and 1000 N start form rest. The pulley is frictionless and also 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. [2+8]



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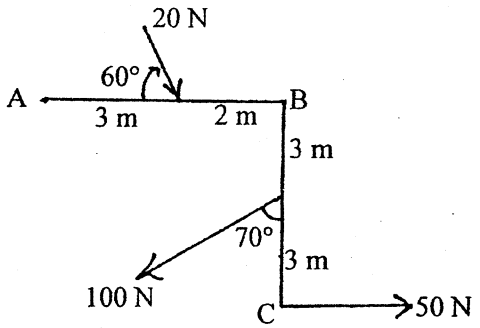
21 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2070 Ashad

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT, BIE, B.Agri, B.Arch	Pass Marks	32
Year / Part	I / I	Time	3 hrs.

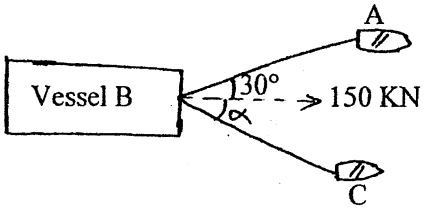
Subject: - Applied Mechanics *(CE401)*

- ✓ 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.*

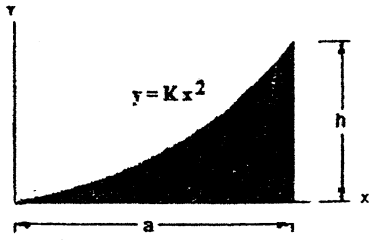
1. Describe the scope of applied mechanics in engineering. [3]
2. What is the physical meaning of equilibrium and why it is important in structure? How can we draw good Free Body Diagram? Explain with suitable examples. [4+4]
3. Determine magnitude, direction and line of action of the resultant of forces acting in the system shown in figure below. [8]



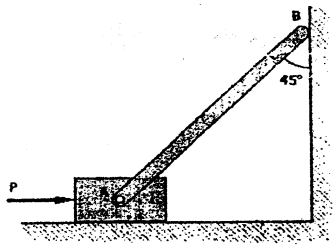
4. A commercial vessel is being pulled into larbour for unloading by two tugboats as shown in figure knowing the vessel requires 150 KN along its axis to move it steadily. Compute the tensions in rope AB and BC when $\alpha = 40°$. [4]



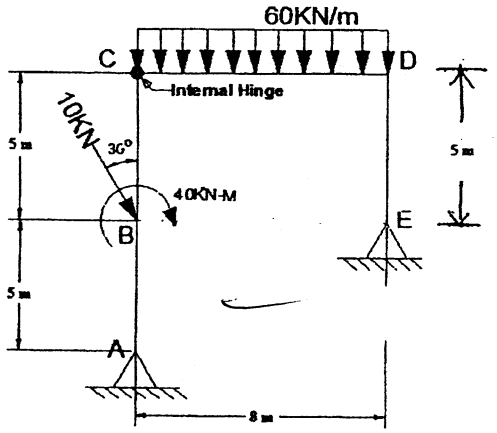
5. State and prove parallel axis theorem. Also determine the centroidal X and Y coordinate of the hatched area. [3+8]



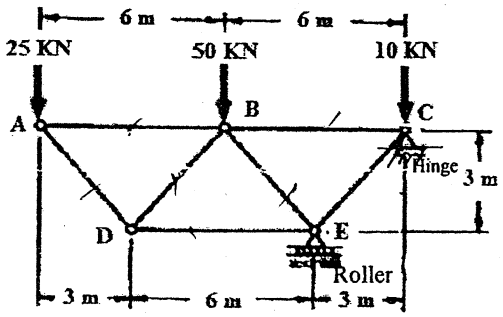
6. A uniform bar AB, weighing 424 N, is fastened by a frictionless pin to a block weighing 200 N as shown in figure. At the vertical wall, $\mu = 0.268$ while under the block, $\mu = 0.20$. Determine the force P needed to start motion to the right. [5]



7. Draw the Axial Force, Shear force and Bending Moment diagram of the given frame. Also show the salient features if any. [13]

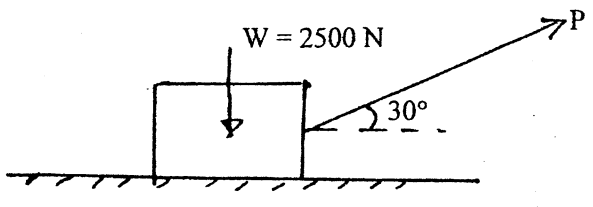


8. Determine the member forces for given truss loaded as shown in figure below. [8]



9. The motion of a vibrating particle is defined by the equations $x = 100 \sin \pi t$ and $y = 25 \cos 2\pi t$ where x and y are expressed in mm and t in sec. [10]
   a) Determine the velocity and acceleration when t = 1 sec
   b) Find the nature of path of the particle

10. Determine the magnitude of force P required to give the block an acceleration of 10 m/s^2. Coefficient of friction between the block and the floor is 0.25. [10]



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26 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2070 Chitra

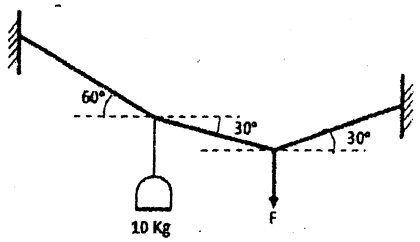
Exam.	Old Back (2065 & Earlier Batch)		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT	Pass Marks	32
Year / Part	I / I	Time	3 hrs.

Subject: - Applied Mechanics *(EG439CE)*

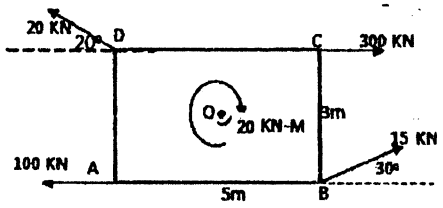
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt any **Five** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. (a.) Describe the Free Body Diagram and its importance in analysis of structure. (3)

(b.) Determine the force in each cable and the force *F* needed to hold the 10Kg lamp in the position shown in figure below. (5)

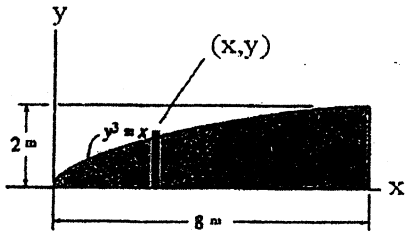


(c.) Determine the magnitude and direction of the resultant force in the given force system (8)



2. (a.) Define the Moment of Inertia, Polar Moment of Inertia and Radius of Gyration. (6)

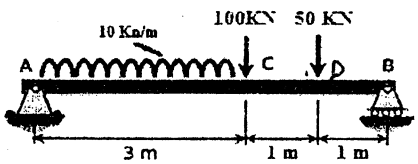
(b.) Determine the Moment of Inertia of following enclosed (hatched) area with the curves $y^3 = x$. Use suitable method. (10)



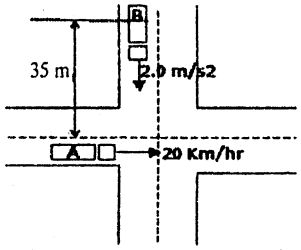
3. (a.) Define the limiting friction, coefficient of friction and angle of friction. (3)

(b.) Write down the ideal assumptions of Truss. (3)

(c.) Draw the ***Axial Force***, ***Shear Force*** and ***Bending Moment diagram*** of the given beam. Also show the salient features, if any. (10)



