

مراجعة الدرس الرابع من الوحدة التاسعة Acceleration Centripetal and Angular منهج انسابير



تم تحميل هذا الملف من موقع المناهج الإماراتية

موقع المناهج ← المناهج الإماراتية ← الصف الحادي عشر المتقدم ← فيزياء ← الفصل الثالث ← ملفات متنوعة ← الملف

تاريخ إضافة الملف على موقع المناهج: 2025-06-08 17:51:58

ملفات اكتب للمعلم اكتب للطالب | اختبارات الكترونية | اختبارات | حلول | عروض بوربوينت | أوراق عمل
منهج انجليزي | ملخصات وتقارير | مذكرات وبنوك | الامتحان النهائي | للمدرس

المزيد من مادة
فيزياء:

التواصل الاجتماعي بحسب الصف الحادي عشر المتقدم



صفحة المناهج
الإماراتية على
فيسبوك

الرياضيات

اللغة الانجليزية

اللغة العربية

التربية الاسلامية

المواد على تلغرام

المزيد من الملفات بحسب الصف الحادي عشر المتقدم والمادة فيزياء في الفصل الثالث

مراجعة الدرس الثالث من الوحدة التاسعة Period and ,frequency Angular ,velocity Angular منهج انسابير

1

مراجعة الدرس الثاني من الوحدة التاسعة Displacement Angular and Coordinates Angular منهج انسابير

2

مراجعة الدرس الأول من الوحدة التاسعة Coordinates Polar منهج انسابير

3

مراجعة الدرس الأول من الوحدة الثامنة gravity of center and mass of Center منهج انسابير

4

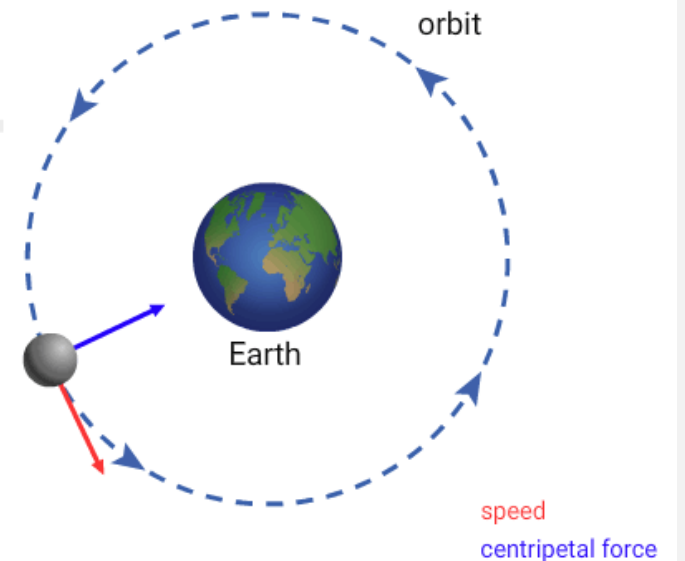
كل ما يخص اختبار نهاية الفصل الثالث ليوم الثلاثاء بتاريخ 2025-06-10

5

Unit 9: Circular motion

Section 9.4

Angular and Centripetal Acceleration





Learning Objectives

Section 9.4

Angular and Centripetal Acceleration

By the end of this section, you will be able to:

- 1) Define and Calculate angular acceleration and distinguish it from linear acceleration.
- 2) Define and calculate tangential acceleration as the component responsible for changing the magnitude of linear velocity.
- 3) Define and calculate centripetal acceleration.
- 4) Differentiate between the three types of acceleration (angular, centripetal, and tangential) in terms of concept, direction, and influencing factors.
- 5) Solve problems involving calculations of all three types of acceleration.



Angular acceleration

Centripetal acceleration

Tangential acceleration

Let's recall what we have learned.



Complete the table with the appropriate information.

Angular velocity	measures how fast the <u>angle θ</u> changes in time.
Frequency	measures <u>cycles</u> per unit time.
Frequency	measured in hertz (Hz).
Angular velocity	measured in rad/s.
Period	the inverse of the frequency.
Period	measures the time interval between two successive instances where the angle has the same value.
Period	the time taken to pass once around the circle.
second	The unit of the period .

