<u>Chapter 09</u> <u>Circular Motion</u>

Multiple Choice Questions

9.5 In-Class Exercise In Solved Problem 9.1, at what speed does the roller coaster car have to enter the bottom of the loop in order to produce the feeling of weightlessness at the top? a) 7.00 m/s b) 12.1 m/s c) 21.4 m/s

c) 13.5 m/s

1. Two hikers begin on opposite sides of a circular lake and walk around the lake in the same direction. One walks three times as fast as the other. The circumference of the lake is *L*. How far does the faster hiker walk before catching up to the slower one? A. L/3

B. *L*/2 <u>C.</u> 3*L*/4

D. L

Bauer - Chapter 09 #1 Less difficult Section: 09.03

$$v_{t_0P} = \sqrt{g_R} = \sqrt{9.81x5} = 7 \quad m \setminus s$$
$$\left(\frac{1}{2}mv^2 + mgh\right)_{top} = \left(\frac{1}{2}mv^2 + 0\right)bot$$

$$\frac{1}{2}(7)^2 + (2 \times 5 \times 9.81) = \frac{1}{2}v^2$$
$$v = 12.12 \ m \backslash s$$

$$X_{f} = X_{f}$$

$$\frac{L}{2} + v_{t} = o + 3vt$$

$$t = \frac{L}{4v}$$

$$\Delta x_{faster} = (3v) \left(\frac{L}{4v}\right) = \frac{3}{4}L$$

2. Two hikers begin at the same initial location and walk around a circular lake in opposite directions. One walks twice as fast as the other. The circumference of the lake is *L*. How far does the faster hiker walk before the two hikers meet at the same final location?

- A. *L*/3
- B. *L*/2
- <u>**C.**</u> 2*L*/3
- D. 3L/4

$$\Delta X_{f} + \Delta X_{s} = L$$

$$2vt + vt = L$$

$$t = \frac{L}{3v}$$

$$\Delta x_{faster} = (2v) \left(\frac{L}{3v}\right) = \frac{2}{3}L$$

3-An object moves around a circle and its linear speed is always increasing. Which statement is always true?

A. Its linear velocity is perpendicular to its tangential acceleration.

B. The magnitude of its tangential acceleration is greater than the magnitude of its centripetal acceleration.

C. Its tangential and centripetal accelerations are both zero.

<u>D.</u> Its tangential and centripetal accelerations are perpendicular.

Bauer - Chapter 09 #3 Less difficult Section: 09.04 4. A plastic disk of radius 10 cm is spinning at 120 rpm. What is the magnitude of the centripetal acceleration of the outer rim of the disk?

<u>A.</u> 15.8 m/s² B. 1440 m/s²

- C. 1580 m/s²
- D. 144 km/ s^2

 $f = 120 \setminus 60 = 2 \text{ rps}$ $a_c = \omega 2 R$ $= (2\pi f)^2 R$ $= 4\pi^2 x 2^2 (0.10) = 15.8$

Bauer - Chapter 09 #4 Less difficult Section: 09.04

5. A clothes dryer is spinning at 75 rpm. A student opens its door and it comes to rest after rotating through four revolutions. Assume constant acceleration. What was the magnitude of the dryer's angular acceleration?

<u>A.</u> 1.23 rad/s²

 $\overline{\text{B.}} 2.45 \text{ rad/s}^2$

C. 703 rad/s^2

D. 1410 rad/s^2

$$\omega^{2} = \omega_{0}^{2} + 2\alpha\Delta\theta$$
$$0 = (2.5\pi)2 + 2\alpha(8\pi)$$
$$\alpha = -1.23 \quad rad \s2$$

Bauer - Chapter 09 #5 Less difficult Section: 09.06

6. A sports utility vehicle has tires which are 110 cm in diameter. If the wheel is rotated through 30 revolutions, how far forward does a point on the tire travel?

A. 54.0 m

B. 86.2 m C. 90.3 m

<u>**D.**</u> 104 m

 $\Delta x = R \Delta \theta$ = 0.55 (30)(2 π) = 104 m

Bauer - Chapter 09 #6 Less difficult Section: 09.02

7. A bicycle has a wheel of radius of 14.0 inches. What is the angular speed of the wheels when the bicycle has a forward speed of 8.0 m/s?

