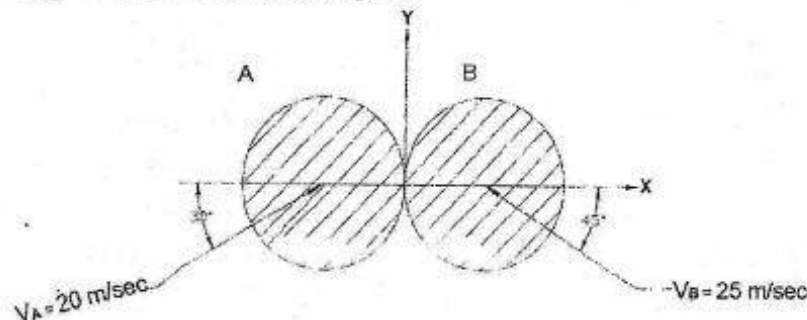


Exam.	Back		
	BE	Full Marks	40
	BCE, BGE	Pass Marks	16
	II / I	Time	1 ½ hrs

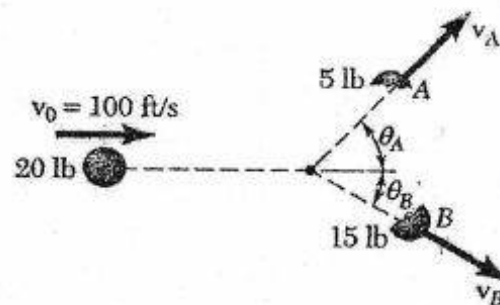
Subject: -Applied Mechanics (Dynamics) (CE 501)

- ✓ 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.

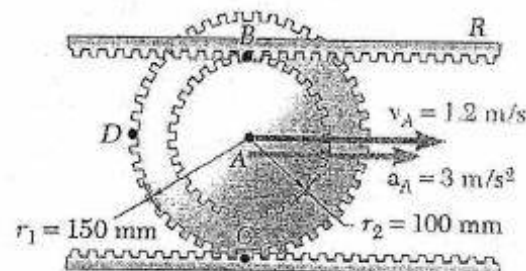
1. Derive an expression for normal and tangential component of acceleration. [4]
2. The magnitude and direction of the velocities of two balls A and B having masses 1 kg and 2 kg respectively before they strike each other are shown as in figure below. Assuming $e = 0.8$, determine the velocity of each ball after the impact. How much kinetic energy will be lost due to the impact? [8]



3. A 20-lb projectile is moving with a velocity of 100 ft/s when it explodes into 5-lb and 15-lb fragments. Immediately after the explosion, the fragments travel in the directions $\theta_A = 45^\circ$ and $\theta_B = 30^\circ$. Determine the velocity of each fragment. Define variable system of particles. [6+2]

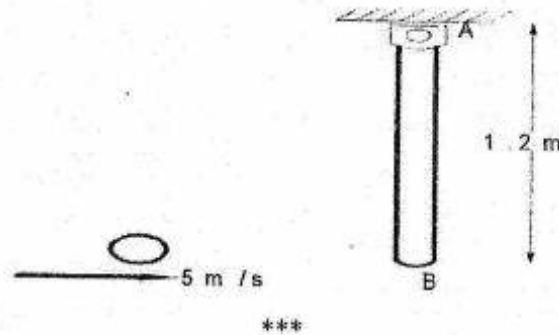


4. Define general plane motion with suitable examples. [4]
5. The center of the double gear has a velocity and acceleration to the right of 1.2 m/s and 3 m/s^2 , respectively. The lower rack is stationary. Determine (a) the angular acceleration of the gear, and (b) the acceleration of points B, C and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



6. A 2-kg sphere moving horizontally to the right with an initial velocity of 5 m/s strikes the lower end and 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 0.9, determine the angular velocity of the rod and the velocity of the sphere immediately after the impact.

[8]

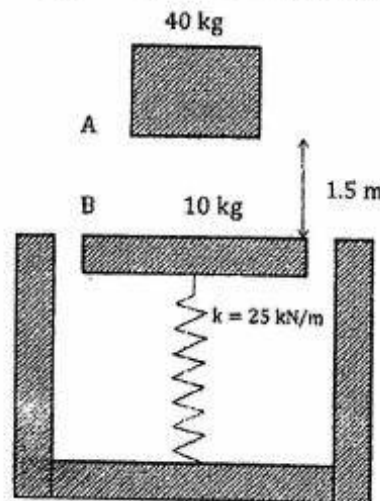


Exam.	Back	
Level	BE	Full Marks 40
Programme	BCE, BGE	Pass Marks 16
Year / Part	II / I	Time 1½ hrs.

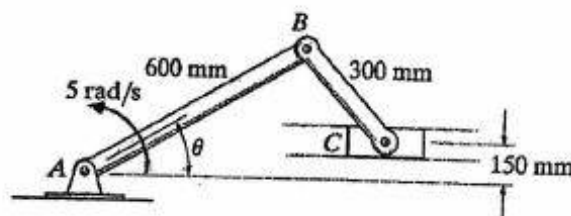
Subject: - Applied Mechanics (Dynamics) (CE 501)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
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1. A projectile is fired with an initial velocity of 240 m/s at a target which is located 600 m above the gun and at a horizontal distance of 3,600 m. Calculate the firing angle. [4]
2. Determine the maximum deflection of the pan as a 40 kg block is dropped from a height of 1.5 m onto the 10 kg pan of a spring scale. Assume the impact to be perfectly plastic. Define Potential energy and its types for particles with relevant equations. [8+2]

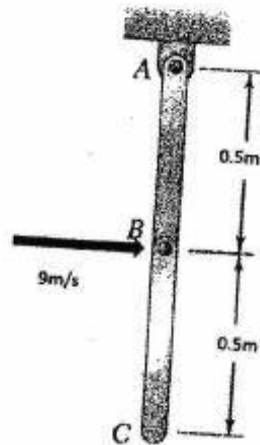


3. Derive an expression for kinetic energy of a system of particles. Explain variable system of particle with suitable examples. [4+2]
4. Crank AB rotates with a constant angular velocity of 5 rad/s. Determine the velocity of midpoint of BC, piston C and the angular velocity of link BC at the instant $\theta = 40^\circ$. Define Coriolis acceleration. [8+2]



5. Explain the conservation of energy in plane motion with relevant equations. The 50 N slender rod is suspended from the pin at A. If a 15 N ball B is thrown at the rod and strikes its centre with a horizontal velocity of 9 m/s, determine the angular velocity of the rod just after impact. The coefficient of restitution is $e = 0.45$.

[4+6]



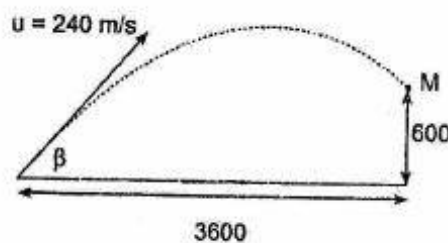
TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2082 Baishakh

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

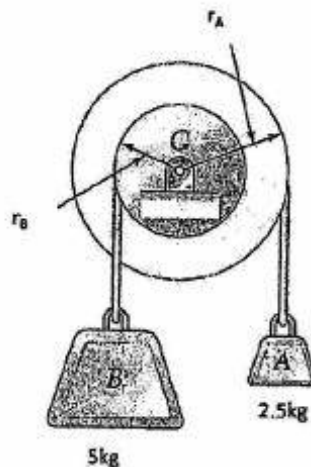
Subject: - Applied Mechanics (Dynamics) (CE 501)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
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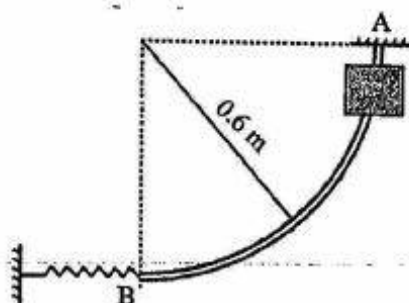
1. a) A projectile is fired with an initial velocity of 240 m/s at a target M located 600 m above a gun G and at a horizontal distance of 3600 m. Neglecting air resistance, determine the value of firing angle β .



- b) A pulley system having a mass of 6 kg and radius of gyration of 200 mm is connected to two cylinders as shown in figure. Determine the angular acceleration of the pulley assuming no friction of the axle. Take $r_A = 250\text{mm}$ and $r_B = 150\text{mm}$.

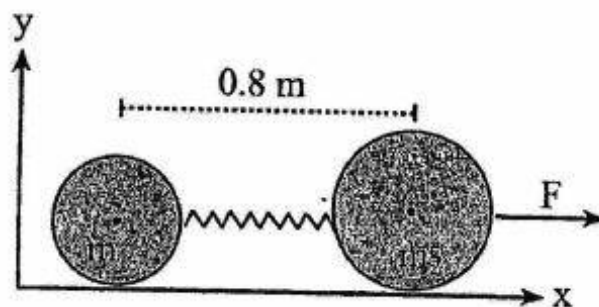


2. Explain conservative and non-conservative forces with examples. A slider having weight of 4 kg is released from its position of rest at position A which then slides down a frictionless rod in vertical plane. If the spring constant is 20 kN/m, determine the maximum deflection of the spring and the velocity with which the slider strikes the spring.



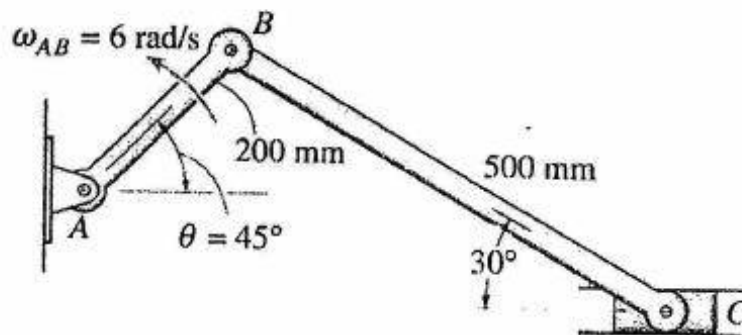
3. Derive the force for variable system of particles. Two sphere 1 kg and 2 kg are connected by a spring of un-stretched length 0.3 m with a modulus of 800N/m along a smooth plane at the instant shown force $F = 20$ N acts on m_2 . Find the acceleration of each mass and acceleration of center of mass.