4. **(a.)** Auto mobile 'A' is travelling east at the constant speed of 20 Km/hr. As automobile 'A' crosses the intersection shown, automobile 'B' starts from rest 35m North of a intersection and moves south with a constant acceleration of $2m/s^2$. Determine the position, velocity, and acceleration of 'B' relative to 'A'; 10 sec after 'A' crosses the intersection. (10)



(b.) Derive the expression for the tangential and normal components of the acceleration. (6)

5. (a.) Describe the translational, rotational and general plane motion of rigid body? Illustrate with suitable examples. (8)

(b.) Describe the impulsive motion and eccentric impact for the rigid body with suitable expression. (8)

6. Write short notes on: (any four) [4×4]

a) Force analysis for rigid bodies and their equations of motion
b) Conservative and non-conservative systems
c) Projectile motion with examples and applications
d) Distribution and centre of pressures on submerged surfaces with examples
e) Determinate and indeterminate frames

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05 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2070 Chitra

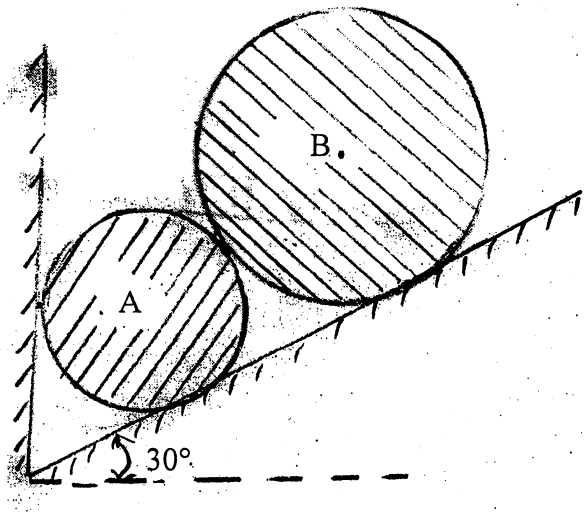
Exam.	Old Back (2065 & Earlier Batch)		
Level	BE	Full Marks	80
Programme	BCE, B.Agri.	Pass Marks	32
Year / Part	I / I	Time	3 hrs.

Subject: - Applied Mechanics I (Statics) *(EG441CE)*

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

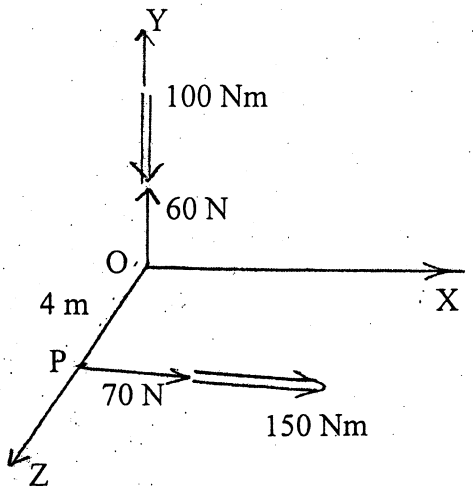
1. a) Define Free Body Diagram with examples. Why it is necessary to assume a solid body as "Perfectly Rigid" for the study of statics? Define also the equation of statics equilibrium. [2+3+3]

   b) Two smooth rollers are supported by an inclined plane and a vertical wall as shown in figure below. Find the reaction at all contact points using the following information: $W_A = 100$ N, $\Upsilon_A = 10$ cm $W_B = 140$ N, $\Upsilon_B = 14$ cm. [8]



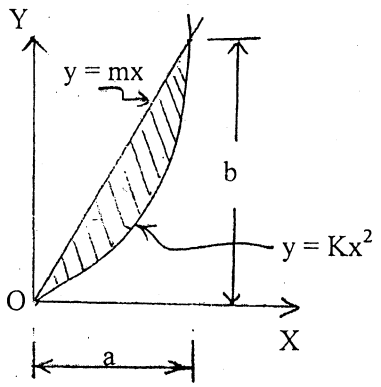
2. a) Define dot and cross product of two vectors. Define also the scalar triple product and show that "scalar triple product represents the volume of the parallelopiped." [2+4]

   b) Two wrenches are shown in figure below, determine the equivalent wrench and also indicate it's line of action. [10]



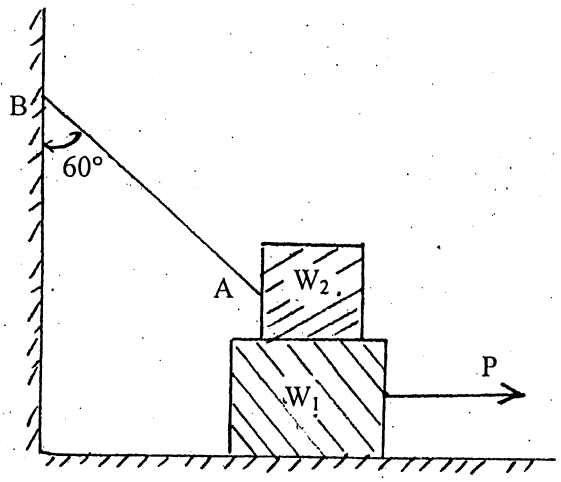
3. a) Define the terms: Centroid, Center of gravity and axis of symmetry. State and prove the parallel axis theorem for moment of inertia. [3+4]

b) Locate the centroid of the shaded area as shown in figure below by the method of integration. [9]



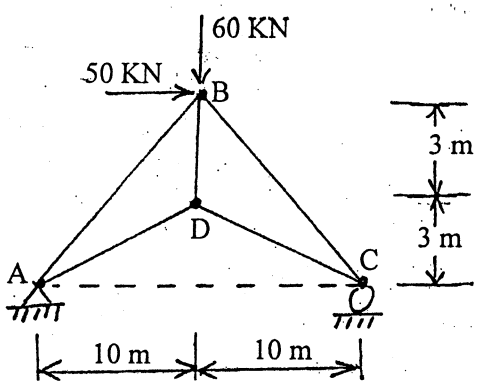
4. a) Obtain the expression for total pressure by the liquid on an inclined immersed surface. [6]

b) How can we assure the condition of sliding and overturning of a block? Explain with suitable example. A block of weight W_1 = 800 N rests on a horizontal surface and supports on top of it another block of weight W_2 = 500 N as shown in figure below. The block W_2 is attached to a vertical wall by the inclined string AB. Find the magnitude of the horizontal force P, applied to the lower block as shown, that will be necessary to cause just sliding. The coefficient of static friction for all contact surfaces is 0.4. [3+7]



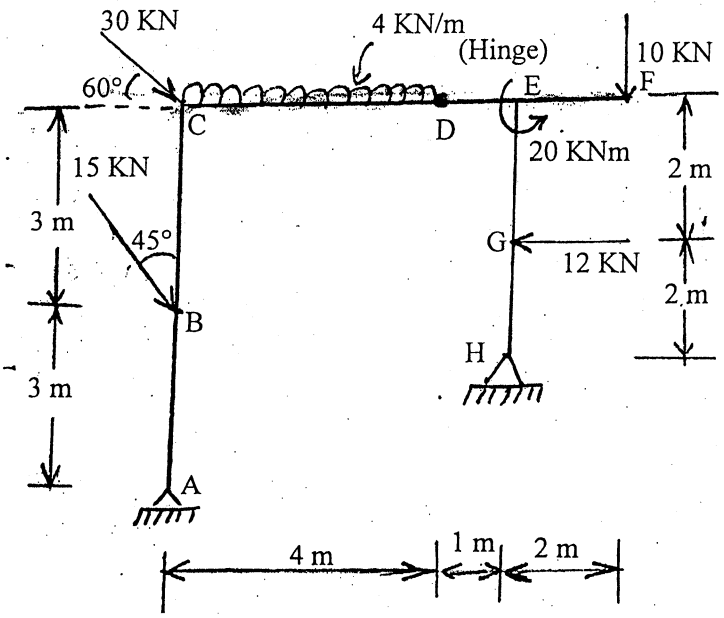
5. a) Define plane and space structures with examples. How can we check the determinacy and stability of the structures (ie beam, frame and truss)? Explain with suitable examples. [2+6]

b) Calculate the force developed in all the members of the truss loaded as shown in figure below. [8]



