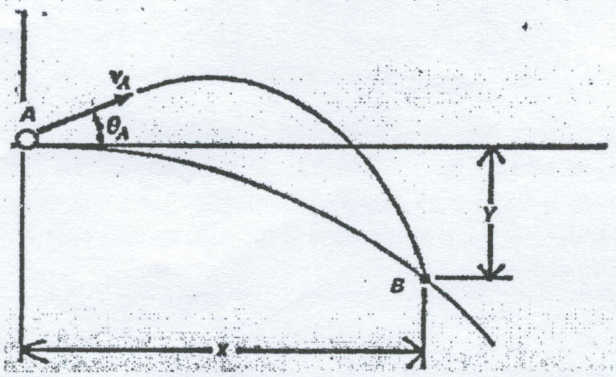
TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2076 Ashwin

Exam.	Back		
Level	BE	Full Marks	40
Programme	BCE, BGE	Pass Marks	16
Year / Part	II / I	Time	1½ hrs.

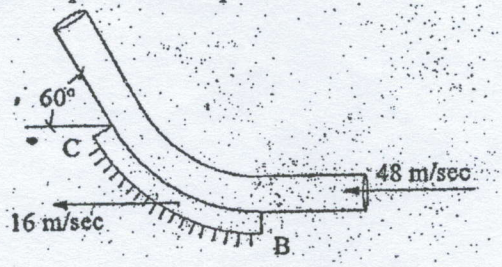
Subject: - Applied Mechanics (Dynamics) *(CE 501)*

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

1. The ball at A is kicked such that $\theta_A=30°$. If it is strikes the ground at B having co-ordinates x=15 ft and y=-9 ft, determine the speed at which it is kicked. [4]

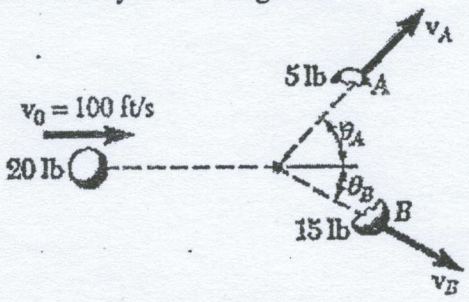


2. A nozzle discharges a stream of water of cross sectional area A = 4000 mm^2 with a speed v = 48m/sec, and the stream is deflected by a fixed vane which is moving in the same direction of water flow with constant speed of 16 m/sec as shown in figure. The mass density of water ρ=1000 kg/m^3. Determine the resultant force exerted on the stream by the fixed vane and maximum power developed. [5+3]

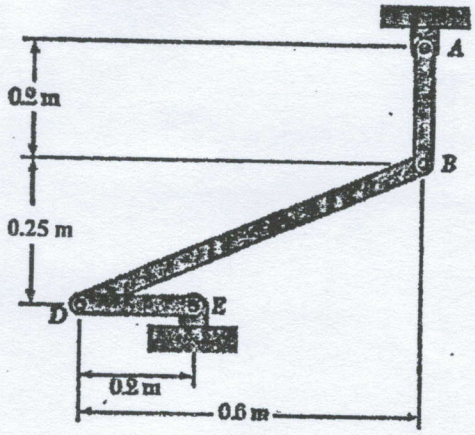


3. Define angular momentum for a rigid body in plane motion with examples. [4]

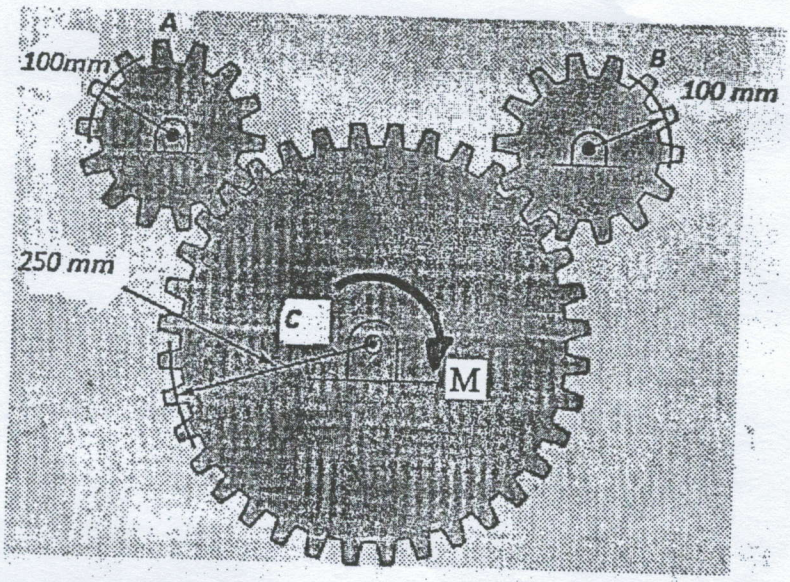
4. A 20-lb projectile is moving with a velocity of 100 ft/s when it explodes into two fragments A and B, weighing 5 lb and 15 lb, respectively. Knowing that immediately after the explosion, fragments A and B travel in directions defined respectively by $\theta_A=45°$ and $\theta_B=30°$, determine the velocity of each fragment. [6]



5. Define Coriolis acceleration of a rigid body in general plane motion. For the figure shown knowing that at the instant shown the velocity of point D is 2.4 m/s upward, determine (a) the angular velocity of rod AB, (b) the velocity of the midpoint of rod BD. [2+8]



6. Each of gear A and B has a weight of 2.5 Kg and radius of gyration of 100 mm inch while gear C has a weight of 12.5 kg and radius of gyration of 180 mm. A couple M of magnitude of 10 N-m is applied to gear C. Determine a) number of revolution of gear C required for its angular velocity to increase from 100 to 450 rpm a) the corresponding tangential force on gear A. [8]



***

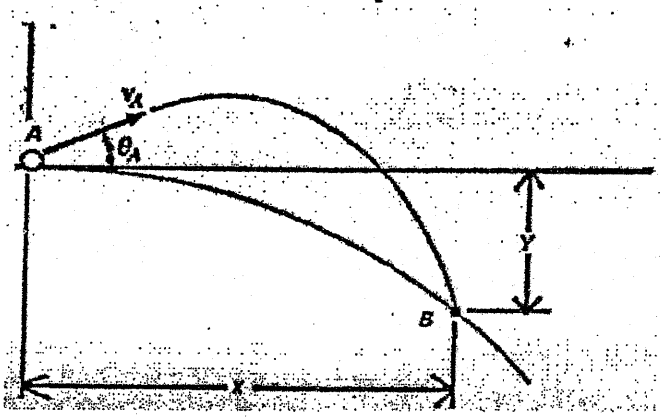
TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2076 Ashwin

Exam.	Back		
Level	BE	Full Marks	40
Programme	BCE, BGE	Pass Marks	16
Year / Part	II / I	Time	1½ hrs.

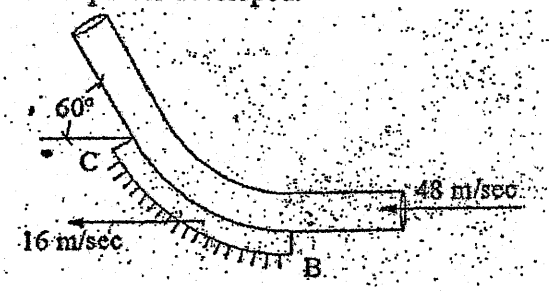
Subject: - Applied Mechanics (Dynamics) *(CE 501)*

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

1. The ball at A is kicked such that $\theta_A=30°$. If it is strikes the ground at B having co-ordinates x=15 ft and y=-9 ft, determine the speed at which it is kicked. [4]

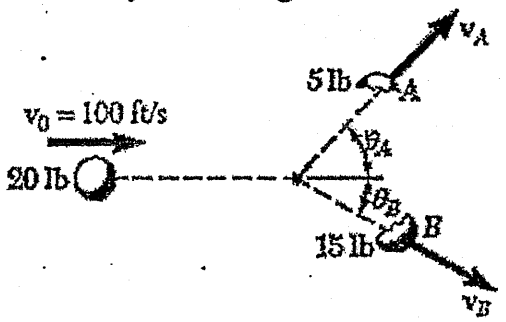


2. A nozzle discharges a stream of water of cross sectional area A = 4000 mm^2 with a speed v = 48m/sec, and the stream is deflected by a fixed vane which is moving in the same direction of water flow with constant speed of 16 m/sec as shown in figure. The mass density of water ρ=1000 kg/m^3. Determine the resultant force exerted on the stream by the fixed vane and maximum power developed. [5+3]

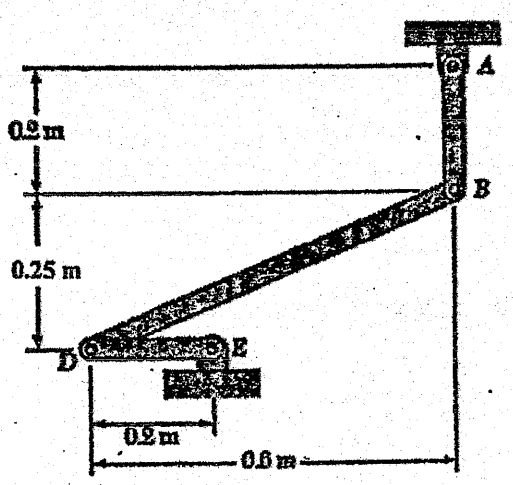


3. Define angular momentum for a rigid body in plane motion with examples. [4]

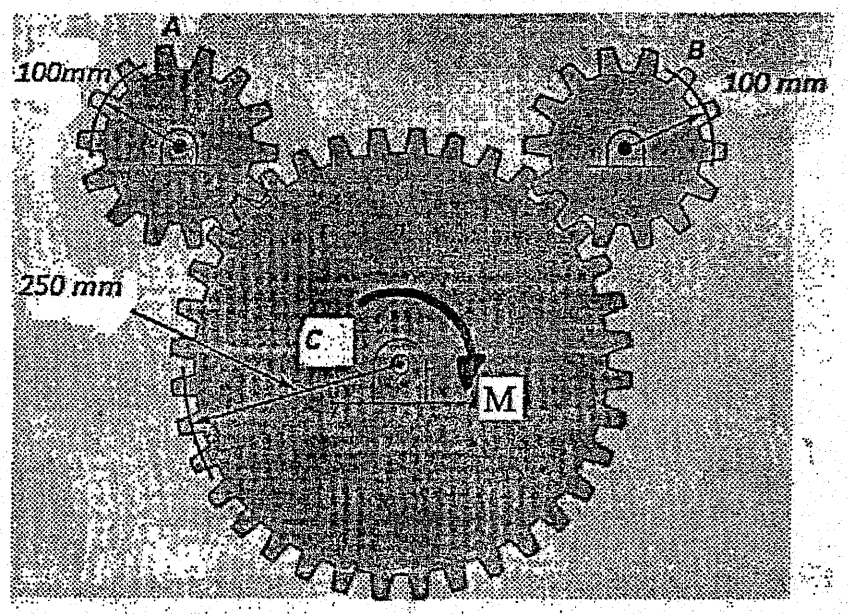
4. A 20-lb projectile is moving with a velocity of 100 ft/s when it explodes into two fragments A and B, weighing 5 lb and 15 lb, respectively. Knowing that immediately after the explosion, fragments A and B travel in directions defined respectively by $\theta_A=45°$ and $\theta_B=30°$, determine the velocity of each fragment. [6]