A. 12.3 rad/s B. 19.4 rad/s C. 22.5 rad/s D. 32.1 rad/s E. 45.2 rad/s

$$\omega = \frac{v}{R} = \frac{8.0}{0.356} =$$

22. 4 *rad\s*

Bauer - Chapter 09 #7 Less difficult Section: 09.03

8. A sports utility vehicle has tires which are 110 cm in diameter. The tires rotate with a constant angular speed. A point on the tire that is 0.30 m from the center has a tangential speed of 2.0 m/s. What is the tangential speed of a point on the rim of the tire?

A. 0.687 m/s B. 1.57 m/s C. 2.33 m/s <u>**D.**</u> 3.67 m/s E. 4.87 m/s

$$\begin{aligned}
 \omega_1 &= \omega_2 \\
 \frac{v_1}{R_l} &= \frac{v_2}{R_2} \\
 v_2 &= \frac{0.30 \ x \ 0.55}{2} = 3.67 \ m \backslash s
 \end{aligned}$$

Bauer - Chapter 09 #8 Less difficult Section: 09.03

9. A ball attached to the end of a string is swung around in a circular path of radius r. If the radius is kept constant and the speed is doubled

A. the centripetal acceleration remains the same.

B. the centripetal acceleration increases by a factor of 2.

C. the centripetal acceleration decreases by a factor of 2.

<u>D.</u> the centripetal acceleration increases by a factor of 4.

E. the centripetal acceleration decreases by a factor of 4.

Bauer - Chapter 09 #9 Less difficult Section: 09.04

Prepared by Amira Emam

10. A ball attached to the end of a string is swung around in a circular path of radius r. If the radius is doubled and the linear speed is kept constant,

A. the centripetal acceleration remains the same.

B. the centripetal acceleration increases by a factor of 2.

<u>C.</u> the centripetal acceleration decreases by a factor of 2.

D. the centripetal acceleration increases by a factor of 4.

E. the centripetal acceleration decreases by a factor of 4.

Bauer - Chapter 09 #9 Less difficult Section: 09.04

11. A ball attached to the end of a string is swung around in a circular path of radius r. If the radius is doubled and the angular speed is kept constant,

A. the centripetal acceleration remains the same.

<u>B.</u> the centripetal acceleration increases by a factor of 2.

 \overline{C} . the centripetal acceleration decreases by a factor of 2.

D. the centripetal acceleration increases by a factor of 4.

E. the centripetal acceleration decreases by a factor of 4.

Bauer - Chapter 09 #9 Less difficult Section: 09.04

Prepared by Amira Emam

12. A ball attached to the end of a string is swung around in a circular path of radius r. If the radius is doubled and the linear speed is held constant, the angular speed will

A. remain the same.

B. increase by a factor of 2.

<u>C.</u> decrease by a factor of 2.

D. increase by a factor of 4.

 $E. \ \ decrease \ by \ a \ factor \ of \ 4.$

Bauer - Chapter 09 #9 Less difficult Section: 09.03

13. A ball attached to the end of a string is swung around in a circular path of radius r. If the radius is doubled and the angular speed is held constant, the linear speed will

A. remain the same.

<u>B.</u> increase by a factor of 2.

 \overline{C} . decrease by a factor of 2.

D. increase by a factor of 4.

E. decrease by a factor of 4.

Bauer - Chapter 09 #9 Less difficult Section: 09.03

Prepared by Amira Emam

14. A roller coaster has a loop of radius 16.0 m. What does the linear speed of the roller coaster car have to be at the top of the loop for the passengers to feel weightless?

A. 2.50 m/s B. 3.75 m/s C. 7.0 m/s

<u>**D.**</u> 12.5 m/s

 $v_{t \circ P} = \sqrt{Rg} = \sqrt{9.81x \ 16} = 12.5 \ m \setminus s$

 $\mathbb{E}.\ 15.5\ m/s$

Bauer - Chapter 09 #10 Less difficult Section: 09.05

15. The angular speed of the minute hand of a clock is _____.

- A. $\frac{\pi}{7200} \frac{\text{rad}}{\text{s}}$ B. $\frac{\pi}{3600} \frac{\text{rad}}{\text{s}}$
- π rad
- <u>C.</u> 1800 s π rad
- D. 60 s
- π rad
- E. 30 s
- F. None are correct.

