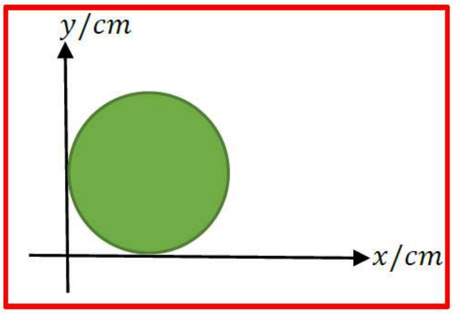
Final Revision G11-ADV -T3

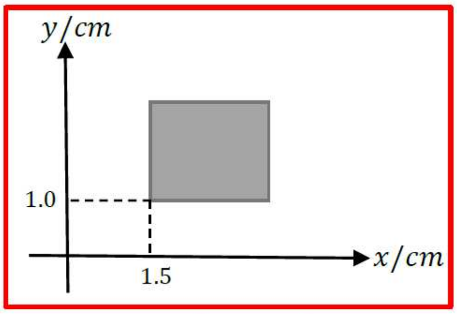
1- The circle shown in the figure has a diameter of 10. cm, what are the coordinates of the center of mass for this circle?



The mass is uniformly distributed

A. C.M (10 ,10)
B. C.M (5.0,10)
C. C.M (10,5.0)
D. C.M (5.0,5.0)

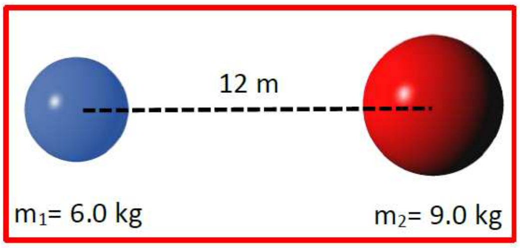
2- The square shown in the figure is 4.0 cm side length, what are the coordinates of the center of mass for this square?



The mass is uniformly distributed

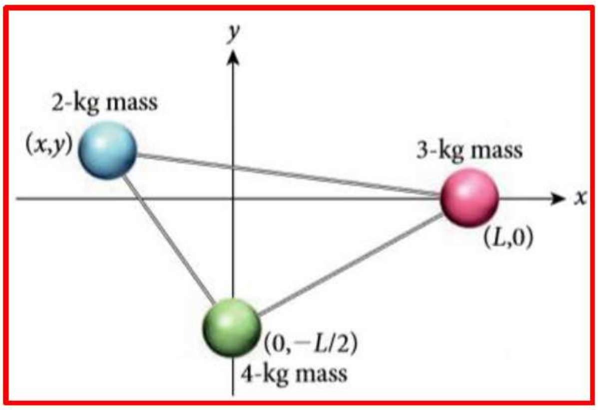
A. C.M (2.0,2.0)
B. C.M (3.5,3.0)
C. C.M (3.0,3.5)
D. C.M (3.5,2.0)

3- The center of mass for each two objects shown in the figure are along the x-axis and separated by 12 m, what is the coordinate of the center of mass for the system?



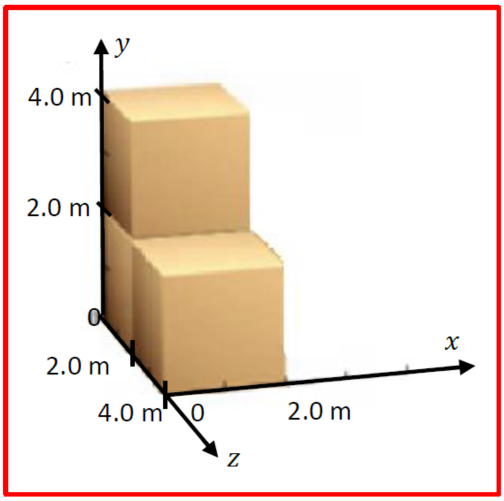
A. x= 7.2 m from object 1
B. x= 4.8 m from object 1
C. x= 7.5 m from object 2
D. x= 5.5 m from object 2

4- The coordinates of the center of mass for the extended object shown in the figure are (L /4, –L /5). What are the coordinates of the 2-kg mass?



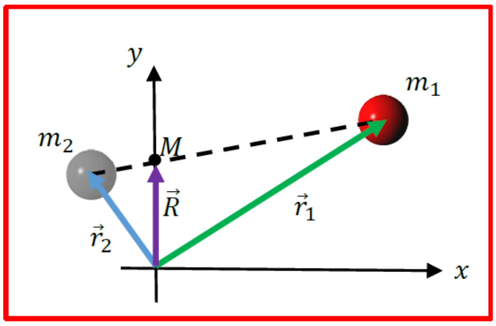
A. C.M (-3L/8, L/10)
B. C.M (3L/4, L/5)
C. C.M (4L/3, L/2)
D. C.m (-2L/3, L/5)

5- What is the center of mass of the arrangement of uniform identical cubes shown in the figure if the length of the side of each cube is 2.0 m?



A. C.M (1,1,1)
B. C.M (1,1,5/3)
C. C.M (1,5/3,5/3)
D. C.M (5/3,5/3,1)

6- In the case shown in the figure, what are the relative magnitude of the two masses m_1 and m_2?