5. Define Coriolis acceleration of a rigid body in general plane motion. For the figure shown knowing that at the instant shown the velocity of point D is 2.4 m/s upward, determine (a) the angular velocity of rod AB, (b) the velocity of the midpoint of rod BD. [2+8]



6. Each of gear A and B has a weight of 2.5 Kg and radius of gyration of 100 mm inch while gear C has a weight of 12.5 kg and radius of gyration of 180 mm. A couple M of magnitude of 10 N-m is applied to gear C. Determine a) number of revolution of gear C required for its angular velocity to increase from 100 to 450 rpm a) the corresponding tangential force on gear A. [8]



***

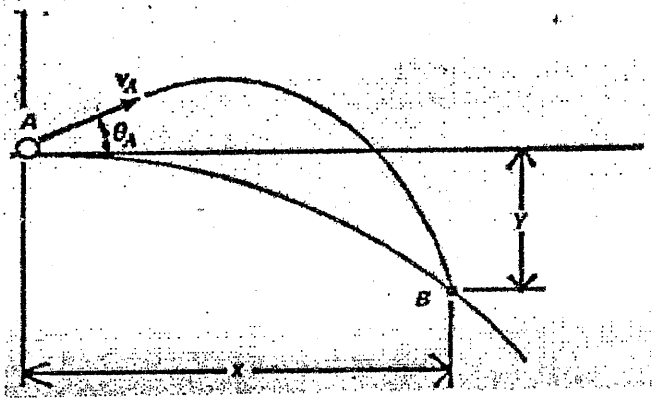
TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2076 Ashwin

Exam.	Back		
Level	BE	Full Marks	40
Programme	BCE, BGE	Pass Marks	16
Year / Part	II / I	Time	1½ hrs.

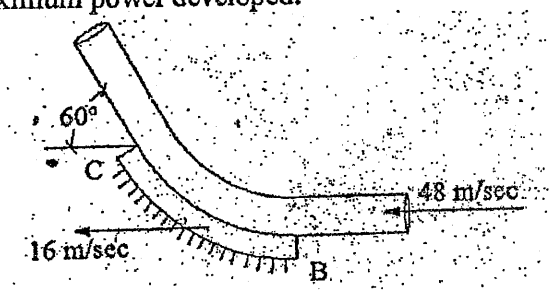
Subject: - Applied Mechanics (Dynamics) *(CE 501)*

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

1. The ball at A is kicked such that $\theta_A=30°$. If it is strikes the ground at B having co-ordinates x=15 ft and y=-9 ft, determine the speed at which it is kicked. [4]

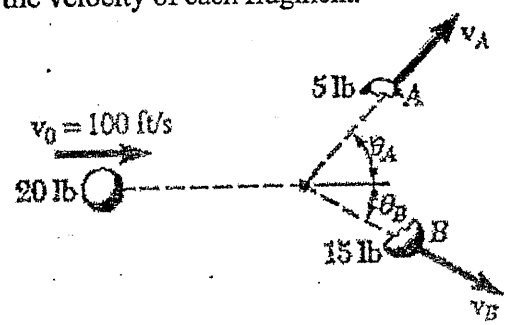


2. A nozzle discharges a stream of water of cross sectional area A = 4000 mm^2 with a speed v = 48m/sec, and the stream is deflected by a fixed vane which is moving in the same direction of water flow with constant speed of 16 m/sec as shown in figure. The mass density of water ρ=1000 kg/m^3. Determine the resultant force exerted on the stream by the fixed vane and maximum power developed. [5+3]

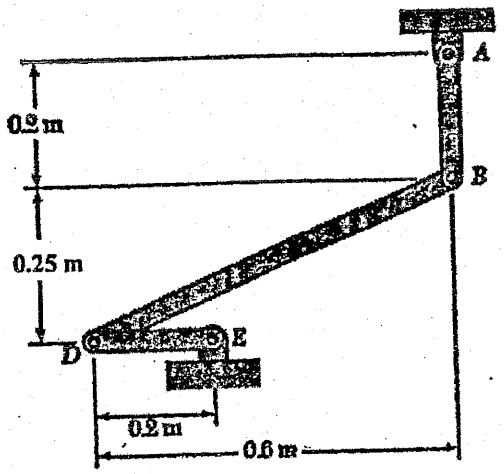


3. Define angular momentum for a rigid body in plane motion with examples. [4]

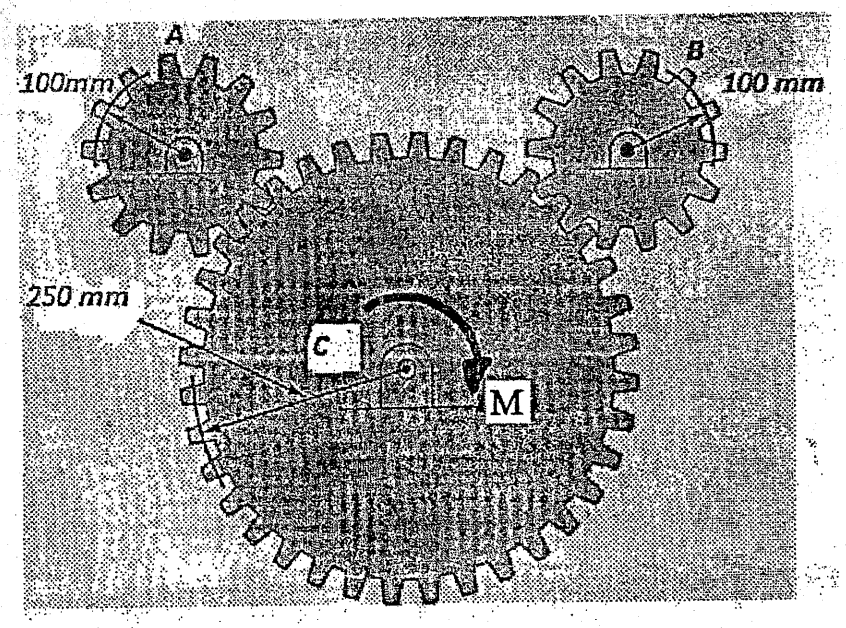
4. A 20-lb projectile is moving with a velocity of 100 ft/s when it explodes into two fragments A and B, weighing 5 lb and 15 lb, respectively. Knowing that immediately after the explosion, fragments A and B travel in directions defined respectively by $\theta_A=45°$ and $\theta_B=30°$, determine the velocity of each fragment. [6]



5. Define Coriolis acceleration of a rigid body in general plane motion. For the figure shown knowing that at the instant shown the velocity of point D is 2.4 m/s upward, determine (a) the angular velocity of rod AB, (b) the velocity of the midpoint of rod BD. [2+8]



6. Each of gear A and B has a weight of 2.5 Kg and radius of gyration of **100 mm** inch while gear C has a weight of 12.5 kg and radius of gyration of 180 mm. A couple M of magnitude of 10 N-m is applied to gear C. Determine a) number of **revolution** of gear C required for its angular velocity to increase from 100 to 450 rpm a) the corresponding tangential force on gear A. [8]



***

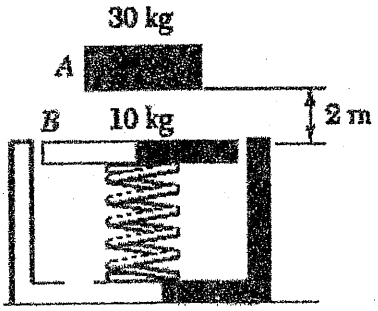
TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2075 Chaitra

Exam.	Regular / Back		
Level	BE	Full Marks	40
Programme	BCE, BGE	Pass Marks	16
Year / Part	II / I	Time	1½ hrs.

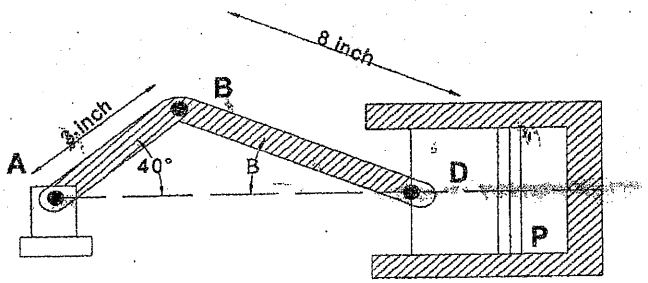
Subject: - Applied Mechanics (Dynamics) *(CE 501)*

- ✓ 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.*

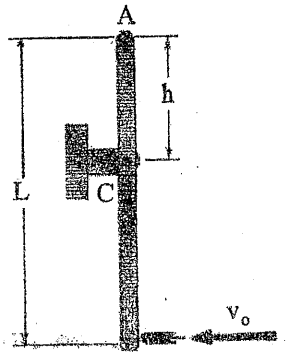
1. Define relative velocity and acceleration with suitable example. [2+2]
2. A 30-kg block is dropped from a height of 2m onto the 10-kg pan of a spring scale. Assuming the impact to be perfectly plastic, determine the maximum deflection of the pan. The constant of the spring is k=30 kN/m. [8]



3. Explain general plane motion of rigid bodies with suitable example. [4]
4. Derive an expression for the force exerted on the system due to change in mass over time. Show that the final acceleration increases when system loses mass. [6]
5. Define centre of rotation. In an engine system as shown in the figure below, crank AB has a constant clockwise angular velocity of 1800 rpm. For the crank position as shown, determine (a) the angular velocity of the connecting rod BD and (b) the velocity of the piston P. [2+8]



6. A bullet weighting 40gm is fired with a horizontal velocity of 600m/s into the lower end of a slender 7 kg bar of length L=600mm. Knowing that h=240mm and that the bar is initially at rest, determine [8]
   a) the angular velocity of the bar immediately after the bullet becomes embedded.
   b) The impulsive reaction at C, assuming that the bullet becomes embedded in 0.001s.



***

160

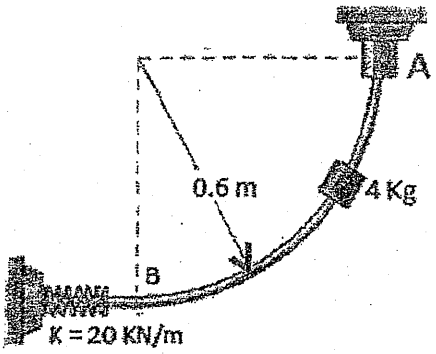
06 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2074 Chaitra

Exam.	Regular		
Level	BE	Full Marks	40
Programme	BCE, BGE	Pass Marks	16
Year / Part	II / I	Time	1 ½ hrs.