6. a) Obtain the relationship between load, shear force and bending moment for a beam section loaded with intensity of load w. [4]

b) Draw AFD, SFD and BMD of the given frame loaded as shown in figure below. Indicate also the salient features if any. [12]



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21 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING

Examination Control Division

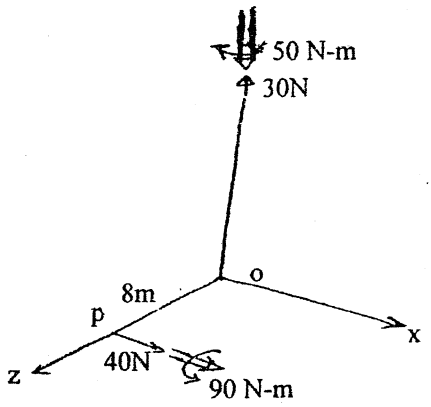
2069 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT, BIE, B.Agri. B.Arch.	Pass Marks	32
Year / Part	I / I	Time	3 hrs.

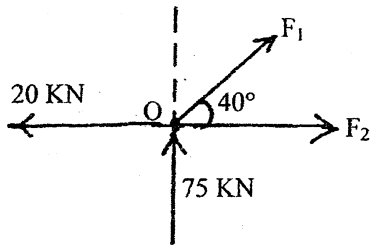
Subject: - Applied Mechanics *(CE401)*

- ✓ 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.*

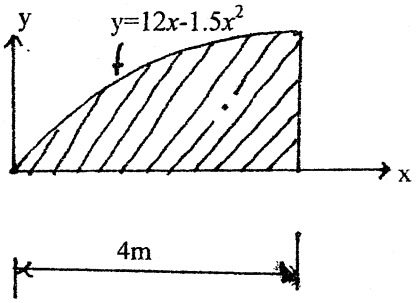
1. Describe briefly the concept of particle, rigid body and deformable body. [3]
2. Describe Free Body Diagram and physical meaning of equilibrium. Also describe the importance of Free Body Diagram and equilibrium in structural analysis. [2+2+2+2]
3. Replace the two wrenches as shown in figure by a single equivalent wrench and determine (a) the resultant force, (b) indicate it's line of action. [8]



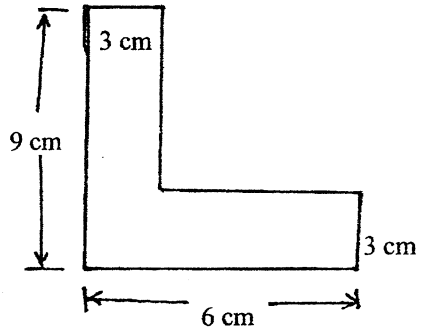
4. Determine the value of F1 and F2 if the forces shown in figure below are in equilibrium. [4]



5. Determine centroidal x coordinate of the shaded area shown in figure below. [4]

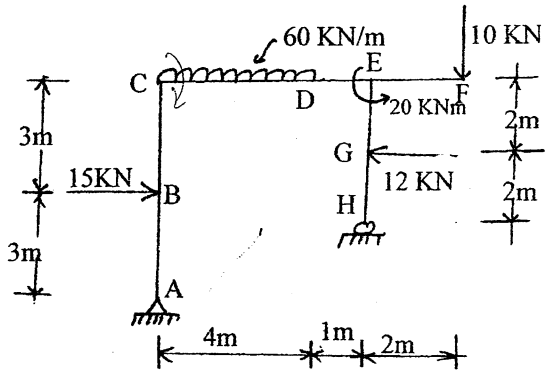


6. Determine radius of gyration (r_x) of the angle section shown in figure below about centrodal x-axis. [8]

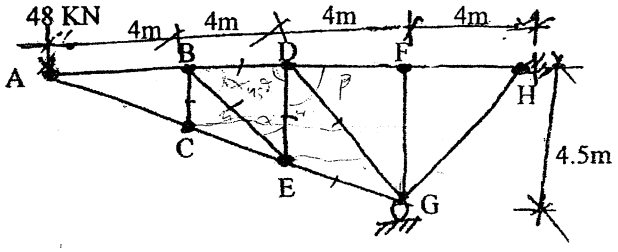


7. Illustrate impending motion state of friction and demonstrate the change in frictional force for different motion stages using relevant figure. [4]

8. Draw AFD, SFD and BMD of the given frame loaded as shown in figure below. Indicate the salient feature if any. [14]

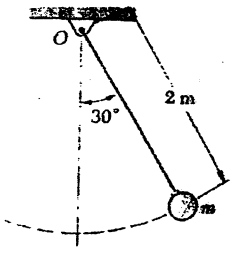


9. Compute the force developed in the member BC, BD, BE, DE, DG and EG of the given truss loaded as shown in figure. [7]



10. Define uniformly rectilinear motion and uniformly accelerated rectilinear motion. A projectile is fired with an initial velocity of 244m/s at a target B located 610m above the level of gun A and at a horizontal distance of 3658m. Neglecting air resistance, determine the value of the firing angle. [2+8]

11. Define the linear momentum and angular momentum. Find the velocity and acceleration of the bob in the given position. The bob of a 2m pendulum describes an arc of a circle in a vertical plane. Tension in the cord is 2.5 times the weight of the bob for the position shown. [2+8]



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21 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division

2068 Baishakh

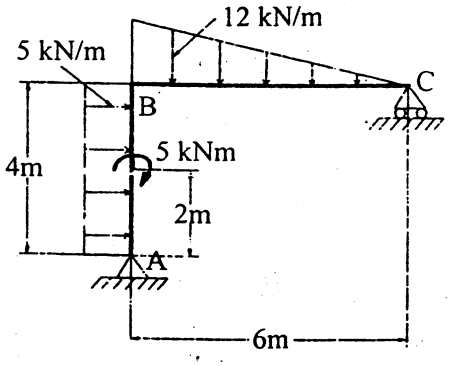
Exam.	**Regular / Back**		
Level	BE	**Full Marks**	80
Programme	BEL, BEX, BCT, BIE, B.Agri., B.Arch.	**Pass Marks**	32
Year / Part	I / I	**Time**	3 hrs.