[4+4]



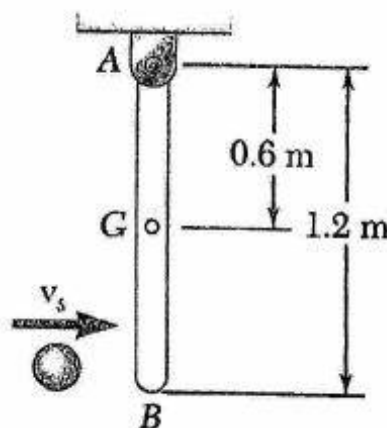
4. What is meant by coriolis' acceleration in plane motion of a rigid body? If bar AB has an angular velocity $\omega_{AB} = 6$ rad/s counterclockwise, determine the velocity of the slider block C at the instant shown.

[2+6]



5. A 2-kg sphere moving horizontally to the right with an initial velocity of 5 m/s strikes the lower end of an 8-kg rigid rod AB. The rod is suspended from a hinge at A and is initially at rest. Knowing that the coefficient of restitution between the rod and the sphere is 0.80, determine the angular velocity of the rod and the velocity of the sphere immediately after the impact.

[8]

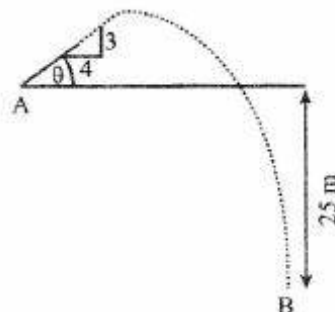


Exam.	Regular		
Level	BE	Full Marks	40
Programme	BCE, BGE	Pass Marks	16
Year / Part	II / I	Time	1 1/2 hrs.

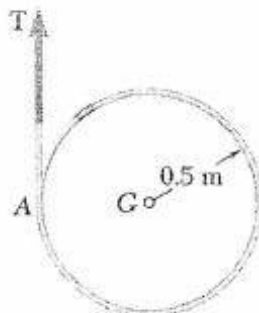
Subject: - Applied Mechanics (Dynamics) (CE 501)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
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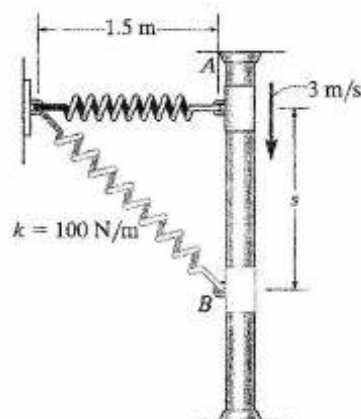
1. a) A projectile is projected as shown in figure with an initial velocity of 30m/s. Determine the time of flight and range. [3]



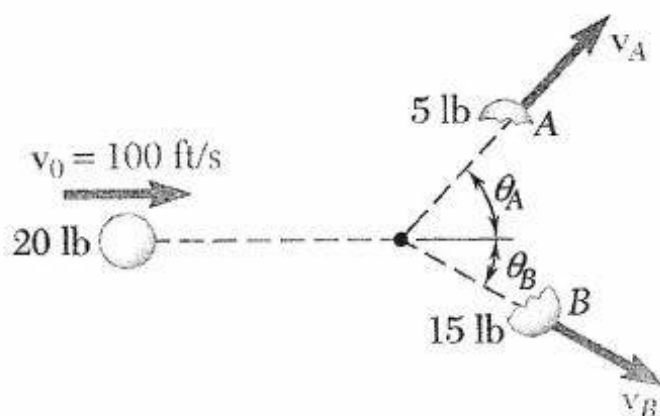
- b) A cord is wrapped around a homogeneous disk with a radius of $r = 0.5\text{m}$ and a mass of $m=15\text{kg}$. If the cord is pulled upward with a force T of magnitude 180N, determine, [5]
- (i) The angular acceleration of the disk.
 - (ii) The acceleration of the cord.



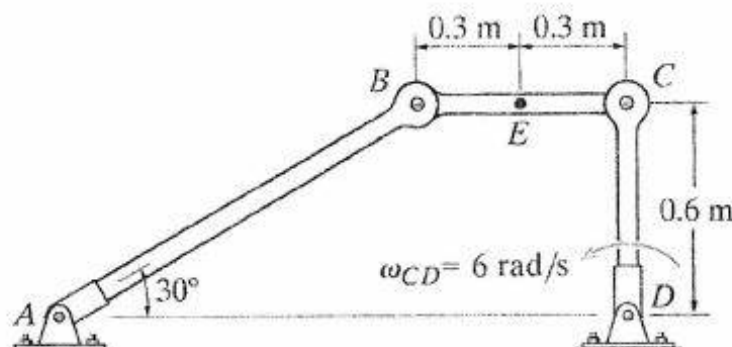
2. Explain types of impact. The 4-kg smooth collar has a speed of 3 m/s when it is at $s=0$. Determine the maximum distance s it travels before it stops momentarily. The spring has an un-stretched length of 1 m. [3+5]



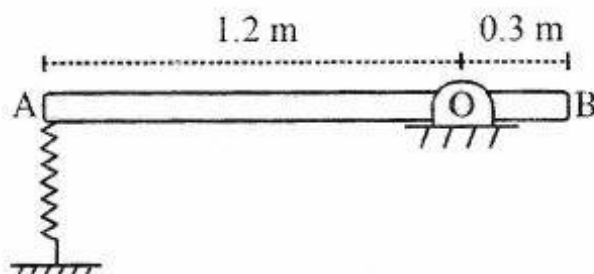
3. Define variable system of particles. A 20 kg projectile is moving with a velocity of 30 m/s when it explodes into two fragments A and B, weighing 5 kg and 15 kg, respectively. Knowing that immediately after the explosion, fragments A and B travel in directions defined respectively by $\theta_A = 45^\circ$ and $\theta_B = 30^\circ$, determine the velocity of each fragment. [2+6]



4. What is meant by corioli's acceleration in plane motion of a rigid body? If link CD has an angular velocity of $\omega_{CD} = 6 \text{ rad/sec}$, determine the velocity of point E on link BC and the angular velocity of link BC at the instant shown. [2+6]



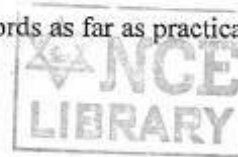
5. Explain impulse momentum principle for rigid body. A rod AB of length 1.5 m having a mass of 15 kg is pivoted about point O which is 0.3 m from the end B. The other end of the rod is pressed against a spring having a spring constant of 300 kN/m until the spring is compressed about 25 mm. The rod is then released from its initial position of rest in horizontal position. Determine the angular velocity of the rod through the vertical position. [2+6]



Exam.	Back		
Level	BE	Full Marks	40
Programme	BCE, BGE	Pass Marks	16
Year / Part	II / I	Time	1 1/2 hrs.

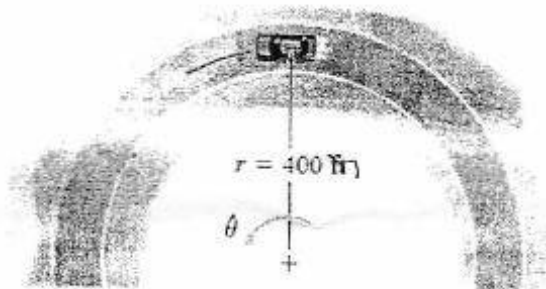
Subject: - Applied Mechanics (Dynamics) (CE 501)

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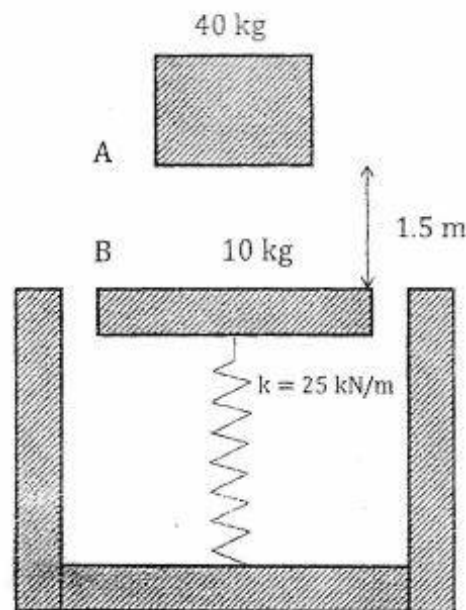
1. The car travels along the circular curve of radius $r = 400$ m with a constant speed of $v = 30$ m/s. Determine the angular rate of rotation θ of the radial line r and the magnitude of the car's acceleration.

[4]

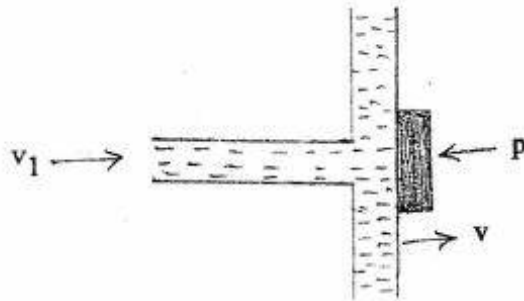


2. Determine the maximum deflection of the pan as a 40 kg block is dropped from a height of 1.5 m onto the 10 kg pan of a spring scale. Assume the impact to be perfectly plastic. Explain central impact and its types.