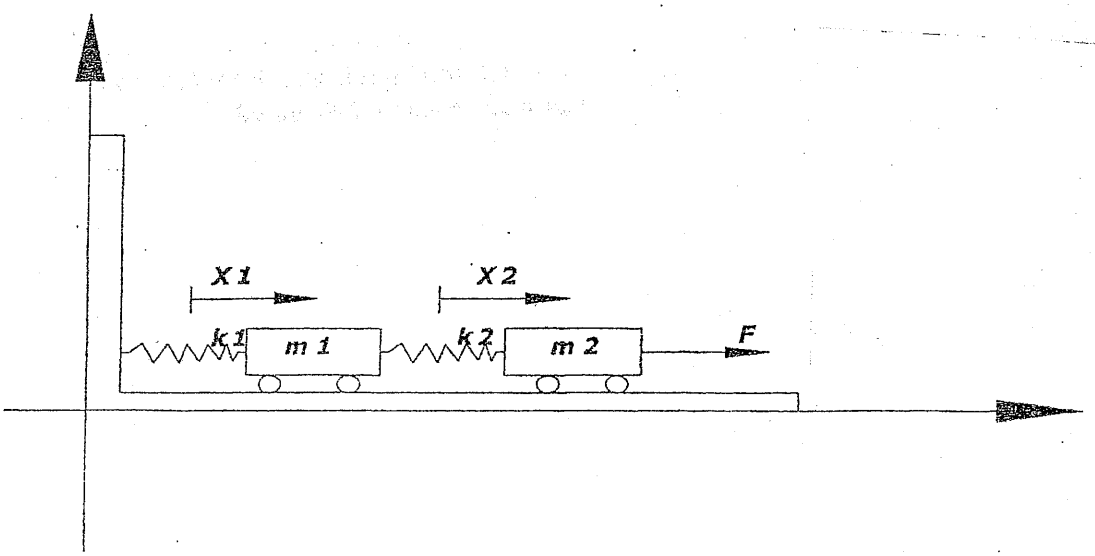
Subject: - Applied Mechanics (Dynamics) *(CE501)*

- ✓ 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.*

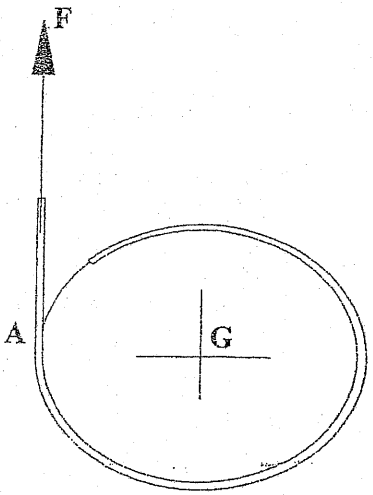
1. Derive relations for the radial and transverse components of the acceleration when a particle is moving curvilinearly. [4]
2. The 4 kg slider is released from rest from position A and slides down the frictionless rod in vertical plane. Determine a) the velocity 'v' of the slider as it strikes the spring b) maximum deflection of spring. [8]



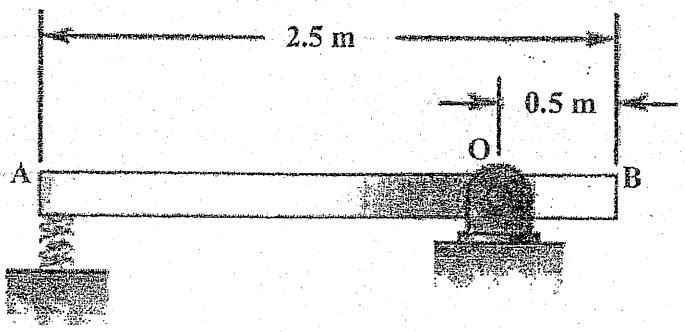
3. Two masses shown in figure oscillate on the smooth plane in the x-direction.
   a) Write the differential equation of motion for each mass
   b) Find the equation of motion for the center of the mass.
   c) Write the expression for kinetic and potential energy of the system of particles. [6]



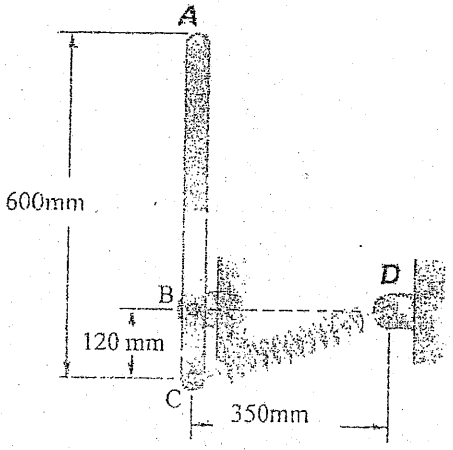
4. A cord is wrapped around a homogenous disk of radius r = 0.5 m and mass 20kg. If the cord is pulled upward with a force of magnitude F = 250N, determine (a) the angular acceleration of the disk, (b) the acceleration of the disk and (c) the acceleration of the cord. [6]



5. A 15 kg slender rod pivots about the point O. The other end is pressed against a spring (k = 300 kN/m) until the spring is compressed one inch and the rod is in a horizontal position. If the rod is released from this position, determine its angular velocity and the reaction at the pivot as the rod passes through a vertical position. [8]



6. Define impulsive motion and eccentric impact. A slender 4 kg rod can rotate in a vertical plane about a pivot at B. A spring of constant k = 400 N/m and of unstretched length 150 mm is attached to the rod as shown. Knowing that the rod is released from rest in the position shown, determine its angular velocity after it has rotated through 90°. [2+6]



***

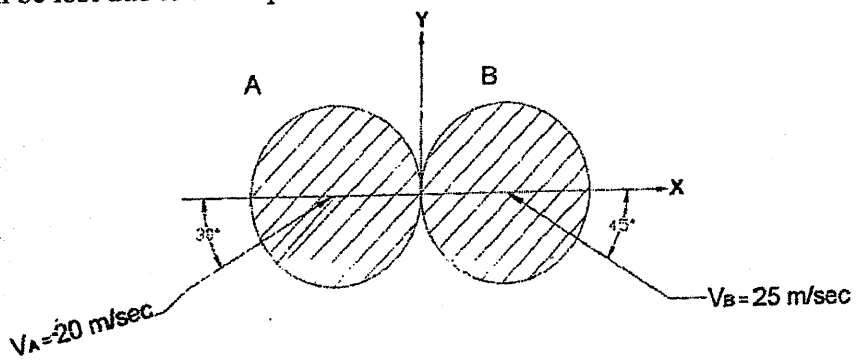
06 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2075 Ashwin

Exam.	Back		
Level	BE	Full Marks	40
Programme	BCE, BGE	Pass Marks	16
Year / Part	II / I	Time	1 ½ hrs.

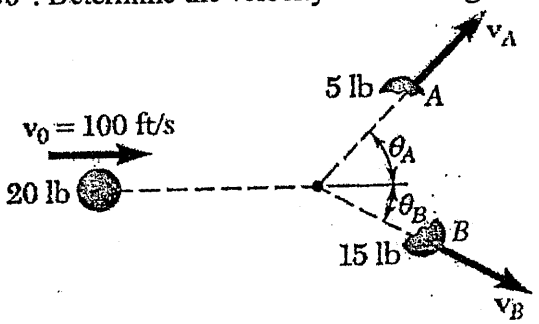
Subject: - Applied Mechanics (Dynamics) *(CE501)*

- ✓ 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.*

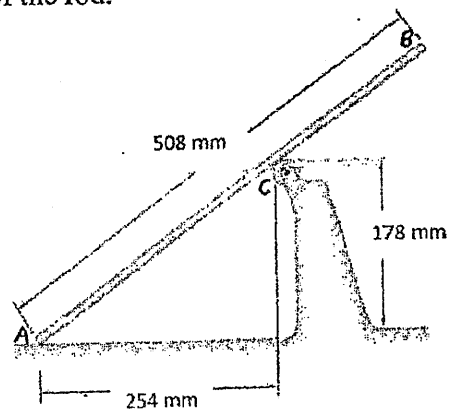
1. The magnitude and direction of the velocities of two balls A and B having masses 1.2kg and 1.8kg respectively before they strike each other are shown as in figure below. Assuming e = 0.84, determine the velocity of each ball after the impact. How much K.E. will be lost due to the impact? [8]



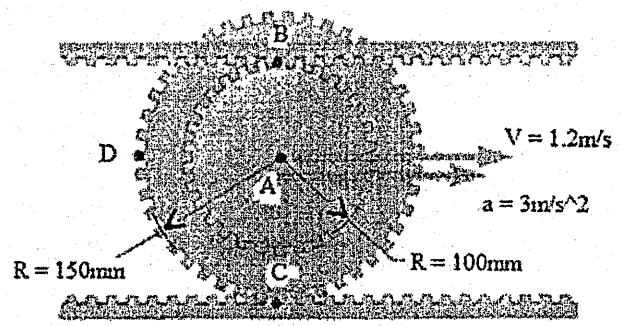
2. A 20-lb projectile is moving with a velocity of 100 ft/s when it explodes into 5 and 15-lb fragments. Immediately after the explosion, the fragments travel in the directions $\theta_A = 45°$ and $\theta_B = 30°$. Determine the velocity of each fragment. [8]



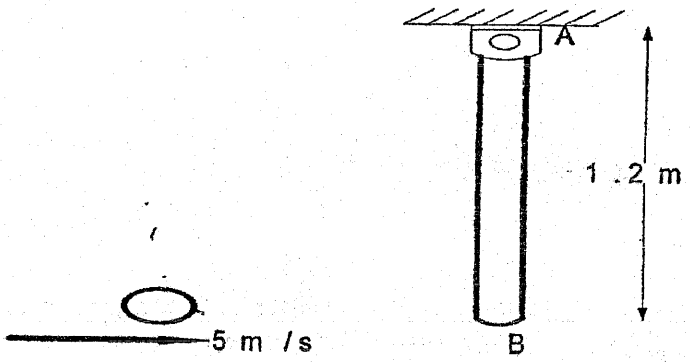
3. Rod AB moves over a small wheel at C while end A moves to the right with a constant velocity of 635 mm/s. At the instant shown, determine (a) the angular velocity of the rod, (b) the velocity of end B of the rod. [8]



4. The center of the double gear has a velocity and acceleration to the right of 1.2m/s and 3m/s2, respectively. The lower rack is stationary. Determine (a) the angular acceleration of the gear, and (b) the acceleration of points B, C and D. [8]



5. A 2.5-kg sphere moving horizontally to the right with an initial velocity of 7m/s strikes the lower end an 10-kg rod AB. The rod is suspended from a hinge at A and is initially at rest. Knowing that the co-efficient of restitution between the rod and the sphere is 0.890, determine the angular velocity of the rod and the velocity of the sphere immediately after the impact. [8]



***

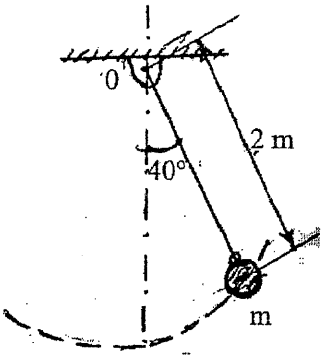
06 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2074 Ashwin

Exam.			
Level	BE	Full Marks	40
Programme	BCE, BGE	Pass Marks	16
Year / Part	II / I	Time	1 ½ hrs.