Subject: - Applied Mechanics

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

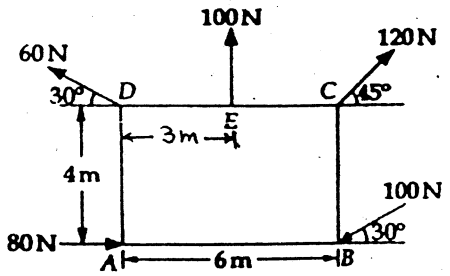
1. a) Derive the relationship between load, shear force and bending moment. [4]

   b) Draw axial force, shear force and bending moment diagram for the given loaded frame as shown in figure below. [12]



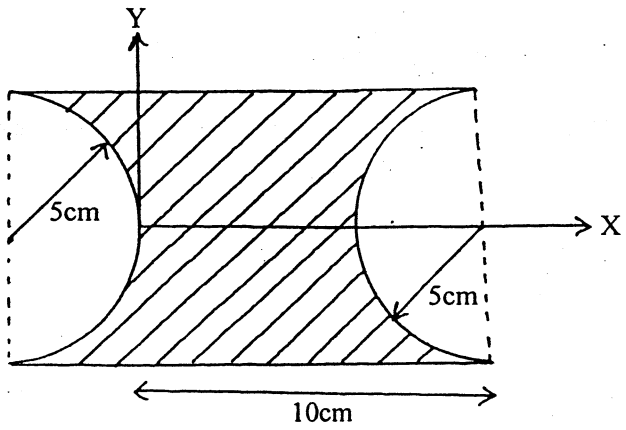
2. a) What is the equilibrium of a body? Write the conditions of equilibrium of a particle. [4]

   b) A plate of size 6m × 4m is acted upon by a set of forces in its plane as shown in figure below. Determine the magnitude, direction and position of resultant force. [12]



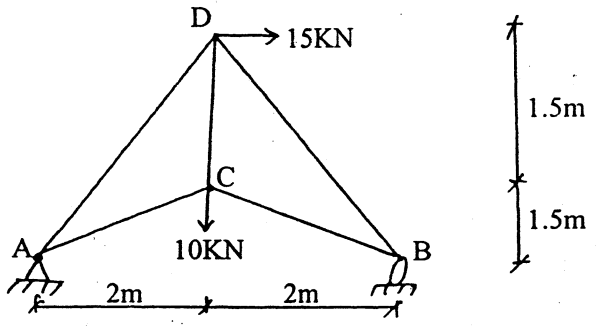
3. a) Determine the centroid of right angle triangle by method of integration. [6]

b) Find the moment of inertia and radius of gyration about X-Y axis of the figure shown below. [10]



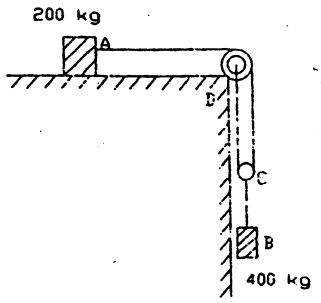
4. a) What is the angle of friction? Explain about tipping and sliding of block? [6]

b) Determine the support reactions and forces in all member in the given pin jointed truss as shown in figure below. [10]



5. a) What is the linear momentum? Explain about rate of change of it. [4]

b) Two blocks shown in figure below start from rest. The horizontal plane and the pulleys are frictionless, and the pulley is assumed to be of negligible mass. Determine the acceleration of each block and the tension in each rod. [12]



6. a) Mention the types of support on structures and support reactions with its free body diagram. [6]

b) For a particular body moving rectilinearly, $a = -10x^{-2}$, where a is the acceleration in m/sec^2 and x is in meter units. It is known that when t = 2 sec, x = 8m and v = 3m/sec. Determine its acceleration when t = 3 sec. [10]

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21 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division

2068 Shrawan

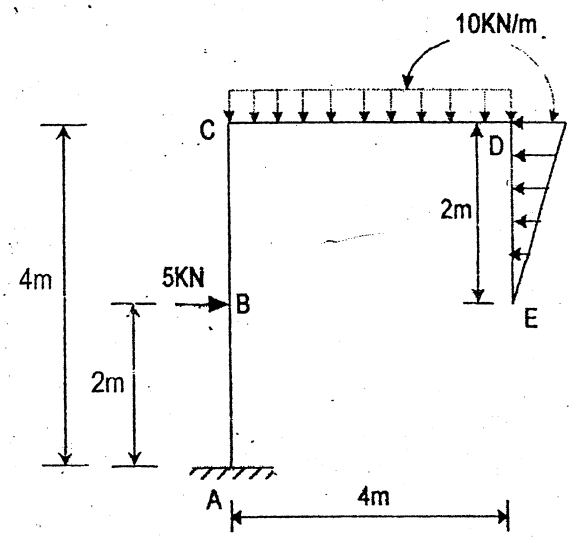
Exam.	New Back (2066 Batch & Later)		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT, BIE, B.Agri., B.Arch.	Pass Marks	32
Year / Part	I / I	Time	3 hrs.

Subject: - Applied Mechanics

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

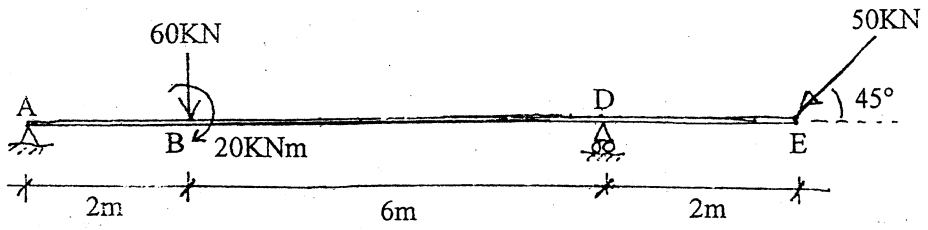
1. a) What are the fundamental concepts and principles of Newtonian mechanics? [4]

   b) Draw bending moment diagram, shear force diagram and axial force diagram for the given figure below. And also indicate the salient points if any. [12]



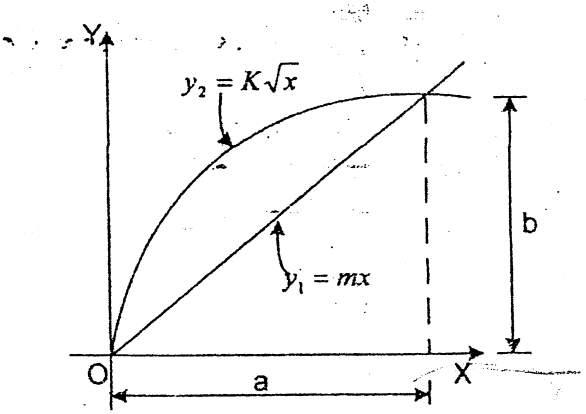
2. a) Explain principles of transmissibility and its limitations. [6]

   b) Determine force couple system about point 'A' for the given system of forces as shown in figure below. [10]

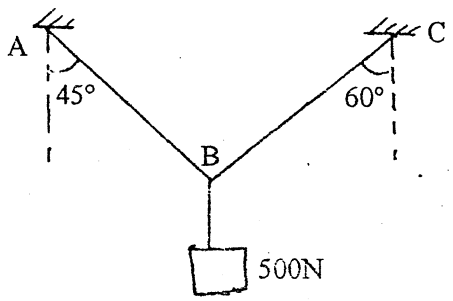


3. a) Explain the characteristics of friction with sketch. [4]

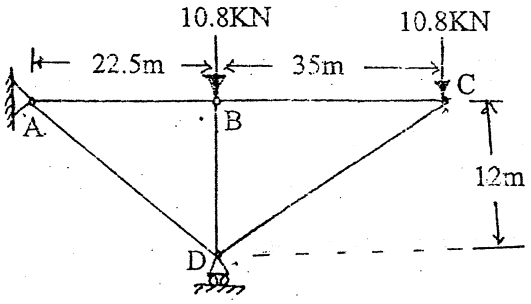
b) Determine the moment of inertia of the common area as shown in figure below about x and y axis. [12]



4. a) Determine the forces in cables AB and AC as shown in figure below. [5]



b) Determine the forces in all members of the truss shown in figure below. [11]



5. a) The position of particle which moves along a straight line is defined by the relation $x = t^3/3 - 6t^2 - 15t$. Where x is in meter and t is in seconds. Determine: [8]

i) The time at which 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

b) Define dynamic equilibrium. Also state equation of motion for rectilinear and curvilinear motion of particle. [8]

6. a) How the motion of a particle is found when the acceleration is a given function of time? [6]

b) A particle projected at an angle of θ to horizontal axis with an initial velocity of 61m/sec hits a target located at 600 meter below the horizontal axis and having the inclined slope of ¾ downward from the axis of to the target. Find the projected angle θ and the maximum height achieved by particle from the target. [10]

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21 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division

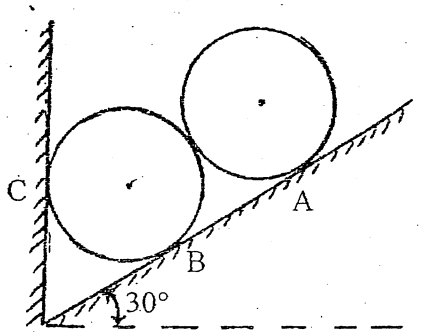
2068 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT, BIE, B.Agri, B.Arch	Pass Marks	32
Year / Part	I / I	Time	3 hrs.