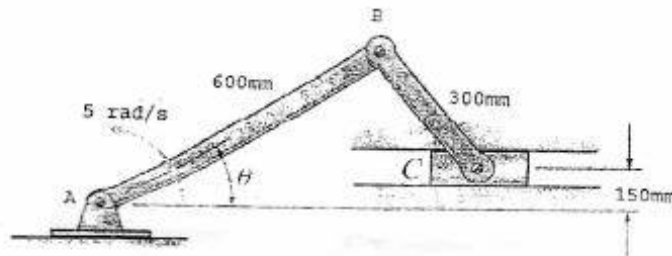
[6+2]



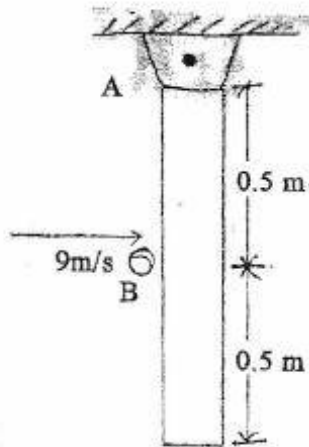
3. Derive an expression for kinetic energy of a system of particles. A stream of water of cross-sectional area A and velocity v_1 strikes a plate which moves to the right with a velocity v . Determine the magnitude of v if $A = 600 \text{ mm}^2$, $v_1 = 30 \text{ m/s}$ and $P = 400 \text{ N}$. [4+4]



4. Crank AB rotates with a constant angular velocity of 5 rad/s . Determine the velocity of piston C and the angular velocity of link BC at the instant $\theta = 30^\circ$. Define Coriolis acceleration. [8+2]



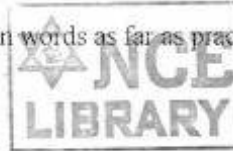
5. Explain constrained plane motion with examples. The 50 N slender rod is suspended from the pin at A. If a 10 N ball B is thrown at the rod and strikes its centre with a horizontal velocity of 9 m/s , determine the angular velocity of the rod just after impact. The coefficient of restitution is $e = 0.4$. [4+6]



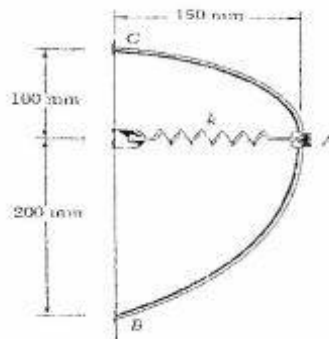
Exam.	BE	Full Marks	40
Level	BCE, BGE	Pass Marks	16
Programme	II / I	Time	1 1/2 hrs.

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

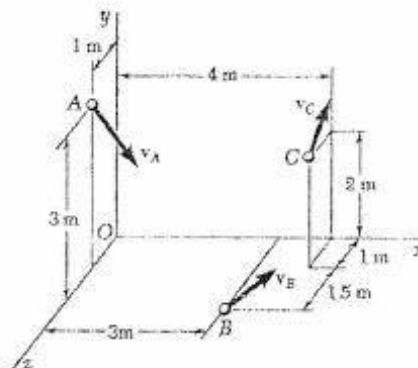
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
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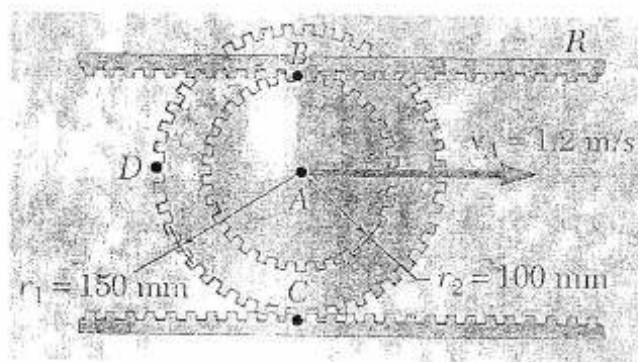
- Derive the radial and transverse components of velocity and acceleration of a body moving in curvilinear path. [4]
- Explain impact and its types. A 500-g collar can slide without friction on the curved rod BC in a horizontal plane. Knowing that the undeformed length of the spring is 80 mm and that $k = 400 \text{ kN/m}$, determine (i) the velocity that the collar should be given at A to reach B with zero velocity, (ii) the velocity of the collar when it eventually reaches C. [2+6]



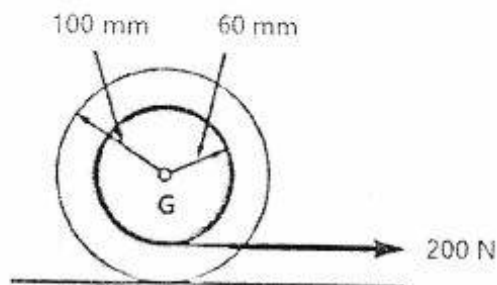
- A system consists of three particles A, B and C with masses $m_A = 1 \text{ kg}$, $m_B = 2 \text{ kg}$ and $m_C = 3 \text{ kg}$ and that the velocities of the particles expressed in m/s are respectively, $\vec{v}_A = 3\mathbf{i} - 2\mathbf{j} + 4\mathbf{k}$, $\vec{v}_B = 4\mathbf{i} + 3\mathbf{j}$, and $\vec{v}_C = 2\mathbf{i} + 5\mathbf{j} - 3\mathbf{k}$. Determine; [6]
 - The angular momentum $\vec{H}_O$ of the system about O.
 - The position of vector $\vec{r}$ of the mass centre G of the system.
 - The angular momentum $\vec{H}_G$ of the system about G.



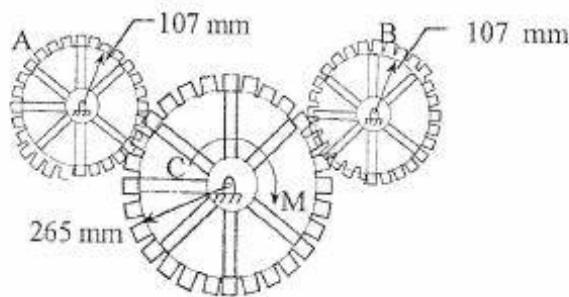
4. Explain different types of rigid body motions. The double gear shown rolls on the stationary lower rack; the velocity of its center A is 1.2 m/s directed to the right. Determine (i) the angular velocity of the gear, (ii) the velocities of the upper rack R and of point D of the gear. [2+6]



5. A cord wrapped around the inner drum of a wheel and pulled horizontally with a force of 200 N . The wheel has a mass of 50 kg and a radius of gyration of 70 mm . Knowing that the coefficients of friction are $\mu_s = 0.20$ and $\mu_k = 0.15$, determine the acceleration of G and the angular acceleration of the wheel. [6]



6. Each of the gears A and B has a mass of 2.1 kg and a radius of gyration of 103 mm and gear C has a mass of 10.3 kg and radius of gyration of 187 mm . A couple of M of constant magnitude 9.26 Nm is applied to gear C. Take $r_A = r_B = 107 \text{ mm}$ and $r_C = 265 \text{ mm}$. Determine: [8]
- The number of revolutions of gear C required for its angular velocity to increase from 100 to 450 rpm
 - The corresponding tangential force action on gear A.



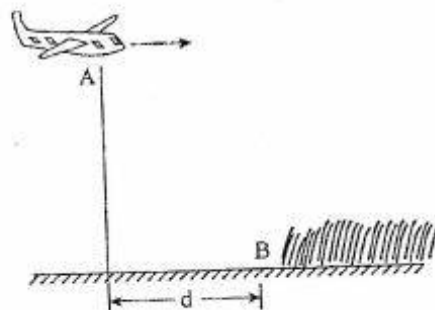
Exam.	Back	
Level	BE	Full Marks 40
Programme	BCE, BGE	Pass Marks 16
Year / Part	II / I	Time 1 1/2 hrs.

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

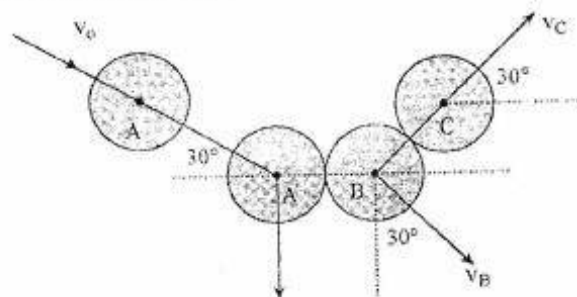


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- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. An airplane used to drop water on brushfires is flying horizontally in a straight line at 315 km/h at an altitude of 80 m. Determine the distance d at which the pilot should release the water so that it will hit the fire at B. [4]

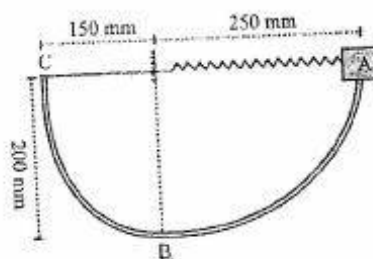


2. Explain variable system of particles. In the game of pool, ball A is moving with a velocity v_0 of magnitude $v_0 = 4.57 \text{ m/s}$. When it strikes ball B and C, which are at rest and aligned as shown. After the collision, three balls move as indicated and assuming frictionless surfaces and perfectly elastic impact, determine the V_A, V_B . Take $V_C = 3.42 \text{ m/s}$. [2+6]



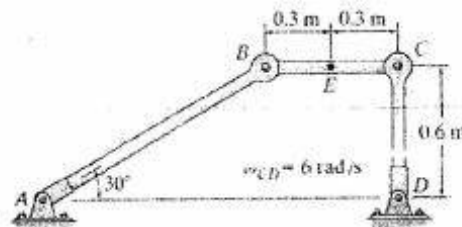
3. Explain about the conservation of energy in study of kinetics of particles with relevant equation. A 5 kg collar is attached to a spring and slides without friction in a vertical plane along a curved rod ABC. The spring is undeformed when its length is 100 mm and its constant is 800 N/m. If the collar is released at 'A' with no initial velocity, determine its velocity. [2+6]

- a) As it passes B
- b) As it reaches at C.



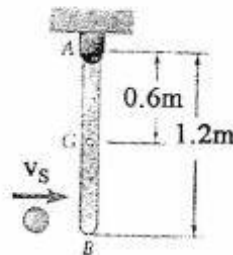
4. If link CD has an angular velocity of $\omega_{CD} = 6 \text{ rad/s}$, determine the velocity of point E on link BC and the angular velocity of link AB at the instant shown. Explain General plane motion (GPM)

[8+2]



5. A 3 -kg sphere with an initial velocity of 5 m/s strikes the lower end of an 8- kg rod AB. The rod is hinged at A and initially at rest. The coefficient of restitution between the rod and sphere is 0.8. Determine the angular velocity of the rod and the velocity of the sphere immediately after impact. Explain D' Alemberts Principle.