Subject: - Applied Mechanics (Dynamics) *(CE501)*

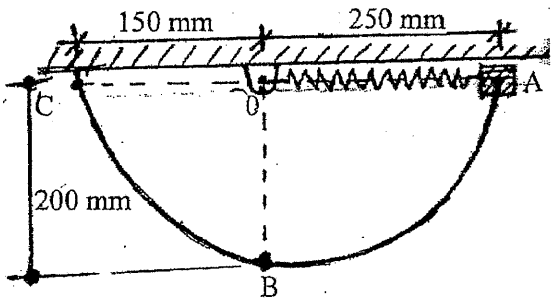
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. The bob of a 2 m pendulum describes an arc of circle in a vertical plane. If the tension in the cord is 2.5 times the weight of the bob for the position shown. Find the velocity and acceleration of the bob in the given position. [4]

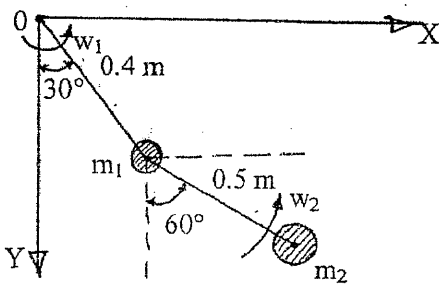


2. a) What is the principle of conservation of energy of a system? Illustrate it with suitable example. [3]

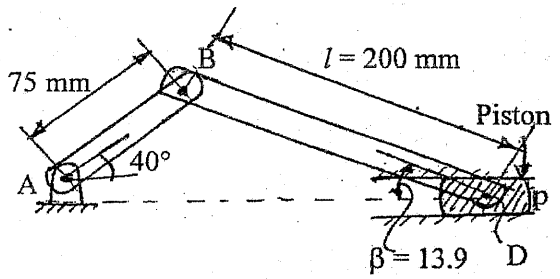
   b) 2 kg collar is attached to a spring and slides without friction in a vertical plane along the curved rod ABC. The spring is undeformed when its length is 100 mm and its constant is 800 N/m. If the collar is released at 'A' with no initial velocity, determine its velocity (a) as it passes through 'B' (b) as it reaches at 'C' [5]



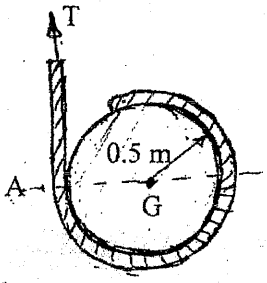
3. Derive the expression for resultant force for the system of variable mass. A double pendulum as shown in figure below oscillates in X-Y plane. At the instant shown, $w_1 = 4$ rad/sec CCW and $w_2 = 5$ rad/sec CCW. What will be the angular momentum about 'O' at this instant, if $m_1 = 3$ kg and $m_2 = 4$ kg? Note that the lower pendulum is connected to mass 'm_1' by a pin joint and is free to rotate about this point. [4+4]



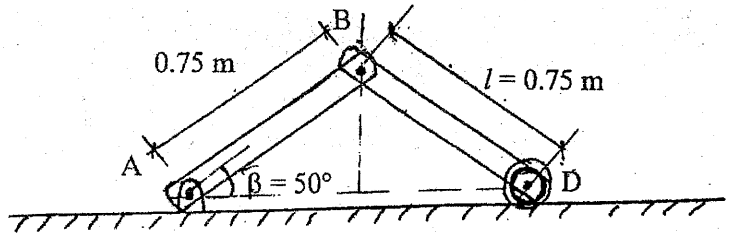
4. What is the meaning of corioli's acceleration in plane motion of Rigid body? Crank AB of the engine system shown in figure below, has a constant clockwise angular velocity of 2000 rev/min. For the crank position as shown in figure below, determine the angular acceleration the connecting rod 'BD' and the acceleration of point 'D'. Given that the value of w_{BD} = 61.9 rad/sec and the angle made by rod BD with horizontal β = 13.9. [8]



5. A cord is wrapped around a homogeneous disk of radius r = 0.5 m and mass m = 15 kg. If the cord is pulled upward with force $\vec{T}$ of magnitude 180 N, determine (a) the acceleration of the center of the disk (b) the angular acceleration of the disk (c) the acceleration of the cord. [4]



6. Differentiate the central and Eccentric impact of the body. Each of the two slender rods as shown in figure below is 0.75 m long and has a mass of 6 kg. If the system is released from rest when β = 50°, determine (a) the angular velocity of rod "AB" when 'β' = 20° (b) the velocity of point 'D' at the same instant. [2+6]



***

06 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2073 Chaitra

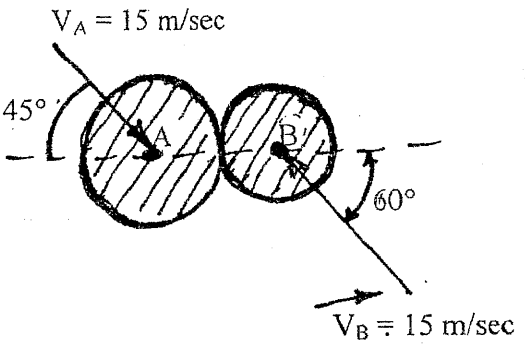
Exam.	Regular		
Level	BE	Full Marks	40
Programme	BCE, BGE	Pass Marks	16
Year / Part	II / I	Time	1 ½ hrs.

Subject: - Applied Mechanics (Dynamics) *(CE501)*

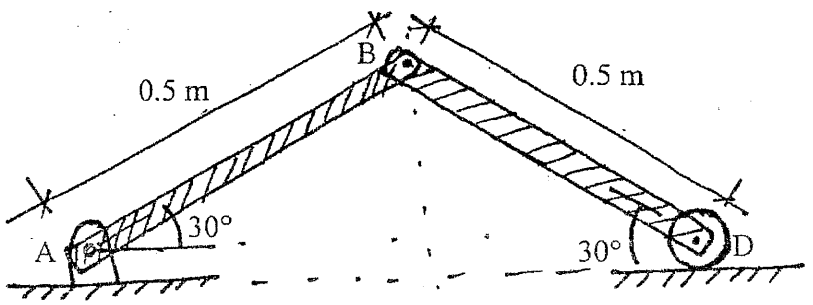
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

130

1. Derive the expression for radial and transverse components of acceleration when a particle moves in a curvilinear path. [4]
2. Two identical balls collides with the velocities of V_A = 15 m/s and V_B = 15 m/s as shown in figure. What are the final velocities after the impact? Given that the coefficient of restitution e = 0.8. [8]

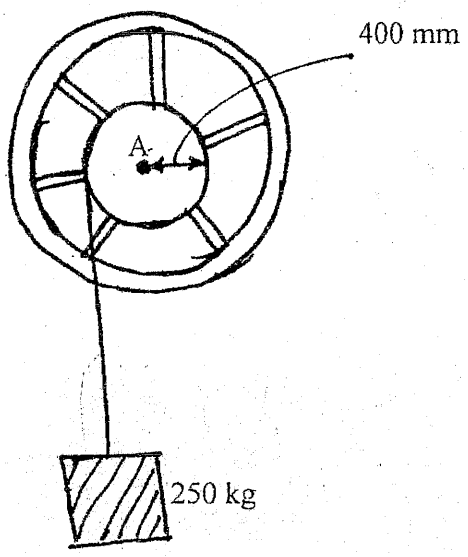


3. Derive the expression for the resultant force exerted on the surface of pipe due to the steady stream of particles. [4]
4. a) Describe about the types of rigid body motion with suitable sketches. [4]
   b) Determine the angular velocities of link BD and AB and also find the velocity of point B at the position shown in figure below. Provided that the block 'B' moves with a speed of 2 m/s. [8]



5. Describe about the constrained motion of rigid body in plane with suitable examples. [4]

6. A 250 kg block is suspended from a inextensible cable which is wrapped around a drum of 400 mm radius rigidly attached to the fly wheel as shown in figure below. The drum and flywheel have a combined centroidal moment of inertia $\bar{I} = 20\,kg\,m^2$. At the instant given in figure, the velocity of the block is 1.5 m/sec directed downward. Knowing that the bearing at 'A' is poorly lubricated and that the bearing friction is equivalent to a couple $\vec{M}$ of magnitude 80 N-m, Determine the velocity of the block after it has moved 1 m downward. [8]



***

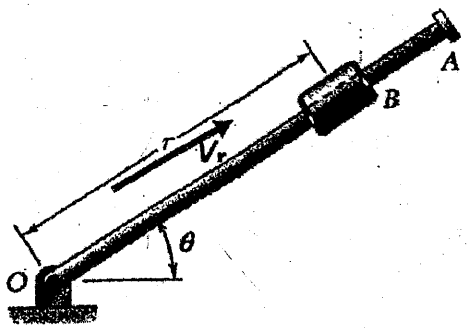
05 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2073 Shrawan

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	40
Programme	BCE, BGE	Pass Marks	16
Year / Part	II / I	Time	1 ½ hrs.

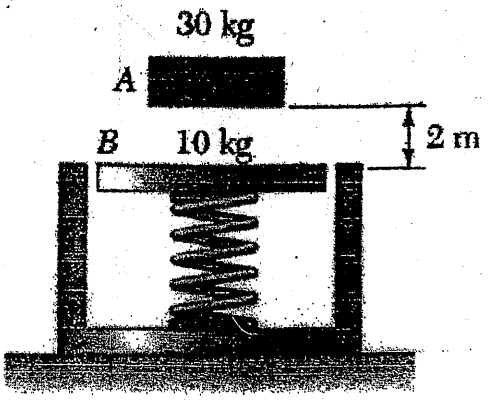
Subject: - Applied Mechanics (Dynamics) *(CE501)*

- ✓ 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.*

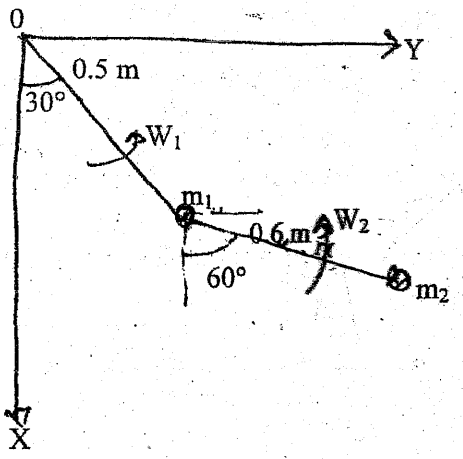
1. Rotation of the arm about O is defined by $\theta = 0.75t^2$ where θ is in radians and t in seconds. Collar B slides along the arm such that $r = 1\text{-}0.3t^2$ where r is in meters. After the arm has rotated through 45°, determine (a) the total velocity of the collar, (b) the total acceleration of the collar and (c) the relative acceleration of the collar with respect to the arm. [6]



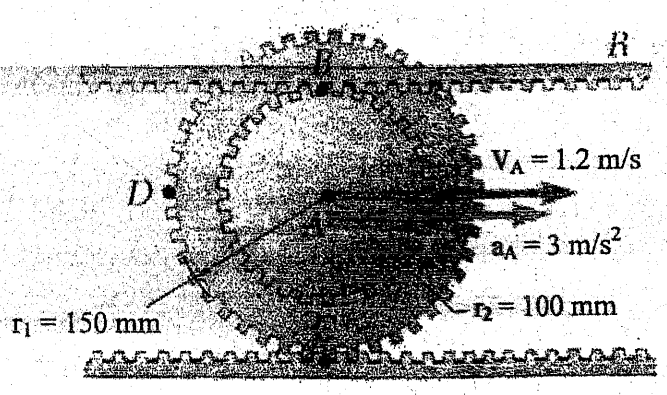
2. A 30 kg block is dropped from a height of 2 m onto the 10 kg pan of a spring scale. Assuming the impact to be perfectly plastic, determine the maximum deflection of the pan. The constant of the spring is k = 20 kN/m. [8]