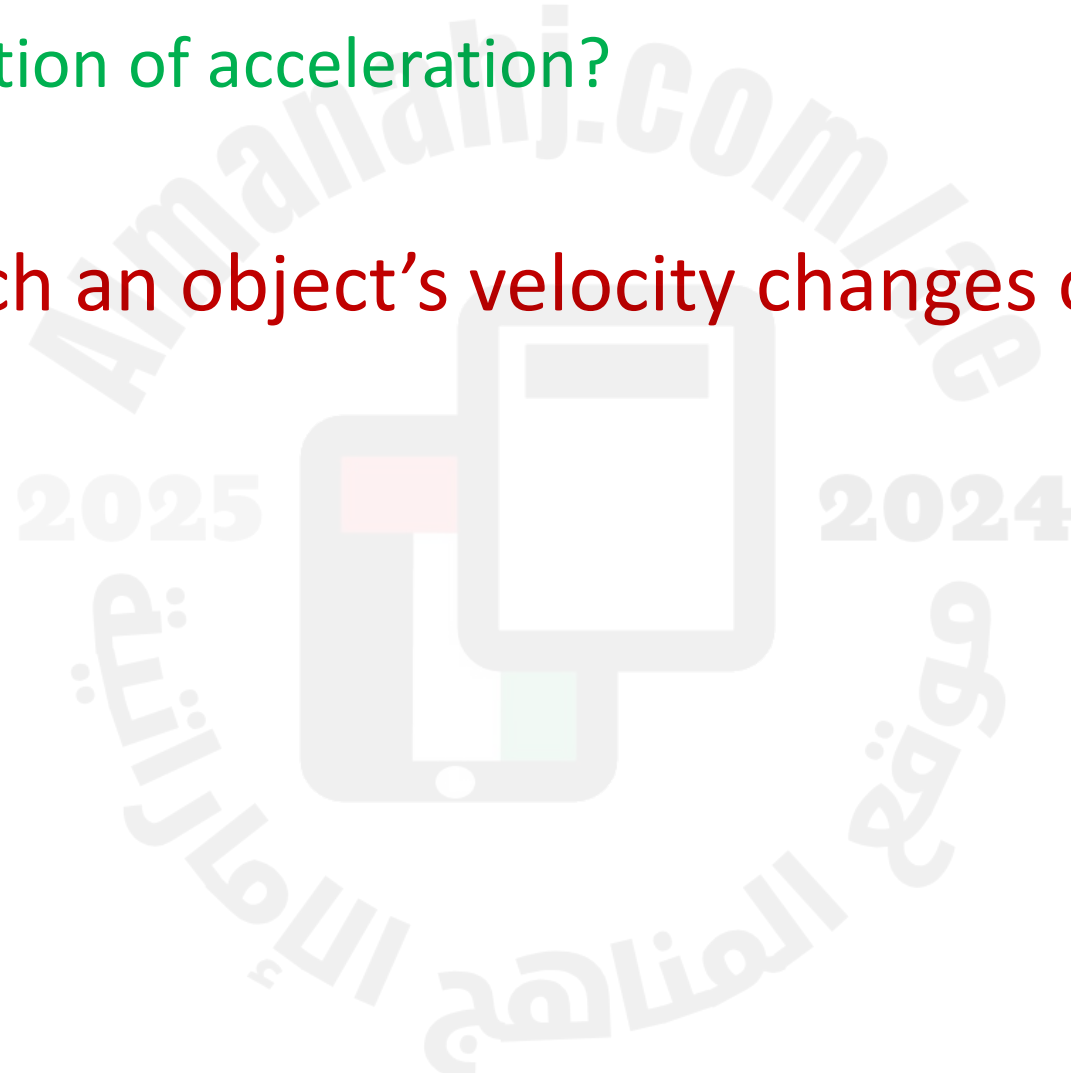
Let's recall what we have learned.



Average angular velocity	Instantaneous angular velocity	Frequency	Period
$\bar{\omega} = \frac{\Delta\theta}{\Delta t}$	$\omega = \frac{d\theta}{dt}$	$f = \frac{\omega}{2\pi}$	$T = \frac{1}{f}$

What is the definition of acceleration?

The rate at which an object's velocity changes over time.





WARM UP

Discussion

Have you ever seen a fan start spinning slowly and then gradually speed up?



This is an example of a special kind of acceleration—not in a straight line, but **around an axis**! This is what we call **angular acceleration**. In this lesson, we'll explore how the **rate of rotation** of an object changes over time.

We'll learn to distinguish between angular velocity and angular acceleration, understand how to calculate it, what factors affect it, and how it relates to the motion of an object in circular paths.

L.O: Define and Calculate angular acceleration and distinguish it from linear acceleration.

Angular acceleration

The rate of change of an object's angular velocity.

It is denoted by the Greek symbol α .

Average angular acceleration is determined from the relationship:

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

L.O: Define and Calculate angular acceleration and distinguish it from linear acceleration.

How can we calculate the instantaneous angular acceleration?

The instantaneous magnitude of the angular acceleration is obtained by calculating the limit as the time interval approaches zero:

$$\alpha = \lim_{\Delta t \rightarrow 0} \bar{\alpha} = \lim_{\Delta t \rightarrow 0} \frac{\Delta \omega}{\Delta t} \equiv \frac{d\omega}{dt} = \frac{d^2\theta}{dt^2}$$

$$\alpha = \frac{d\omega}{dt}$$



In the previous section, how did we calculate the linear velocity using the angular velocity?

$$v = r\omega$$

L.O: Define and calculate tangential acceleration as the component responsible for changing the magnitude of linear velocity.

Just as we found the relationship between linear velocity and angular velocity.

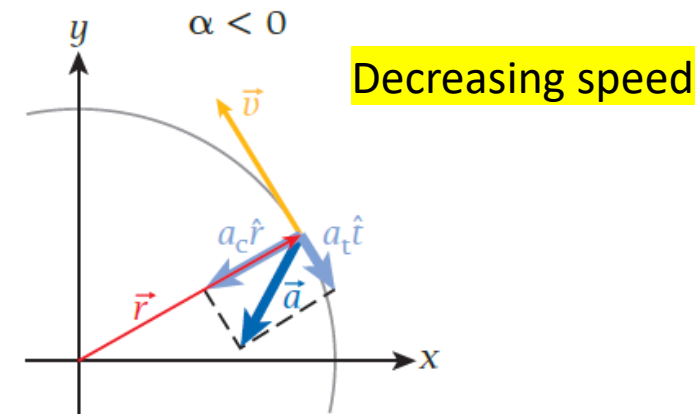
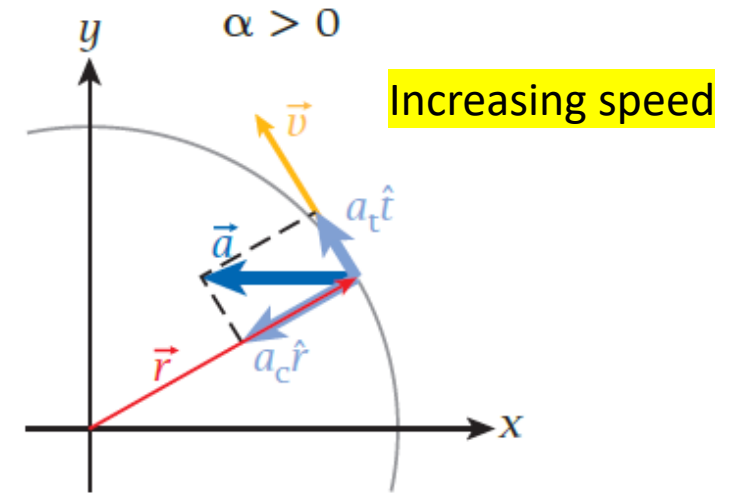
We can also find the **relationship** between **tangential acceleration** and **angular acceleration**.

