Practice Exam Chapters 6-8 (Ungraded) (11820676)

Due: Wed, Apr 8, 2020 05:00 PM EDT

Question 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25

Description

This will not be graded. It is for your practice only. There will be few questions on the real test. I wanted to provide more for your practice.

1. Question Details SerCP8 8.MC.009. [3499874]

A solid disk and a hoop are simultaneously released from rest at the top of an incline and roll down without slipping. Which object reaches the bottom first?

- The one that has the largest radius arrives first.
- The one that has the largest mass arrives first.
- The hoop and the disk arrive at the same time.
- The disk arrives first.
- The hoop arrives first.

2. Question Details SerCP8 8.MC.013. [3499796]

A mouse is initially at rest on a horizontal turntable mounted on a frictionless, vertical axle. As the mouse begins to walk clockwise around the perimeter, which of the following statements *must* be true of the turntable?

- It turns counterclockwise with the same angular velocity as the mouse.
- It also turns clockwise.
- It remains stationary.
- It turns counterclockwise because mechanical energy is conserved.
- It turns counterclockwise because angular momentum is conserved.

3. Question Details SerCP9 7.MC.002. [3503200]

A 0.400-kg object attached to the end of a string of length 0.500 m is swung in a circular path and in a vertical plane. If a constant angular speed of 8.00 rad/s is maintained, what is the tension in the string when the object is at the top of the circular path?

- 8.88 N
- 10.5 N
- 12.8 N
- 19.6 N
- none of these

4. Question Details SerCP9 7.MC.003. [3503133] -

A cyclist rides a bicycle with a wheel radius of 0.500 m across campus. A piece of plastic on the front rim makes a clicking sound every time it passes through the fork. If the cyclist counts 320 clicks between her apartment and the cafeteria, how far has she traveled?

- 0.80 km
- 0.50 km
- 1.0 km
- 1.5 km
- 1.8 km

5. Question Details SerCP9 7.MC.006. [3503351] -

Consider an object on a rotating disk a distance *r* from its center, held in place on the disk by static friction. Which of the following statements is *not* true concerning this object?

- If the disk has an angular acceleration, the object has both a centripetal and a tangential acceleration.
- If the angular speed is constant, the object is not accelerated.
- The object has a tangential acceleration only if the disk has an angular acceleration.
- The object always has a centripetal acceleration except when the angular speed is zero.
- If the angular speed is constant, the object must have constant tangential speed.

6. Question Details SerCP9 7.MC.007. [3503236] -

A merry-go-round rotates with constant angular speed. As a rider moves from the rim of the merry-go-round toward the center, what happens to the magnitude of total centripetal force that must be exerted on him?

- It increases.
- It decreases.
- It is not zero, but remains the same.
- It's always zero.
- It increases or decreases, depending on the direction of rotation.

7. Question Details SerCP9 7.MC.009. [3503373] -

A satellite moves in a circular orbit at a constant speed around Earth. Which of the following statements is true?

- Work is done on the satellite by the force of gravity.
- The satellite has an acceleration directed toward Earth.
- The satellite has an acceleration directed away from Earth.
- The satellite moves at constant speed and hence doesn't accelerate.
- No force acts on the satellite.

8. Question Details SerCP9 8.MC.001. [3503462]

What is the magnitude of the angular acceleration of a 25.0-kg disk of radius 0.800 m when a torque of magnitude 40.0 N · m is applied to it?

- ○ 10.0 rad/s^2
- ○ 7.50 rad/s^2
- ○ 12.5 rad/s^2
- ○ 5.00 rad/s^2
- ○ 2.50 rad/s^2

9. Question Details SerCP9 8.MC.003. [3503697]

A wrench 0.500 m long is applied to a nut with a force of 80.0 N. Because of the cramped space, the force must be exerted upward at an angle of 60.0° with respect to a line from the bolt through the end of the wrench. How much torque is applied to the nut?

