حل مراجعة أسئلة خاصة وفق الهيكل الوزاري الخطة C القسم الالكتروني

المزيد من الملفات بحسب الصف الحادي عشر المتقدم والمادة فيزياء في الفصل الثالث	
4	حل مراجعة باللغة العربية وفق الهيكل الوزاري الخطة C
5	مراجعة باللغة العربية وفق الهيكل الوزاري الخطة A و C

MCQ

Question 8-12, 15

as per the EOT

Part 2/3

EOT – Grade 11 Adv
Plan C

Ms. Asmaa Alhameed

2023-2024

EOT – Grade 11 Adv
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MCQ

Question 8-12, 15

as per the EOT

8.	Identify that the centripetal force, necessary for circular motion, can be provided by different forces such as the force of friction, tension, gravitational force, Coulomb force, or the normal force..	Student Book (S.B) Exercises/Q. 9.50	264 281

f T Fg F FN

$$F_c = ma_c = mv\omega = m\frac{v^2}{r} = m\omega^2 r$$

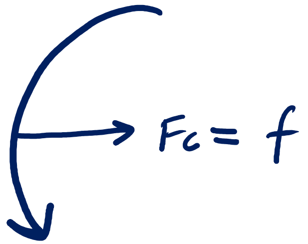
As you can see from this discussion, practically any force can act as the centripetal force. It was the force of static friction for the markers on the rotating table and the horizontal component of the tension in the string for the conical pendulum. But it can also be the gravitational force, which forces planets into (almost) circular orbits around the Sun, the Coulomb force acting on the electrons in atoms, or the normal force from a wall (see the following solved problem).

8.	Identify that the centripetal force, necessary for circular motion, can be provided by different forces such as the force of friction, tension, gravitational force, Coulomb force, or the normal force..	Student Book (S.B) Exercises/Q. 9.50	264 281

F_c

9.50 Calculate the centripetal force exerted on a vehicle of mass $m = 1500.$ kg that is moving at a speed of 15.0 m/s (v) around a curve of radius $R = 400.$ m. Which force plays the role of the centripetal force in this case?

Friction



$$F_c = \frac{mv^2}{r} = \frac{1500 \times 15^2}{400} = 843\,N$$

9.	Apply the kinematic relationships for circular motion with constant angular acceleration to calculate angular position, angular displacement, angular velocity, angular acceleration, or time.	Example 9.6 Example 9.7 Exercises/Q. 9.35	264 271 280

Table 9.1 Comparison of Kinematical Variables for Circular Motion

Quantity	Linear	Angular	Relationship
Displacement	s	θ	$s = r\theta$
Velocity	v	ω	$v = r\omega$
Acceleration	a	α	$a_t = r\alpha$
			$a_c = r\omega^2$
			$\vec{a} = r\alpha\hat{t} - r\omega^2\hat{r}$

$$\left\{\begin{aligned}
\theta &= \theta_0 + \omega_0 t + \tfrac{1}{2}\alpha t^2 \\
\theta &= \theta_0 + \bar{\omega} t \\
\omega &= \omega_0 + \alpha t \\
\bar{\omega} &= \tfrac{1}{2}(\omega + \omega_0) \\
\omega^2 &= \omega_0^2 + 2\alpha(\theta - \theta_0).
\end{aligned}\right.$$

9.	Apply the kinematic relationships for circular motion with constant angular acceleration to calculate angular position, angular displacement, angular velocity, angular acceleration, or time.	Example 9.6 Example 9.7 Exercises/Q. 9.35	264 271 280

سؤال وزاري سابق

A merry-go-round has an angular acceleration of $0.30\ rad/s^2$ (α). After accelerating from rest ($v_i = 0$, $w_i = 0$) for 2.8 s (t), through what angle in radians (θ) does the merry-go-round rotate?

تتحرك لعبة دوارة في مدينة الملاهي بتسارع زاوي يساوي ($0.30\ rad/s^2$) من السكون لمدة 2.8 s، ما الزاوية التي تدور فيها اللعبة بالتقدير الدائري ؟

- 1.2 rad
- 2.4 rad
- 2.0 rad
- 8.0 rad

$$\theta = \theta_0 + w_0 t + \frac{1}{2}\alpha t^2$$

$$= 0 + 0 + \frac{1}{2}(0.3)(2.8)^2$$

$$= 1.2\ rad$$

9.	Apply the kinematic relationships for circular motion with constant angular acceleration to calculate angular position, angular displacement, angular velocity, angular acceleration, or time.	Example 9.6 Example 9.7 Exercises/Q. 9.35	264 271 280

EXAMPLE 9.6 CD Player

PROBLEM

In Example 9.2 we established that a CD track is 5.4 km long. A music CD can store 74 min of music. What are the angular velocity and the ~~tangential~~ angular acceleration of the disc as it spins inside a CD player, assuming a constant linear velocity?