a_t

α

Tangential acceleration a_t can be found by:

$$a_t = r\alpha$$

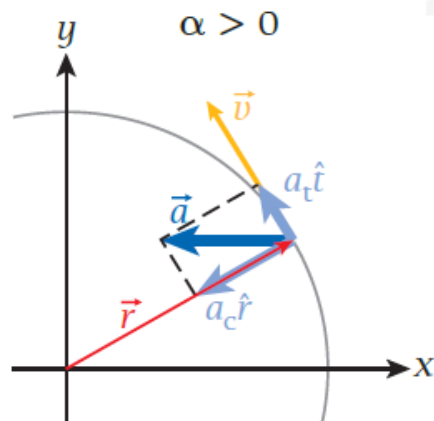


(c)

L.O: Define and calculate tangential acceleration as the component responsible for changing the magnitude of linear velocity.

In what case does a body moving in circular motion have tangential acceleration?

When the **speed** of an object moving in a circular path **changes** over time.



So, in **uniform circular motion** (where speed is constant), there's **no tangential acceleration**, only centripetal acceleration .

L.O: Define and calculate centripetal acceleration.

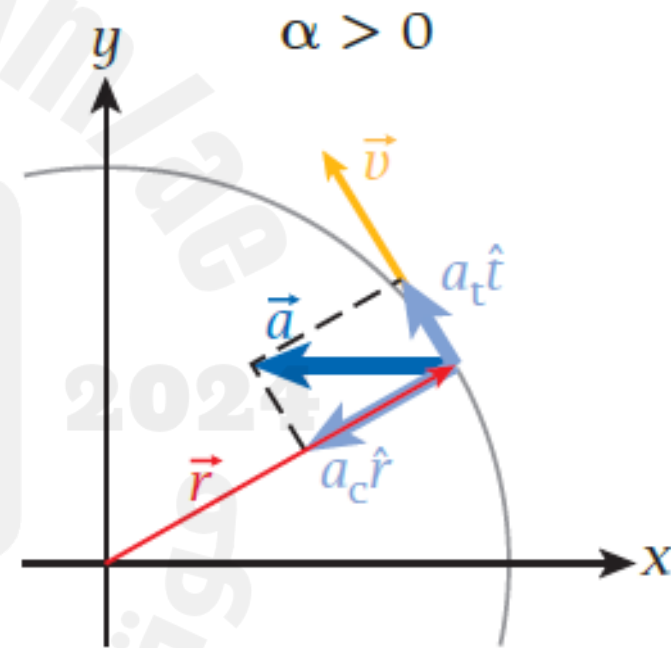
What is the acceleration in circular motion?

We find that:

- ❖ Tangential acceleration a_t
- ❖ Centripetal acceleration (Radial acceleration) a_c

What is the direction of centripetal acceleration?

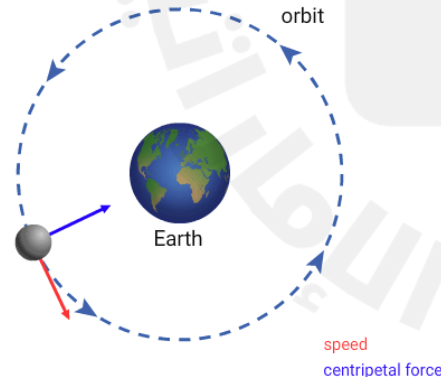
It is directed in the inward radial direction.
(centripetal means “center-seeking”).



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

L.O: Define and calculate centripetal acceleration.

Why is there always centripetal acceleration when a body moves in circular motion?



Centripetal acceleration exists in circular motion because the **direction of the velocity vector** is constantly changing as the body moves along the curved path.

Even if the object's speed (magnitude of velocity) remains constant, the **direction** of the velocity is always changing to keep the object moving in a circle.

Centripetal acceleration is present even if the circular motion proceeds at constant speed.

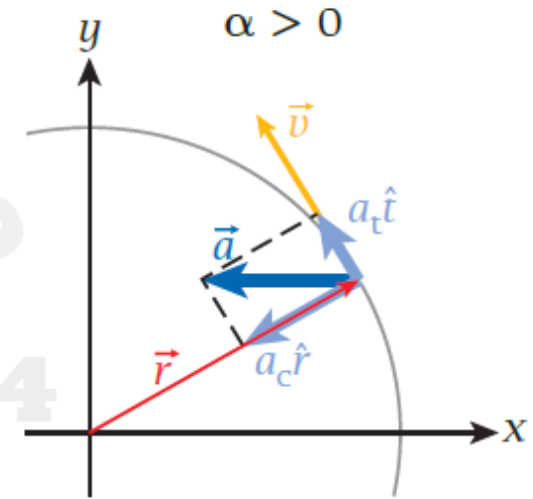
What is the acceleration in circular motion?