[2+8]



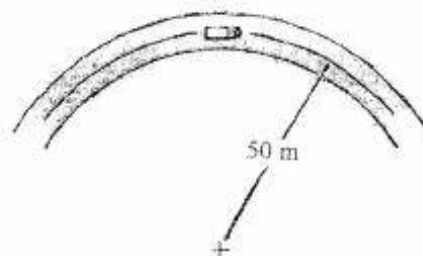
Exam.	Regular	
Level	BE	Full Marks
Programme	BCE, BGE	Pass Marks
Year / Part	II / I	Time
		1 ½ hrs

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

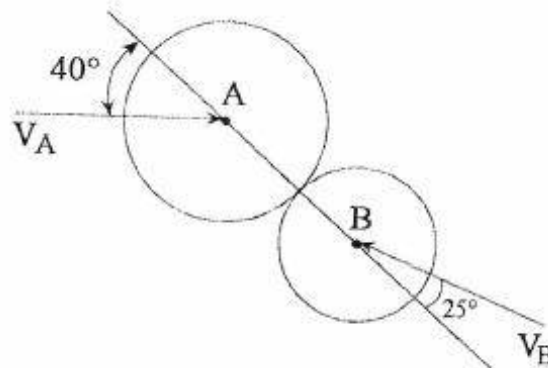
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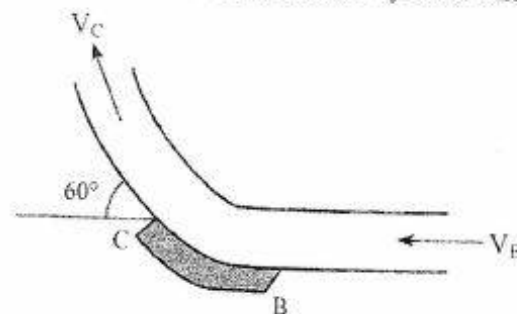
- *1. The truck travels along a circular road that has a radius of 50 m at a speed of 4 m/s. For a short distance when $t = 0$, its speed is then increased by $a_t = (0.4t) \text{ m/s}^2$, where t is the seconds. Determine the speed and the magnitude of the truck's acceleration when $t = 4\text{s}$. [4]



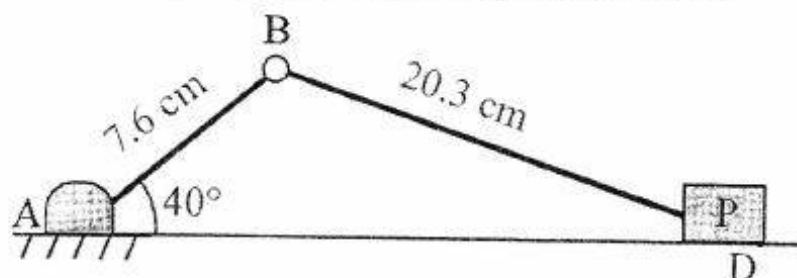
2. Two frictionless balls ($m_A = 6 \text{ kg}$, $m_B = 3 \text{ kg}$) strike each other as shown in figure. The coefficient of restitution between the balls is $e = 0.67$. Find the velocities of A and B after the impact if initial velocity are $v_A = 3 \text{ m/s}$ and $v_B = 4.5 \text{ m/s}$. Explain the principle of work and energy with governing equation. [6+2]



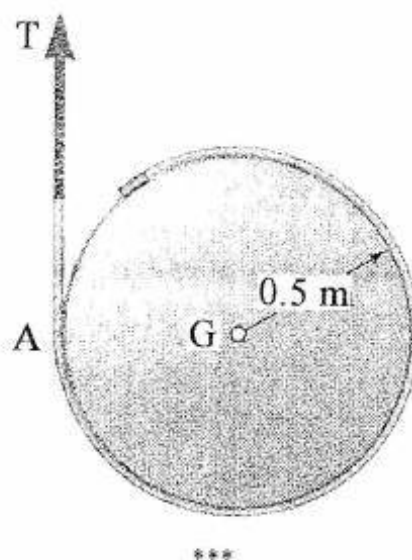
3. Define linear and angular momentum of system of particles. A nozzle discharges a stream of water of cross-sectional area $A = 100 \text{ mm}^2$ with a speed of $v = 60 \text{ m/s}$ and the stream is deflected by a fixed vane as shown in figure. The mass density of water $\rho = 1000 \text{ kg/m}^3$. Determine the resultant force $\vec{F}$ exerted on the stream by fixed vane. [2+6]



4. Define Instantaneous centre of rotation (ICR) with examples. Crank AB of the engine system has a constant clockwise angular velocity of 2000 rpm. For the crank position shown, calculate angular acceleration of rod BD and acceleration of piston P (point D). [Take $\omega_{BD} = 61.87 \text{ rad/s}$ (ccw) and $v_D = 13.2558 \text{ m/s}$ ($\rightarrow$) (if necessary)] [2+8]



5. Explain the principle of impulse and momentum for the plane motion of rigid body. A cord is wrapped around a homogeneous disk of radius $r = 0.5 \text{ m}$ and mass $m = 15 \text{ kg}$. If the cord is pulled upward with a force $\vec{T}$ of magnitude 200 N, determine [4+6]
- the acceleration of the center of the disk.
 - the angular acceleration of the disk.
 - the acceleration of the cord.

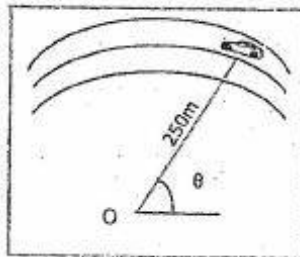


Exam.	Regular		
Level	BE	Full Marks	40
Programme	BCE, BGE	Pass Marks	16
Year / Part	II / I	Time	1 ½ hrs.

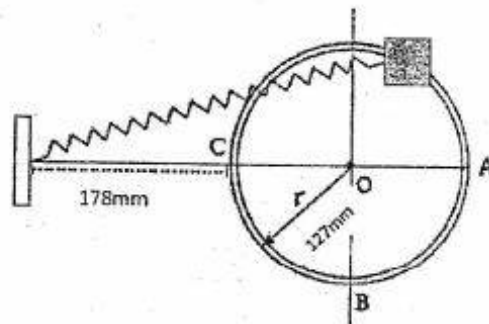
Subject: - Applied Mechanics (Dynamics) (CE 501)

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- ✓ The figures in the margin indicate **Full Marks**.
- ✓ Assume suitable data if necessary.

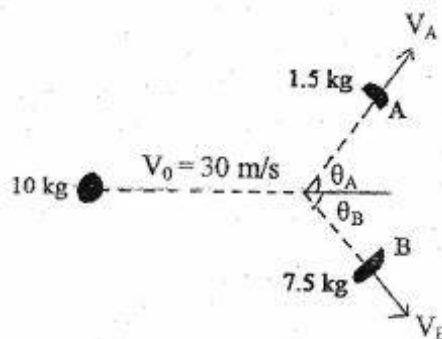
1. A radar gun at 'O' rotates with the angular velocity of $(d\theta/dt) = 0.15 \text{ rad/sec}$ and angular acceleration of $(d^2\theta/dt^2) = 0.025 \text{ rad/sec}^2$ at the instant $\theta = 40^\circ$, as it follows the motion of the car travelling along the circular road having radius of $r = 250 \text{ m}$. Determine the magnitude of velocity and acceleration of the car at this instant. [4]



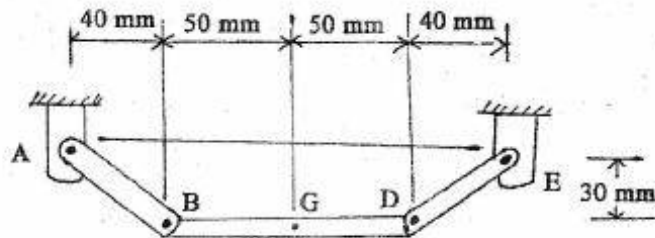
2. A 0.45 kg collar is attached to a spring and slides without friction along a circular rod in a vertical plane. The spring has an undeformed length of 127 mm and a constant $K = 146 \text{ N/m}$. Knowing that the collar is released from being held at A, determine the speed of the collar and the normal force between the collar and the rod as the collar passes through B. [8]



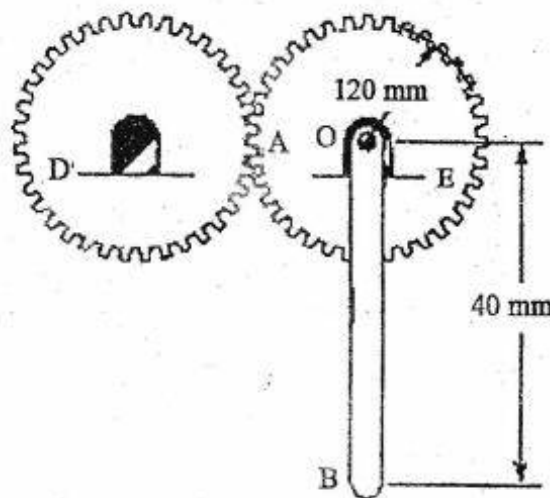
3. Define angular momentum for a system particle. A 10 kg projectile is moving with a velocity of 30 m/s when it explodes into two fragments A and B weighing 2.5 kg and 7.5 kg respectively, knowing that immediately after the explosion, fragments A and B travel in the directions defined respectively by $\theta_A = 45^\circ$ and $\theta_B = 30^\circ$, determine the velocity of each fragment. [2+4]



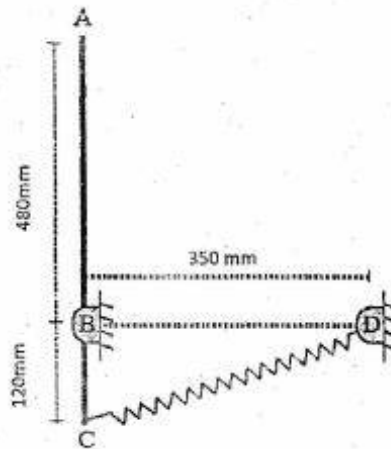
4. Define General plane motion with suitable example. Knowing that at the instant shown rod AB has zero angular acceleration and an angular velocity of 15 rad/s counter clockwise. Determine [2+6]
- angular acceleration of arm DE
 - the acceleration of Point D.