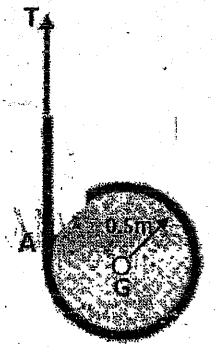
3. A double pendulum as shown in figure below oscillates in the X-Y plane. As shown in figure below, $W_1 = 2$ rad/sec. CCW and $W_2 = 4$ rad/sec CCW. What is $\vec{H}_0$ at this instant if $m_1 = 1$ kg and $m_2 = 2$ kg. The lower pendulum is connected to mass m_1, by a pin joint and is free to rotate about this point. [8]



4. The center of the double gear has a velocity and acceleration to the right of 1.2 m/s and 3 m/s^2, respectively. The lower rack is stationary. Determine (a) the angular acceleration of the gear and (b) the acceleration of points B, C and D. [8]



5. A chord is wrapped around a homogeneous disk of radius r = 0.5 m and mass m = 30 kg as shown in figure below. If the cord is pulled upward with a force T of magnitude 200N, determine (a) the acceleration of the center of the disk (b) the angular acceleration of the disk (c) the acceleration of the chord. [6]



6. Derive the expression for the resultant force on the system with variable mass. [4]

***

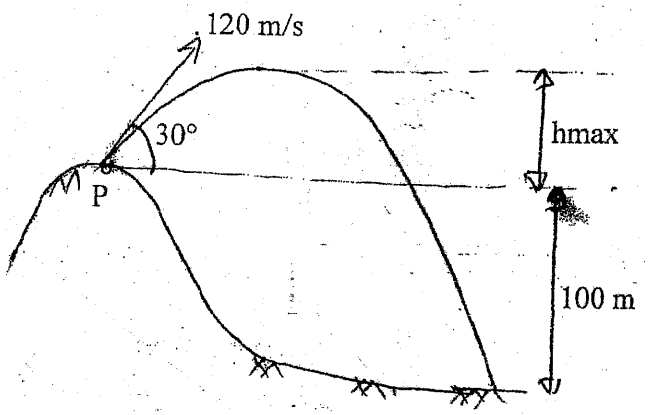
06 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2072 Chaitra

Exam.	Regular		
Level	BE	Full Marks	40
Programme	BCE, BGE	Pass Marks	16
Year / Part	II / I	Time	1 ½ hrs.

Subject: - Applied Mechanics (Dynamics) *(CE501)*

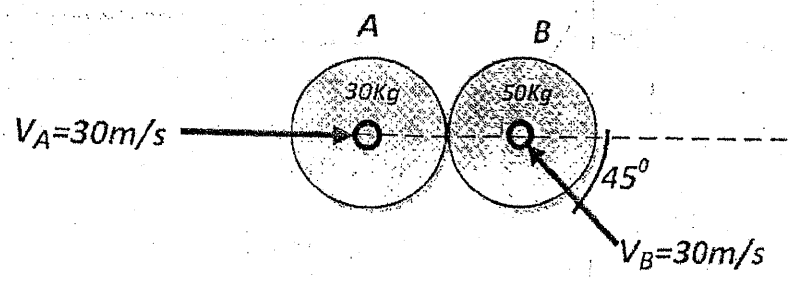
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. A bullet is fined at an angle of 30° to the horizontal from a point 'P' on a hill and it strikes a target which is 100m lower than the level of projection. The initial velocity of the bullet is 120 m/s. Neglecting the air resistance calculate: [6]



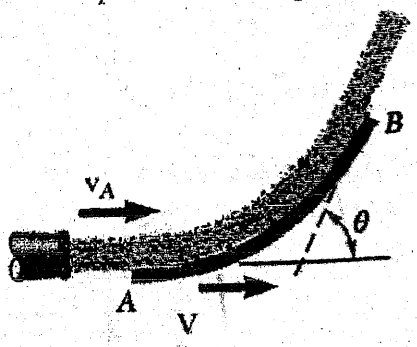
i) The maximum height to which the bullet will rise above the horizontal
ii) The actual velocity with which it will strike the target
iii) The total time required for the flight of bullet

2. The magnitude and direction of the velocities of two frictionless balls with the mass m_A = 30 kg and m_B = 50kg before they strike each other are shown in figure below. Assume e = 0.9, determine the magnitude and direction of the velocity of each ball after the impact. [8]

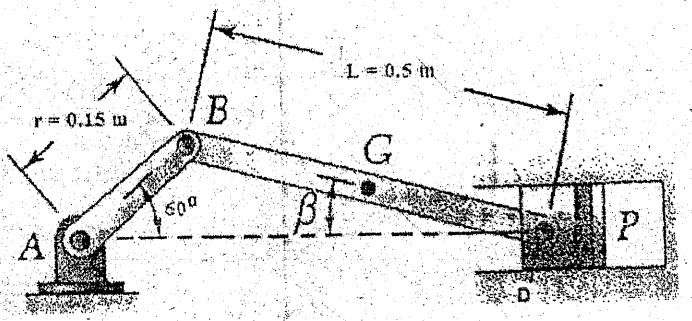


3. A nozzle discharges a stream of water of cross-sectional area "A" with a velocity V_A. The stream is deflected by single blade which moves to the right with a constant velocity V. Assuming that the water moves along the blade at a constant. Determine: [8]

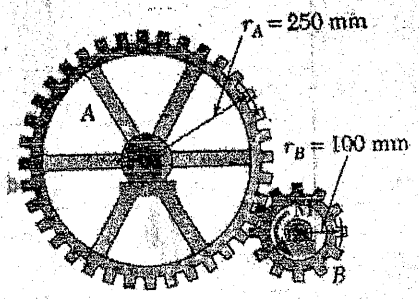
   i) The component of forces exerted by the blade on the stream.
   ii) The velocity V for which maximum power is developed.



4. Crank AB of the engine system has a constant clockwise angular velocity of 200 rpm, which makes the angle 60° with horizontal level. For the crank position shown in figure below. Determine the angular acceleration of the connecting rod BD and the acceleration of point D. [8]



5. The system is at rest when a moment of M = 8 N-m is applied to gear B. Neglecting friction (a) determine the number of revolutions of gear B before its angular velocity reaches 540 rpm and (b) tangential force exerted by gear B on gear A. [6]



$m_A = 10\,\text{kg}$ $\bar{k}_A = 200\,\text{mm}$
$m_B = 3\,\text{kg}$ $\bar{k}_B = 80\,\text{mm}$

6. Deduce an expression which shows the relation for the force exerted by the vane on the stream while you are dealing with the steady stream of particles. [4]

***

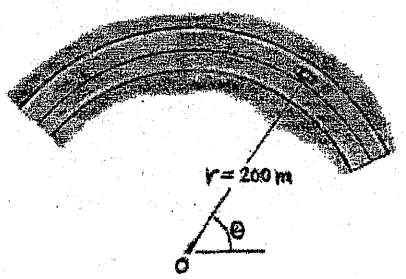
06 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2072 Kartik

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	40
Programme	BCE, BGE	Pass Marks	16
Year / Part	II / I	Time	1 ½ hrs.

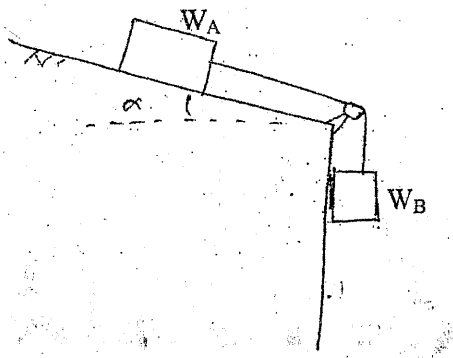
Subject: - Applied Mechanics (Dynamics) *(CE501)*

- ✓ 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.*

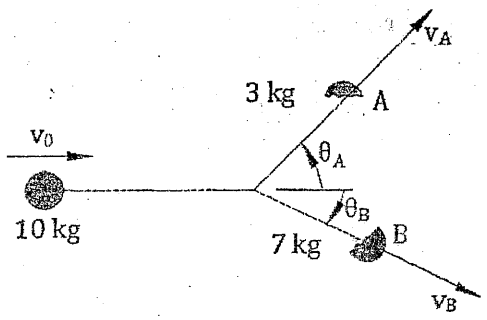
1. A radar gun at 0 rotates with the angular velocity of $\dot{\theta} = 0.1\,\text{rad/s}$ and angular acceleration of $\ddot{\theta} = 0.025\,\text{rad/s}^2$, at the instant $\theta = 45°$, as it follows the motion of the car travelling along the circular road having a radius of r = 200 m. Determine the magnitude of velocity and acceleration of the car at this instant. [4]



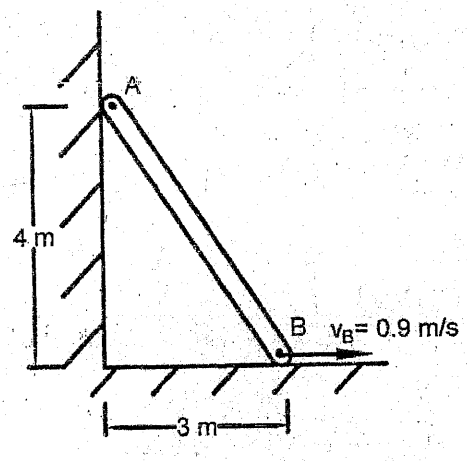
2. Tow block A and B are connected by means of an inextensible and weightless cord as shown in figure below. The bodies start to slide from rest. If the dynamic coefficient of friction is 'μd' for block A on the surface inclined at an angle α, compute the velocity of the object A at any time t, before the body A reaches the end of incline. [8]



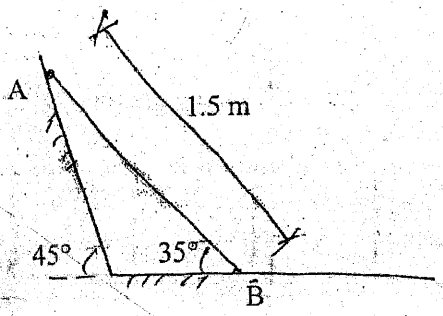
3. Derive equation for kinetic energy of a system of particles. A 10 kg projectile is moving with a velocity of 30 m/s when it explodes into two fragments A and B, weighing 3 kg and 7 kg respectively. Knowing that immediately after the explosion, fragments A and B travel in directions defined respectively by $\theta_A = 45°$ and $\theta_B = 30°$, determine the velocity of the each fragment. [4+4]