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

For circular motion, the acceleration vector has two components:

- ✓ Tangential acceleration a_t
 $a_t = r\alpha$
- ✓ Radial acceleration (Centripetal acceleration)
acceleration a_c

$$a_c = v\omega$$



$$\vec{a}(t) = r\alpha \hat{t} - v\omega \hat{r}$$

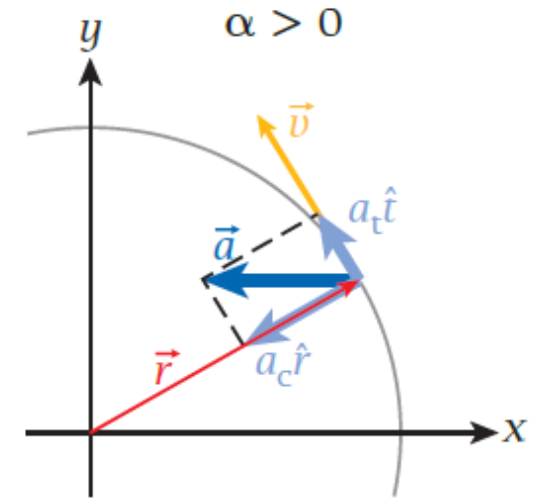
- So we can write the equation for the **acceleration** of an object in circular motion as the sum of the **tangential acceleration** and the **centripetal acceleration**:

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

Therefore, the magnitude of the acceleration in circular motion is:

$$a = \sqrt{a_t^2 + a_c^2}$$

Centripetal acceleration : $a_c = v\omega = \frac{v^2}{r} = r\omega^2$

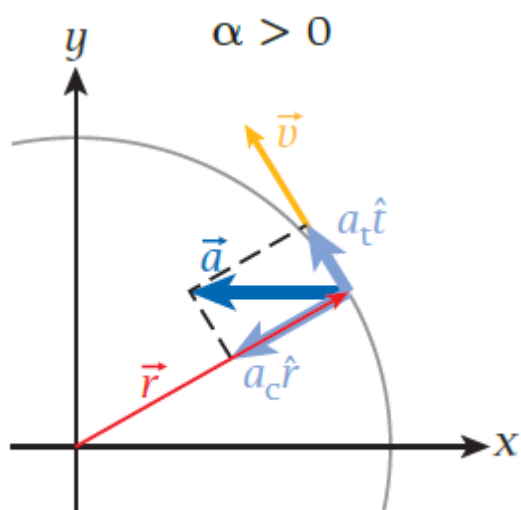


$$a = \sqrt{a_t^2 + a_c^2} = \sqrt{(r\alpha)^2 + (r\omega^2)^2} = r\sqrt{\alpha^2 + \omega^4}.$$

Check your understanding:

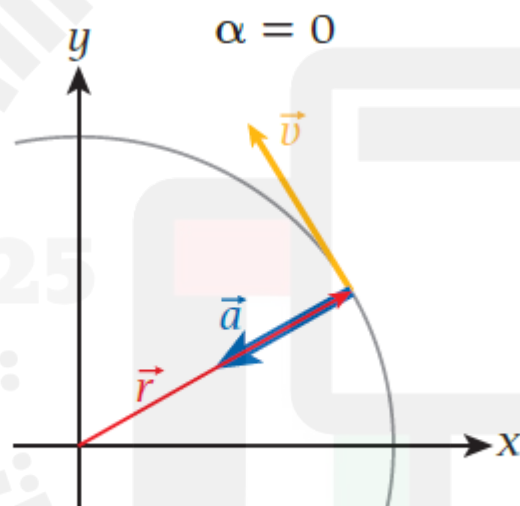
Match the correct description with the appropriate diagram from the following:

Decreasing speed - Increasing speed - Constant speed



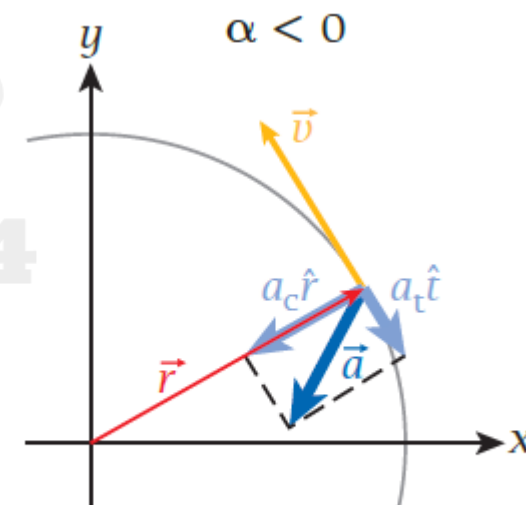
(a)

Increasing speed



(b)

Constant speed



(c)

Decreasing speed

L.O: Differentiate between the three types of acceleration (angular, centripetal, and tangential) in terms of concept, direction, and influencing factors.

WS # 9: (Exercise 1)

Complete the table with the appropriate information.

Angular acceleration	The rate of change of an object's angular velocity.
Centripetal acceleration	It is directed in the inward radial direction.
Angular acceleration	It is denoted by the Greek symbol α .
Angular acceleration	measured in rad/s^2 .
Centripetal acceleration	exists in circular motion because the direction of the velocity vector is constantly changing as the body moves along the curved path.
Tangential acceleration	Can be found by: $a_t = r\alpha$
Centripetal acceleration	It is denoted by the Greek symbol a_c .
Tangential acceleration	It is denoted by the Greek symbol a_t .