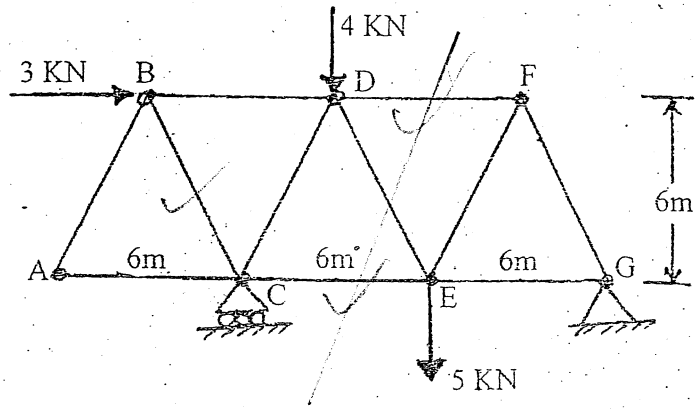
Subject: - Applied Mechanics *(CE401)*

- ✓ 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.*

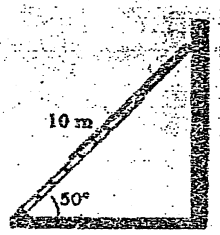
1. What are the fundamental principles of mechanics? Explain briefly. [3]
2. Two identical rollers each of weight W = 500N are supported by an inclined plane and a vertical wall as shown figure below. Draw the free body diagram of each roller separately. Assuming smooth surfaces, find the reactions induced at the points of support A, B and C. [8]



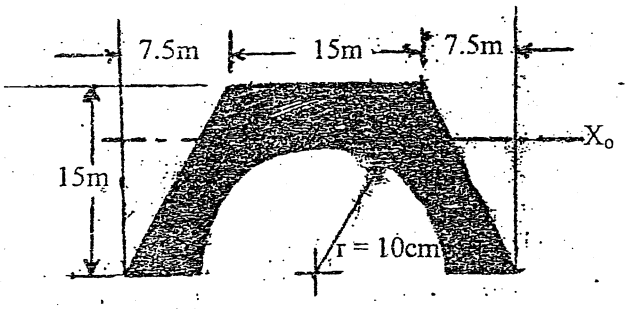
3. Use the method of sections to compute the force in bars BC, DF and CE of the Warren truss loaded as shown in figure below. [8]



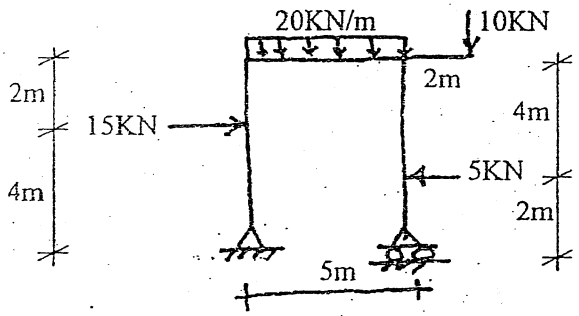
4. A 10m ladder is leaning against a smooth vertical wall and the floor with the friction coefficient 0.4. Determine the normal reactions and the friction force at the top and bottom of the ladder. [4]



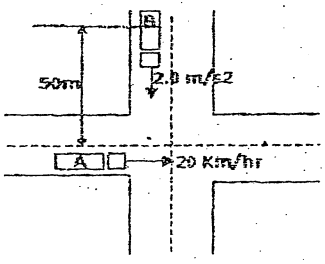
5. Determine the moment of inertia of the shaded area shown in figure below about its centroidal X_0 axis. [12]



6. What are statically determinate and indeterminate structures? Draw axial force, shear and bending moment diagrams of the frame loaded as shown in figure below. [3+10]



7. Define the uniformly rectilinear and uniformly accelerated rectilinear motion. Auto mobile 'A' is travelling east at the constant speed of 20 Km/hr. As automobile 'A' crosses the intersection shown, automobile 'B' starts rest 35m North of a intersection and moves South with a constant acceleration of $2m/s^2$. Determine the position, velocity and acceleration of 'B' relative to 'A'; 10 sec after 'A' crosses the intersection. [2+8]



8. A particle projected at an angle of 20° with the horizontal axis with an initial velocity of 50m/sec. hits the target located at 'h' meter below the horizontal axis having the inclined

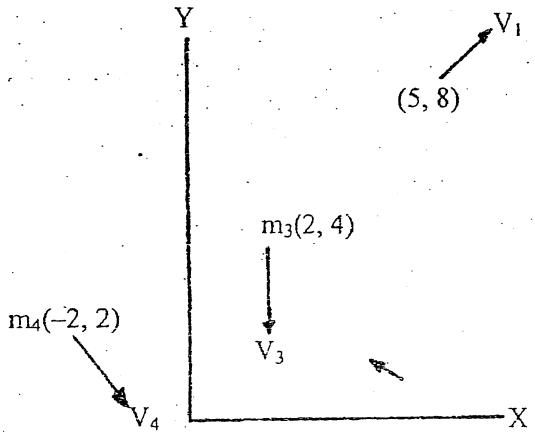
slope of ¾ download from the axis of the target. Determine the sloping distance covered by the projectile and the maximum height achieved by the projectile from the target. [12]

OR

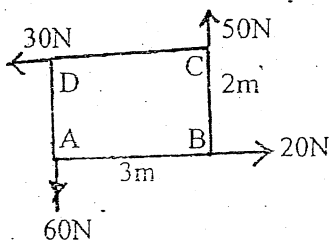
In Figure below is shown a system of particles at time t moving in the xy plane. The following data apply:

$m_1 = 0.5$ kg	$V_1 = 1.5i + 1.5j$ m/s
$m_2 = 0.35$ kg	$V_2 = -1.3i + 1j$
$m_3 = 1$ kg	$V_3 = -1.3i$
$m_4 = 0.75$ kg	$V_4 = 1i - 1.3j$

a) What is the total linear momentum of the system?
b) What is the linear momentum of the center of mass?
c) What is the total moment of momentum of the system about the origin and about point (2,6) ? [4+4+4]



9. Define moment and couple. Determine magnitude direction and position of the resultant force of the forces acting on a rectangular plate shown in figure below. [2+8]



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21 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division

2067 Ashadh

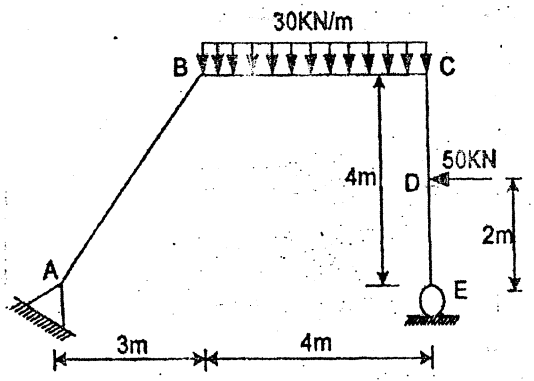
Exam.	Regular/Back		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT, BIE, B.Agri., B.Arch.	Pass Marks	32
Year / Part	I / I	Time	3 hrs.

