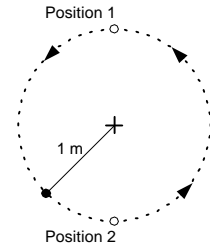


Problem 1 2 pts

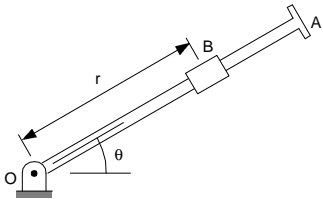
A child twirls a small ball attached to the end of a 1-m string so that the ball traces a circle in a vertical plane as shown. What is the minimum speed that the ball must have when in position 1.

- (a) 0 m/s (b) 3.13 m/s (c) 5.67 m/s (d) not enough information given (e) none of these

**Problem 2** 2 pts

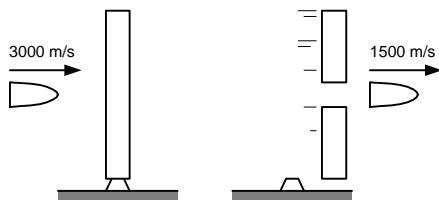
The rod OA shown in the figure is rotating in the x-y plane such that at any instant $\theta = t$ rad., where t is time measured in seconds. At the same time, Collar B is sliding outward along OA so that $r = 110t$ mm. (Again t is time measured in seconds). Determine the magnitude of the collar velocity when $t = 1$ s.

- (a) 110 mm/s (b) 155 mm/s (c) 220 mm/s (d) 12,100 mm/s (e) none of these

**Problem 3** 2pts

A 180 gram projectile with initial velocity of 3000 m/s strikes a disk of mass 960 grams. The disk is initially at rest. The projectile exits the disk with a velocity of 1500 m/s. Determine the final disk speed.

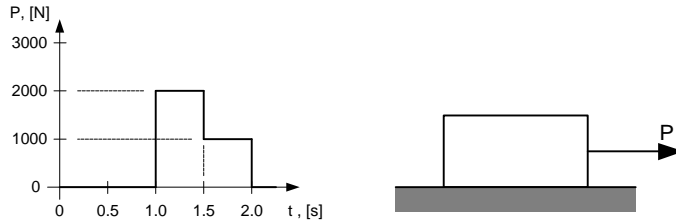
- (a) 0 m/s (b) 160 m/s (c) 281 m/s (d) 562 m/s (e) none of these



Problem 4 2pts

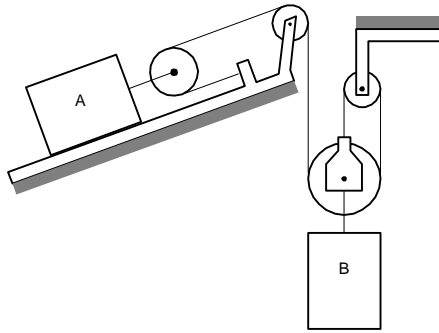
A 10-kg object is sitting on a frictionless surface when a force P is applied in the horizontal direction. If P varies according to the accompanying graph, remains constant in direction, and is the only force acting on the body in the horizontal direction, what is the speed of the object after 2 seconds?

- (a) 30 m/s (b) 40 m/s (c) 150 m/s (d) 400 m/s (e) none of these

**Problem 5** 2pts

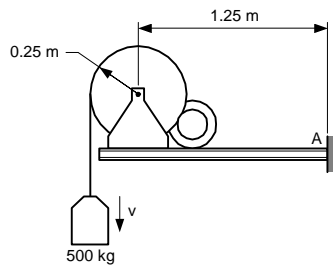
Block A has a velocity of 6 ft/s up the incline. What is the velocity of block B at this instant?

- (a) 2 ft/s down (b) 4 ft/s down (c) 6 ft/s down (d) 18 ft/s down (e) none of these

**Problem 6** 2pts

A mass of 500 kg is being lowered with a downward acceleration of 1.35 m/s^2 . Determine the tension in the hoisting cable.

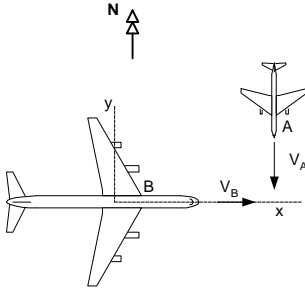
- (a) 175 N (b) 4230 N (c) 5580 N (d) 15,425 N (e) none of these



Problem 7 2pts

A passenger aircraft B is flying east with a speed of 500 km/hr. A military jet traveling south with a velocity of 1200 km/hr passes under B at a slightly lower altitude. What speed does A appear to have to a passenger in B?