$\times 60 = 4440\ s$

$\omega = ?$

$\alpha = ?$

$$v = \frac{l}{t} = \frac{5.4\times10^{3}}{4440} = 1.21\ m/s$$

$r_1 = 25\,mm$

$$\omega_1 = \frac{v}{r_1} = \frac{1.21}{25\times10^{-3}} = 48.64\ rad/s$$

$r_2 = 58\,mm$

$$\omega_2 = \frac{v}{r_2} = \frac{1.21}{58\times10^{-3}} = 20.97\ rad/s$$

$$\alpha = \frac{\Delta\omega}{\Delta t} = \frac{20.97-48.64}{4440} = -6.2\times10^{-3}\ rad/s^2$$

slow down

9.	Apply the kinematic relationships for circular motion with constant angular acceleration to calculate angular position, angular displacement, angular velocity, angular acceleration, or time.	Example 9.6 Example 9.7 Exercises/Q. 9.35	264 271 280

EXAMPLE 9.7 Hammer Throw

One of the most interesting events in track-and-field competitions is the hammer throw. The task is to throw the "hammer," a 12 cm-diameter iron ball attached to a grip by a steel cable, a maximum distance. The hammer's total length is 121.5 cm, and its total mass is 7.26 kg. The athlete has to accomplish the throw from within a circle of radius 2.13 m (7 ft), and the best way to throw the hammer is for the athlete to spin, allowing the hammer to move in a circle around him, before releasing it. At the 1988 Olympic Games in Seoul, the Russian thrower Sergey Litvinov won the gold medal with an Olympic record distance of 84.80 m. He took seven turns before releasing the hammer, and the period to complete each turn was obtained from examining the video recording frame by frame: 1.52 s, 1.08 s, 0.72 s, 0.56 s, 0.44 s, 0.40 s, and 0.36 s.

T_1 T_2 T_3 T_4 T_5 T_6 T_7

PROBLEM 1

What was the average angular acceleration during the seven turns? Assume constant angular acceleration for the solution, and then check whether this assumption is justified.

α?

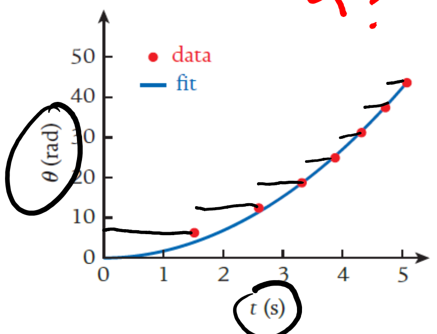


FIGURE 9.21 Angle as a function of time for Sergey Litvinov's 1988 gold-medal–winning hammer throw.

① total time

$t = 1.52 + 1.08 + 0.72 + 0.56 + 0.44 + 0.40 + 0.36 = 5.08\ s$

② total θ

$1\ rev = 2\pi$

$7\ rev = ?$

$\theta = \frac{7 \times 2\pi}{1} = 14\pi\ rad$

③ $\theta = \theta_0 + \omega_0 t + \frac{1}{2}\alpha t^2$

$14\pi = 0 + 0 + \frac{1}{2}\alpha (5.08)^2$

$\frac{2 \times 14\pi}{(5.08)^2} = \alpha$

$\alpha = 3.41\ rad/s^2$

9.	Apply the kinematic relationships for circular motion with constant angular acceleration to calculate angular position, angular displacement, angular velocity, angular acceleration, or time.	Example 9.6 Example 9.7 Exercises/Q. 9.35	264 271 280

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PROBLEM 2

Assuming that the radius of the circle on which the hammer moves is 1.67 m (the length of the hammer plus the arms of the athlete), what is the linear speed with which the hammer is released?

v

$$v = r\omega$$

$$= r\alpha t$$

$$= 1.67 \times 3.41 \times 5.08$$

$$= 28.9 \text{ m/s}$$

$$\alpha = \frac{\omega}{t}$$

$$\omega = \alpha t$$

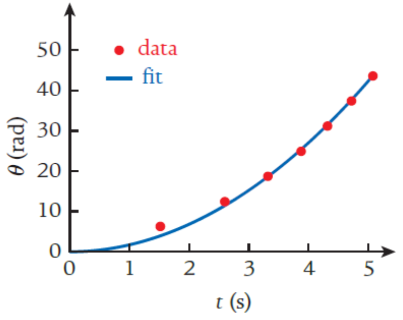

FIGURE 9.21 Angle as a function of time for Sergey Litvinov's 1988 gold-medal–winning hammer throw.

9.	Apply the kinematic relationships for circular motion with constant angular acceleration to calculate angular position, angular displacement, angular velocity, angular acceleration, or time.	Example 9.6 Example 9.7 Exercises/Q. 9.35	264 271 280

EXAMPLE 9.7 Hammer Throw

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PROBLEM 3

What is the centripetal force that the hammer thrower has to exert on the hammer right before he releases it?

$$F_c = \frac{mv^2}{r}$$

$$= \frac{7.26 \times (28.93)^2}{1.67}$$

$$= 3638\ N$$

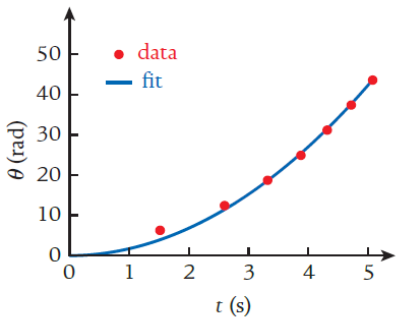


FIGURE 9.21 Angle as a function of time for Sergey Litvinov's 1988 gold-medal–winning hammer throw.