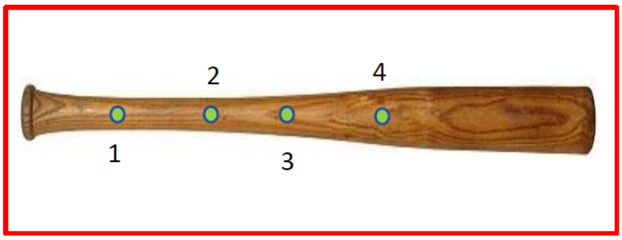


A. $m_1 = m_2$
B. $m_1 > m_2$
C. $m_1 < m_2$
D. We can't determine that

7- A system contains three identical objects located in the x-y plane, if the centers of masses of the objects are (5,2) for object 1, (-1,4) for object 2, (2,6) for object 3, what is the coordinates of the center of mass for this system?

A. C.M (3,4)
B. C.M (2,4)
C. C.M (1,5)
D. C.M (5,3)

8- At what point, the center of mass can be approximately located for the object shown in the figure?



A. 1
B. 2
C. 3
D. 4

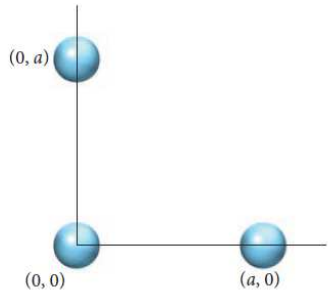
Three identical balls of mass *m* are placed in the configuration shown in the figure. **Find the location of the center of mass.**

A- $\overline{R}_{com} = \frac{a}{2}\,\hat{x} + \frac{a}{2}\,\hat{y}$

B- $\overline{R}_{com} = \frac{a}{3}\,\hat{x} + \frac{a}{2}\,\hat{y}$

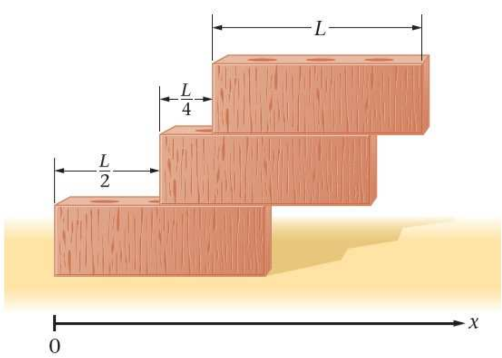
C- $\overline{R}_{com} = \frac{a}{2}\,\hat{x} + \frac{a}{3}\,\hat{y}$

D- $\overline{R}_{com} = \frac{a}{3}\,\hat{x} + \frac{a}{3}\,\hat{y}$



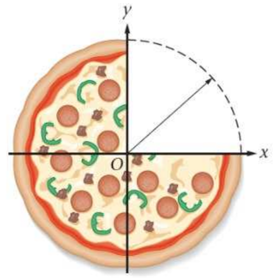
Three particles of masses m_1 = 1.2 kg, m_2 = 2.5 kg, and m_3 = 3.4 kg form an equilateral triangle of edge length a = 140 cm. **Where is the center of mass of this system?**

Find the x coordinate of the centre of mass of the bricks shown

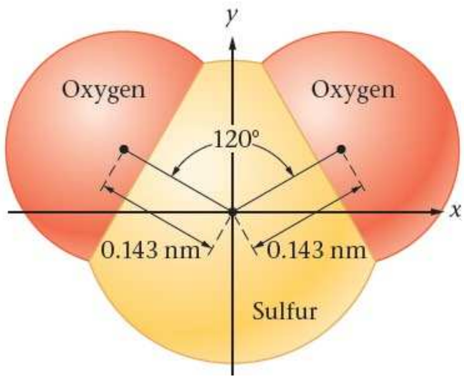


$$X_{cm} = \frac{\sum mx}{M} = \frac{m_1x_1 + m_2x_2 + m_3x_3}{m_1 + m_2 + m_3} = \frac{m\left(\frac{L}{2} + L + \frac{5L}{4}\right)}{3m} = \frac{1}{3}\left(\frac{11L}{4}\right) = \boxed{\frac{11}{12}L}$$

The location of the center of mass of the partially eaten, 12-m-diameter pizza shown is X_{cm} = -1.4 m. and Y_{cm} = -1.4 m. Assuming each quadrant of the pizza to be the same, find the center of mass of the uneaten pizza above the x axis



Find the *x* and *y* coordinates of the centre of mass of SO_2 molecule.



The center of mass of the molecule will lie somewhere along the y-axis because it is symmetric in the x direction

The distance between a carbon atom and an oxygen atom in the CO molecule is 1.13×10^{-10} m. How far from the carbon atom is the centre of mass of the molecule?

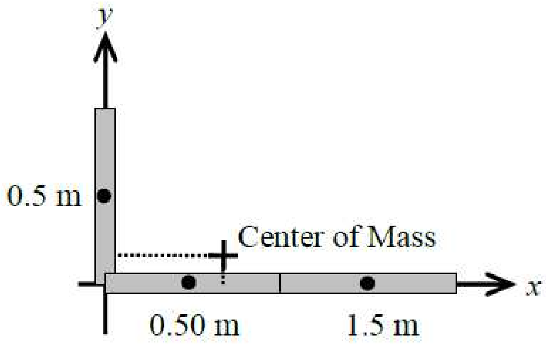
تبلغ المسافة بين ذرة الكربون وذرة الأكسجين في جزيء أول أكسيد الكربون (1.13×10^{-10} m).
كم يبعد مركز كتلة الجزيء عن ذرة الكربون؟

m_{oxygen}= 2.66×10^{-26} kg
m_{carbon}= 1.99×10^{-26} kg

Three uniform metersticks, each of mass *m*, are placed on the floor as follows: stick 1 lies along the *y* axis from $y = 0$ to $y = 1.0$ m, stick 2 lies along the *x* axis from $x = 0$ to $x = 1.0$ m, stick 3 lies along the *x* axis from $x = 1.0$ m to $x = 2.0$ m.