Subject: - Applied Mechanics

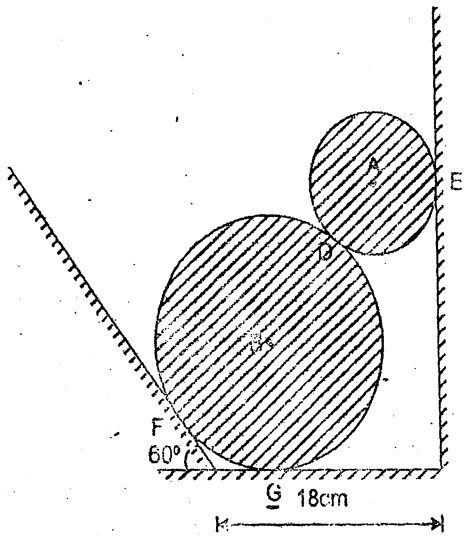
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt any **Five** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. a) Define rigid and deformable body. Explain principles of free body diagram and static equilibrium while solving problems in statics? Support your answer with examples. [4]

   b) Draw bending moment, shear force and axial force diagrams for the given figure. And also give ordinates of the salient points, if any. [12]

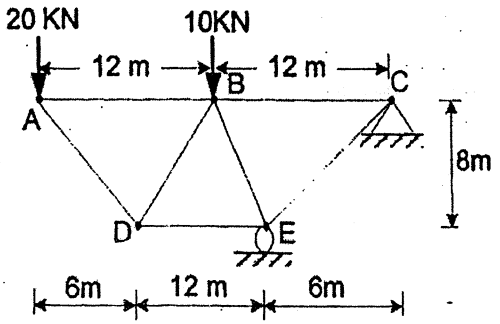


2. a) Two cylinders A and B rest in a channel as shown in figure below. 'A' has a diameter of 10cm and weight 20kg. 'B' has 18cm diameter and weight 50kg. The channel is 18cm wide at the bottom with one side vertical and other side at 120° as shown. Determine the reactions at four contact points. [11]



b) State and prove the parallel axis theorem for moment of inertia. [5]

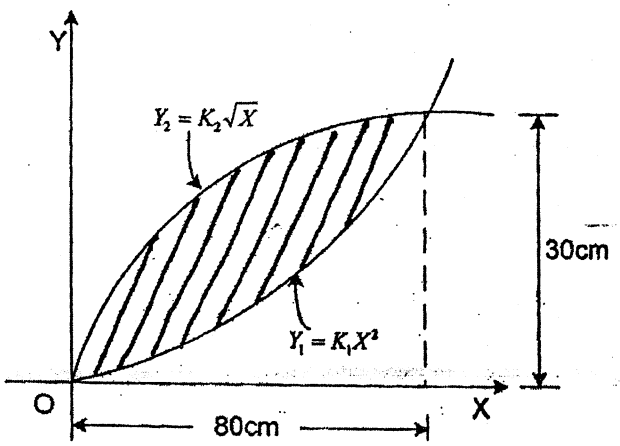
3. a) Calculate the member forces of the given truss shown in figure below. [10]



b) Define discrete and continuum structure. Also discuss about stability, indeterminacy, and determinacy of structures with suitable examples. [6]

4. a) Define limiting friction and impending motion. Justify why coefficient of static friction is greater than coefficient of kinetic friction. [5]

b) Determine the moment of inertia and radius of gyration of the common area as shown in figure below about x and y axis. [11]



5. a) The acceleration of a particle is directly proportional to the time (t). At time (t) = 0, the velocity of the particle is v = 16 m/sec. Knowing that velocity (v) = 15 m/sec position (x) = 20m and time (t) = 1 sec, determine the velocity, the position and total distance travelled when time (t) = 7 sec. [8]

b) A particle is projected at an angle of 30° to horizontal axis with an initial velocity of 61m/sec hit the target located at 'h' meter below the horizontal axis and having the inclined slope of ¾ downward from the axis of the target. Find the sloping distance covered by the projectile and the maximum height achieved by particle from the target. [8]

6. a) Define angular momentum and also prove that rate of change of angular momentum is equal to the moment of the force acting on that particle about the same point. [6]

b) The motion of a particle is defined by the position vector (r) = $3t^2i + 4t^3j + 5t^4k$ where r is in meter and t is in second. Find the normal and tangential component of acceleration and the principal radius of curvature at the instant when t = 4 secs. [10]

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26 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2066 Shrawan

Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT	Pass Marks	32
Year / Part	I / I	Time	3 hrs.

Subject: - Applied Mechanics

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

1. a) Define free body diagram with a suitable example. Also mention the points to be considered while drawing free body diagram. [4]

   b) Draw bending moment, shear force and axial force diagrams for the given Figure 1. And also indicate the salient points. [12]

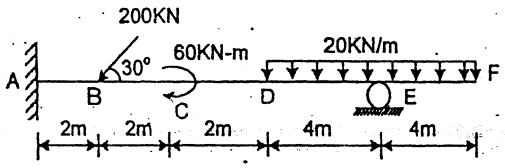

Figure 1

2. a) Two identical rollers, each of weight (W) = 100N, are supported by an inclined plane and vertical wall as shown in Figure 2. Find the reaction at the contact points. Assume all surfaces to be smooth. [8]

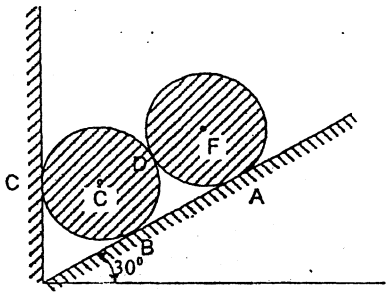

Figure 2

   b) Determine the forces in the truss shown in Figure 3 which carries a horizontal load of 50 KN.[8]

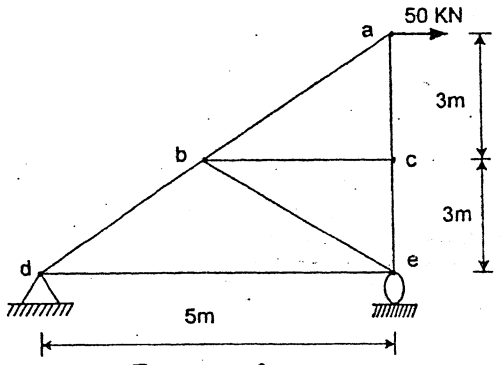

Figure 3

3. a) Prove that centre of pressure is always below the centroid of plane surface submerged in the liquid. [6]

b) Determine the moment of inertia and radius of gyration of the given area as shown in Figure 4 about centroidal axis. [10]