9.	Apply the kinematic relationships for circular motion with constant angular acceleration to calculate angular position, angular displacement, angular velocity, angular acceleration, or time.	Example 9.6 Example 9.7 Exercises/Q. 9.35	264 271 280

9.35 A vinyl record plays at 33.3 rpm. Assume it takes 5.00 s for it to reach this full speed, starting from rest.

a) What is its angular acceleration during the 5.00 s?

b) How many revolutions does the record make before reaching its final angular speed?

ω_2 t $\omega_1 = 0$ $v_1 = 0$ $\rightarrow \theta$

$$33.3 \text{ rpm} \times \frac{2\pi}{60} = \frac{111}{100}\pi \text{ rad/s}$$

a) $\alpha = ?$

$$\omega_2 = \omega_1 + \alpha t$$

$$\frac{111}{100}\pi = 0 + \alpha(5)$$

$$\alpha = 0.697 \text{ rad/s}^2$$

b) $\theta = \theta_0 + \omega_0 t + \frac{1}{2}\alpha t^2$

$$= 0 + 0 + \frac{1}{2}(0.697)(5)^2$$

$$= 8.71 \text{ rads}$$

1 rev = 2π rad

?? = 8.71 rad

$$\text{rev} = \frac{1 \times 8.71}{2\pi} = 1.38 \text{ rev}$$

10.	Convert angle measurements between degrees and radians.	Student Book (S.B)	256

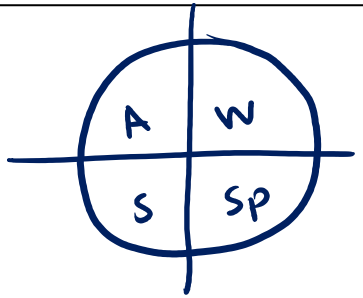
The two most commonly used units for angles are degrees (°) and radians (rad). These units are defined such that the angle measured by one complete circle is 360°, which corresponds to 2π rad. Thus, the unit conversion between the two angular measures is

$$\theta\ (\text{degrees})\frac{\pi}{180} = \theta\ (\text{radians}) \Leftrightarrow \theta\ (\text{radians})\frac{180}{\pi} = \theta\ (\text{degrees})$$

$$1\ \text{rad} = \frac{180^\circ}{\pi} \approx 57.3^\circ.$$

10.	Convert angle measurements between degrees and radians.	Student Book (S.B)	256

9.31 What is the angle in radians that the Earth sweeps out in its orbit during winter?



$\theta = \frac{\pi}{2}$

What is 30° in radians?

a. $\frac{\pi}{12}$

b. $\frac{\pi}{9}$

c. $\frac{\pi}{6}$

d. $\frac{\pi}{3}$

$30^\circ \times \frac{\pi}{180^\circ} = \frac{\pi}{6}$ rad

10.	Convert angle measurements between degrees and radians.	Student Book (S.B)	256

1- convert the degree of the angle to radian measure:

$A)\ \mathbf{60°}$ $B)\ \mathbf{240°}$

2- convert the radian measure to degree:

$A)\ \dfrac{2\pi}{3}$ $B)\ \dfrac{11\pi}{6}$

10.	Convert angle measurements between degrees and radians.	Student Book (S.B)	256

سؤال وزاري سابق

A bike wheel rotates 4.50 revolutions. How many radians has it rotated?

يدور إطار الدراجة 4.50 دورة. كم يدور نفس الإطار بوحدة الراديان؟

- 28.3 rad
- 0.08 rad
- 7.0 rad
- 4.5 rad

$1 \text{rev} = 2\pi$

$4.50 = ??$

$\frac{4.5 \times 2\pi}{1} = 9\pi = 28.3 \text{ rad}$

11.	Sketch the path taken in circular motion (uniform and non-uniform) and explain the velocity and acceleration vectors (magnitudes and directions) during the motion	S.B/Figure 9.12 S.B/MCQ/Q.9.4	262 278

