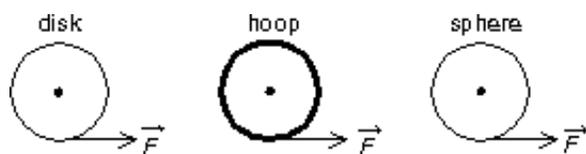


### Question 1 (2 points)

A uniform solid disk, a thin hoop, and a uniform solid sphere, all with the same mass and same outer radius, are each free to rotate about a fixed axis through its center. Assume the hoop is connected to the rotation axis by light spokes. With the objects starting from rest, identical forces are simultaneously applied to the rims, as shown. Rank the objects according to their angular velocities after a given time  $t$ , **least to greatest**.



a) disk, hoop, sphere

b) disk, sphere, hoop

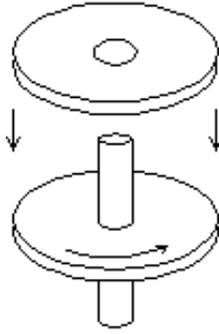
c) hoop, sphere, disk

d) hoop, disk, sphere

e) sphere, disk, hoop

### Question 2 (2 points)

A wheel, with rotational inertia  $I$ , mounted on a vertical shaft with negligible rotational inertia, is rotating with angular speed  $\omega_0$ . A non rotating wheel with rotational inertia  $2I$  is suddenly dropped onto the same shaft as shown. What is the resultant rotational speed of the combination of the two wheels and shaft?



- a)  $\omega_0/9$
- b)  $2\omega_0$
- c)  $\omega_0/3$
- d)  $3\omega_0$
- e)  $\omega_0/4$

### Question 3 (2 points)

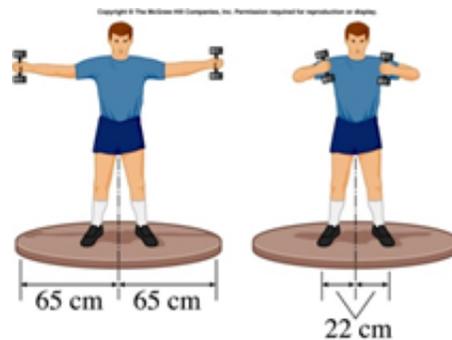
The angular velocity of a rotating turntable is given in rad/s by

$\omega(t) = 4.5 + 0.64t - 2.7t^2$ . What is its angular acceleration at  $t = 2.0$  s?

- a) -10 rad/s
- b) -5.0 rad/s
- c) -5.4 rad/s
- d) 2.4 rad/s
- e) 3.1 rad/s

#### Question 4 (2 points)

A student stands on a horizontal platform that is free to rotate around a vertical axis. He holds two weights in his outstretched hands. Another student gives him a push and starts the platform rotating at 0.500 rev/s. The student then pulls the weights in close to his chest. What happens and why?



- a) They speed up because angular momentum is conserved, and they increased their moment of inertia
- b) They slow down because rotational kinetic energy is conserved, and they decreased their moment of inertia
- c) They speed up because rotational kinetic energy is conserved, and they decreased their moment of inertia
- d) They slow down because rotational kinetic energy is conserved, and they increased their moment of inertia
- e) They speed up because angular momentum is conserved, and they lowered their moment of inertia
- f) Both (c) and (e) are correct

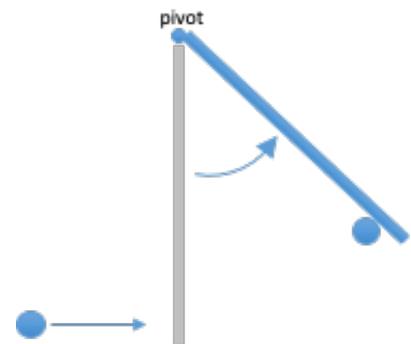
### Question 5 (2 points)

An ice cube starts from rest and slides down a frictionless ramp starting from a height  $h$ . At the same time, a solid sphere starts from rest and rolls without slipping down a ramp starting from a height  $h$ . Which one has the largest translational speed at the bottom and why?

- a) The sphere because it has more total energy
- b) The sphere because it has the lower moment of inertia
- c) The ice because it has the more total energy
- d) The ice because it has no rotational energy
- e) They tie because they have the same total energy

### Question 6 (2 points)

A uniform bar of mass  $m$  and length  $L$  is pivoted at one end and hanging vertically. A piece of clay is shot at the bar and sticks to it. As a result, the bar swings upward to some maximum angle.



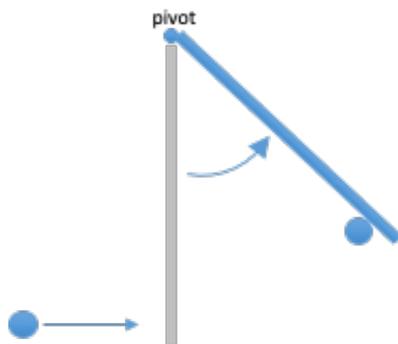
You are asked to find the angular speed right after the collision. What concept could you use?

- A) Newton's 2nd Law combined with constant-acceleration kinematics
- B) Conservation of energy
- C) Conservation of angular momentum
- D) All three would work
- E) Two of the three would work

- a) A only
- b) B only
- c) C only
- d) D
- e) E

### Question 7 (2 points)

A uniform bar of mass  $m$  and length  $L$  is pivoted at one end and hanging vertically. A piece of clay is shot at the bar and sticks to it. As a result, the bar swings upward to some maximum angle.



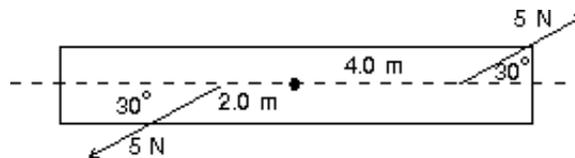
You are asked to find the **maximum height** that it reaches, given that you already found the angular speed right after the collision. What concept could you use?

- A) Newton's 2nd Law combined with constant-acceleration kinematics
- B) Conservation of energy
- C) Conservation of angular momentum
- D) All three would work
- E) Two of the three would work

- a) A only
- b) B only
- c) C only
- d) D
- e) E

### Question 8 (2 points)

A rod is pivoted about its center. A 5-N force is applied 4 m from the pivot and another 5-N force is applied 2 m from the pivot, as shown. What is the magnitude of the net torque about the pivot?



- a) 0 N.m
- b) 5.0 N.m
- c) 8.7 N.m
- d) 15 N.m
- e) 26 N.m

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*0 of 8 questions saved*