5. The portion AOB of the mechanism is actuated by gear D and at the instant shown has a clockwise angular velocity of 8 rad/s and a counter clockwise angular acceleration of 40 rad/s^2 . Determine tangential force exerted by gear D. Take $m_E = 4 \text{ kg}$, $\bar{k}_E = 85 \text{ mm}$ and $m_{OB} = 3 \text{ kg}$ [8]



6. A slender 4 kg rod can rotate in a vertical plane about a pivot at B. A spring of constant $k = 400 \text{ N/m}$ 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° . [6]



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2078 Kartik

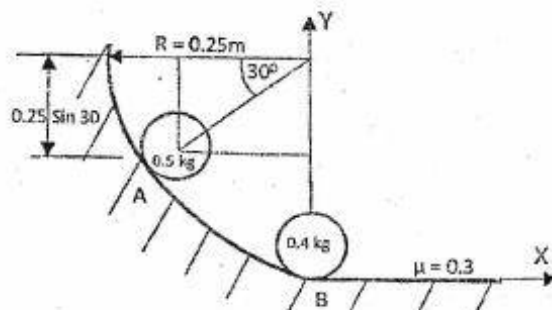
Exam.	Back		
Level	BE	Full Marks	40
Programme	BCE, BGE	Pass Marks	16
Year / Part	II / I	Time	1 ½ hrs.

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

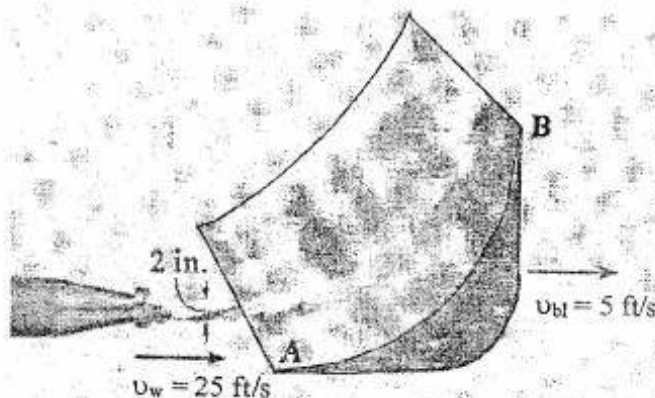
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.



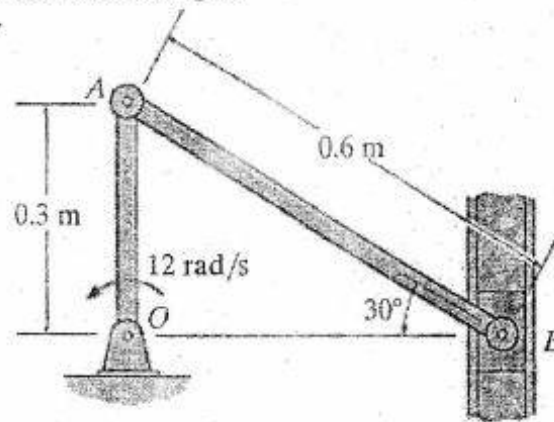
1. A bullet is fired into a viscous medium with an initial velocity of 80 m/s. The resistance of the medium produces a resistance equal of $a = (-0.5 v^3) \text{ m/s}^2$, where v is in m/s. Calculate the bullet's velocity and position 3 sec after it is fired. [4]
2. a) Differentiate the concept of "work-energy" and "impulse-momentum" principles for study of kinetics of particle. [2]
- b) A particle having mass 0.5 kg is released from rest and strikes the stationary particle of mass 0.4 kg as shown in figure. Assume the impact is direct and elastic. If the horizontal surface has a kinetic coefficient of friction $\mu = 0.3$. Locate the final position of each mass from the origin of x-axis. [6]



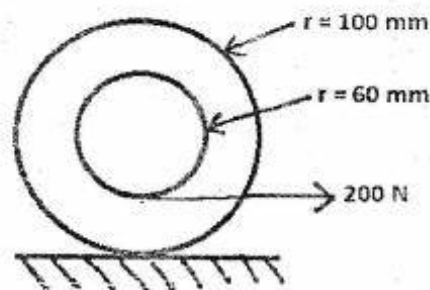
3. A 2-in -diameter water jet having a velocity of 25 ft/s impinges upon a single moving blade as shown in figure. If the blade moves with a constant velocity of 5 ft/s away from the jet, determine the horizontal and vertical components of force which the blade is exerting on the water. What power does the water generate on the blade? Water has a specific weight of 62.4 lb/ft³. [6]



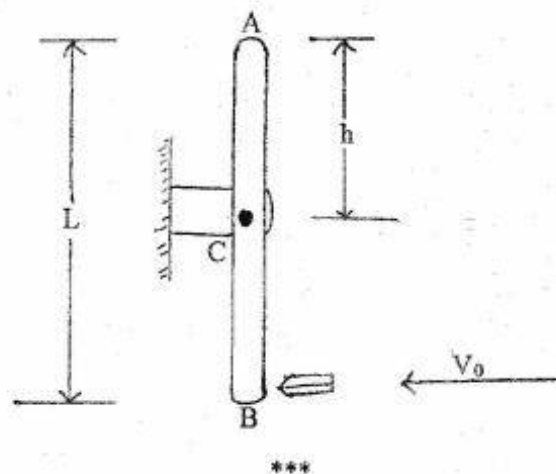
4. If crank OA rotates with an angular velocity 12 rad/s , determine the velocity of piston B, velocity of midpoint of AB and the angular velocity of rod AB at the instant shown. Define constrained motion with examples. [6+2]



5. A wheel is wrapped around the inner drum of a wheel and pulled horizontally with a force of 200 N . The wheel has a mass of 45 kg and radius of gyration of 70 mm . Knowing that $\mu_s = 0.2$ and $\mu_k = 0.15$, determine the acceleration of G and angular acceleration of wheel. [8]



6. A bullet weighing 40 gm is fired with horizontal velocity of 600 m/s into the lower end of a slender 7 kg bar of length $L = 600 \text{ mm}$. Knowing that $h = 260 \text{ mm}$ and that the bar is initially at rest, determine (a) the angular velocity of bar immediately after the bullet becomes embedded, (b) the impulsive reaction at C, assuming that the bullet becomes embedded in 0.001 s . [6]



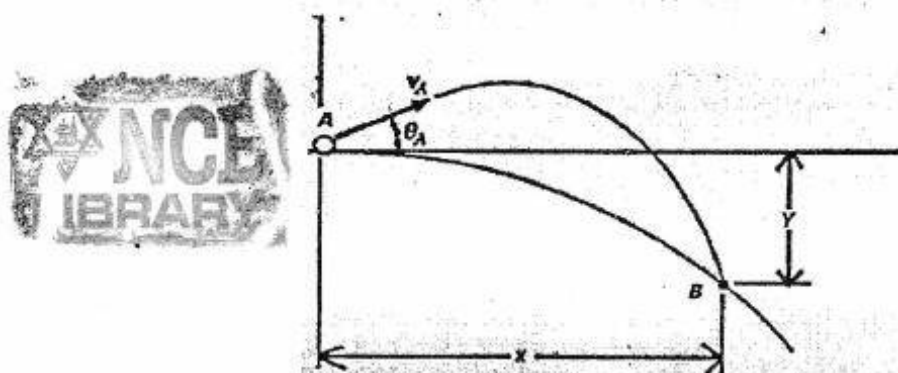
TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2076 Ashwin

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

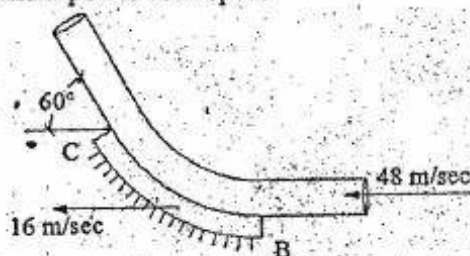
Subject: - Applied Mechanics (Dynamics) (CE 501)

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

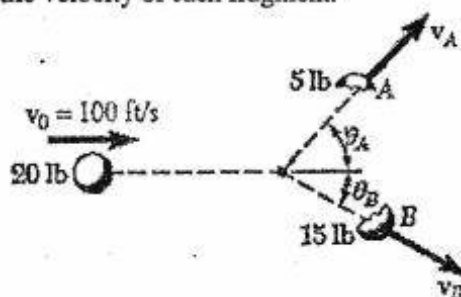
1. The ball at A is kicked such that $\theta_A = 30^\circ$. If it strikes the ground at B having co-ordinates $x = 15$ ft and $y = -9$ ft, determine the speed at which it is kicked. [4]



2. A nozzle discharges a stream of water of cross sectional area $A = 4000 \text{ mm}^2$ with a speed $v = 48 \text{ m/sec}$, 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 $\rho = 1000 \text{ kg/m}^3$. Determine the resultant force exerted on the stream by the fixed vane and maximum power developed. [5+3]

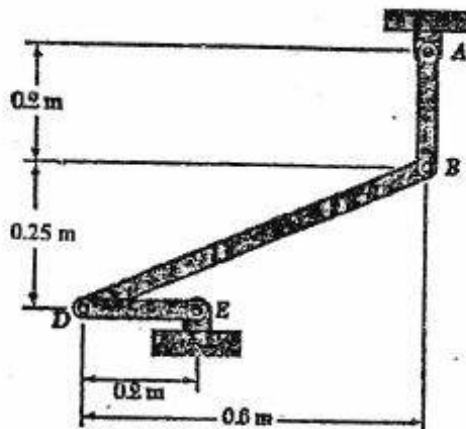


3. Define angular momentum for a rigid body in plane motion with examples. [4]
4. A 20-lb projectile is moving with a velocity of 100 ft/s when it explodes into two fragments A and B, weighing 5 lb and 15 lb, respectively. Knowing that immediately after the explosion, fragments A and B travel in directions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



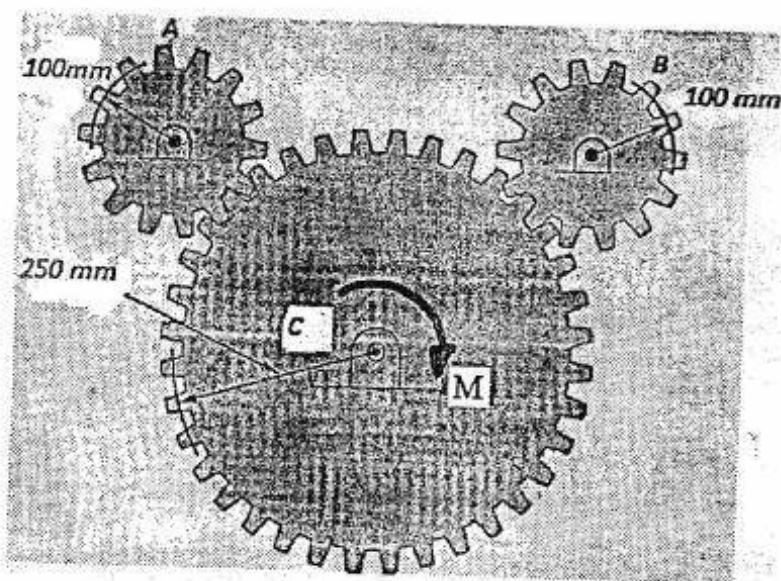
5. Define Coriolis acceleration of a rigid body in general plane motion. For the figure shown knowing that at the instant shown the velocity of point D is 2.4 m/s upward, determine (a) the angular velocity of rod AB, (b) the velocity of the midpoint of rod BD.