- ○ 34.6 N · m
- ○ 20.0 N · m
- ○ 11.8 N · m
- ○ 14.2 N · m
- ○ 4.56 N · m

10. Question Details SerCP9 6.MC.001. [3503298]

A soccer player runs up behind a 0.450-kg soccer ball traveling at 3.20 m/s and kicks it in the same direction as it is moving, increasing its speed to 12.8 m/s. What magnitude impulse did the soccer player deliver to the ball?

- ○ 2.45 kg · m/s
- ○ 5.61 kg · m/s
- ○ 4.32 kg · m/s
- ○ 7.08 kg · m/s
- ○ 9.79 kg · m/s

11. Question Details SerCP9 6.MC.003. [3503139]

A car of mass m traveling at speed v crashes into the rear of a truck of mass $2m$ that is at rest and in neutral at an intersection. If the collision is perfectly inelastic, what is the speed of the combined car and truck after the collision?

- ○ v
- ○ $v/2$
- ○ $v/3$
- ○ $2v$
- ○ none of these

12. Question Details SerCP9 6.MC.004. [3503292]

A 57.0-g tennis ball is traveling straight at a player at 21.0 m/s. The player volleys the ball straight back at 25.0 m/s. If the ball remains in contact with the racket for 0.060 s, what average force acts on the ball?

- 102 kg · m/s^2
- 32.5 kg · m/s^2
- 43.7 kg · m/s^2
- 72.1 kg · m/s^2
- 22.6 kg · m/s^2

13. Question Details SerCP9 6.MC.006. [3503369]

A 5-kg cart moving to the right with a velocity of +6 m/s collides with a concrete wall and rebounds with a velocity of −2 m/s. What is the change of momentum of the cart?

- 40 kg · m/s
- −10 kg · m/s
- −40 kg · m/s
- −30 kg · m/s
- 0

14. Question Details SerCP9 6.MC.007. [3503207]

A 1.7-kg object moving to the right with a speed of 4.3 m/s makes a head-on, elastic collision with a 1.1-kg object that is initially at rest. What is the velocity of the 1.1-kg object after the collision?

- greater than 4.3 m/s
- less than 4.3 m/s
- equal to 4.3 m/s
- zero
- impossible to say based on the information provided

15. Question Details SerCP9 6.MC.008. [3503277]

A 3-kg object moving to the right on a frictionless, horizontal surface with a speed of 2 m/s collides head on and sticks to a 2-kg object that is initially moving to the left with a speed of 4 m/s. After the collision, which statement is true?

- The kinetic energy of the system is 20 J.
- The momentum of the system is less than the momentum of the system before the collision.
- The kinetic energy of the system is greater than 5 J but less than 20 J.
- The momentum of the system is −2 kg · m/s.
- The momentum of the system is 14 kg · m/s.

16. Question Details SerCP10 6.P.001. [3490035]

Calculate the magnitude of the linear momentum for the following cases.

(a) a proton with mass 1.67×10^{-27} kg, moving with a speed of 4.30×10^{6} m/s

7.18e-21 kg · m/s

(b) a 15.5-g bullet moving with a speed of 455 m/s

7.05 kg · m/s

(c) a 73.5-kg sprinter running with a speed of 12.0 m/s

882 kg · m/s

(d) the Earth (mass = 5.98×10^{24} kg) moving with an orbital speed equal to 2.98×10^{4} m/s.

1.78e+29 kg · m/s

Solution or Explanation

Use $p = mv$ for each of the following calculations.

(a) $p = (1.67 \times 10^{-27}\text{ kg})(4.30 \times 10^{6}\text{ m/s}) = \underline{7.18 \times 10^{-21}\text{ kg} \cdot \text{m/s}}$

(b) $p = (0.0155\text{ kg})(455\text{ m/s}) = \underline{7.05\text{ kg} \cdot \text{m/s}}$

(c) $p = (73.5\text{ kg})(12.0\text{ m/s}) = \underline{882\text{ kg} \cdot \text{m/s}}$

(d) $p = (5.98 \times 10^{24}\text{ kg})(2.98 \times 10^{4}\text{ m/s}) = \underline{1.78 \times 10^{29}\text{ kg} \cdot \text{m/s}}$

17. Question Details SerCP10 6.P.005. [3490134]

Drops of rain fall perpendicular to the roof of a parked car during a rainstorm. The drops strike the roof with a speed of 13 m/s, and the mass of rain per second striking the roof is 0.042 kg/s.