L.O: Differentiate between the three types of acceleration (angular, centripetal, and tangential) in terms of concept, direction, and influencing factors.

WS # 9: (Exercise 2)

Write the formulas needed to calculate each of the following :

Average angular acceleration	Instantaneous angular acceleration	Tangential acceleration	Centripetal acceleration
$\bar{\alpha} = \frac{\Delta\omega}{\Delta t}$ <i>rad/s²</i> <i>rad/s</i> <i>s</i>	$\alpha = \frac{d\omega}{dt}$ <i>rad/s</i>	$a_t = r\alpha$ <i>m/s²</i> <i>m</i> <i>rad/s</i>	$a_c = v\omega = \frac{v^2}{r} = r\omega^2$ <i>m/s²</i> <i>m</i> <i>rad/s</i>

L.O: Solve problems involving calculations of all three types of acceleration.

WS # 9: (Exercise 3)

$$r = \frac{1.2}{2} = 0.6 \text{ m}$$

\propto

A flywheel of **diameter** 1.2 m has a constant angular acceleration of 5.0 rad/s².
The tangential acceleration of a point on its rim is ____.

- A. 3.0 m/s²
- B. 5.0 m/s²
- C. 6.0 m/s²
- D. 10 m/s²

$$a_t = ?$$

$$a_t = r \alpha$$

$$= 0.6 \times 5$$

$$= 3 \text{ m/s}^2$$

✓ A. 3.0 m/s²

L.O: Solve problems involving calculations of all three types of acceleration.

WS # 9: (Exercise 4)

A flywheel increases its angular speed from 5 rad/s to 15 rad/s in 5 s . Its angular acceleration is:

- $\alpha = ?$
- A. 2 rad/s^2
 - B. 3 rad/s^2
 - C. 4 rad/s^2
 - D. 6 rad/s^2
- ✓ A. 2 rad/s^2

$$\begin{aligned}\alpha &= \frac{\Delta \omega}{\Delta t} = \frac{\omega_f - \omega_i}{\Delta t} \\ &= \frac{15 - 5}{5} \\ &= 2 \text{ rad/s}^2\end{aligned}$$

L.O: Solve problems involving calculations of all three types of acceleration.

WS # 9: (Exercise 5)

When a fan is turned off, its angular speed decreases uniformly from 10.0 rad/s to 6.30 rad/s in 5.00 s . What is the magnitude of the angular acceleration of the fan?

A. 0.360 rad/s^2

☒ B. 0.740 rad/s^2

C. 0.921 rad/s^2

D. 1.35 rad/s^2

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

$$= \frac{6.30 - 10.0}{5} = -0.74 \text{ rad/s}^2$$

✓ B. 0.740 rad/s^2

L.O: Solve problems involving calculations of all three types of acceleration.

WS # 9: (Exercise 6)

Δt Ten seconds after an electric fan is turned on, the fan rotates at ω_f 300 rev/min. Its average angular acceleration is .

- $\omega_i = 0$
- $\alpha = ?$
- A. 3.14 rad/s²
 - B. 30 rad/s²
 - C. 30 rev/s²
 - D. 50 rev/min²

A

$$\alpha = \frac{\Delta \omega}{\Delta t} = \frac{31.4 - 0}{10} = 3.14 \text{ rad/s}^2$$

Convert to rad/s

$$\omega_f = \frac{300 \times 2\pi}{60} = 31.4 \text{ rad/s}$$

L.O: Solve problems involving calculations of all three types of acceleration.

WS # 9: (Exercise 7)

The angular displacement θ of a rotating wheel is described by the equation $\theta = \theta_0 + at^2 - bt^3$, where t is time and θ_0 , a , and b are positive constants.

$\omega = ?$

The angular velocity of the wheel as a function of time t is ____.

A. zero

B. $2a - 6bt$

☒ C. $2at - 3bt^2$

D. $\theta_0 t + \frac{1}{3}at^3 - \frac{1}{4}bt^4$

$$\omega = \frac{d\theta}{dt}$$

$$\omega = 0 + 2at - 3bt^2$$

$$\omega = 2at - 3bt^2$$

C

$\alpha = ?$

The angular acceleration of the wheel as a function of time t is ____.

A. zero

☒ B. $2a - 6bt$

C. $2at - 3bt^2$

D. $\theta_0 t + \frac{1}{3}at^3 - \frac{1}{4}bt^4$

$$\alpha = \frac{d\omega}{dt}$$

$$\alpha = 2a - 6bt$$

B

L.O: Solve problems involving calculations of all three types of acceleration.

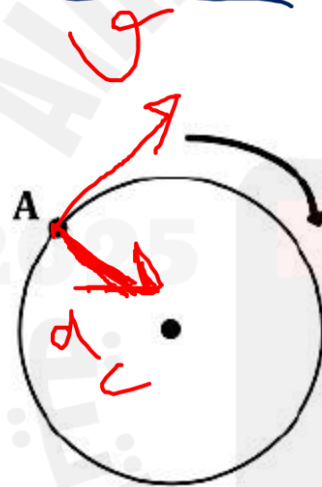
WS # 9: (Exercise 8)

$$a_t = 0$$

$$a = a_c$$

Consider an object that moves in a circular path at **constant speed**. When it reaches point A, which of the following describes the direction of its acceleration (a) and velocity (v)?