(a) Find the location of the center of mass of the metersticks.

(b) How would the location of the center of mass be affected if the mass of the metersticks were doubled?



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.

d. Its tangential and centripetal accelerations are perpendicular.

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.

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

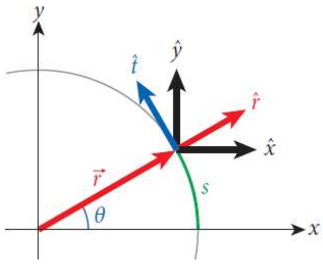
Using polar coordinates to study circular motion:

The radial unit vector $\hat{r}$ $\hat{r} = \frac{x}{r}\hat{x} + \frac{y}{r}\hat{y} = (\cos\theta)\hat{x} + (\sin\theta)\hat{y}$

- **the tangential unit vector $\hat{t}$** is **perpendicular** to **radial unit vector $\hat{r}$**

$$\hat{r} \bullet \hat{t} = 0$$

- **the tangential unit vector $\hat{t}$** and the **radial unit vector $\hat{r}$** have a length of 1.



$$\hat{r} \bullet \hat{r} = 1$$
$$\hat{t} \bullet \hat{t} = 1$$

- **Cartesian unit vectors** stay **constant** in time, while the **radial** and **tangential** unit vectors **change their directions** during the process of circular motion.

An object is moving in a circular path. If the centripetal force is suddenly removed, how will the object move?

a) It will move radially outward.

b) It will move radially inward.

c) It will move vertically downward.

d) It will move in the direction in which its velocity vector points at the instant the centripetal force vanishes.

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

d. 104 m

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

Concept Check 9.1

A bicycle's wheels have a radius R. The bicycle is traveling with speed v. Which one of the following expressions describes the angular speed of the front tire?

a) $\omega = \frac{1}{2}Rv^2$

b) $\omega = \frac{1}{2}vR^2$

c) $\omega = R/v$

d) $\omega = Rv$

e) $\omega = v/R$

A rotating platform with a radius of 4.0 m makes one complete turn every 2.0 s. The angular velocity of the platform is most nearly _____.

A. 0.32 rad/s

B. 1.0 rad/s

C. 1.6 rad/s

D. 3.1 rad/s

If a wheel is rotating at a constant rate completes 100 revolutions in 10 s, its angular speed is ____.

A. 0.31 rad/s

B. 0.63 rad/s

C. 10 rad/s

D. 63 rad/s

The figure shows a cylinder of radius 0.7 m rotating about its axis at 10 rad/s.

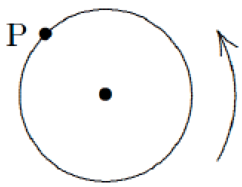
The speed of the point P is:

A. 7.0 m/s

B. 14π rad/s

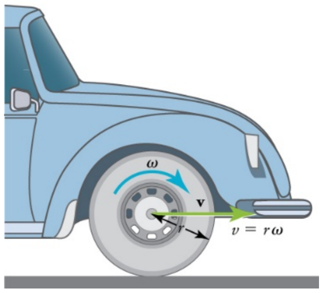
C. 7.0π rad/s

D. 0.70 m/s



The wheel rotates 4.50 revolutions.

How many radians has it rotated?



$$4.50 \text{ revolutions} = (4.50 \text{ rev})\left(2\pi \frac{\text{rad}}{\text{rev}}\right) = 9.00\pi \text{ rad} = 28.3 \text{ rad}.$$

The angular position of a point on the rim of a rotating wheel is given by $\theta = 4.0t - 3t^2 + t^3$, where θ is in radians and t is in seconds. What are the angular velocities at t= 2.0 s

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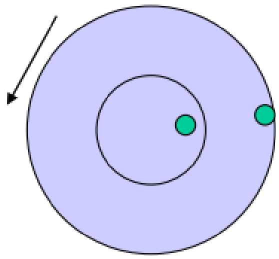
Two objects are attached to a rotating turntable.
One is much farther out from the axis of rotation.
Which one has the larger angular velocity?

(A) the one nearer the disk center
(B) the one nearer the disk edge
(C) they both have the same angular velocity



Problem

The flywheel of a steam engine starts to rotate from rest with a constant angular acceleration of α = 1.43 rad/s^2. The flywheel undergoes this constant angular acceleration for t = 25.9 s and then continues to rotate at a constant angular velocity, ω. After the flywheel has been rotating for 59.5 s, what is the total angle through which it has rotated since it started?

The latitude of Lubbock, Texas (known as the Hub City of the South Plains), is 33° N. What is its rotational speed, assuming the radius of the Earth at the Equator to be 6380 km? $T_E = 1\,\text{day}$

$$\omega = \frac{2\pi}{T_E} \qquad v = r\omega \qquad v = (R_E \cos\theta)\left(\frac{2\pi}{T_E}\right)$$

A point on a Blu-ray disc is a distance *R/4* from the axis of rotation.