 $\omega = \frac{2\pi}{\frac{60x60}{\pi}}$ $= \frac{\pi}{1800} rad s$

Bauer - Chapter 09 #11 Less difficult Section: 09.03

Prepared by Amira Emam

16. The angular speed of the second hand of a clock is _____



 $\omega = \frac{2\pi}{60} = \frac{\pi}{30} rad s$

Bauer - Chapter 09 #12 Less difficult Section: 09.03

17. A centrifuge in a medical laboratory rotates at an angular speed of 5,400 rpm (revolutions per minute). When switched off, it rotates 100.0 times before coming to rest. Find the magnitude of the constant angular acceleration of the centrifuge while it slows down to a stop.

A. $65.0\pi \text{ rad/s}^2$ B. $60.0\pi \text{ rad/s}^2$ C. $81.0\pi \text{ rad/s}^2$ D. $76.0\pi \text{ rad/s}^2$ E. 0

Bauer - Chapter 09 #13 Less difficult Section: 09.06

(v) $\omega^2 = \omega_0^2 + 2n(\theta - \theta_0).$

$$\alpha = \frac{w_0^2}{2(2\pi)(100)}$$
$$= \frac{(5400 \times 2\Pi \div 60)^2}{2(2\pi)x(100)}$$
$$= -81\Pi \text{ rad}$$

18. A centrifuge in a medical laboratory is to be operated at an angular speed of 3,600 rpm (revolutions per minute). When switched on, it rotates 72.0 times before reaching the prescribed angular speed. Find the constant angular acceleration of the centrifuge while it speeds up.

A. 40.0π rad/s²
B. 50.0π rad/s²
C. 60.0π rad/s²
D. 70.0π rad/s²
E. 80.0π rad/s²

 $w_f^2 = \omega_i^2 + 2\alpha\Delta\theta$ $(120\pi)^2 = 0 + 2\alpha(72)(2\Pi)$ $\alpha = -50\Pi$

Bauer - Chapter 09 #14 Less difficult Section: 09.06

19. A centrifuge in a medical laboratory is to be operated at an angular speed of <u>3,600</u> rpm (revolutions per minute). If the centrifuge starts from rest and the angular acceleration is 80.0π rad/s², how many revolutions does the centrifuge make as it speeds up to its operating angular speed?

A. 14

B. 40

- C. 23
- <u>**D.</u></u> 45</u>**
- E. 52

 $w_f^2 = \omega_i^2 + 2\alpha\Delta\theta$ $(120\pi)^2 = 0 + 2(80\Pi)\Delta\theta$ $\Delta\theta = \frac{(120\Pi)^2}{2(8\infty\pi)} = 90\Pi \setminus 2\Pi$ = 45

Bauer - Chapter 09 #14 Less difficult Section: 09.06

20. The figure represents the velocity and the acceleration of a particle moving clockwise in a circle of radius 25.0 cm. At a certain instant of time, the magnitude of its acceleration, $a = |\vec{a}|$ is 16.0 m/s² and it makes an angle $\theta = 20^{\circ}$ with position vector as shown in the figure. At this instant, find the speed, $v = |\vec{v}|$ of the particle.



$$ac = a (\cos \theta) = \frac{v^2}{R}$$
$$= 16 \cos 2\theta = \frac{v^2}{0.25}$$
$$V = 1.94 \text{ m} \text{ s}$$

Bauer - Chapter 09 #15 More difficult Section: 09.04

21. The figure represents the velocity and the acceleration of a particle moving clockwise in a circle of radius 25.0 cm. At a certain instant of time, the magnitude of its acceleration, $a = |\vec{a}|$ is 16.0 m/s² and it makes an angle $\theta = 20^{\circ}$ with position vector as shown in the figure. At this instant, what is the magnitude of the angular acceleration of the particle?



$\alpha = a \backslash R$
$= asin \theta \setminus (R)$
$=16.0 \sin(20) \setminus (0.25)$
$= 21.9 \text{ rad} \text{s}^2$

Bauer - Chapter 09 #15 More difficult Section: 09.04