- | | a | v |
|----|--------------|---------------|
| A. | \nearrow | \searrow |
| B. | \checkmark | \nwarrow |
| C. | \searrow | \nearrow |
| D. | \nwarrow | \rightarrow |



- | | a | v |
|----|--------------|---------------|
| A. | \nearrow | \searrow |
| B. | \checkmark | \nwarrow |
| C. | \searrow | \nearrow |
| D. | \nwarrow | \rightarrow |



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



Learning Objectives

Section 9.4

Angular and Centripetal Acceleration

- Solve problems involving calculations of all three types of acceleration (angular, centripetal, and tangential).



Angular acceleration

Centripetal acceleration

Tangential acceleration

L.O: Differentiate between the three types of acceleration (angular, centripetal, and tangential) in terms of concept, direction, and influencing factors.

Complete the table with the appropriate information.



Angular acceleration	The rate of change of an object's angular velocity.
Centripetal acceleration	It is directed in the inward radial direction.
Angular acceleration	It is denoted by the Greek symbol α .
Angular acceleration	measured in rad/s^2 .
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Tangential acceleration	Can be found by: $a_t = r\alpha$
Centripetal acceleration	It is denoted by the Greek symbol a_c .
Tangential acceleration	It is denoted by the Greek symbol a_t .

L.O: Differentiate between the three types of acceleration (angular, centripetal, and tangential) in terms of concept, direction, and influencing factors.

Write the formulas needed to calculate each of the following :



Average angular acceleration	Instantaneous angular acceleration	Tangential acceleration	Centripetal acceleration
$\bar{\alpha} = \frac{\Delta\omega}{\Delta t}$ rad/s ² (pointing to $\bar{\alpha}$) rad/s (pointing to $\Delta\omega$) s (pointing to Δt)	$\alpha = \frac{d\omega}{dt}$ rad/s (pointing to α)	$a_t = r\alpha$ m/s ² (pointing to a_t) m (pointing to r) rad/s ² (pointing to α)	$a_c = v\omega = \frac{v^2}{r} = r\omega^2$ m/s ² (pointing to a_c) m/s (pointing to v) rad/s (pointing to ω) m/s ² (pointing to v^2) m (pointing to r) rad/s ² (pointing to ω^2)

?

Test your knowledge!



1. What does angular acceleration measure?

- A) The rate of change of linear velocity
- B) The rate of change of angular velocity
- C) The speed of an object in a straight line
- D) The radius of circular motion.

Correct answer: B



Test your knowledge!



2. Centripetal acceleration always points:

- A) Tangent to the path
- B) Opposite to the direction of motion
- C) Toward the center of the circular path
- D) Away from the center of the circle

Correct answer: C

?

Test your knowledge!



3. Which of the following best describes tangential acceleration?

- A) Acceleration directed toward the center of the circle.
- B) Acceleration due to gravity.
- C) Acceleration that changes the speed along the circular path.
- D) Acceleration that changes the direction only.

Correct answer: C



Test your knowledge!



4. Which of the following factors does NOT affect centripetal acceleration?

- A) Speed of the object
- B) Radius of the circular path
- C) Mass of the object
- D) All affect centripetal acceleration

Correct answer: C

L.O: Solve problems involving calculations of all three types of acceleration.

WS # 10: (Exercise 1)

$$r = \frac{10}{100} = 0.1 \text{ m}$$

A plastic disc has a radius of 10 cm and rotates at 120 rpm (revolutions per minute).

convert to ω

What is the centripetal acceleration of a point on the edge of the disc?

$$a_c = ?$$

$$\begin{aligned} a_c &= r \omega^2 \\ &= 0.1 \times (12.6)^2 \\ &= 15.9 \text{ m/s}^2 \end{aligned}$$

$$\omega = \frac{120 \times 2\pi}{60}$$

$$\omega = 12.6 \text{ rad/s}$$

- ☒ 15.8 m/s^2
- ☐ 1440 m/s^2
- ☐ 1580 m/s^2
- ☐ 144 m/s^2

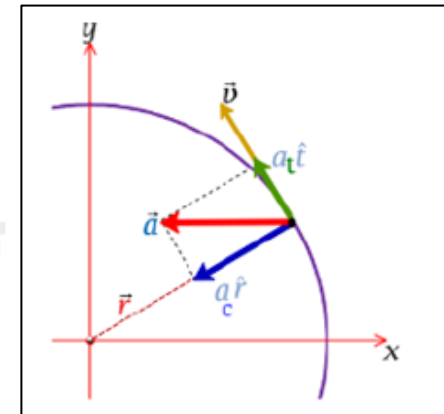
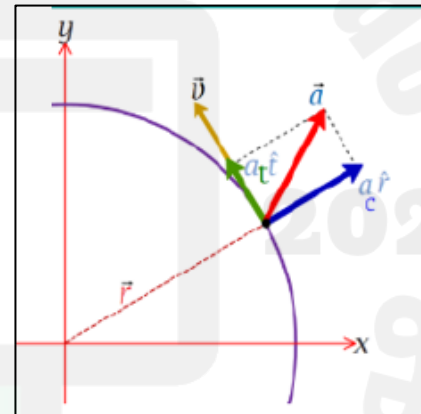
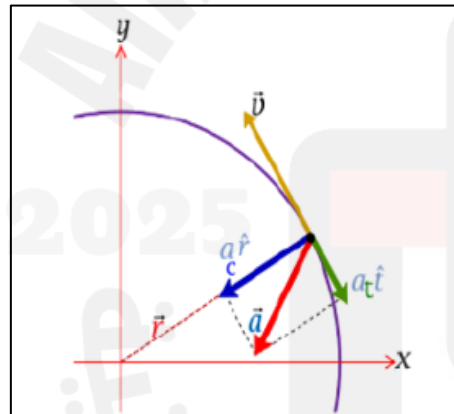
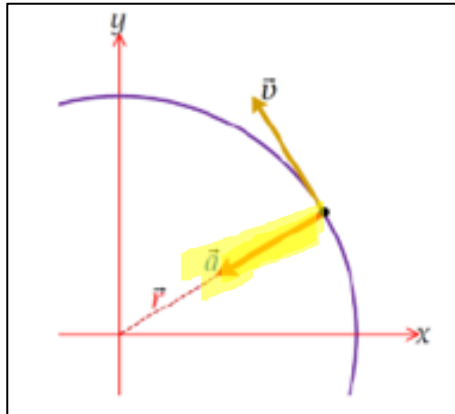
L.O: Solve problems involving calculations of all three types of acceleration.