How far from the axis of rotation is a second point that has, at any instant, a linear velocity twice that of the first point?

a) *R*/16

b) *R*/8

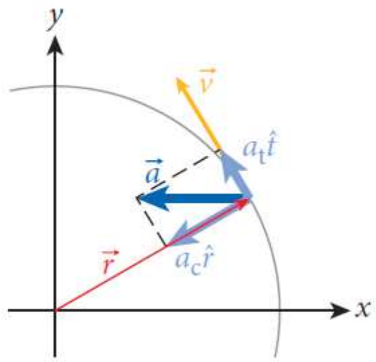
c) *R*/2

d) *R*

A spot of paint on a bicycle tire moves in a circular path of radius 0.29 m. When the spot has traveled a linear distance of 2.73 m, through what angle has the tire rotated? Give your answer in radians.

Angular acceleration α	Centripetal acceleration a_c
The rate of change of an object's angular velocity	*The acceleration that changes the direction of the velocity vector without changing its magnitude*
Average $\bar{\alpha} = \frac{\Delta\omega}{\Delta t}$ Instantaneous $\alpha = \lim_{\Delta t \to 0} \bar{\alpha} = \lim_{\Delta t \to 0} \frac{\Delta\omega}{\Delta t} \equiv \frac{d\omega}{dt} = \frac{d^2\theta}{dt^2}$	$a_c = \frac{v^2}{r} = \omega^2 r$
$\alpha = 0$ when ω is constant	$a_c = 0$ when v = 0

the acceleration in circular motion has two components tangential acceleration & radial acceleration



tangential acceleration $a_t\ \hat{t}$	radial acceleration $a_c\ \hat{r}$
always tangential to the path	towards the instantaneous center
$a_t = \alpha\, r$	$a_c = \omega^2 r$

The acceleration of an object in circular motion as the sum of the tangential acceleration and the centripetal acceleration:

$$\vec{a} = a_t\hat{t} - a_c\hat{r}.$$

$$a = \sqrt{a_t^2 + a_c^2} = \sqrt{(r\alpha)^2 + (r\omega^2)^2} = r\sqrt{\alpha^2 + \omega^4}.$$

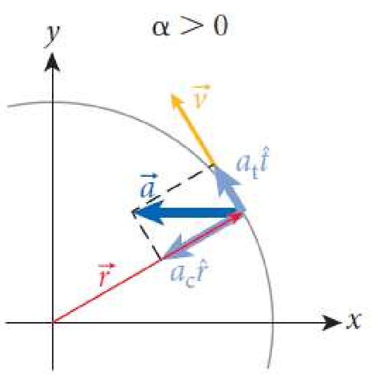
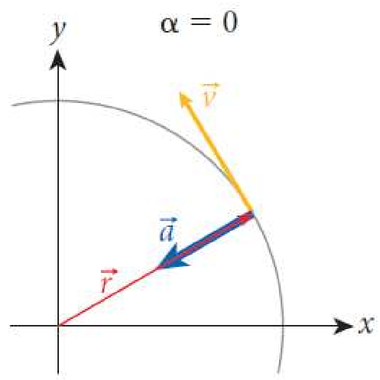
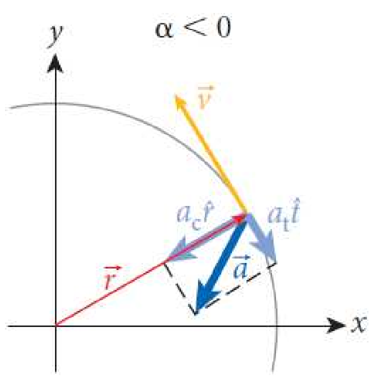
1. Radial acceleration is always along normal to the instantaneous velocity so it is also known as normal acceleration.

2. Radial acceleration is always directed towards the instantaneous center of curvature of the trajectory so it is also named centripetal acceleration.

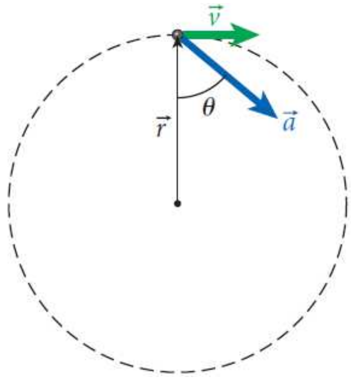
3. The magnitude of radial acceleration at any instant is $\frac{V^2}{r}$

4. The magnitude of the tangential acceleration is equal to the rate of change of speed of the particle w.r.t. time and it is always tangential to the path.

5. If the angular velocity is constant, the tangential angular acceleration is zero, but the velocity vector still changes direction continuously as the object moves in its circular path.

increasing speed	constant speed	decreasing speed
		

•**9.46** A particle is moving clockwise in a circle of radius 1.00 m. At a certain instant, the magnitude of its acceleration is $a = |\vec{a}| = 25.0 \text{ m/s}^2$, and the acceleration vector has an angle of $\theta = 50.0°$ with the position vector, as shown in the figure. At this instant, find the speed, $v = |\vec{v}|$, of this particle.



If you want to generate 840,000 *g* of centripetal acceleration in a sample rotating at a distance of 23.5 cm from the rotation axis.

What is the frequency you have to enter into the controls?