(a) Assuming the drops come to rest after striking the roof, find the average force exerted by the rain on the roof.

magnitude [ ] 0.546 N

direction ---Select--- downward

(b) If hailstones having the same mass as the raindrops fall on the roof at the same rate and with the same speed, how would the average force on the roof compare to that found in part (a)? (Assume the hailstones bounce back up off the roof.)

- The magnitude would be one fourth times in part (a).
- The magnitude would be double that in part (a).
- The magnitude would be half that in part (a).
- The magnitude would be the same as in part (a).

Solution or Explanation

(a) If Δm is the mass of rain hitting the roof in time Δt, the impulse imparted to the rain by the roof is

$$\vec{\mathbf{I}}_{\text{rain}} = (\vec{\mathbf{F}}_{\text{av}})_{\text{rain}}\,\Delta t = (\Delta m)\vec{\mathbf{v}}_f - (\Delta m)\vec{\mathbf{v}}_i$$

or (taking upward as positive)

$$(\vec{\mathbf{F}}_{\text{av}})_{\text{rain}} = \frac{0 - (\Delta m)\vec{\mathbf{v}}_i}{\Delta t} = (0.042\text{ kg/s})[0 - (-13\text{ m/s})] = +0.546\text{ N}.$$

From Newton's third law, the average force the rain exerts on the roof is

$$(\vec{\mathbf{F}}_{\text{av}})_{\text{roof}} = -(\vec{\mathbf{F}}_{\text{av}})_{\text{rain}} = -0.546\text{ N} = 0.546\text{ N downward}.$$

(b) Hailstones striking the roof would rebound upward, and hence experience a greater change in momentum than that experienced by an equal mass of liquid water which strikes the roof without rebounding. Thus, the impulse-momentum theorem, $\vec{\mathbf{F}} = \Delta\vec{\mathbf{p}}/\Delta t$, tells us that the hail will experience a greater average force than that experienced by an equal mass of water striking the roof. Newton's third law then tells us that the hailstones will exert the greater force on the roof.

18. Question Details SerCP10 6.P.023. [3490209]

A 45.0-kg girl is standing on a 157-kg plank. The plank, originally at rest, is free to slide on a frozen lake, which is a flat, frictionless surface. The girl begins to walk along the plank at a constant velocity of 1.35 m/s to the right relative to the plank. (Let the direction the girl is moving in be positive. Indicate the direction with the sign of your answer.)

(a) What is her velocity relative to the surface of ice?

[ ] 1.05 m/s

(b) What is the velocity of the plank relative to the surface of ice?

[ ] -0.301 m/s

Solution or Explanation

The velocity of the girl relative to the ice, v_{GI}, is $v_{GI} = v_{GP} + v_{PI}$, where v_{GP} = velocity of girl relative to plank, and v_{PI} = velocity of plank relative to ice. Since we are given that $v_{GP} = 1.35$ m/s, this becomes

$v_{GI} = 1.35 \text{ m/s} + v_{PI}$. **[1]**

(a) Conservation of momentum gives $m_G v_{GI} + m_P v_{PI} = 0$, or $v_{PI} = -(m_G/m_P)v_{GI}$. **[2]**

Then, Equation [1] becomes

$$v_{GI} = 1.35 \text{ m/s} - \left(\frac{m_G}{m_P}\right)v_{GI} \text{ or } \left(1 + \frac{m_G}{m_P}\right)v_{GI} = 1.35 \text{ m/s}$$

giving

$$v_{GI} = \frac{1.35 \text{ m/s}}{1 + \left(\frac{45.0 \text{ kg}}{157 \text{ kg}}\right)} = 1.05 \text{ m/s}.$$

(b) Then, using Equation [2] above,

$$v_{PI} = -\left(\frac{45.0 \text{ kg}}{157 \text{ kg}}\right)(1.05 \text{ m/s}) = -0.301 \text{ m/s}$$

or $v_{PI} = 0.301$ m/s directed opposite to the girl's motion.