WS # 10: (Exercise 2)



الرسوم البيانية التالية تعبر عن جسم يتحرك حركة دائرية. أي من الرسوم البيانية تدل على حركة الجسم بسرعة زاوية ثابتة؟

In the following graphs, the object moves in a circular motion. In which of the graphs the object moves with a **constant angular velocity**?



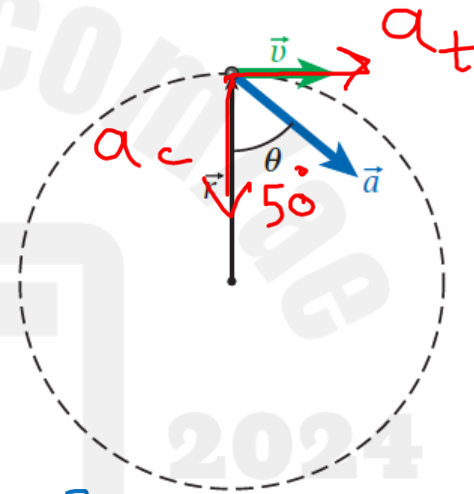
$a_t = 0$
↑

So v constant $\rightarrow \omega$ constant.

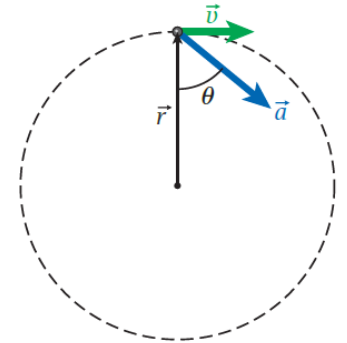
L.O: Solve problems involving calculations of all three types of acceleration.

WS # 10: (Exercise 3)

●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 $a = |\vec{a}| = \underline{25.0 \text{ m/s}^2}$, and the acceleration vector has an angle of $\theta = \underline{50.0^\circ}$ with the position vector, as shown in the figure. At this instant, find the speed, $v = |\vec{v}|$, of this particle.



$$a_t = a \sin \theta$$
$$a_c = a \cos \theta$$



$v = ?$

To find v , use $a_c = \frac{v^2}{r}$

so, find $a_c = a \cos \theta$

$$= 25 \cos 50^\circ = 16.07 \text{ m/s}^2$$

$$a_c = \frac{v^2}{r}$$
$$16.07 = \frac{v^2}{1} \Rightarrow v = 4 \text{ m/s}$$

Answer:

4.01 m/s

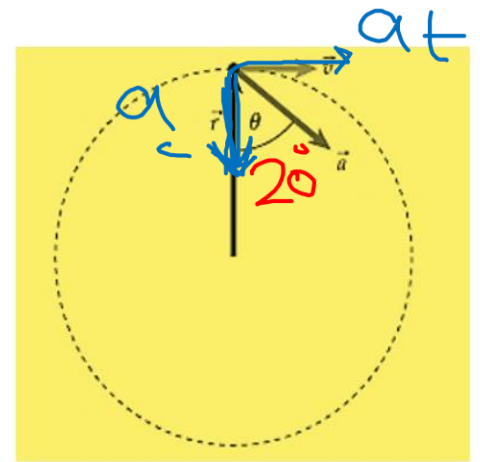
L.O: Solve problems involving calculations of all three types of acceleration.



WS # 10: (Exercise 4) $\rightarrow r = \frac{25}{100} = 0.25\text{m}$

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?



$$\alpha = ?$$

To find $\alpha \Rightarrow$ use $a_t = r\alpha$

So, find $a_t = a \sin \theta$

$$a_t = 16 \sin 20^\circ$$

$$a_t = 5.47 \text{ m/s}^2$$

$$a_t = r\alpha$$

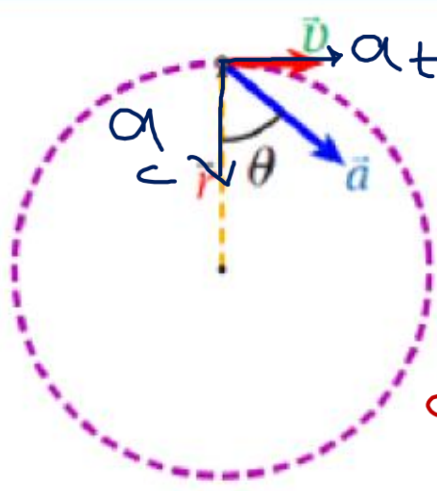
$$\alpha = \frac{a_t}{r} = \frac{5.47}{0.25}$$

$$= 21.88 \text{ rad/s}^2$$

- ☐ 60.1 rad/s²
- ☐ 1.37 rad/s²
- ☐ 3.75 rad/s²
- ☒ 21.9 rad/s²

L.O: Solve problems involving calculations of all three types of acceleration.