- (a) 700 km/hr (b) 1200 km/hr (c) 1300 km/hr (d) 1700 km/hr (e) none of these

**Problem 8** 2pts

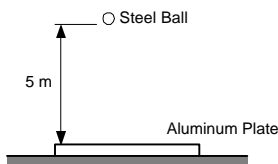
A punch press flywheel operates at 300 RPM with a mass moment of inertia of 15 slug-ft². Find the speed in RPM to which the wheel will be reduced after a sudden punching requiring 4500 ft-lb of work.

- (a) 5.83 RPM (b) 150 RPM (c) 187.8 RPM (d) 220 RPM (e) none of these

Problem 9 2pts

An experiment is performed to determine the coefficient of restitution for a 10 N steel ball and a heavy flat aluminum plate resting on the ground. The ball is dropped from a distance of 5 m above the plate and is measured to have a vertical speed of 4.8 m/s just after impact. Determine the coefficient of restitution.

- (a) 0.04 (b) 0.34 (c) 0.92 (d) 0.96 (e) none of these



Problem 10 2pts

A particle is acted on by a force given by $F = -(3x^2 + 2x)$. Where F is in Newton's and x is in meters. What is the work done by this force as the particle moves from $x = 0$ m to $x = 0.2$ m.

- (a) -0.040 J (b) -0.048 J (c) -0.104 J (d) -0.520 J (e) none of these

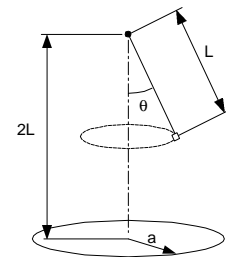
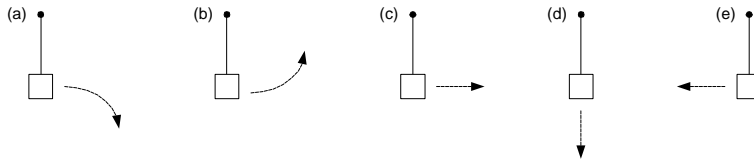
Problem 11 2pts

A man is standing on a bathroom scale in an elevator. When will the scale read the largest weight?

- (a) When the elevator starts to move downwards
 (b) When the elevator starts to move upwards
 (c) When the elevator is moving at a constant speed
 (d) When the elevator is at rest
 (e) None of the above

Problem 12 2pts

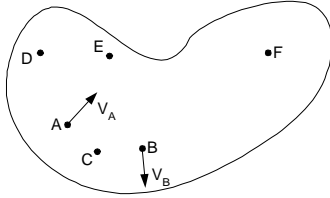
A bucket is attached to a rope of length L and is made to revolve in a horizontal circle. The bucket is rotating counterclockwise when viewed from the ceiling. Drops of water fall from the bucket and strike the floor along the perimeter of a circle of radius a . Which sketch accurately reflects the path of a drop of water as viewed from the ceiling?



Problem 13 2pts

A rigid body has velocities V_A and V_B as shown. Which labeled point on the body will have the greatest velocity?

- (a) Point A (b) Point C (c) Point D (d) Point E (e) Point F

**Problem 14** 2pts

Using the same rigid body of problem 13, which labeled point on the body will have the smallest velocity?

- (a) Point A (b) Point C (c) Point D (d) Point E (e) Point F

Problem 15 2pts

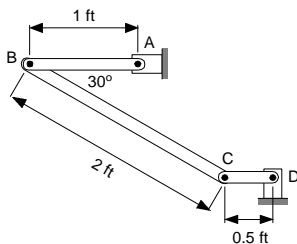
A rigid body rotating in a plane has a clockwise angular velocity of 1 rad/s and a counterclockwise angular acceleration of 2 rad/s^2 . Two points on this same rigid body are separated by 1 ft . Determine the magnitude of the normal relative acceleration component between these two points.

- (a) 0 ft/s^2 (b) 1 ft/s^2 (c) 2 ft/s^2 (d) 3 ft/s^2 (e) none of these

Problem 16 2pts


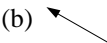


The angular velocity of rod AB is 5 rad/s clockwise. What is the angular velocity of rod BC?