19. Question Details SerCP10 7.P.004. [3490485]

A potter's wheel moves uniformly from rest to an angular speed of 0.15 rev/s in 32.0 s.

(a) Find its angular acceleration in radians per second per second.

[ ] 0.0295 rad/s^2

(b) Would doubling the angular acceleration during the given period have doubled final angular speed?

- ○ Yes
- ○ No

Solution or Explanation

(a) We have the following formula.

$$\alpha = \frac{\omega_f - \omega_i}{t}$$

We use it to find the angular acceleration.

$$\alpha = \frac{0.15\ \text{rev/s} - 0}{32.0\ \text{s}}\left(\frac{2\pi\ \text{rad}}{1\ \text{rev}}\right) = \underline{0.0295\ \text{rad/s}^2}$$

(b) Yes. When an object starts from rest, its angular speed is related to the angular acceleration and time by the equation

$$\omega = \alpha\,(\Delta t)$$

Thus, the angular speed is directly proportional to both the angular acceleration and the time interval. It the time interval is held constant, doubling the angular acceleration will double the angular speed attained during the interval.

20. Question Details SerCP10 7.P.012. [3490321]

A 41.0-cm diameter disk rotates with a constant angular acceleration of 3.00 rad/s^2. It starts from rest at t = 0, and a line drawn from the center of the disk to a point P on the rim of the disk makes an angle of 57.3° with the positive x-axis at this time.

(a) At t = 2.50 s, find the angular speed of the wheel.
7.5 rad/s

(b) At t = 2.50 s, find the magnitude of the linear velocity and tangential acceleration of P.

linear velocity 1.54 m/s
tangential acceleration 0.615 m/s^2

(c) At t = 2.50 s, find the position of P (in degrees, with respect to the positive x-axis).
-126 ° counterclockwise from the +x-axis

Solution or Explanation

Note: We are displaying rounded intermediate values for practical purposes. However, the calculations are made using the unrounded values.

(a) The angular speed is $\omega = \omega_0 + \alpha t = 0 + (3.00 \text{ rad/s}^2)(2.50 \text{ s}) = 7.50 \text{ rad/s}$

(b) Since the disk has a diameter of 41.0 cm, its radius is r = (0.410 m/2) = 0.205 m. Thus,

$$v_t = r\omega = (0.205 \text{ m})(7.50 \text{ rad/s}^2) = 1.54 \text{ m/s}$$

and

$$a_t = r\alpha = (0.205 \text{ m})(3.00 \text{ rad/s}^2) = 0.615 \text{ m/s}^2$$

(c) The angular displacement of the disk is

$$\Delta\theta = \theta_f - \theta_0 = \frac{\omega_f^2 - \omega_0^2}{2\alpha} = \frac{(7.50 \text{ rad/s})^2 - 0}{2(3.00 \text{ rad/s}^2)} = (9.38 \text{ rad})\left(\frac{360°}{2\pi \text{ rad}}\right) = 537°$$

and the final angular position of the radius line through P is

$$\theta_f = \theta_0 + \Delta\theta = 57.3° + 537° = 594°$$

or it is at 234° counterclockwise from the +x-axis after turning 177° beyond one full revolution.

21. Question Details SerCP10 7.P.022.MI.FB. [4272169]

A 36.0-kg child swings in a swing supported by two chains, each 3.06 m long. The tension in each chain at the lowest point is 416 N.