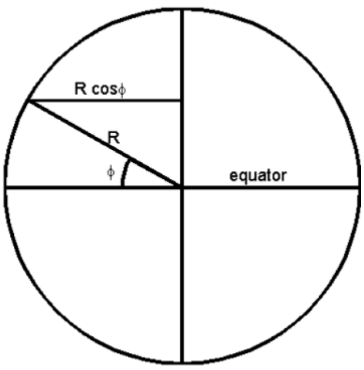
What is the linear speed with which the sample is then moving?

$$f = \frac{1}{2\pi}\sqrt{\frac{a_c}{r}} = \frac{1}{2\pi}\sqrt{\frac{(840{,}000)(9.81 \text{ m/s}^2)}{0.235 \text{ m}}} = 942 \text{ s}^{-1} = 56{,}500 \text{ rpm}$$

$$v = r\omega = 2\pi r f = 2\pi(0.235 \text{ m})(942 \text{ s}^{-1}) = 1.39 \text{ km/s}.$$

Centripetal Acceleration Due to Earth's Rotation

$$a_c = \omega^2 r = \omega^2 R_{\text{Earth}} \cos\vartheta$$
$$= (7.27 \cdot 10^{-5} \text{ s}^{-1})^2 (6.38 \cdot 10^6 \text{ m})(\cos\vartheta)$$
$$= (0.034 \text{ m/s}^2)(\cos\vartheta).$$



ϑ indicating the latitude angle relative to the Equator

Concept Check 9.2

The rotation of the Earth on its axis creates a centripetal acceleration at the surface of the Earth. Suppose you were standing on the Equator and the Earth stopped rotating. When the Earth stopped, you would

a) feel slightly lighter than before.

b) feel slightly heavier than before.

c) fly off the surface of the Earth.

d) not be able to tell whether the Earth was still rotating.

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	$a_t = r\alpha$
			$a_c = r\omega^2$
			$\vec{a} = r\alpha\hat{t} - r\omega^2\hat{r}$

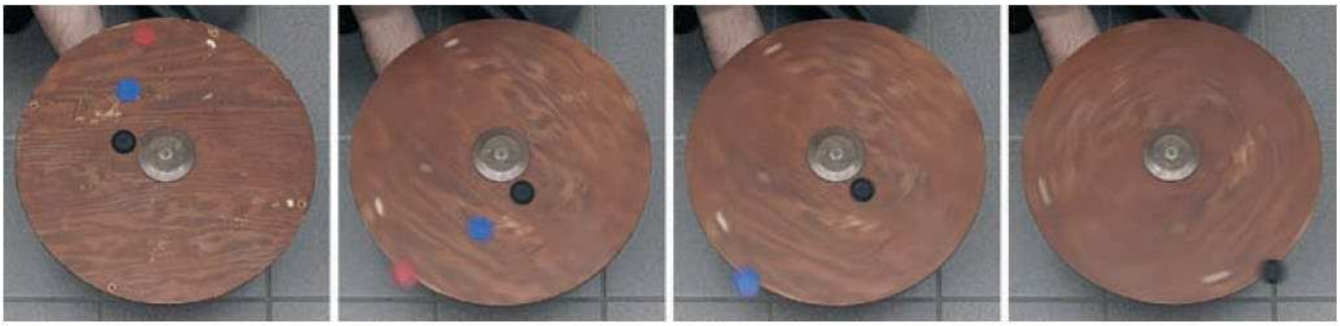
Linear	Angular
(i) $x = x_0 + v_{x0}t + \frac{1}{2}a_x t^2$	(i) $\theta = \theta_0 + \omega_0 t + \frac{1}{2}\alpha t^2$
(ii) $x = x_0 + \bar{v}_x t$	(ii) $\theta = \theta_0 + \bar{\omega} t$
(iii) $v_x = v_{x0} + a_x t$	(iii) $\omega = \omega_0 + \alpha t$
(iv) $\bar{v}_x = \frac{1}{2}(v_x + v_{x0})$	(iv) $\bar{\omega} = \frac{1}{2}(\omega + \omega_0)$
(v) $v_x^2 = v_{x0}^2 + 2a_x(x - x_0)$.	(v) $\omega^2 = \omega_0^2 + 2\alpha(\theta - \theta_0)$.

9.5 Centripetal Force

$\vec{F}_c$ the net inward force needed to provide the centripetal acceleration

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

A higher angular velocity means a larger centripetal force



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

If we spin the table slowly as in part (a), all three chips are in circular motion.

- In parts (b), (c), and (d), the table is spinning progressively faster.
- The chips slide friction force < centripetal force
- the outermost chip slides off first, and the innermost chip last $F_c = m\omega^2 r$

All points on the surface of the spinning table have the same angular velocity, $\boldsymbol{\omega}$ because all of them take the same time to complete one revolution

Concept Check 9.3

You are sitting on a carousel, which is in motion. Where should you sit so that the largest possible centripetal force is acting on you?

a) close to the outer edge

b) close to the center

c) in the middle

d) The force is the same everywhere.

When you go through a vertical loop on a high-speed roller coaster, what keeps you in your seat?