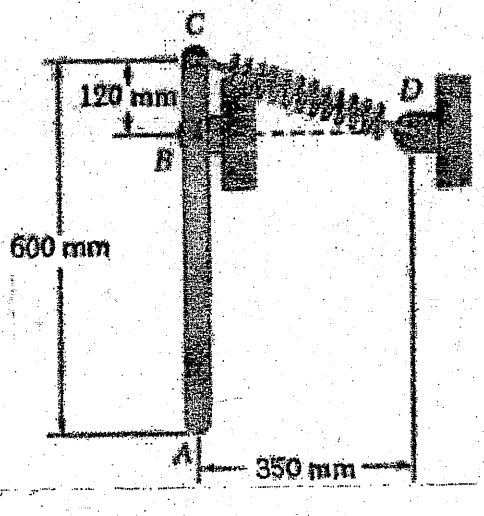
4. When does a general plane motion occur in a rigid body? Give some examples of GPM. The end B of the rod AB moves with a constant velocity $V_B = 0.9\,m/s$ (toward right). Determine velocity of end A and angular velocity of rod AB. [3+5]



5. The entremities of a 1.5 m rod of mass 30 kg may move freely and with no friction. If the rod is released initially from rest from the position shown, determine angular acceleration of the rod. [4]



6. Write the expression for kinetic energy of a rigid body in rotational motion with notations. A slender 4 kg rod AC can rotate in a vertical plane about a pivot at B. A spring of constant K = 400 N/m and of outstretched length 150 mm is attached to the rod as shown. Knowing that the rod is released from rest in the position shown, determine its angular velocity after it has rotated through 90°. [1+7]



***

CIVIL II/I 140

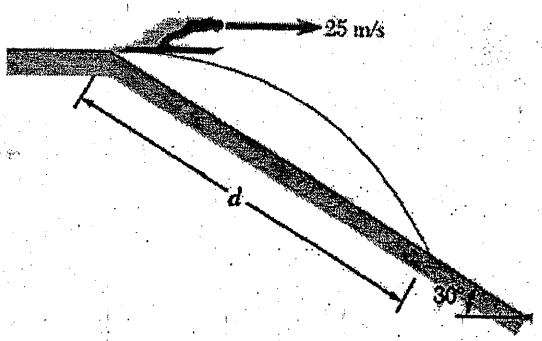
06 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2071 Chaitra

Exam.	Regular		
Level	BE	Full Marks	40
Programme	BCE, BGE	Pass Marks	16
Year / Part	II / I	Time	1 ½ hrs.

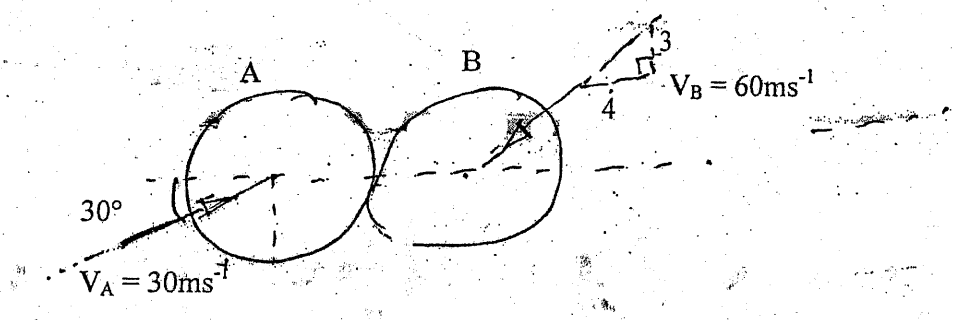
Subject: - Applied Mechanics (Dynamics) *(CE501)*

- ✓ 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.*

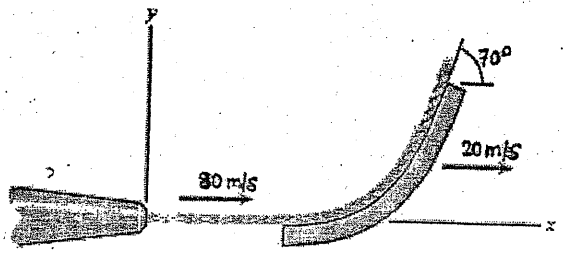
1. A sky jumper starts with a horizontal take off velocity of 25 m/s and lands on a straight landing hill inclined at 35° as shown in figure below. Determine the time between take-off and landing. [4]



2. Determine the magnitude and direction of the velocities of two identical balls after collision and loss of energy due to impact if e = 0.8. [8]

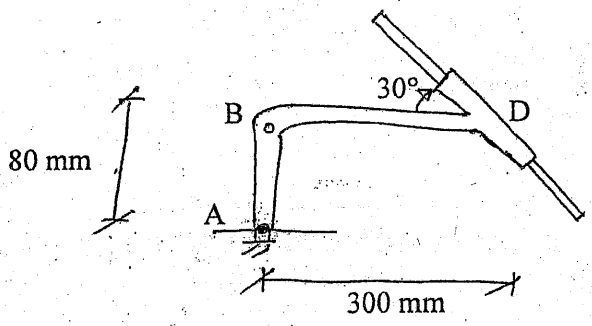


3. Derive the expression for the kinetic energy of the system of particles. A stream of water with velocity 80 m/sec and a mass flow of 6 kg/s strikes a turbine blade moving with constant velocity 20 m/sec. Determine the force exerted on the blade by the water. [4+4]

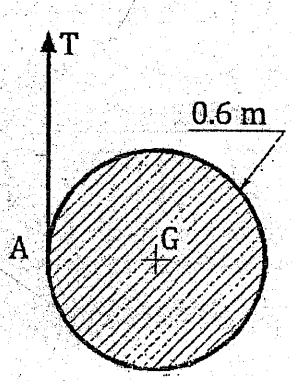


4. Crank AB has constant angular CCW velocity of 15 rad/s. For the position shown, Determine: [8]

   i) The angular velocity of rod BD
   ii) Velocity of collar D

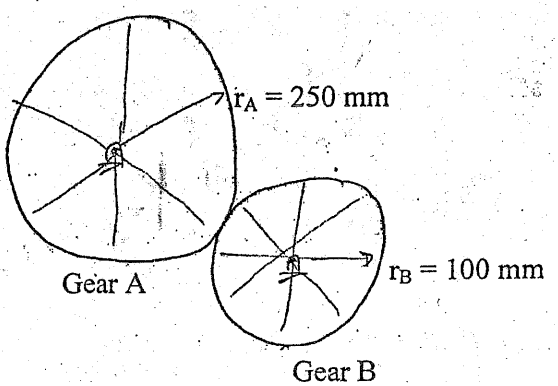


5. A cord is wrapped around a homogenous disk of radius (r) = 0.5m and mass (m) = 15 kg as shown in figure below. If the cord is pulled upward with a force T of magnitude 180 N, determine (a) the acceleration of the center of the disk and (b) the angular acceleration of the disk. [4]



6. Gear A has mass 10 kg and radius of gyration 200 mm while Gear B has mass 6 kg and radius of gyration 60 mm. The system is initially at rest when a couple of magnitude 10 Nm is applied constantly to Gear A. Neglecting friction: [8]

   i) Determine revolution of Gear A before its ω reaches 800 r/min
   ii) Tangential force enerted on Gear B.



***

05 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2070 Chaitra

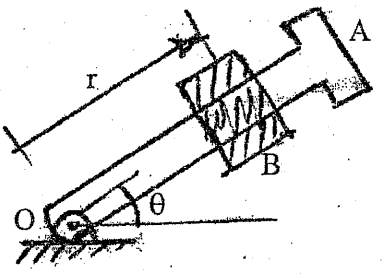
Exam.	Regular		
Level	BE	Full Marks	40
Programme	BCE	Pass Marks	16
Year / Part	II / I	Time	1½ hrs.

Subject: - Applied Mechanics (Dynamics) *(CE501)*

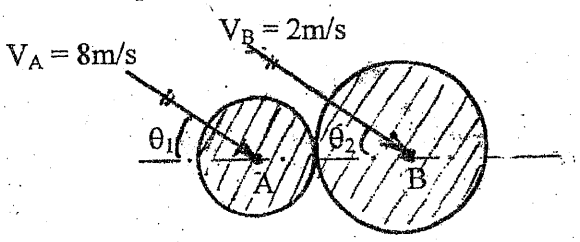
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1201-

1. Rotation of the arm about 'O' is defined by $\theta = 0.45t^2$, where 'θ' is in radian and 't' is in seconds. Collar 'B' slides along the arm such that $r = 1-0.4t^2$, where 'r' is in meter. After the arm has rotated through 60°; determine: (a) the total velocity of the collar (b) the total acceleration of the collar (c) the relative acceleration of the collar with respect to the arm. [4]

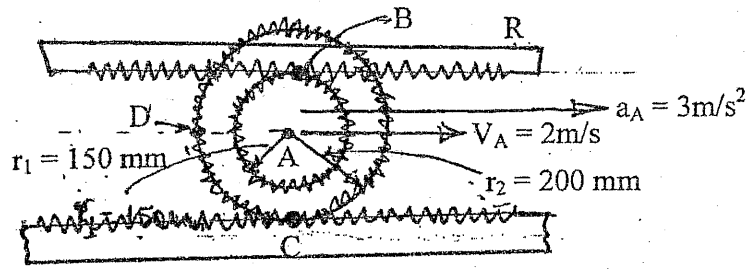


2. The two balls of masses 2 kg and 4 kg with a velocities 8m/s and 2m/s respectively; collides to each other. At the instant of impact, the velocities of the two bodies are parallel and inclined at 30° to the line of impact. Determine the magnitude and directions of the velocities after the impact if the coefficient of restitution, $\rho = 0.6$. [8]



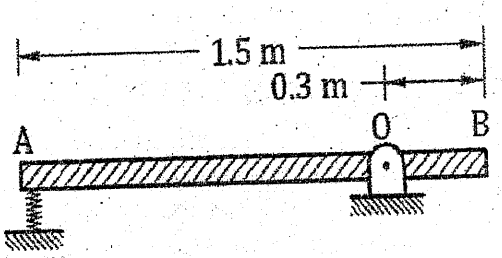
3. Show that the moment due to force resultant force about the fixed point O of the external forces is equal to the rate of change of angular momentum about O of the system of particles. While crushing in level flight at a speed of 913.3 km/hr a jet airplane scoops in air at a rate of 108.86 kg/s and discharges it with a velocity of 670.56 m/s relative to the airplane. Determine the total power developed by the engine. [2+6]

4. Define the instantaneous center of rotation with examples. The center of double gear has a velocity of 2m/s to the right and the acceleration of 3 m/s^2 to the right. If the lower rack is stationary; determine: (a) The angular acceleration of the gear (b) The acceleration of the points B, C and D of the gear. [4+4]



5. Explain De'Alembert's principle in relation to Newton's 2nd Law of motion. [4]

6. Define conservative and non conservative system with two examples for each. A 13.6 kg slender rod AB is 1.5 m long and is pivoted about a point O which is 0.3 m from end B. The other end is pressed against a spring of constant k = 315 kN/m until the spring is compressed 2.54 cm. The rod is then in a horizontal position. If the rod is released from this position, determine its angular velocity and the reaction at the pivot O as rod passes through a vertical position. [2+6]



***

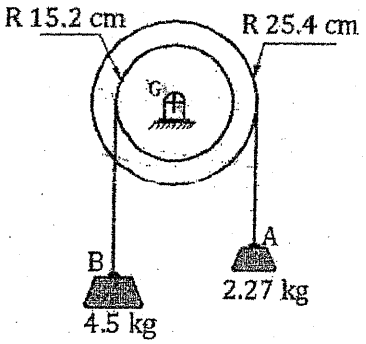
05 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2071 Shawan

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	40
Programme	BCE, BGE	Pass Marks	16
Year / Part	II / I	Time	1½ hrs.