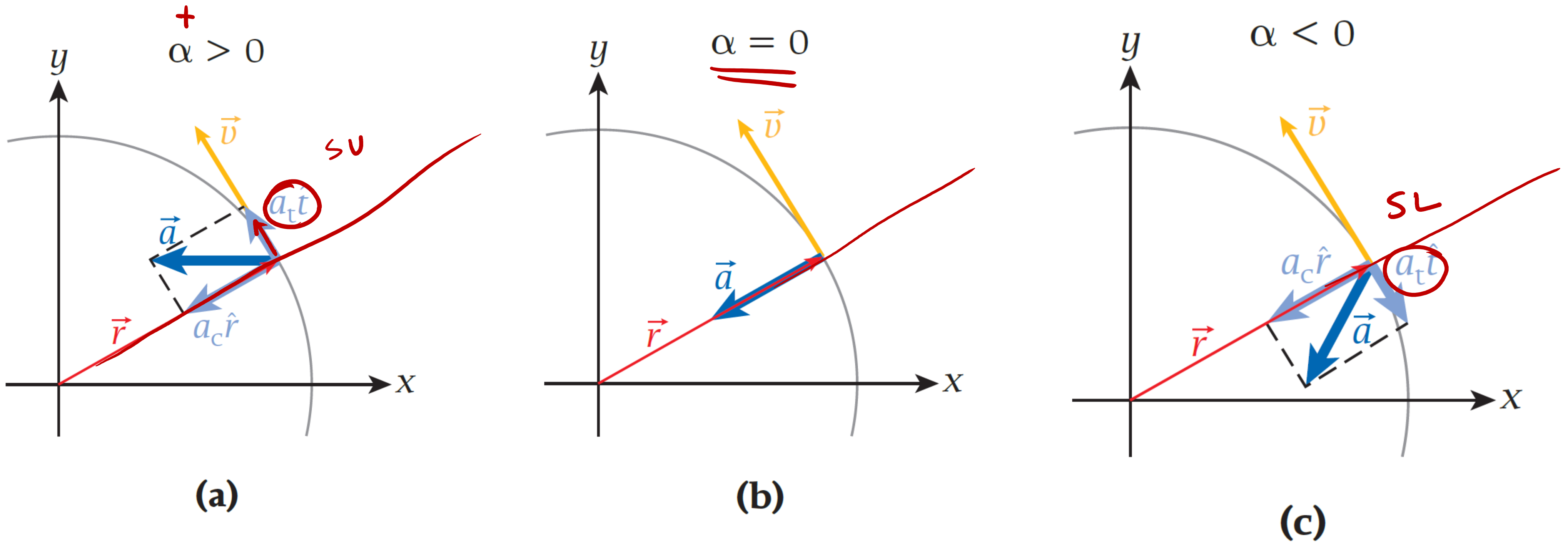
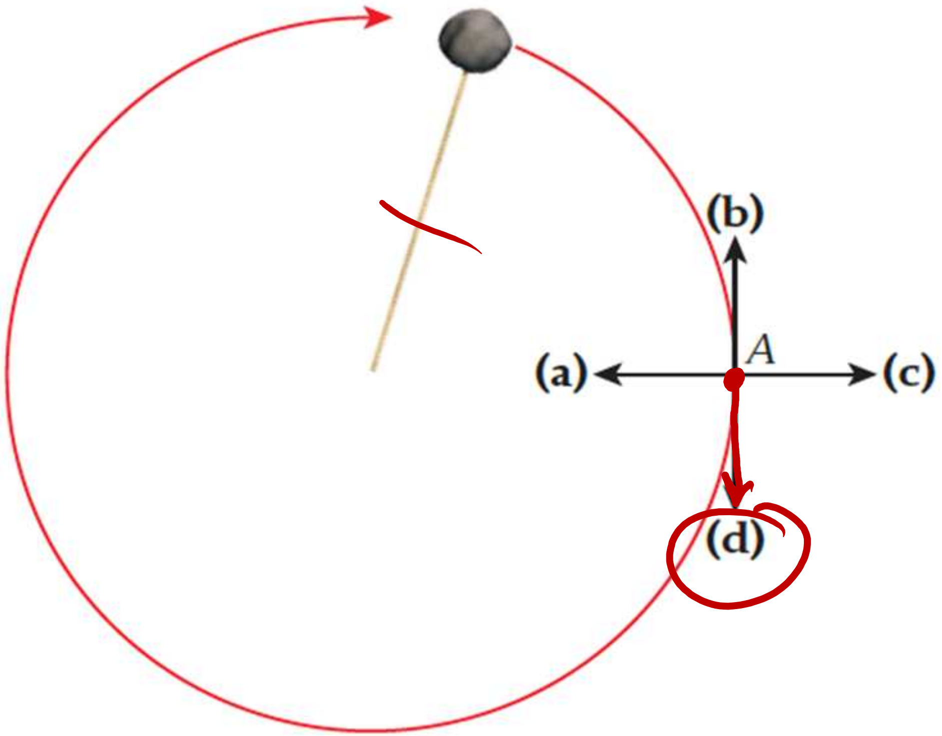


FIGURE 9.12 Relationships among linear acceleration, centripetal acceleration, and angular acceleration for (a) increasing speed; (b) constant speed; and (c) decreasing speed.

11.	Sketch the path taken in circular motion (uniform and non-uniform) and explain the velocity and acceleration vectors (magnitudes and directions) during the motion	S.B/Figure 9.12 S.B/MCQ/Q.9.4	262 278

9.4 A rock attached to a string moves clockwise in uniform circular motion. In which direction from point *A* is the rock thrown off when the string is cut?



11.	Sketch the path taken in circular motion (uniform and non-uniform) and explain the velocity and acceleration vectors (magnitudes and directions) during the motion	S.B/Figure 9.12 S.B/MCQ/Q.9.4	262 278

Activity: A merry-go-round has a radius of $3\ \text{m}$. Determine the direction of the centripetal acceleration, which is affecting one of the seats, and calculate its magnitude knowing that the linear velocity of the seat is $3.77\ \frac{\text{m}}{\text{s}}$. Give the result to an accuracy of 0.01.