[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]



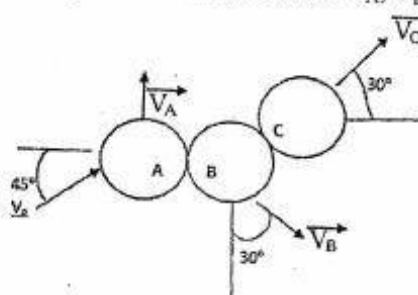
TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2076 Chaitra

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

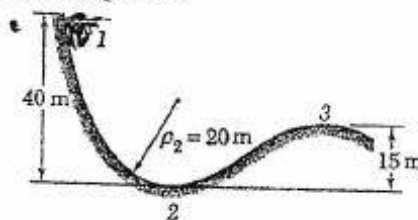
Subject: - Applied Mechanics (Dynamics) (CE 501)

- ✓ 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.

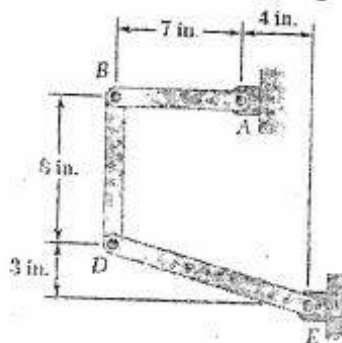
- Derive the radial and transverse components of acceleration when a particle moves in a curvilinear path. [6]
- In a game of pool ball A is moving with a velocity V_0 of magnitude 5m/s when it strikes balls B and C, where at rest and aligned shown knowing that after the collision the three balls move in the directions indicated and assuming frictionless surfaces and perfectly elastic impact, determine the magnitude of the velocities V_A , V_B and V_C . [6]



- Derive the coefficient of restitution for two particles involve in direct central impact. A 30 KN car starts from rest at point 1 and moves without friction down the track shown. Determine the force exerted by the track on the car at point 2, and the minimum safe value of the radius of curvature at point 3. [4+4]

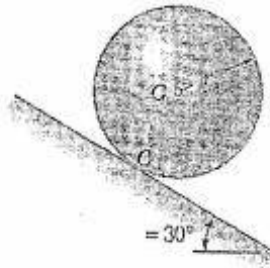


- Define instantaneous center of rotation with example. In the position shown, bar AB has an angular velocity of 6 rad/s clockwise. Determine the angular velocity of bar BD. [3+5]



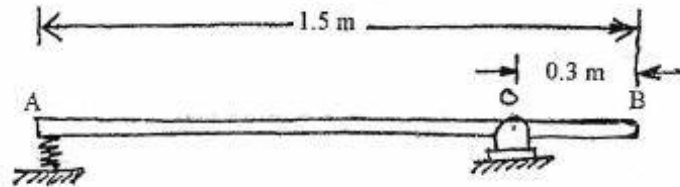
5. A sphere of weight 80 kN is released with no initial velocity and rolls without slipping on the incline. Determine: a) the minimum value of the coefficient of friction, b) the velocity of G after the sphere has rolled 15 ft and c) the velocity of G if the sphere were to move 20 ft down a frictionless incline.

[6]



6. A 15 kg slender rod AB is 1.5 m long and is pivoted about a point O which is 0.3 m from the end B. The other end is pressed against a spring of constant $K = 300 \text{ kN/m}$ until the spring is compressed 25 mm. The rod is then in horizontal position. If the rod is released from this position, determine the angular velocity as the rod passes through a vertical position.

[6]

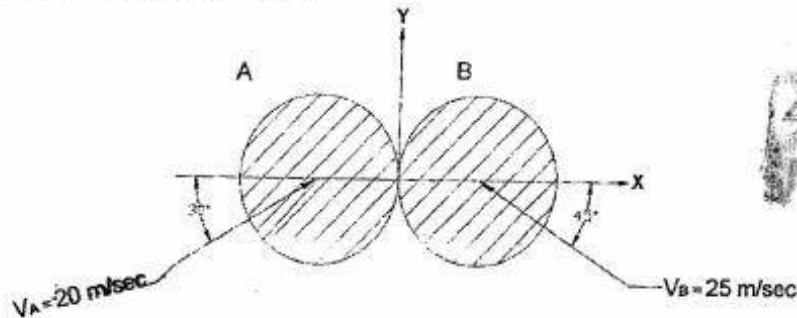


Exam.	BE	Full Marks	40
Level	BE	Full Marks	40
Programme	BCE, BGE	Pass Marks	16
Year / Part	II / I	Time	1 ½ hrs.

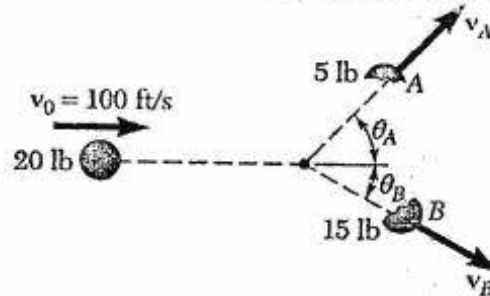
Subject: - Applied Mechanics (Dynamics) (CE501)

- ✓ 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.

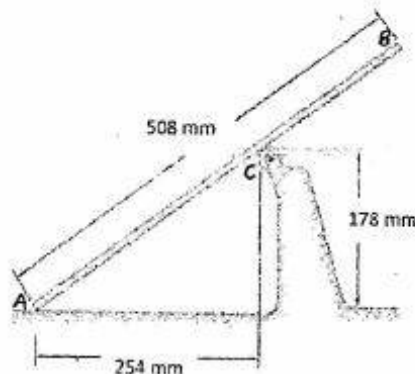
1. The magnitude and direction of the velocities of two balls A and B having masses 1.2kg and 1.8kg respectively before they strike each other are shown as in figure below. Assuming $e = 0.84$, determine the velocity of each ball after the impact. How much K.E. will be lost due to the impact? [8]



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 $\theta_A = 45^\circ$ and $\theta_B = 30^\circ$. Determine the velocity of each fragment. [8]

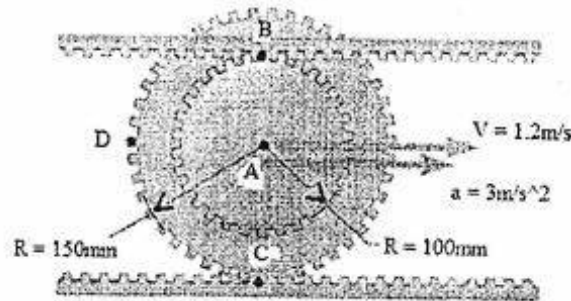


3. Rod AB moves over a small wheel at C while end A moves to the right with a constant velocity of 635 mm/s. At the instant shown, determine (a) the angular velocity of the rod, (b) the velocity of end B of the rod. [8]



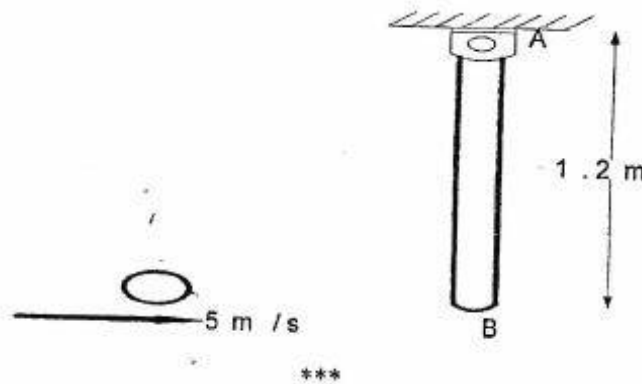
4. The center of the double gear has a velocity and acceleration to the right of 1.2 m/s and 3 m/s^2 , respectively. The lower rack is stationary. Determine (a) the angular acceleration of the gear, and (b) the acceleration of points B, C and D.

[8]



5. A 2.5-kg sphere moving horizontally to the right with an initial velocity of 7 m/s strikes the lower end of a 10-kg rod AB. The rod is suspended from a hinge at A and is initially at rest. Knowing that the coefficient 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]

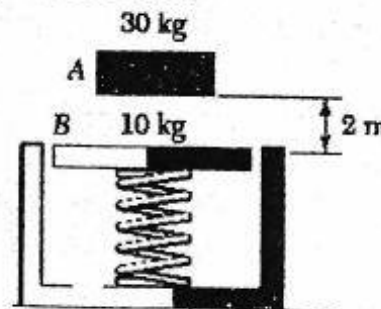


Exam.	Regular / Back		
Level	BE	Full Marks	40
Programme	BCE, BGE	Pass Marks	16
Year / Part	II / I	Time	1 1/2 hrs.

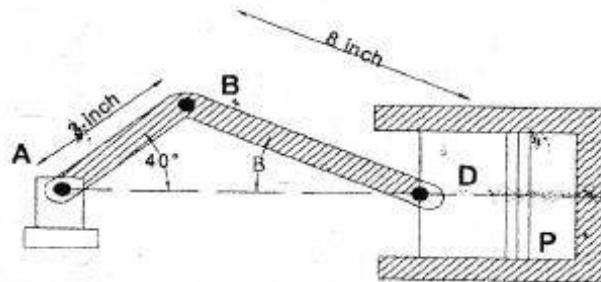
Subject: - Applied Mechanics (Dynamics) (CE 501)

- ✓ 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.