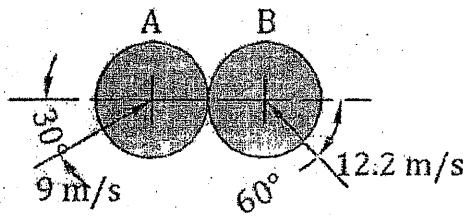
Subject: - Applied Mechanics *(Dynamics) (CE501)*

- ✓ 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. Derive expression for tangential and normal components of acceleration while the particle moves in a curve path. A pulley weighing 5.44 kg and having a radius of gyration of 20.3 cm is connected to two blocks as shown in figure below. Assuming no axel friction, determine the angular acceleration of the pulley. [4+4]



2. Illustrate "Principle of conservation of energy" with an appropriate example. The magnitude and direction of the velocities of two identical frictionless balls before they strike each other are as shown in figure below. Assuming e = 0.9, determine the magnitude and direction of the velocity of each ball after the impact. [3+5]



3. A system of particles has masses $m_1 = 5$ kg, $m_2 = 2$ kg and $m_3 = 6$ kg and their locations and velocities at time t_1 and time t_2 are shown in figure (a) and (b) respectively. What is the total linear impulse on the system during this time interval? Also determine the total angular impulse of the system during this time interval about the origin. [8]

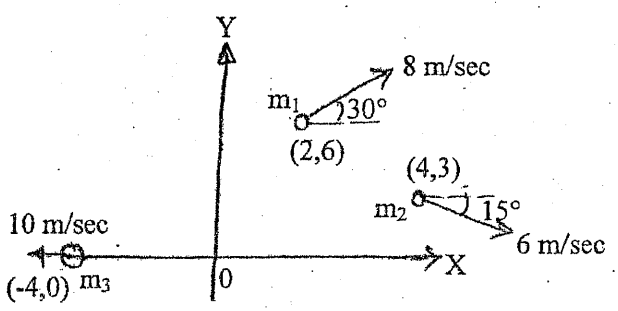


Figure (a)

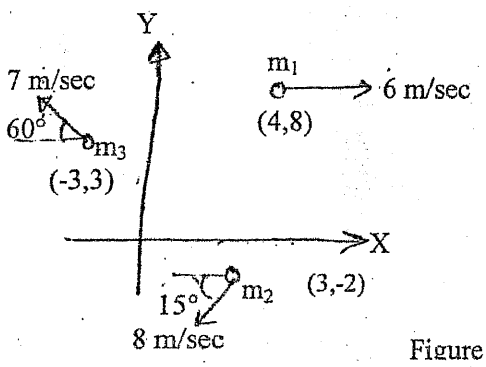
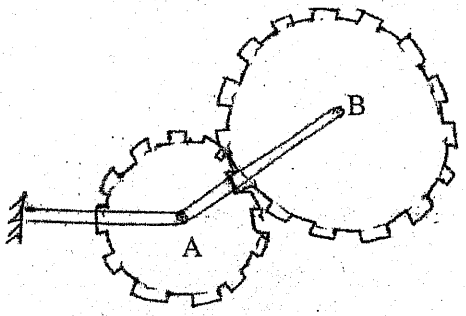


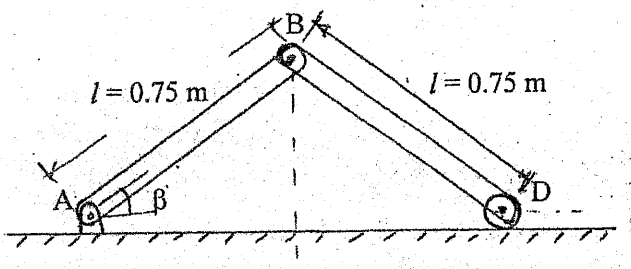
Figure (b)

4. Gear A rotates with an angular velocity of 120 rpm clockwise and angular velocity of arm AB is 90 rpm. Determine the corresponding angular velocity of Gear B. [8]



$r_A = 60$ mm
$r_B = 90$ mm

5. Each of the two slender rods shown in figure below is 0.75 m long and has a mass of 5 kg. If the system is released from rest when β=50°, determine: (a) the angular velocity of rod AB, when $\beta = 30°$ (b) the velocity of point D at the same instant. [8]



***

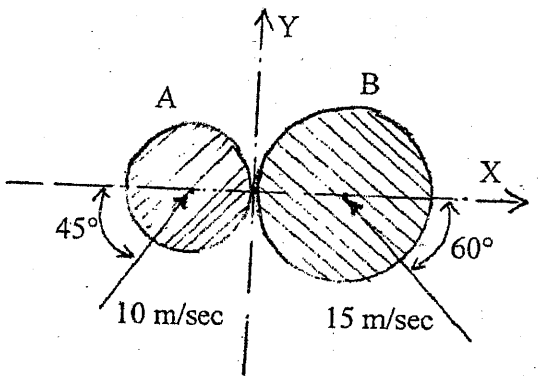
03 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2070 Ashad

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	40
Programme	BCE	Pass Marks	16
Year / Part	II / I	Time	1½ hrs.

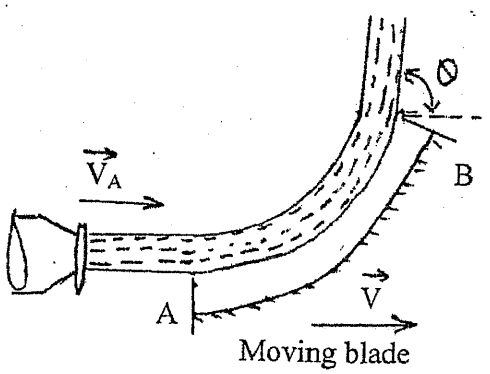
Subject: - Applied Mechanics (Dynamics) *(CE501)*

- ✓ 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.*

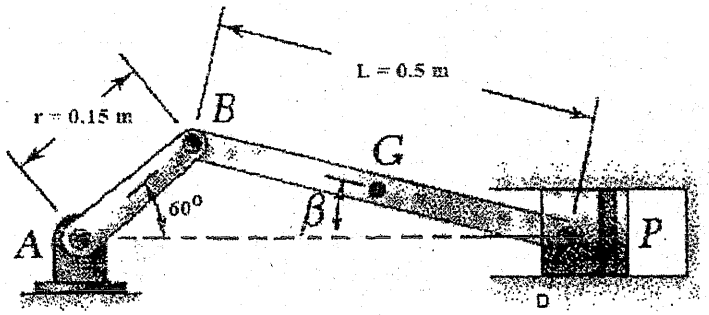
1. What do you understand by Radial and Transverse components of acceleration? Derive an expression for the same. [4]
2. Two balls A and B having mass 5 kg and 8 kg respectively collide as shown in figure below. Determine their velocity immediately after the impact if the coefficient of restitution is 0.80. How much K.E will be lost due to the impact? [8]



3. A nozzle discharges a stream of water of cross sectional area A with a velocity $\vec{V}_A$. The stream is deflected by a single blade which moves to the right with a constant velocity $\vec{V}$. Assuming that water moves along the blade at constant speed, determine the components of the force $\vec{F}$ exerted by the blade on the stream and velocity $\vec{V}$ for which maximum power is developed. (see figure below). [8]

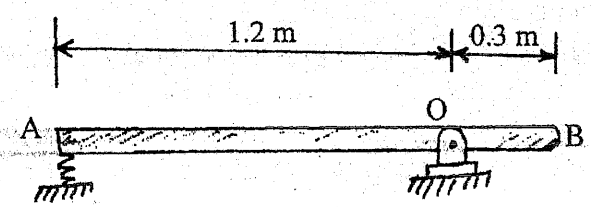


4. Crank AB of the engine system has a constant clockwise angular velocity of 200 rpm, which makes the angle 60° with horizontal level. For the crank position shown in figure below. Determine the angular acceleration of the connecting rod BD and the acceleration of point D. [8]



5. Define the term rigid body. Describe, with an example, how you would apply D' Alemberts principle in plane motion of rigid body. [4]

6. A 20 kg slender rod AB is 1.5 m long and is pivoted about a point 'O' which is 0.3 m from end 'B'. The other end is pressed against a spring of constant K = 400 KN/m until the spring is compressed 20 mm. The rod is then in horizontal position. If the rod is released from this position, determine it's angular velocity and reaction at the pivot 'O' as the rod passes through a vertical position. (see figure below) [8]



***

03 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2069 Chaitra

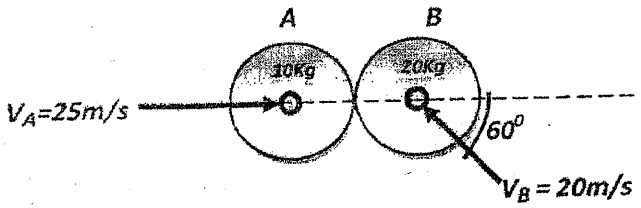
Exam.	Regular		
Level	BE	Full Marks	40
Programme	BCE	Pass Marks	16
Year / Part	II / I	Time	1½ hrs.

Subject: - Applied Mechanics (Dynamics) *(CE501)*

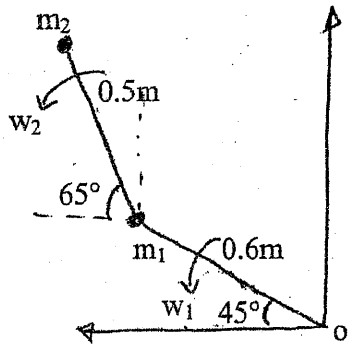
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. Derive an expression for tangential and normal components of a acceleration for a particle moving along a curve path. [4]

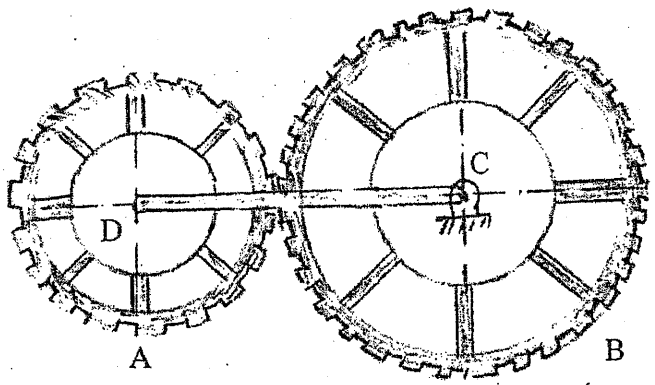
2. The magnitude and direction of the velocities of two frictionless balls with the mass m_A = 100kg and m_B = 20kg before they strike each other are shown in figure below. Assume e = 0.7, determine the magnitude and direction of the velocity of each ball after the impact. How much K.E will be lost due to the impact? [8]



3. Mass m_2 rotates about mass m_1 with angular velocity w_2 and mass m_1 rotates about 0 with angular velocity w_1. Calculate the angular momentum of the system about origin. w_1 = 5 rad/s ccw m_1 = 2.2 kg w_2 = 4 rad/s ccw m_2 = 1.6 kg [8]