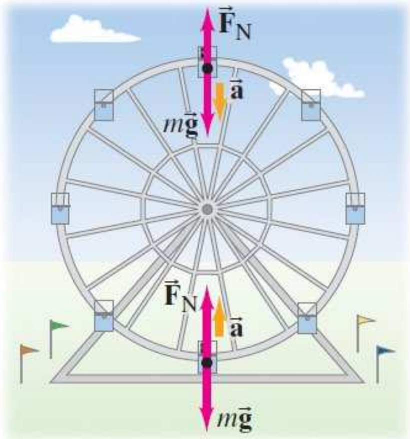
a) centrifugal force

b) the normal force from the track

c) the force of gravity

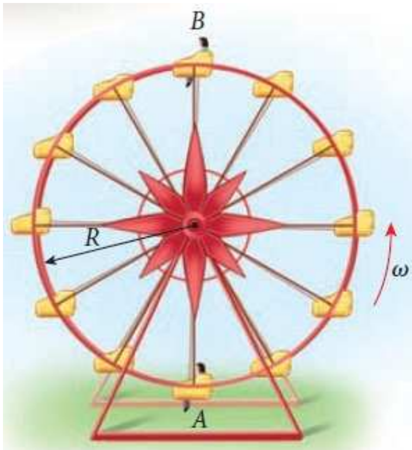
d) the force of friction

e) the force exerted by the seat belt

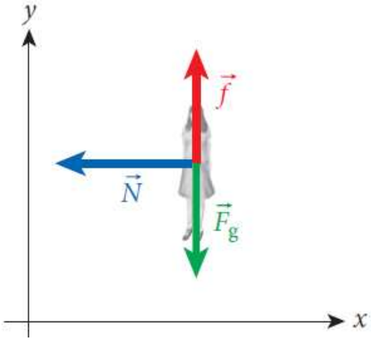


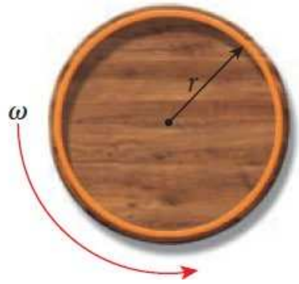
A person rides on a Ferris wheel of radius R, which is rotating at a constant angular velocity ω. Compare the normal force of the seat pushing up on the person at point A to that at point B in the figure.

Which force is greater, or are they the same?



If the radius of the cylinder **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 μ_s **= 0.390**





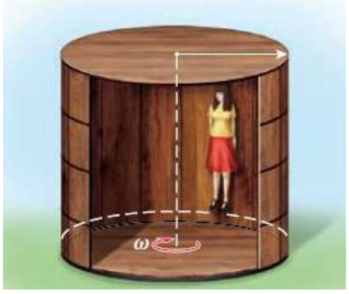
$F_c = N$	$f = F_g = mg$	$F_c = mr\omega^2$

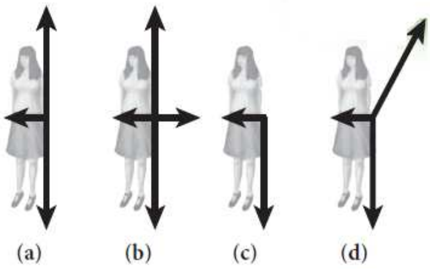
what is the minimum angular velocity, ω, at which the floor can be withdrawn?

$f \leq f_{max} = \mu_s N$	$mg \leq \mu_s N$	$mg \leq \mu_s m r \omega^2$

$$\omega_{min} = \sqrt{\frac{g}{\mu_s r}}$$

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?





At the top of a vertical loop in a roller coaster, what condition must be met for the car to stay on the track?

a) The centrifugal force acting on the car must equal the centripetal force.

b) The normal force exerted by the track on the car must be equal to the force of gravity.

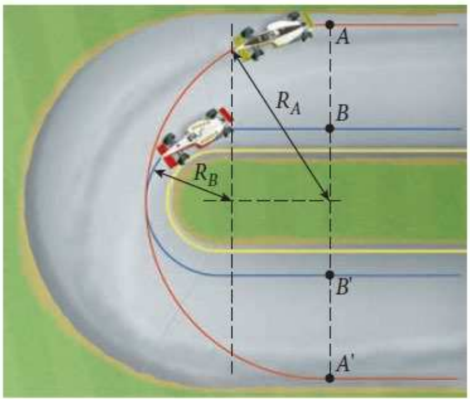
c) The normal force exerted by the track on the car must be in the direction opposite to the force of gravity.

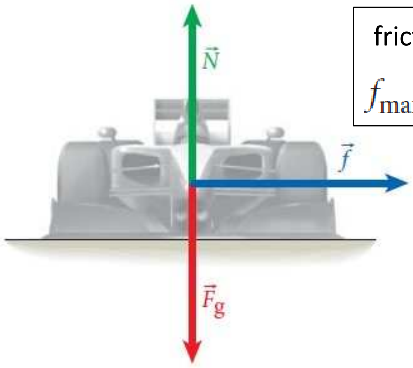
d) The centripetal force required to keep the car moving in a circle must be equal to or greater than the force of gravity.

e) The normal force exerted by the track on the car must be zero.

Suppose that cars move through the U-turn at constant speed and that the coefficient of static friction between the tires and the road is $\mu_s = 1.2$. (As was mentioned

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*'?