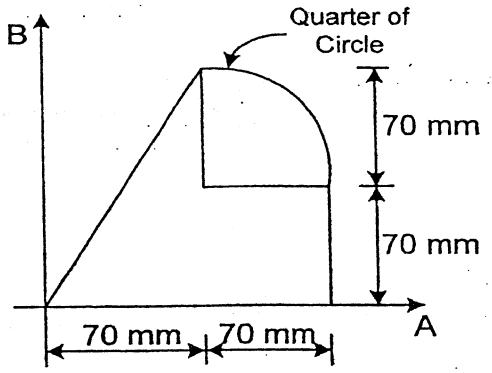

Figure 4

4. a) The acceleration of the particle is directly proportional to the time (t). At t = 0, the velocity of the particle (v) = 16m/sec. Knowing that velocity (v) = 15m/sec and that x = 20m when t = 1 sec, determine the velocity, the position and the total distance travelled when t = 7 sec. [8]

b) An aeroplane used to drop water on bushfire is flying horizontally in a straight line at 315 km/hr at an altitude of 80m. Determine the distance (d) at which the pilot should release water so that it will hit the point whereat fire starts. [8]

5. a) A 30 kg block is dropped from a height of 2m onto the 10 kg pan on the top of a spring scale. Assuming the impact to be perfectly plastic, determine the maximum deflection of the pan. The constant of spring (K) = 20 KN/m. [10]

b) What is meant by kinetic energy of a particle? Show that the kinetic energy of a particle also represents the capacity to do work. [6]

6. a) Describe general plane motion briefly with suitable figure. [4]

b) A 20 gm bullet 'B' is fired with a horizontal velocity of 450 m/sec into the side of a 10 kg square panel suspended from a hinge as 'A' as shown in Figure 5. Knowing that the panel is initially at rest, determine (i) angular velocity of the panel immediately after the bullet becomes embedded, (ii) the impulsive reaction at 'A', assuming that the bullet becomes embedded in 0.6 mins. [12]

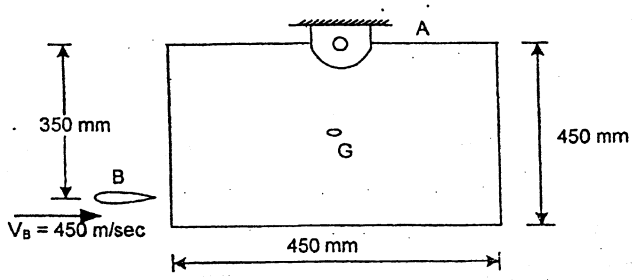

Figure 5

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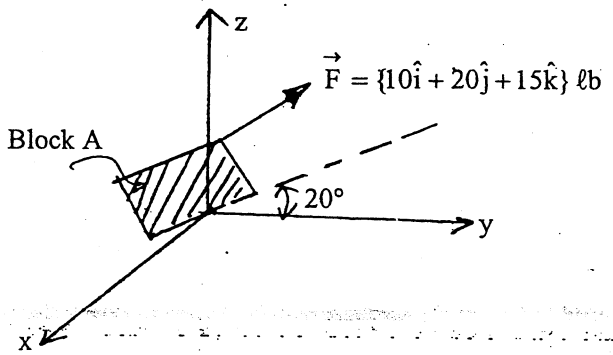
26 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2066 Jestha

Exam.		Back	
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT	Pass Marks	32
Year / Part	I / I	Time	3 hrs.

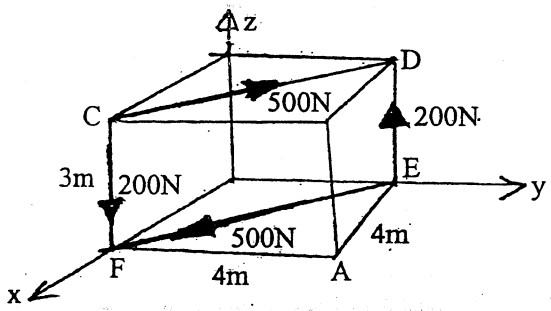
Subject: - Applied Mechanics

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

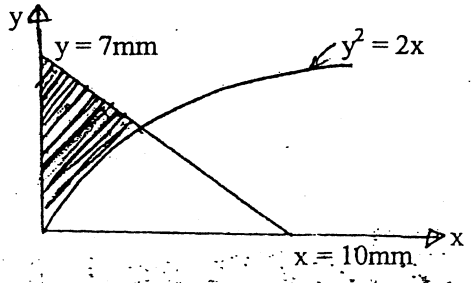
1. a) A block A is constrained to move along a 20° incline in the yz plane. How far does the block have to move if the force F is to do 10 ft-ℓb work? [6]



b) What is the moment of the forces shown about point A and about a point P having a position vector $\vec{r}_p = \{10\hat{i} + 7\hat{j} + 15\hat{k}\}$m. [10]

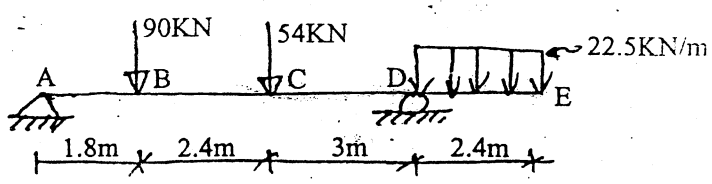


2. a) What are the co-ordinates of the centroid of the shaded area? The parabola is given as $y^2 = 2x$ with y and x in millimeters. [10]

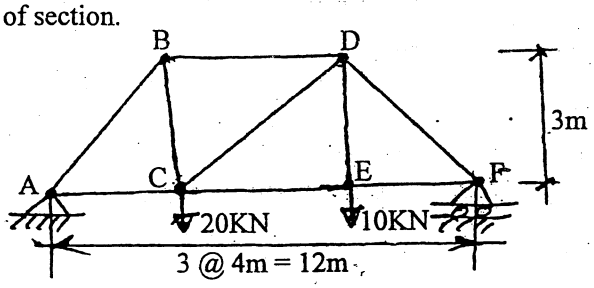


b) State and prove the parallel axis theorem. [6]

3. a) Draw the shear force and bending moment diagrams for the beam loaded as shown. Find the value of shear force where the value of bending moment is maximum sagging. [10]

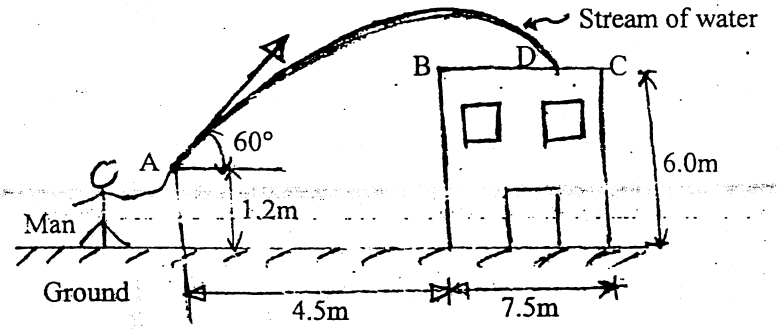


b) Determine the number forces in members BD, CD and CE for the truss as shown using method of section. [6]

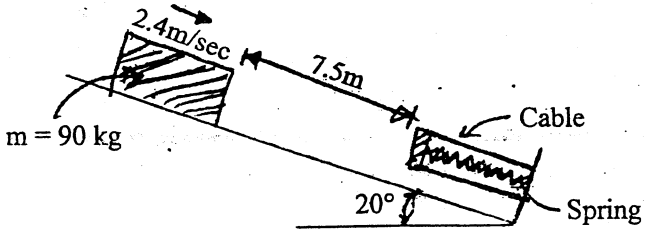


4. a) The acceleration of a particle is defined by the relation $a = -Kx^{-2}$. The particle starts with no initial velocity at x = 800mm, and it is observed that its velocity is 6 m/sec when x = 500mm. Determine (i) the value of K (ii) the velocity of the particle when x = 250mm. [8]

b) A nozzle at A discharges water with an initial velocity of 12 m/sec at an angle of 60° with the horizontal. Determine where the stream of water strikes the roof. Check that the stream will clear the edge of the roof. [8]