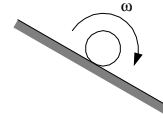
- (a) zero (b) 2.5 rad/s ccw (c) 5 rad/s ccw (d) undefined ω (e) none of these



Problem 17 2pts





A cylinder rolls without slipping down an inclined plane as shown below. What is the direction of the friction force?

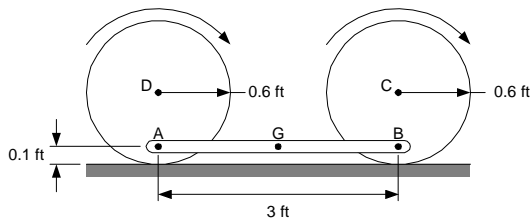
- (a)  (b)  (c)  (d)  (e) none of these



Problem 18 2pts

Two uniform disks rotate without slipping at a constant 4 rad/s cw. Determine the acceleration of the center of gravity, a_G , of the uniform connecting link mass center for the position shown.

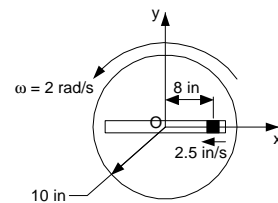
- (a) 0 ft/s^2  (b) 1.6 ft/s^2  (c) 8 ft/s^2  (d) 9.6 ft/s^2  (e) none of these



Problem 19 2pts

The axis xy is attached to the rotating disk. The pin travels with respect to the disk at a constant 2.5 in/s in the direction shown. If the disk rotates with a constant angular velocity of 2 rad/s in a ccw direction, determine the acceleration of the pin as it passes the point O.

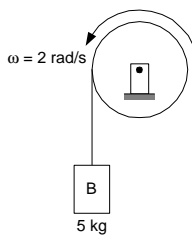
- (a) $-10 \mathbf{j} \text{ in/s}^2$ (b) $-8 \mathbf{i} \text{ in/s}^2$ (c) $0 \mathbf{j} \text{ in/s}^2$ (d) $10 \mathbf{j} \text{ in/s}^2$ (e) none of these



Problem 20 2pts

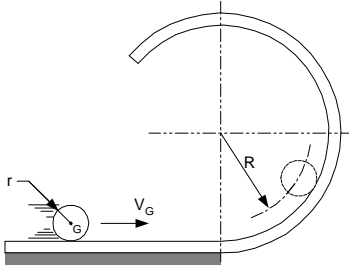
The disk has a radius of 0.4 m, a mass of 10 kg and a radius of gyration of 0.3m. Block B has a mass of 5 kg and a radius of gyration of 0.2 m. Determine the total kinetic energy of the system at this instant.

- (a) 1.8 J (b) 3.4 J (c) 3.8 J (d) 7.4 J (e) none of these



Problem 21 20pts

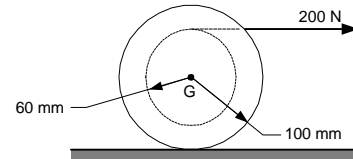
A ball of mass m and a radius r is cast onto the horizontal surface such that it rolls without slipping. Determine the speed V_G of its mass center G so that it rolls without slipping completely around the loop of radius $R + r$ without leaving the track. $I_G = (2/5)mr^2$. Express your answer in terms of radius R and the acceleration of gravity g . Hint: The velocity of the ball at the top of the circle is not zero.



Problem 22 20pts

A cord is wrapped around the inner drum of a wheel and pulled horizontally with a force of 200N. The wheel has a mass of 50 kg and a radius of gyration of 0.07 m. Let $\mu_s = 0.20$ and $\mu_k = 0.15$.

- (a) Determine the friction force, F at the wheel ground contact point assuming that the wheel rolls without slipping.
- (b) Compare the friction force F found in (a) to F_{\max} and comment with respect to the rolling without slipping assumption.



Problem 23 20pts

A slender 12 ft. bar weighing 322 lbs. in the vertical plane is released from rest 1ft. 6 5/8 in. above a firmly fixed peg A in the position shown. The bar has a small hook attached at one end and arranged so that it will remain hooked to peg A as it rotates. The rotating bar impacts another peg B 8 ft. directly below peg A . The coefficient of restitution between peg B and the bar is 0.4. **What is the bar's angular speed just after impact with peg B ?** (Hint: Energy is lost when the hook hits peg A .)