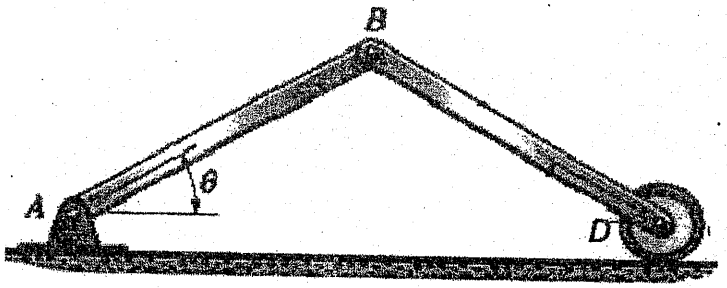


4. The gear A of the system as shown in figure below rotates with angular velocity w_A = 200rpm ( ) and connecting arm CD rotates with w_{CD} = 70rmp ( ) . Determine the angular velocity of gear B. Radius of gear A and B are 100 and 150 mm respectively. [8]



5. State De' Alembert's principle and show that the external force acting on the body are equivalent to a force-couple system consisting of a vector force attached to the mass center and a couple about the mass center. [4]

6. Each of two slender rods AB and BD has length 1.5m and has the same mass of 12kg as shown in figure below. If the system is released from rest with $\theta = 50°$, determine (a) the angular velocity of rod AB when $\theta = 10°$ (b) the velocity of point D at the same instant. [8]



***

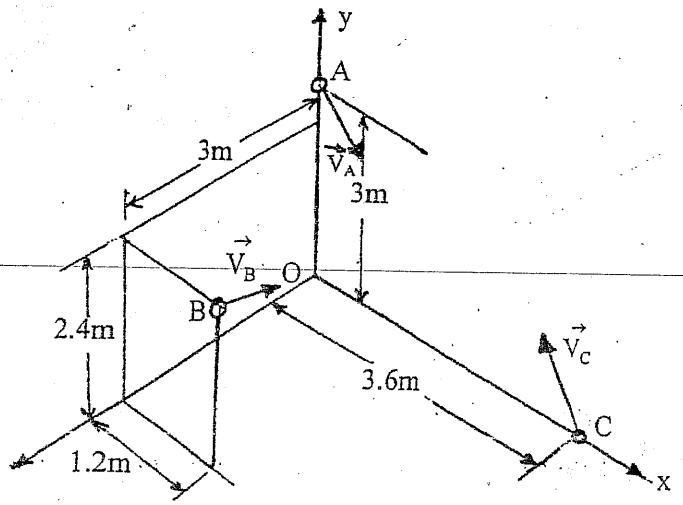
03 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2068 Chaitra

Exam.	Regular		
Level	BE	Full Marks	40
Programme	BCE	Pass Marks	16
Year / Part	II / I	Time	1½ hrs.

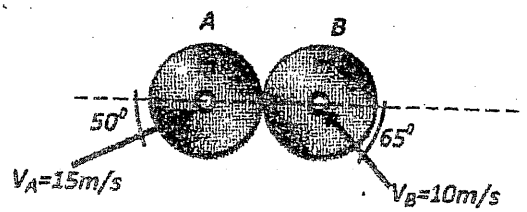
Subject: - Applied Mechanics (Dynamics) ***(CE 501)***

- ✓ 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. The motion of a particle is defined by the position vector $\vec{r} = 5t\hat{i} + 3t^2\hat{j} + \frac{1}{3}t^3\hat{k}$ where r is in meter and t is in seconds. At the instant when t is two seconds, find the tangential and normal components of acceleration and the principle radius of curvature. [4]
2. Explain variable system of particles with examples. A system consists of three particles A, B and C. The masses of A, B and C are respectively m_A = 3kg, m_B = 2kg, and m_C =4 kg and that the velocities of the particles expressed in m/sec are respectively $\vec{V}_A = 4\hat{i} + 2\hat{j} + 2\hat{K}$, $\vec{V}_B = 4\hat{i} + 3\hat{j}$ and $\vec{V}_C = -2\hat{i} + 4\hat{j} + 2\hat{K}$, determine the angular momentum $\vec{H}_o$ of the system about O. [3+5]

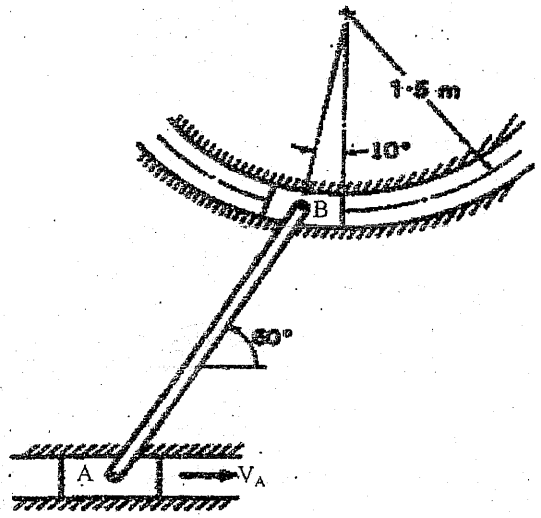


3. The magnitude and direction of the velocities of two identical frictionless balls before they strike each other are as shown below. Assume e = 0.5, determine the magnitude and direction of the velocity of each ball after the impact. [8]



4. Briefly describe the constrained motion of rigid body in plane with suitable examples. [4]

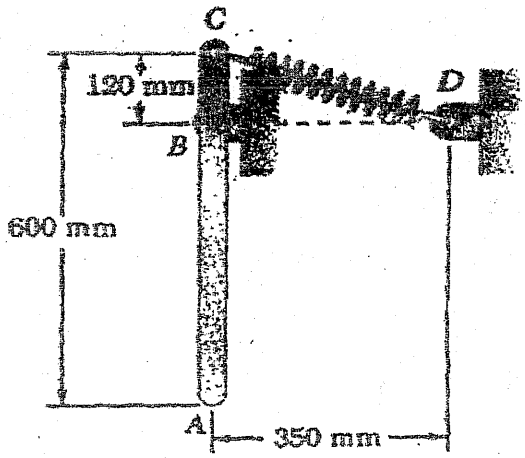
5. In figure shown a mechanism with two sliders. Slider A at the instant of interest has a speed of 3m/s and is accelerating at the rate of $1.5m/s^2$. If member AB is 3m in length, what are the angular velocity and angular acceleration for this member? Find the instantaneous center of rotation of bar AB if V_A is 3m/s and is decelerating at the rate of $1.5m/s^2$. [4+4]



6. Define the eccentric impact and also derive the expression for coefficient of restitution of the eccentric impact. [8]

OR

A slender 4 kg rod can rotate in a vertical plane about a pivot at B. A spring of constant k = 400N/m and of outstretched length 150mm is attached to the rod as shown. Knowing that the rod is released from rest in the position shown, determine its angular velocity after it has rotated through 90°. [8]



***

03 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2068 Baishakh

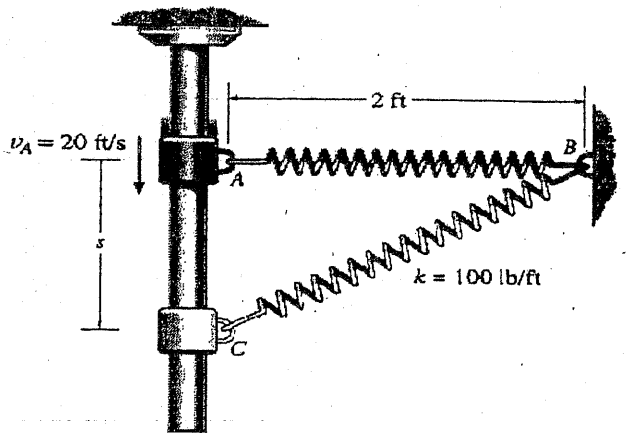
Exam.	Regular / Back		
Level	BE	Full Marks	40
Programme	BCE	Pass Marks	16
Year / Part	II / I	Time	1½ hrs.

Subject: - Applied Mechanics (Dynamics)

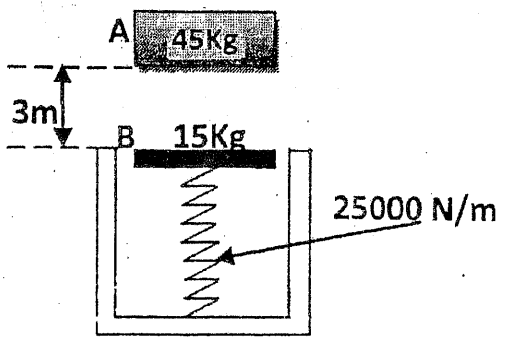
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt <u>All</u> questions.*
- ✓ *The figures in the margin indicate <u>Full Marks</u>.*
- ✓ *Assume suitable data if necessary.*

1. Derive an expression for radial and transverse component of acceleration of particle in curvilinear motion. [4]

2. The 2-lb block is given an initial velocity of 20ft/s when it is at A. If the spring has an untstretched length of 2 ft and a stiffness of k = 100lb/ft, determine the velocity of the block when s = 1ft. [8]

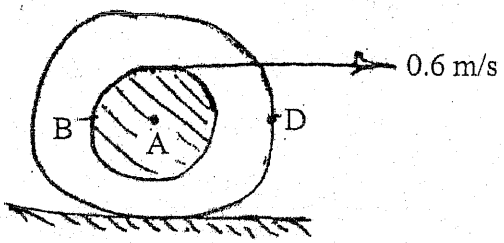


3. A 45kg block is dropped from a height of 3m on to the 15kg pan of a spring scale as shown in figure below. Assume that the impact is perfectly plastic. Determine the maximum deflection of pan. The constant of the spring is 25000N/m. [8]



4. What is the general plane motion of the rigid body? Explain with suitable examples. How will you justify the statement "The work done due to the internal forces in a rigid body is always zero"? [4]

5. A drum of radius 120mm is mounted on a wheel of radius 180mm as shown, where rope is wound around the drum. The end E of rope is pulled with constant velocity $V_E = 0.6m/s$ ($\rightarrow$) and wheel rolls without slipping. Determine: (a) V_D of point D, (b) Rate at which rope is wound or unwound. [3+3]

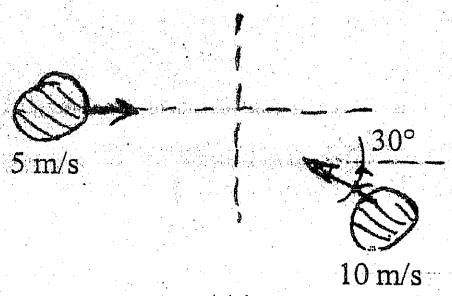


6. A spherical mass is projected along horizontal surface, with no angular velocity. Determine the time at which sphere will start rolling without sliding and linear and angular velocity of sphere. Assume suitable notation. [4]

7. When will you observe coriolis acceleration? Develop such acceleration on your expression. [6]

OR

Two balls of identical mass collide with velocities as shown. For a coefficient of restitution 0.85, what will be their final velocities after they impact? Find loss of kinetic energy during impact.



***