(a) Find the child's speed at the lowest point.
6.38 m/s

(b) Find the force exerted by the seat on the child at the lowest point. (Ignore the mass of the seat.)
832 N (upward)

22. Question Details SerCP10 8.P.005. [4274104]

A simple pendulum consists of a small object of mass 2.7 kg hanging at the end of a 2.0-m-long light string that is connected to a pivot point.

(a) Calculate the magnitude of the torque (due to the force of gravity) about this pivot point when the string makes a 3.5° angle with the vertical.

3.23 N · m

(b) Does the torque increase or decrease as the angle increase?

- increase
- decrease

Explain.

Key: Since sin θ increases as θ, the torque also increases with the angle.

Solution or Explanation

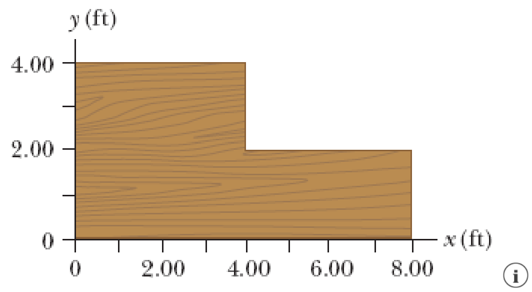
$|\tau| = F \cdot (\text{lever arm}) = mg \cdot [L \sin(\theta)] = (2.7\text{ kg})(9.8\text{ m/s}^2) \cdot [(2.0)\sin(3.5°)] = 3.23\text{ N} \cdot \text{m}$

23. Question Details SerCP10 8.P.011. [4272029]

Find the x- and y-coordinates of the center of gravity of a 4.00-ft by 8.00-ft uniform sheet of plywood with the upper right quadrant removed as shown in the figure below. *Hint*: The mass of any segment of the plywood sheet is proportional to the area of that segment.

x = 3.33 ft

y = 1.67 ft



Solution or Explanation

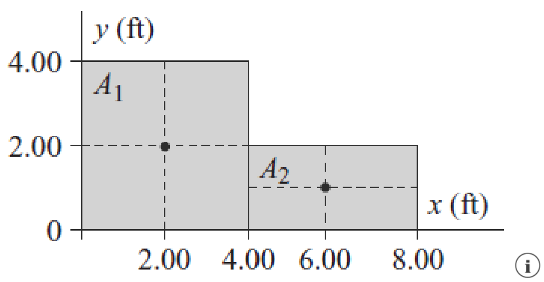
Note the values in this solution reflect those of the text book question, not the values you may have received for this question above.

Consider the remaining plywood to consist of two parts: A_1 is a 4.00 ft by 4.00 ft section with center of gravity located at (2.00 ft, 2.00 ft), while A_2 is a 2.00 ft by 4.00 ft section with center of gravity at (6.00 ft, 1.00 ft). Since the plywood is uniform, its mass per area σ is constant and the mass of a section having area A is $m = \sigma A$. The center of gravity of the remaining plywood has coordinates given by

$$x_{cg} = \frac{\sum m_i x_i}{\sum m_i} = \frac{\sigma A_1 x_1 + \sigma A_2 x_2}{\sigma A_1 + \sigma A_2} = \frac{(16.0\text{ ft}^2)(2.00\text{ ft}) + (8.00\text{ ft}^2)(6.00\text{ ft})}{(16.0\text{ ft}^2) + (8.00\text{ ft}^2)} = 3.33\text{ ft}$$

and

$$y_{cg} = \frac{\sum m_i y_i}{\sum m_i} = \frac{\sigma A_1 y_1 + \sigma A_2 y_2}{\sigma A_1 + \sigma A_2} = \frac{(16.0\text{ ft}^2)(2.00\text{ ft}) + (8.00\text{ ft}^2)(1.00\text{ ft})}{(16.0\text{ ft}^2) + (8.00\text{ ft}^2)} = 1.67\text{ ft}$$



24. Question Details SerCP10 8.P.042. [3490440] -

A car is designed to get its energy from a rotating flywheel with a radius of 1.50 m and a mass of 590 kg. Before a trip, the flywheel is attached to an electric motor, which brings the flywheel's rotational speed up to 5,800 rev/min.