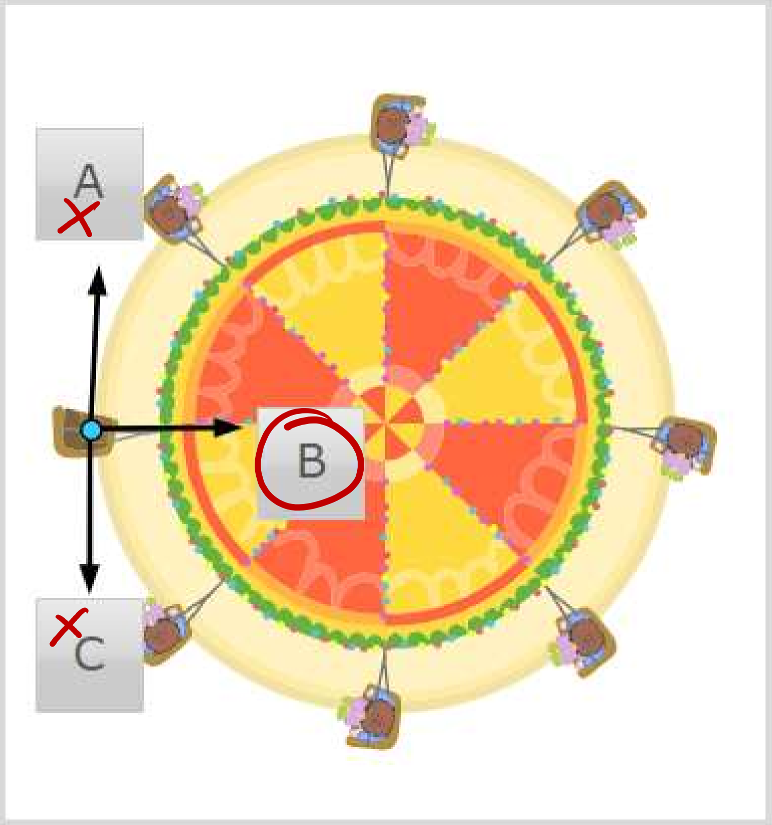
$a_{cp} = \boxed{4.74}\ \frac{\text{m}}{\text{s}^2}$

$r = 3\ m$

$v = 3.77\ m/s$

$a_c = \frac{v^2}{r}$

$= \frac{(3.77)^2}{3} = 4.74\ m/s^2$



12.	Identify that for an object in circular motion with a given angular velocity, the centripetal force increases with the distance from the center	Student Book (S.B) Example 9.8	264 273

$v = r\omega$

The three markers have the same angular velocity, ω, but are placed on different locations (different r). Their centripetal force is proportional to the distance, r, from the center of the disk.

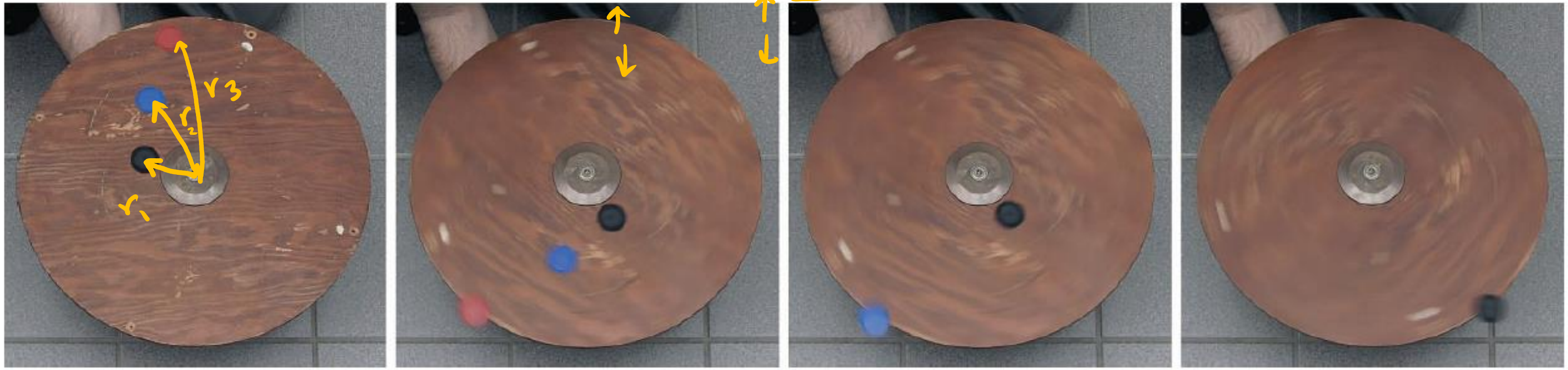
$F_c = mr\omega^2$

$r_1 < r_2 < r_3$

$\omega_1 = \omega_2 = \omega_3$

$v_1 < v_2 < v_3$

$F_1 < F_2 < F_3$



(a) (b) (c) (d)

FIGURE 9.14 Markers on a spinning table. Shown from left to right are the initial positions of the markers and the moments when the three markers slide off during the process of circular motion.

12.	Identify that for an object in circular motion with a given angular velocity, the centripetal force increases with the distance from the center	Student Book (S.B) Example 9.8	264 273

$v = \frac{l}{t} \rightarrow t = \frac{l}{v}$

$t_A = \frac{l_A}{v_A} = \frac{101}{19.5} = 5.20\,s$ | $t_B = \frac{76.2}{11} = 6.92\,s$

EXAMPLE 9.8 Formula 1 Racing

If you watch a Formula 1 race, you can see that the race cars approach curves from the outside, cut through to the inside, and then drift again to the outside, as shown by the red path in Figure 9.24a. The blue path is shorter. Why don't the drivers follow the shortest path?