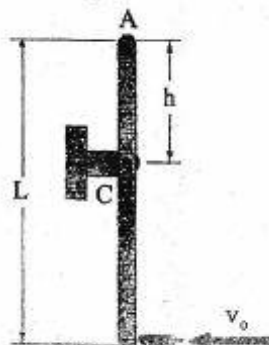
1. Define relative velocity and acceleration with suitable example. [2+2]
2. A 30-kg block is dropped from a height of 2m onto the 10-kg pan of a spring scale. Assuming the impact to be perfectly plastic, determine the maximum deflection of the pan. The constant of the spring is $k=30 \text{ kN/m}$. [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 $L=600\text{mm}$. Knowing that $h=240\text{mm}$ and that the bar is initially at rest, determine
 - 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.

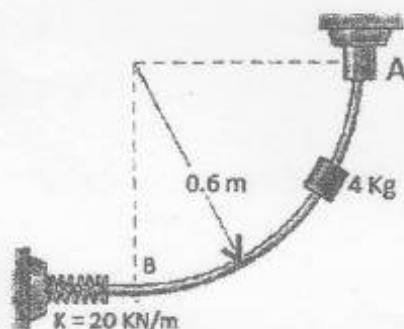


Exam.	Regular		
Level	BE	Full Marks	40
Programme	BCE, BGE	Pass Marks	16
Year / Part	II / I	Time	1 ½ hrs.

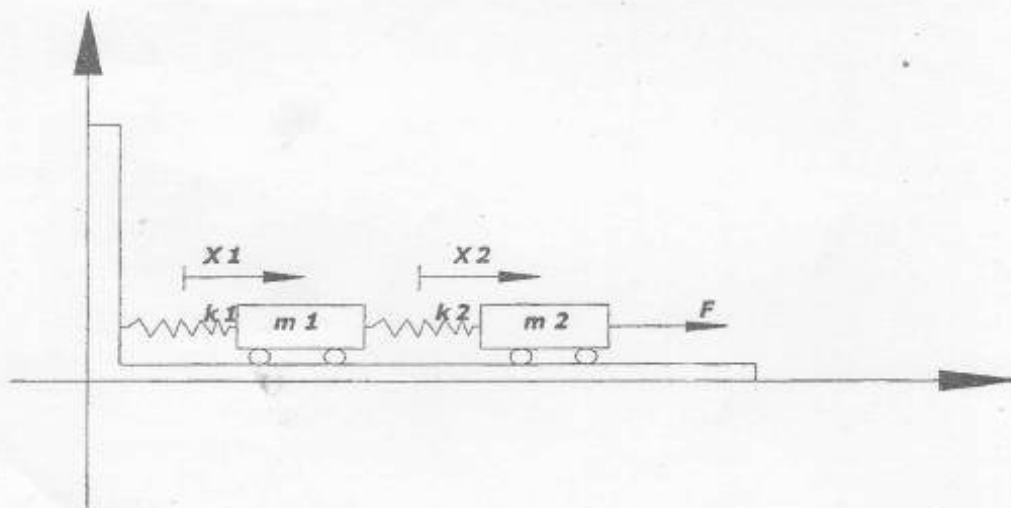
Subject: - Applied Mechanics (Dynamics) (CE501)

- ✓ 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.
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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]

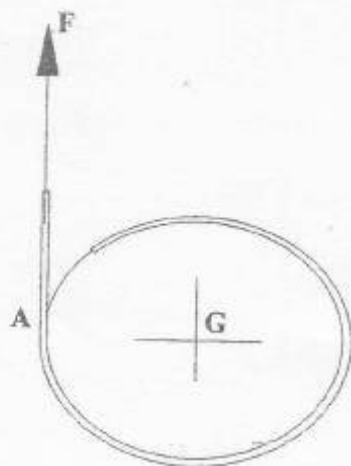


3. Two masses shown in figure oscillate on the smooth plane in the x-direction.
 - a) Write the differential equation of motion for each mass
 - b) Find the equation of motion for the center of the mass.
 - c) Write the expression for kinetic and potential energy of the system of particles.
 [6]



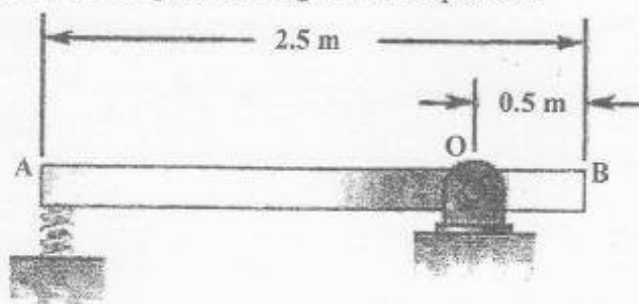
4. A cord is wrapped around a homogenous disk of radius $r = 0.5 \text{ m}$ and mass 20 kg . If the cord is pulled upward with a force of magnitude $F = 250 \text{ N}$, determine (a) the angular acceleration of the disk, (b) the acceleration of the disk and (c) the acceleration of the cord.

[6]



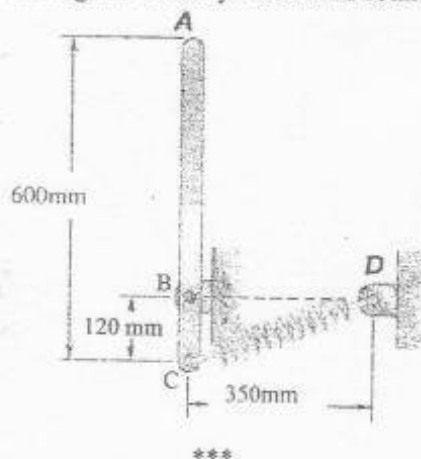
5. A 15 kg slender rod pivots about the point O . The other end is pressed against a spring ($k = 300 \text{ kN/m}$) until the spring is compressed one inch and the rod is in a horizontal position. If the rod is released from this position, determine its angular velocity and the reaction at the pivot 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 $k = 400 \text{ N/m}$ 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]

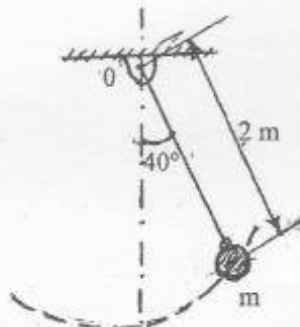


Exam.	Back		
Level	BE	Full Marks	40
Programme	BCE, BGE	Pass Marks	16
Year / Part	II / I	Time	1 ½ hrs.

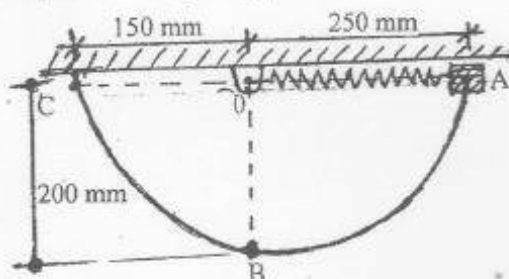
Subject: - Applied Mechanics (Dynamics) (CE501)

- ✓ 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.

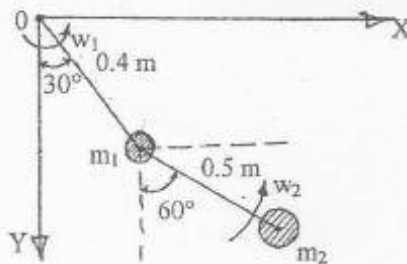
1. The bob of a 2 m pendulum describes an arc of circle in a vertical plane. If the tension in the cord is 2.5 times the weight of the bob for the position shown. Find the velocity and acceleration of the bob in the given position. [4]



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]

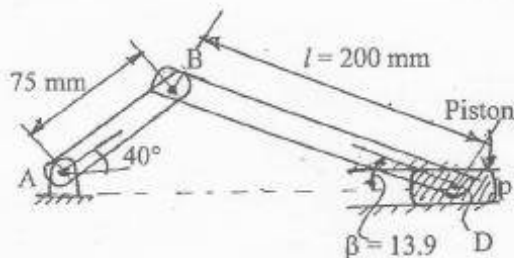


3. Derive the expression for resultant force for the system of variable mass. A double pendulum as shown in figure below oscillates in X-Y plane. At the instant shown, $w_1 = 4$ rad/sec CCW and $w_2 = 5$ rad/sec CCW. What will be the angular momentum about 'O' at this instant, if $m_1 = 3$ kg and $m_2 = 4$ kg? Note that the lower pendulum is connected to mass 'm₁' by a pin joint and is free to rotate about this point. [4+4]



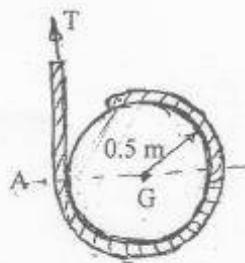
4. What is the meaning of Coriolis's acceleration in plane motion of Rigid body? Crank AB of the engine system shown in figure below, has a constant clockwise angular velocity of 2000 rev/min. For the crank position as shown in figure below, determine the angular acceleration of the connecting rod 'BD'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

[8]



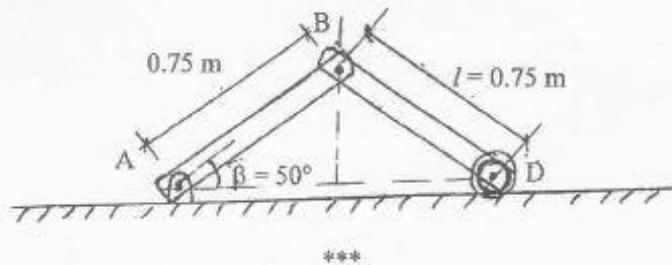
5. A cord is wrapped around a homogeneous disk of radius $r = 0.5$ m and mass $m = 15$ kg. If the cord is pulled upward with force $\vec{T}$ of magnitude 180 N, determine (a) the acceleration of the center of the disk (b) the angular acceleration of the disk (c) the acceleration of the cord.

[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 $\beta = 50^\circ$, determine (a) the angular velocity of rod "AB" when $\beta' = 20^\circ$ (b) the velocity of point 'D' at the same instant.

[2+6]

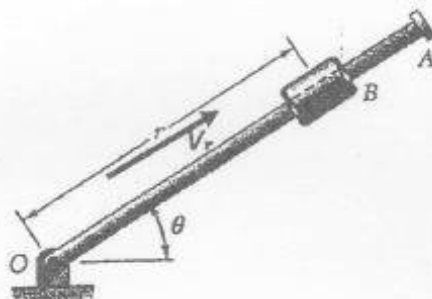


Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	40
Programme	BCE, BGE	Pass Marks	16
Year / Part	II / I	Time	1 ½ hrs.