(a) Find the kinetic energy stored in the flywheel.

1.22e+08 J

(b) If the flywheel is to supply energy to the car as a 20.0-hp motor would, find the length of time the car could run before the flywheel would have to be brought back up to speed.

2.28 h

Solution or Explanation

(a) The moment of inertia of the flywheel is

$$I = \frac{1}{2}MR^2 = \frac{1}{2}(590\text{ kg})(1.50\text{ m})^2 = 6.64 \times 10^2\text{ kg}\cdot\text{m}^2$$

and the angular velocity is

$$\omega = \left(5{,}800\ \frac{\text{rev}}{\text{min}}\right)\left(\frac{2\pi\text{ rad}}{1\text{ rev}}\right)\left(\frac{1\text{ min}}{60\text{ s}}\right) = 607\text{ rad/s.}$$

Therefore, the stored kinetic energy is

$$KE_{\text{stored}} = \frac{1}{2}I\omega^2 = \frac{1}{2}(6.64 \times 10^2\text{ kg}\cdot\text{m}^2)(607\text{ rad/s})^2 = 1.22 \times 10^8\text{ J.}$$

(b) A 20.0-hp motor supplies energy at the rate of

$$P = (20.0\text{ hp})\left(\frac{746\text{ W}}{1\text{ hp}}\right) = 1.49 \times 10^4\text{ J/s.}$$

The time the flywheel could supply energy at this rate is

$$t = \frac{KE_{\text{stored}}}{P} = \frac{1.22 \times 10^8\text{ J}}{1.53 \times 10^4\text{ J/s}} = 8.21 \times 10^3\text{ s}\left(\frac{1\text{h}}{3{,}600\text{ s}}\right) = 2.28\text{ h.}$$

25. Question Details SerCP10 8.P.054. [3490375]

Each of the following objects has a radius of 0.154 m and a mass of 2.14 kg, and each rotates about an axis through its center (as in this table) with an angular speed of 41.3 rad/s. Find the magnitude of the angular momentum of each object.

(a) a hoop

2.1 $\text{kg} \cdot \text{m}^2/\text{s}$

(b) a solid cylinder

1.05 $\text{kg} \cdot \text{m}^2/\text{s}$

(c) a solid sphere

0.838 $\text{kg} \cdot \text{m}^2/\text{s}$

(d) a hollow spherical shell

1.4 $\text{kg} \cdot \text{m}^2/\text{s}$

Solution or Explanation

(a) $L = I\omega = (MR^2)\omega = (2.14 \text{ kg})(0.154 \text{ m})^2(41.3 \text{ rad/s}) = 2.10 \text{ kg} \cdot \text{m}^2/\text{s}$

(b) $L = I\omega = \left(\frac{1}{2}MR^2\right)\omega = \frac{1}{2}(2.14 \text{ kg})(0.154 \text{ m})^2(41.3 \text{ rad/s}) = 1.05 \text{ kg} \cdot \text{m}^2/\text{s}$

(c) $L = I\omega = \left(\frac{2}{5}MR^2\right)\omega = \frac{2}{5}(2.14 \text{ kg})(0.154 \text{ m})^2(41.3 \text{ rad/s}) = 0.838 \text{ kg} \cdot \text{m}^2/\text{s}$

(d) $L = I\omega = \left(\frac{2}{3}MR^2\right)\omega = \frac{2}{3}(2.14 \text{ kg})(0.154 \text{ m})^2(41.3 \text{ rad/s}) = 1.40 \text{ kg} \cdot \text{m}^2/\text{s}$

Assignment Details

Name (AID): **Practice Exam Chapters 6-8 (Ungraded) (11820676)**
Submissions Allowed: **10**
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Code:
Locked: **Yes**
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