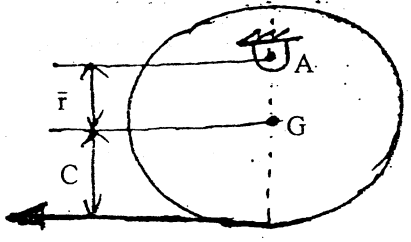
5. a) A spring is used to stop 90 kg package which is moving from a 20° incline. The spring has a constant of K = 22 KN/m and is held by cables so that it is initially compressed 150mm. Knowing that the velocity of package is 2.4 m/sec when it is 7.5m from spring and neglecting friction. Determine the maximum additional deformation of the spring in bringing the package to rest. [10]



b) State and explain the principle of conservation of energy. [6]

6. a) General plane motion of a rigid body can be considered as the sum of translational and rotational motion. Justify the expression with examples. [6]

b) A uniform disk of radius C = 160mm and mass m = 6 kg hanges freely from a pin support at A. A force P of magnitude 20N is applied as shown to the chord wrapped around the disk. Determine (i) the distance $\bar{r}$ for which the horizontal component of the reaction at A is zero, (ii) the corresponding angular acceleration of the disk. [10]



Where
C = radius of the disk

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26 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2065 Shrawan

Exam.	Regular/Back		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT	Pass Marks	32
Year / Part	I / I	Time	3 hrs.

Subject: - Applied Mechanics

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

1. a) State the Varignon's theorem and also prove that a couple is a free vector. [4]
   b) Draw bending moment diagram, shear force diagram and axial force diagram for the frame shown in Figure No. 1. [12]

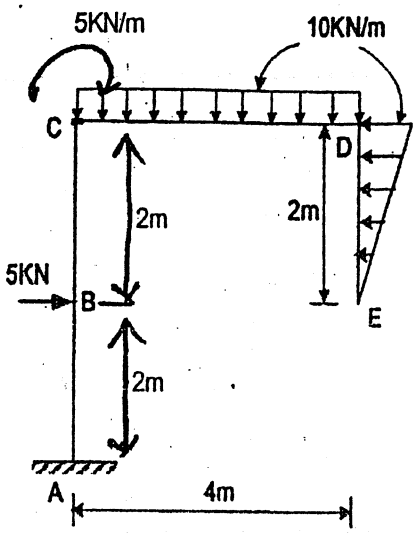

Figure no.1

2. a) Find the magnitude and direction of the resultant forces and moment of the following system about the point 'O' as shown in Figure No. 2. [8]

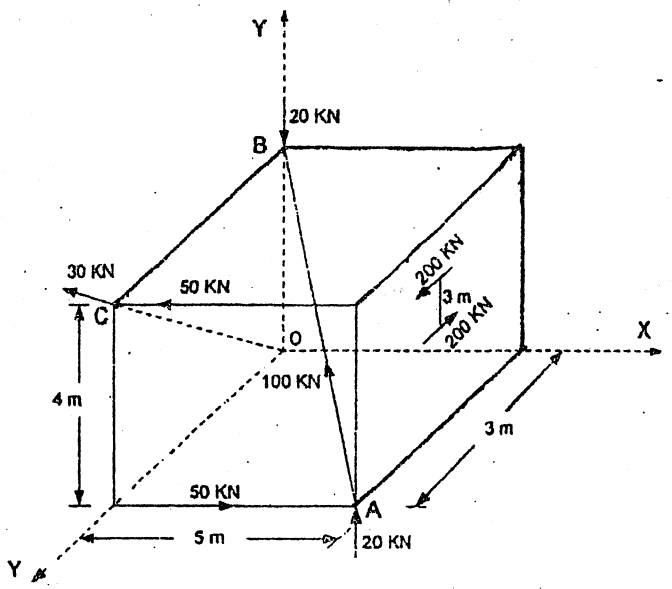

Figure no.2

b) Determine the member forces in the pin joined truss shown in Figure No. 3. [8]

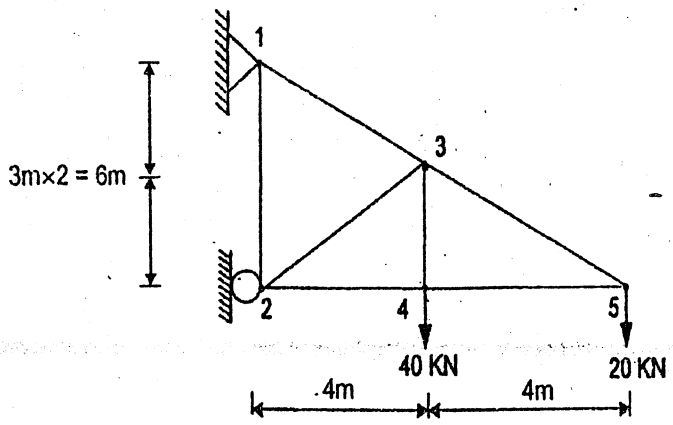

Figure no.3

3. a) Prove that centre of pressure is always below the centroid of vertical plane surface submerged in the liquid. [6]

b) Determine the moment of inertia and radius of gyration of the shaded area as shown in Figure No. 4 about X and Y axes. [10]

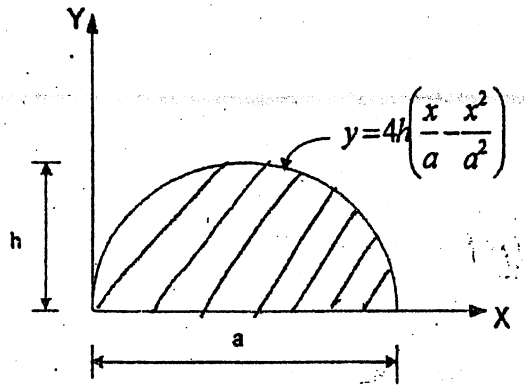

Figure no.4

4. a) A ball is thrown vertically upward from the 12-m level in as elevator shaft with an initial velocity of 18 m/sec. At the same instant an open-platform elevator passes the 5-m level, moving upward with a constant velocity of 2 m/sec. Determine (i) when and where ball will hit the elevator, (ii) the relative velocity of ball with respect to the elevator when ball hits the elevator. [8]

b) The rectangular component of acceleration for particle are $a_x = 3t$ and $a_y = 10t$, where, a is in m/sec^2. If the particle starts from rest at the origin, find the radius of curvature of the path at the instant of 2 sec. [8]

5. a) The balls 'A' and 'B' having same masses are coming from opposite direction forming an oblique central impact along horizontal plane surface (line of impact along x-axis). The velocities and direction of balls are 40 m/sec, 60° and 30 m/sec, 30° to x-axis respectively. Assuming e = 0.9, determine the magnitude and direction of the velocity of each ball after the impact. [10]

b) Show that the rate of change of angular momentum of the particle about any point is equal to the sum of the moments about the same points of the forces acting on the particle. [6]

6. a) State D'Alembert's Principle; also derive the equation of angular momentum of a rigid body in plane motion. [4]

b) A sphere of radius 'r' and mass 'm' is released with no initial velocity on the incline surface and rolls down without slipping. Determine (i) the minimum value of the coefficient of static friction compatible with the rolling motion, (ii) the velocity of the mass center of the sphere after the sphere has rolled 4m, (iii) the velocity of mass centre if the sphere were to move 4m down a frictionless 30° incline. [12]

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