friction force

$f_{max} = \mu_s mg$

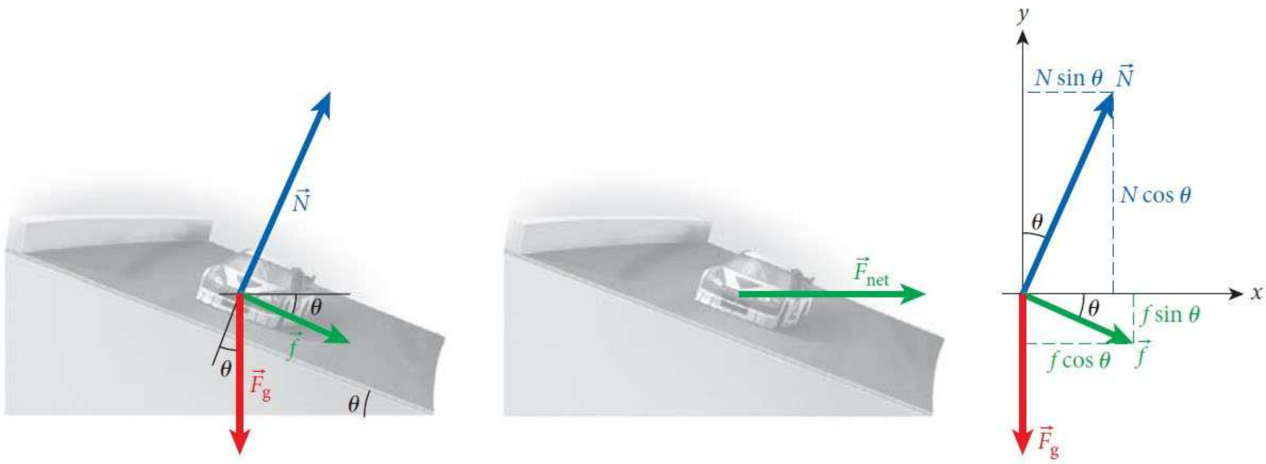
$$m\mu_s g = m\frac{v^2}{R} \Rightarrow v = \sqrt{\mu_s g R}$$

$$v_{red} = \sqrt{\mu_s g R_A} = \sqrt{(1.2)(9.81\ \text{m/s}^2)(32.2\ \text{m})} = 19.5\ \text{m/s}$$

$$v_{blue} = \sqrt{\mu_s g R_B} = \sqrt{(1.2)(9.81\ \text{m/s}^2)(10.3\ \text{m})} = 11.0\ \text{m/s}.$$

$\ell_{red} = \pi R_A = 101.\ \text{m}$	$\ell_{blue} = \pi R_B + 2(R_A - R_B) = 76.2\ \text{m}$
$t_{red} = \frac{\ell_{red}}{v_{red}} = \frac{101.\ \text{m}}{19.5\ \text{m/s}} = 5.20\ \text{s}$	$t_{blue} = \frac{\ell_{blue}}{v_{blue}} = \frac{76.2\ \text{m}}{11.0\ \text{m/s}} = 6.92\ \text{s}$

If the coefficient of static friction between the track surface and the car's tires is μ_s = 0.620 and the radius of the turn is R = 110. m, what is the maximum speed with which a driver can take a curve banked at θ = 21.1°?



$$N\sin\theta + \mu_s N\cos\theta = m\frac{v^2}{R}$$

$$N\cos\theta - mg - \mu_s N\sin\theta = 0$$

$$\frac{\sin\theta + \mu_s\cos\theta}{\cos\theta - \mu_s\sin\theta} = \frac{v^2}{gR}.$$

$$v = \sqrt{\frac{Rg(\sin\theta + \mu_s\cos\theta)}{\cos\theta - \mu_s\sin\theta}}$$

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

Two skaters, A and B, of equal mass are moving in clockwise uniform circular motion on the ice. Their motions have equal periods, but the radius of skater A's circle is half that of skater B's circle.

a) What is the ratio of the speeds of the skaters?

b) What is the ratio of the magnitudes of the forces acting on each skater?

A car of weight ***W* = 10.0 kN** makes a turn on a track that is banked at an angle of ***θ* = 20.0°**. Inside the car, hanging from a short string tied to the rear-view mirror, is an ornament. As the car turns, the ornament swings out at an angle of φ = 30.0° measured from the vertical inside the car. **What is the force of static friction between the car and the road?**

$$T\cos(\theta+\phi)=m_0 g,\quad T\sin(\theta+\phi)=m_0\frac{v^2}{r},\quad F_c=F_f=m_c\frac{v^2}{r}$$

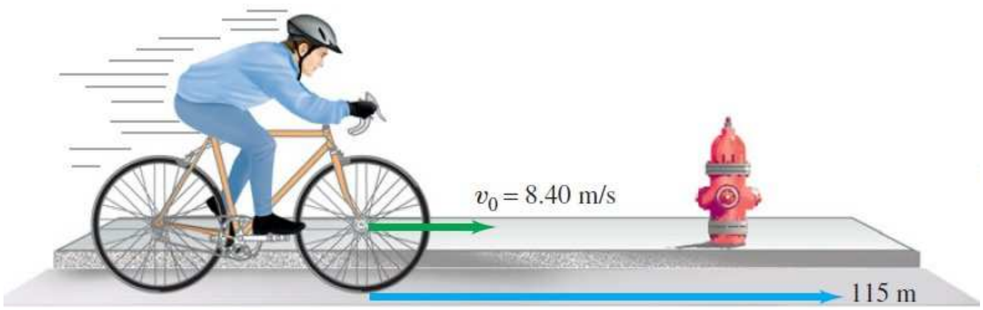
A bicycle slows down uniformly from to rest over a distance of 115 m. Each wheel and tire has an overall diameter of 68.0 cm.

Determine (*a*) the angular velocity of the wheels at the initial instant

(*b*) the total number of revolutions each wheel rotates before coming to rest;

(*c*) the angular acceleration of the wheel

(*d*) the time it took to come to a stop.



EXAMPLE 8–4 **Angular and linear velocities.** A carousel is initially at rest. At $t = 0$ it is given a constant angular acceleration $\alpha = 0.060\ \text{rad/s}^2$, which increases its angular velocity for 8.0 s. At $t = 8.0\ \text{s}$, determine (*a*) the angular velocity of the carousel, and (*b*) the linear velocity of a child (Fig. 8–7a) located 2.5 m from the center, point P in Fig. 8–7b.