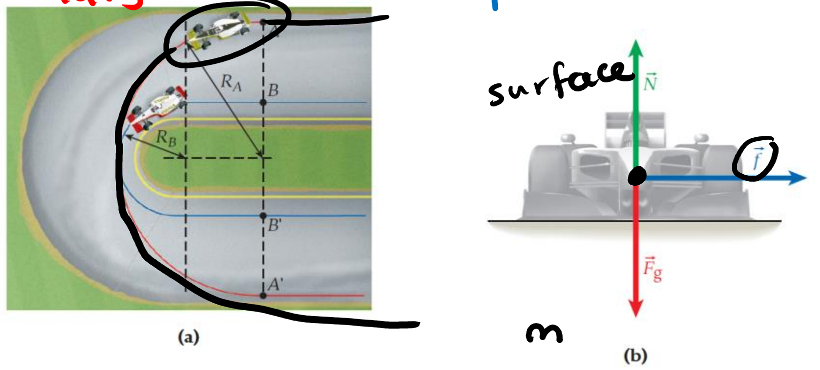
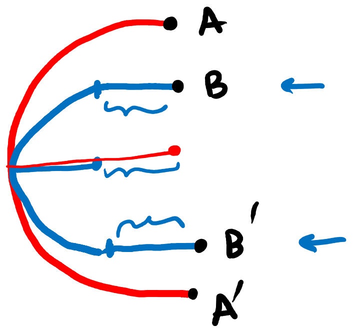


FIGURE 9.24 (a) Paths of race cars negotiating a turn on an oval track in two ways. (b) Free-body diagram for a race car in a curve.

PROBLEM

Suppose that cars move through the U-turn shown in Figure 9.24a at constant speed and that the coefficient of static friction between the tires and the road is $\mu_s = 1.2$. (As was mentioned in Chapter 4, modern race car tires can have coefficients of friction that exceed 1 when they are heated to race temperature and thus are very sticky.) If the radius of the inner curve shown in the figure is $R_B = 10.3$ m and radius of the outer is $R_A = 32.2$ m and the cars move at their maximum speed, how much time will it take to move from point A to A' and from point B to B'?



$F_g = mg$

$F_N = mg$

$f = \mu_s F_N = \mu_s mg$

$F_c = \frac{mv^2}{r}$

$t \rightarrow v, l \rightarrow F_c$

$F_c = f$

$\frac{\cancel{m}v^2}{r} = \mu_s \cancel{m}g$

$v = \sqrt{r \mu_s g}$

$v_A = \sqrt{r_A \mu_s g} = \sqrt{32.2 \times 1.2 \times 9.81}$

$= 19.5\,m/s$

$v_B = \sqrt{10.3 \times 1.2 \times 9.81} = 11\,m/s$

$l_A = \frac{1}{2}(2\pi r_A) = \frac{1}{2}(2\pi \times 32.2) = 101\,m$

$l_B = 2(r_A - r_B) + \frac{1}{2}(2\pi r_B) = 2(32.2 - 10.3) + \frac{1}{2}(2\pi \times 10.3)$

$= 76.2\,m$

15.	Apply Newton's laws of motion and/or energy conservation principles to analyze circular motion in a vertical or horizontal plane (motion in vertical loop of an amusement park ride, rotating cylinder, moving through a levelled or banked curve,...)	S.B/Figure 9.18/9.19 S.B/Figure 9.20 S.B/MCQ/Q.9.11	266 268 278

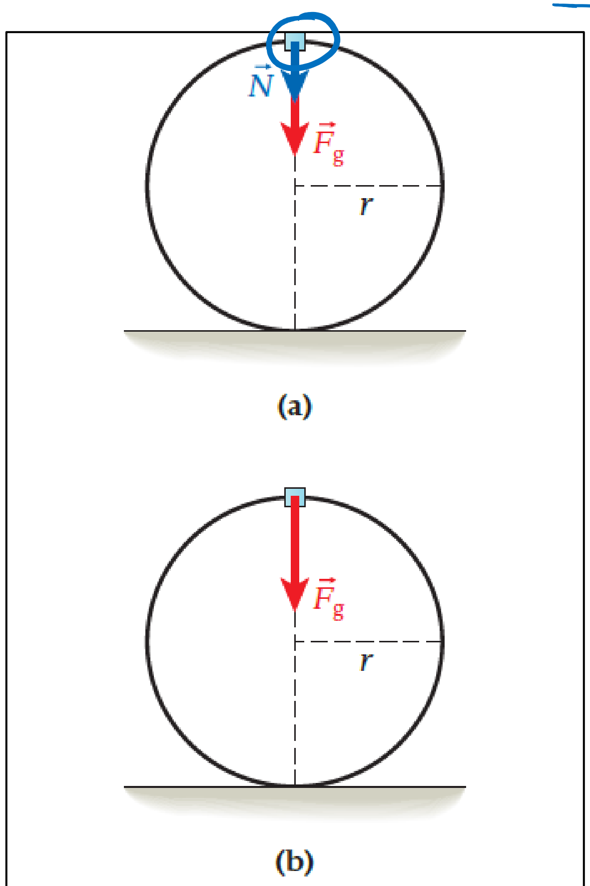


FIGURE 9.18 (a) Free-body diagram for a passenger at the top of the vertical loop of a roller coaster. (b) Condition for the feeling of weightlessness.