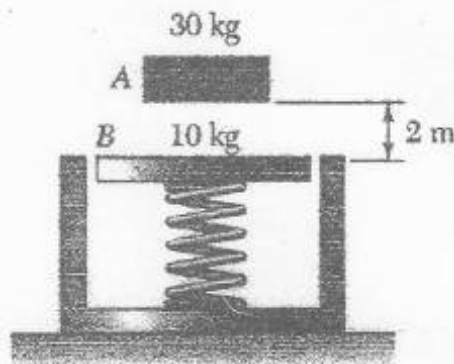
Subject: - Applied Mechanics (Dynamics) (CE501)

- ✓ 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 $r = 1 - 0.3t^2$ 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]

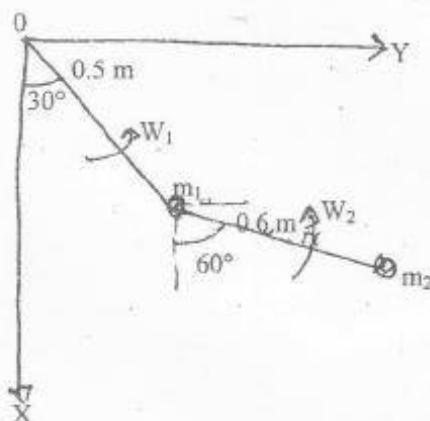


2. A 30 kg block is dropped from a height of 2 m onto the 10 kg pan of a spring scale. Assuming the impact to be perfectly plastic, determine the maximum deflection of the pan. The constant of the spring is $k = 20 \text{ kN/m}$. [8]



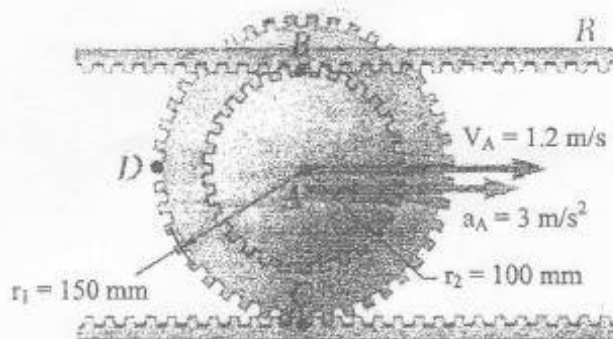
3. A double pendulum as shown in figure below oscillates in the X-Y plane. As shown in figure below, $W_1 = 2 \text{ rad/sec}$ CCW and $W_2 = 4 \text{ rad/sec}$ CCW. What is $\vec{H}_O$ at this instant if $m_1 = 1 \text{ kg}$ and $m_2 = 2 \text{ kg}$. The lower pendulum is connected to mass m_1 , by 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 $r = 0.5 \text{ m}$ and mass $m = 30 \text{ kg}$ as shown in figure below. If the cord is pulled upward with a force T of magnitude 200 N , 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]

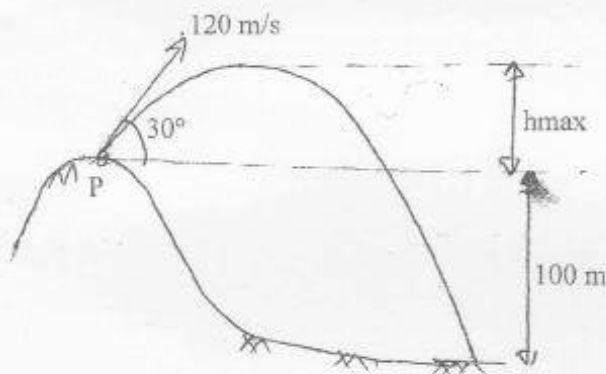
Exam.	Regular		
Level	BE	Full Marks	40
Programme	BCE, BGE	Pass Marks	16
Year / Part	II / I	Time	1 ½ hrs.

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.

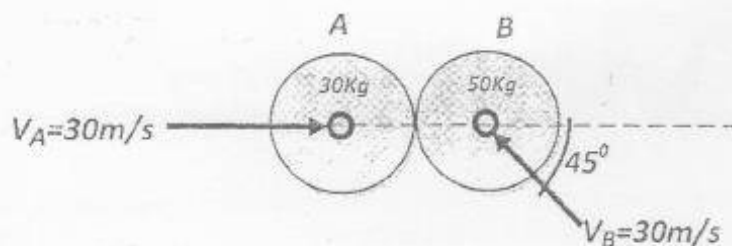
1. A bullet is fired at an angle of 30° to the horizontal from a point 'P' on a hill and it strikes a target which is 100m lower than the level of projection. The initial velocity of the bullet is 120 m/s. Neglecting the air resistance calculate:

[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 $m_A = 30 \text{ kg}$ and $m_B = 50 \text{ kg}$ 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.

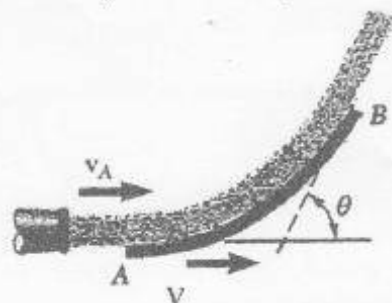
[8]



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:

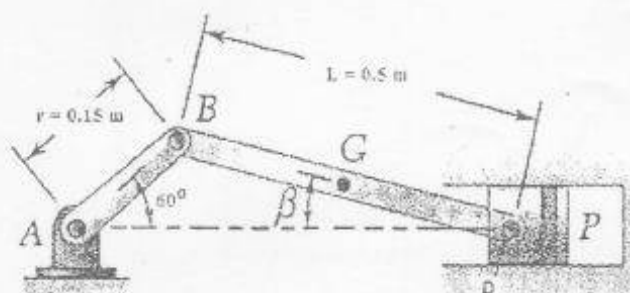
[8]

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



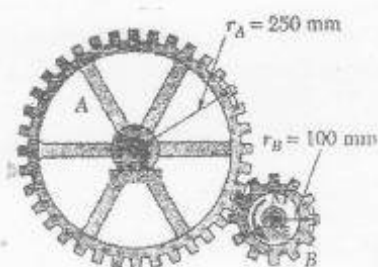
4. Crank AB of the engine system has a constant clockwise angular velocity of 200 rpm, which makes the angle 60° with horizontal level. For the crank position shown in figure below. Determine the angular acceleration of the connecting rod BD and the acceleration of point D.

[8]



5. The system is at rest when a moment of $M = 8 \text{ N-m}$ 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]



$$\begin{aligned} m_A &= 10 \text{ kg} & \bar{k}_A &= 200 \text{ mm} \\ m_B &= 3 \text{ kg} & \bar{k}_B &= 80 \text{ mm} \end{aligned}$$

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]

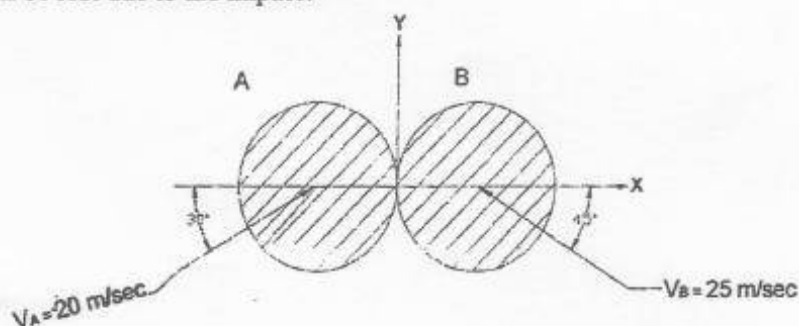
Exam.	Back		
Level	BE	Full Marks	40
Programme	BCE, BGE	Pass Marks	16
Year / Part	II / I	Time	1 ½ hrs.

Subject: - Applied Mechanics (Dynamics) (CE501)

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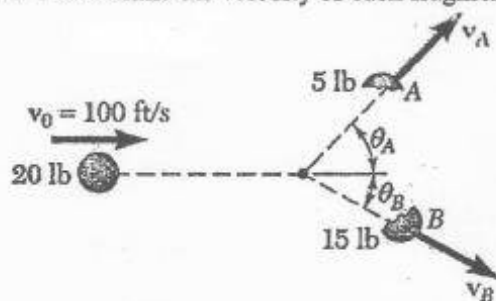
1. The magnitude and direction of the velocities of two balls A and B having masses 1.2kg and 1.8kg respectively before they strike each other are shown as in figure below. Assuming $e = 0.84$, determine the velocity of each ball after the impact. How much K.E. will be lost due to the impact?

[8]



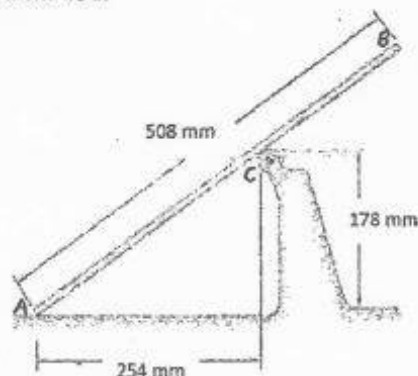
2. A 20-lb projectile is moving with a velocity of 100 ft/s when it explodes into 5 and 15-lb fragments. Immediately after the explosion, the fragments travel in the directions $\theta_A = 45^\circ$ and $\theta_B = 30^\circ$. Determine the velocity of each fragment.

[8]



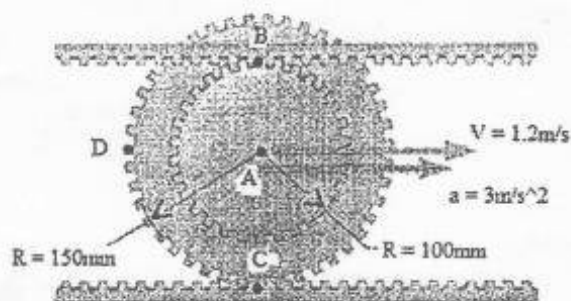
3. Rod AB moves over a small wheel at C while end A moves to the right with a constant velocity of 635 mm/s. At the instant shown, determine (a) the angular velocity of the rod, (b) the velocity of end B of the rod.

[8]



4. The center of the double gear has a velocity and acceleration to the right of 1.2 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 2.5-kg sphere moving horizontally to the right with an initial velocity of 7 m/s strikes the lower end of a 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]