APPROACH The angular acceleration α is constant, so we can use $\alpha = \Delta\omega/\Delta t$ (Eq. 8–3a) to solve for ω after a time $t = 8.0\ \text{s}$. With this ω, we determine the linear velocity using Eq. 8–4, $v = r\omega$.

SOLUTION (*a*) In Eq. 8–3a, $\bar{\alpha} = (\omega_2 - \omega_1)/\Delta t$, we put $\Delta t = 8.0\ \text{s}$, $\bar{\alpha} = 0.060\ \text{rad/s}^2$, and $\omega_1 = 0$. Solving for ω_2, we get

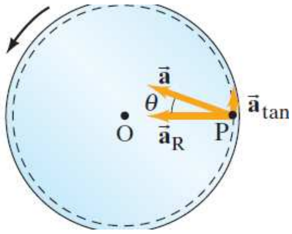
$$\omega_2 = \omega_1 + \bar{\alpha}\,\Delta t = 0 + (0.060\ \text{rad/s}^2)(8.0\ \text{s}) = 0.48\ \text{rad/s}.$$

During the 8.0-s time interval, the carousel accelerates from $\omega_1 = 0$ to $\omega_2 = 0.48\ \text{rad/s}$.

(*b*) The linear velocity of the child with $r = 2.5\ \text{m}$ at time $t = 8.0\ \text{s}$ is found using Eq. 8–4:

$$v = r\omega = (2.5\ \text{m})(0.48\ \text{rad/s}) = 1.2\ \text{m/s}.$$

EXAMPLE 8–5 **Angular and linear accelerations.** For the child on the rotating carousel of Example 8–4, determine that child's (*a*) tangential (linear) acceleration, (*b*) centripetal acceleration, (*c*) total acceleration.



APPROACH We use the relations discussed above, Eqs. 8–5 and 8–6.

SOLUTION (*a*) The child's tangential acceleration is given by Eq. 8–5:

$$a_{\text{tan}} = r\alpha = (2.5\ \text{m})(0.060\ \text{rad/s}^2) = 0.15\ \text{m/s}^2,$$

and it is the same throughout the 8.0-s acceleration period.

(*b*) The child's centripetal acceleration at $t = 8.0\ \text{s}$ is given by Eq. 8–6:

$$a_R = \frac{v^2}{r} = \frac{(1.2\ \text{m/s})^2}{(2.5\ \text{m})} = 0.58\ \text{m/s}^2.$$

$$a = \sqrt{a_{\text{tan}}^2 + a_R^2} = \sqrt{(0.15\ \text{m/s}^2)^2 + (0.58\ \text{m/s}^2)^2} = 0.60\ \text{m/s}^2.$$

$$\theta = \tan^{-1}\left(\frac{a_{\text{tan}}}{a_R}\right) = \tan^{-1}\left(\frac{0.15\ \text{m/s}^2}{0.58\ \text{m/s}^2}\right) = 0.25\ \text{rad}$$

A centrifuge rotor is accelerated for 30 s from rest to 20,000 rpm (revolutions per minute).

(*a*) What is its average angular acceleration?

(*b*) Through how many revolutions has the centrifuge rotor turned during its acceleration period, assuming constant angular acceleration?

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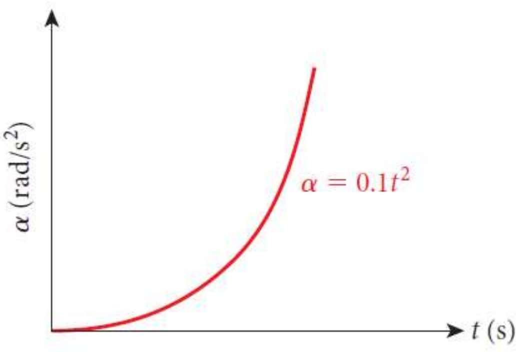
flywheel with a diameter of 1.00 m is initially at rest. Its angular acceleration is plotted versus time in the figure.



a) What is the angular separation between the initial position of a fixed point on the rim of the flywheel and the point's position 8.00 s after the wheel starts rotating?

b) The point starts its motion at $\theta = 0$. Calculate and sketch the linear position, velocity vector, and acceleration vector 8 s after the wheel starts rotating.

During a certain time interval, the angular position of a swinging door is described by θ= 4:95 + 9:4t + 2:05t^2, where θ is in radians and t is in seconds. Determine the angular position, angular speed, and angular acceleration of the door at t=0

An electric motor rotating a workshop grinding wheel at 1.06 x 10^2 rev/min is switched off. Assume the wheel has a constant negative angular acceleration of magnitude 1.96 rad/s^2.

- a) How long does it take the grinding wheel to stop?
- b) Through how many radians has the wheel turned during the time interval found in part (a)?

A wheel 1.65 m in diameter lies in a vertical plane and rotates about its central axis with a constant angular acceleration of 3.70 rad/s^2. The wheel starts at rest at t = 0, and the radius vector of a certain point P on the rim makes an angle of 57.3° with the horizontal at this time. At t = 2.00 s, find the following:

- a) the angular speed of the wheel.
- b) the tangential speed of the point P.
- c) the total acceleration of the point P.
- d) the angular position of the point P.

A discus thrower accelerates a discus from rest to a speed of 25.3 m/s by whirling it through 1.28 rev. Assume the discus moves on the arc of a circle 0.99 m in radius.

a) Calculate the final angular speed of the discus.

b) Determine the magnitude of the angular acceleration of the discus, assuming it to be constant.

- c) Calculate the time interval required for the discus to accelerate from rest to 25.3 m/s.