SOLVED PROBLEM 9.1 Analysis of a Roller Coaster

Perhaps the biggest thrill to be had at an amusement park is on a roller coaster with a vertical loop in it (Figure 9.17), where passengers feel almost weightless at the top of the loop.

PROBLEM

Suppose the vertical loop has a radius of 5.00 m. What does the linear speed of the roller coaster have to be at the top of the loop for the passengers to feel weightless? (Assume that friction between roller coaster and rails can be neglected.)

F_N

N

$F_N = 0$

$$F_c = \cancel{N} + F_g$$

$$\frac{\cancel{m} v^2}{r} = \cancel{m} g$$

$$\frac{v^2}{r} = g$$

$$v = \sqrt{rg} = \sqrt{5 \times 9.81} = 7 \text{ m/s}$$

15.	Apply Newton's laws of motion and/or energy conservation principles to analyze circular motion in a vertical or horizontal plane (motion in vertical loop of an amusement park ride, rotating cylinder, moving through a levelled or banked curve,...)	S.B/Figure 9.18/9.19 S.B/Figure 9.20 S.B/MCQ/Q.9.11	266 268 278

$r=5$

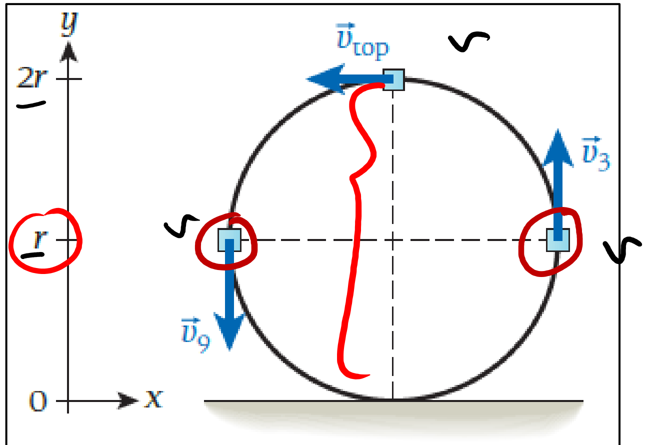


FIGURE 9.19 Directions of the velocity vectors at several points along the vertical roller coaster loop.

cons. of energy

$$E = K_3 + U_3 = K_{top} + U_{top} = K_a + U_a$$

$$\frac{1}{2}\cancel{m}v_3^2 + \cancel{m}gy_3 = \frac{1}{2}\cancel{m}v_{top}^2 + \cancel{m}gy_{top} = \frac{1}{2}\cancel{m}v_a^2 + \cancel{m}gy_a$$

$$v_3 = v_a$$

$$\frac{1}{2}v_3^2 + gy_3 = \frac{1}{2}v_{top}^2 + gy_{top}$$

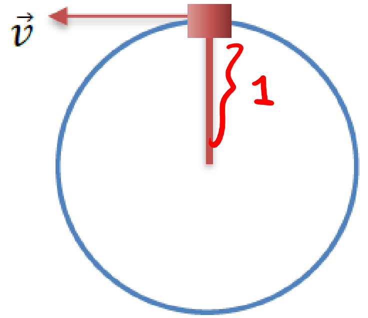
$$\frac{1}{2}v_3^2 = \frac{1}{2}v_{top}^2 + g(y_{top} - y_3)$$

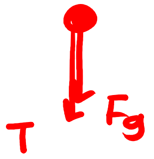
$$v_3 = \sqrt{2\left(\frac{1}{2}v_{top}^2 + g(y_{top} - y_3)\right)}$$

$$= \sqrt{2\left(\frac{1}{2}(7)^2 + 9.81(2\times5 - 5)\right)} = 12.1 \text{ m/s}$$

15.	Apply Newton's laws of motion and/or energy conservation principles to analyze circular motion in a vertical or horizontal plane (motion in vertical loop of an amusement park ride, rotating cylinder, moving through a levelled or banked curve,...)	S.B/Figure 9.18/9.19 S.B/Figure 9.20 S.B/MCQ/Q.9.11	266 268 278

A ball that has a mass of 1.00 kg is attached to a string 1.00 m long and is whirled in a vertical circle at a constant speed of 10.0 m/s. Determine the tension in the string when the ball is at the top of the circle.





$$F_c = T + F_g$$

$$\frac{mv^2}{r} = T + mg$$

$$\frac{mv^2}{r} - mg = T$$

$$\frac{1\times10^2}{1} - 1\times9.81 = T$$

$$T = 90.2\ N$$

15.	Apply Newton's laws of motion and/or energy conservation principles to analyze circular motion in a vertical or horizontal plane (motion in vertical loop of an amusement park ride, rotating cylinder, moving through a levelled or banked curve,...)	S.B/Figure 9.18/9.19 S.B/Figure 9.20 S.B/MCQ/Q.9.11	266 268 278

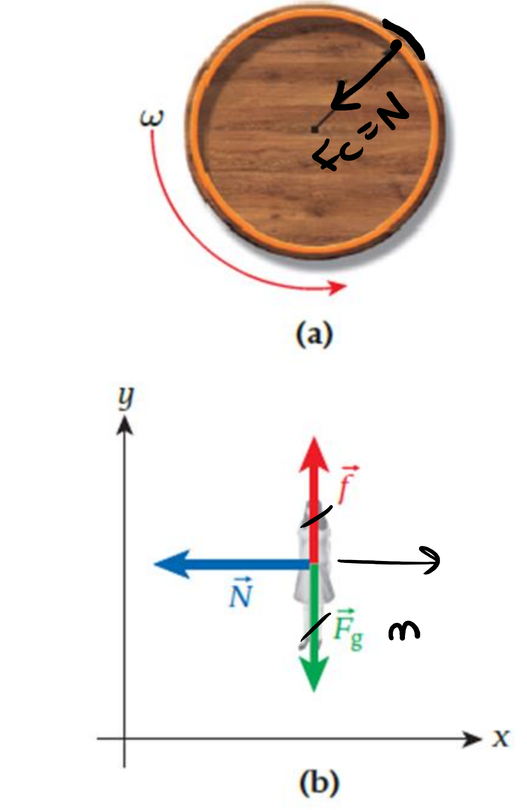


FIGURE 9.20 (a) Top view of the rotating cylinder of a carnival ride. (b) Free-body diagram for one of the riders.

SOLVED PROBLEM 9.2 Carnival Ride

PROBLEM

One of the rides found at carnivals is a rotating cylinder. The riders step inside the vertical cylinder and stand with their backs against the curved wall. The cylinder spins very rapidly, and at some angular velocity, the floor is pulled away. The thrill-seekers now hang like flies on the wall. If the radius of the cylinder is $r = 2.10$ m, the rotation axis of the cylinder remains vertical, and the coefficient of static friction between the people and the wall is $\mu_s = 0.390$, what is the minimum angular velocity, ω, at which the floor can be withdrawn?

$F_c = F_N \rightarrow F_N = mr\omega^2$

$F_g = f$

$mg = \mu F_N$

$\cancel{m}g = \mu \cancel{m} r\omega^2$

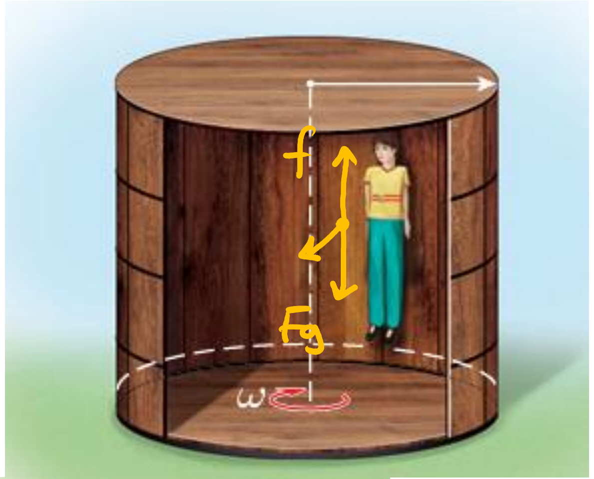
$\sqrt{\frac{g}{\mu r}} = \omega$

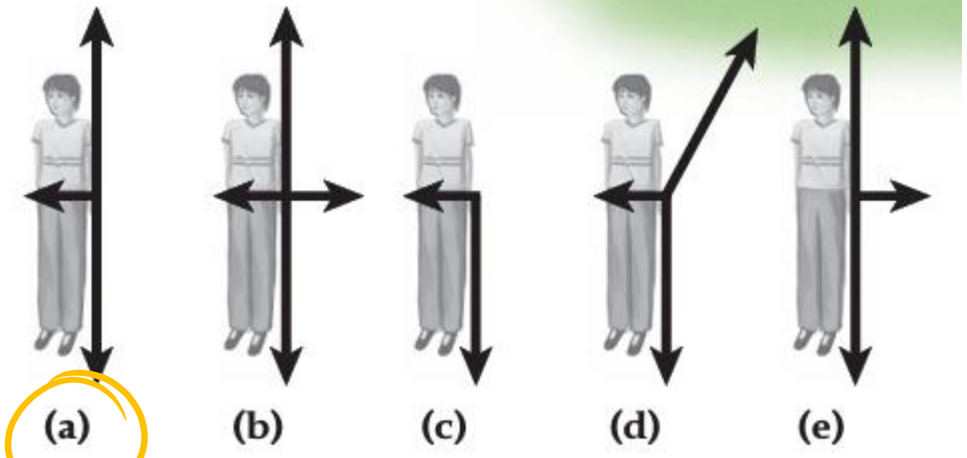
$\omega = \sqrt{\frac{9.81}{0.390 \times 2.10}}$

$= 3.4$ rad/s

15.	Apply Newton's laws of motion and/or energy conservation principles to analyze circular motion in a vertical or horizontal plane (motion in vertical loop of an amusement park ride, rotating cylinder, moving through a levelled or banked curve,...)	S.B/Figure **9.18/9.19** S.B/Figure **9.20** S.B/MCQ/Q.**9.11**	**266** **268** **278**

9.11 The figure shows a rider stuck to the wall without touching the floor in the Barrel of Fun at a carnival. Which diagram correctly shows the forces acting on the rider?





End of MCQ

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