WS # 10: (Exercise 5)



يتحرك جسيم بسرعة v في اتجاه عقارب الساعة في دائرة نصف قطرها 1.28 m . عند لحظة معينة، يكون مقدار تسارع الجسيم 25.0 m/s^2 ويصنع متجه التسارع زاوية $\theta = 60.0^\circ$ مع متجه الموضع، كما هو موضح في الشكل. ما مقدار السرعة v ؟

A particle is moving with speed v clockwise in a circle of radius 1.28 m . At a certain instant, the magnitude of its acceleration is 25.0 m/s^2 , the acceleration vector has an angle of $\theta = 60.0^\circ$, with the position vector, as shown in the figure.

What is the velocity v ?

☒ 4.00 m/s

☐ 5.26 m/s

☐ 16.0 m/s

☐ 1.60 m/s

$$a_c = a \cos \theta$$
$$= 25 \cos 60^\circ = 12.5 \text{ m/s}^2 \Rightarrow \text{so}$$

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

$$\Rightarrow v = \sqrt{r a_c}$$

$$= \sqrt{1.28 \times 12.5}$$
$$= 4 \text{ m/s}$$

L.O: Solve problems involving calculations of all three types of acceleration.



WS # 10: (Exercise 6)

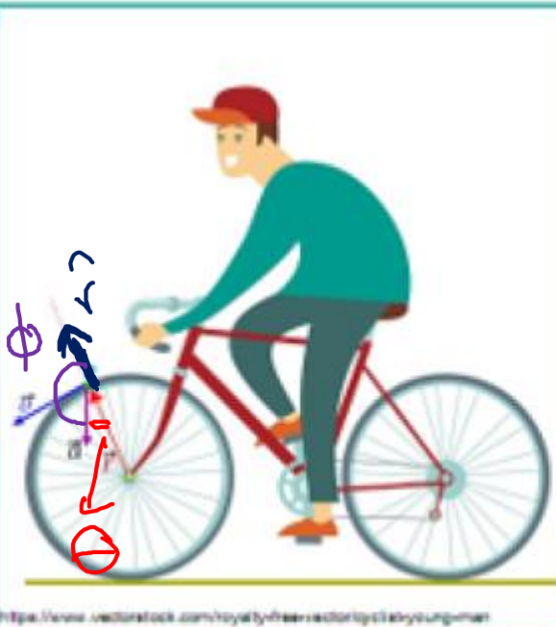


An object moves in a circular path with an increasing linear velocity. Which of the following is true?

- ☐ The tangential acceleration of a body is greater than its centripetal acceleration.
- ☐ The linear velocity vector of a body is perpendicular to its tangential acceleration.
- ☐ Both the centripetal acceleration and tangential acceleration of the body are zero.
- ☒ The tangential acceleration and centripetal acceleration of a body are perpendicular.

L.O: Solve problems involving calculations of all three types of acceleration.

WS # 11: (Exercise 1)



يتحرك دولاب دراجة في حركة دائرية كما هو موضح في الشكل.
تسارع الحركة للنقطة **P** على الطرف الخارجي لدولاب الدراجة كما يلي:

$$\vec{a} = (1.73 \text{ m/s})\hat{t} - (3.0 \text{ m/s})\hat{r}$$

ما الزاوية بين \vec{a} والمتجه \hat{r} ؟

A cycle wheel moves in circular motion as shown in the figure. The acceleration of point **P** at the outside of the bicycle wheel is given as follows:

$$\vec{a} = (1.73 \text{ m/s})\hat{t} - (3.0 \text{ m/s})\hat{r}$$

What is the angle between \vec{a} and vector \hat{r} ?

☐ 150°

☐ 30°

☐ 180°

☐ 50°

Now find ϕ
 $\nearrow 180^\circ - 30^\circ$
 $= 150^\circ$

Find $\theta \rightarrow$ then ϕ

$$\theta = \tan^{-1} \left(\frac{a_t}{a_c} \right)$$

$$\theta = \tan^{-1} \left(\frac{1.73}{3.0} \right) = 30^\circ$$

150°

L.O: Solve problems involving calculations of all three types of acceleration.

WS # 11: (Exercise 2)



A disk with a diameter of (1.0 m) starts rotating from rest, and its angular acceleration varies with time according to the function $(\alpha = 0.2 t)$. What is the angular velocity of the disk after (8.0 s) from the start of rotation?

بدأ قرص قطره (1.0 m) الدوران من السكون وكان التسارع الزاوي للقرص يتغير مع الزمن وفق الدالة $(\alpha = 0.2 t)$. ما مقدار السرعة الزاوية للقرص بعد (8.0s) من بدء الدوران؟

$$\omega = \int_{t_0}^t \alpha \cdot dt$$
$$= \int_0^8 0.2t \cdot dt = 6.4 \text{ rad/s}$$

17 rad/s ☐

51 rad/s ☐

6.4 rad/s ☒

3.2 rad/s ☐

In uniform circular motion, which type of acceleration is always present?

- A) Tangential acceleration
- B) Angular acceleration
- C) Centripetal acceleration
- D) No acceleration

Correct answer: C



**EXIT
CARD**

Extra Exercises:

9.41 You are holding the axle of a bicycle wheel with radius 35.0 cm and mass 1.00 kg. You get the wheel spinning at a rate of 75.0 rpm and then stop it by pressing the tire against the pavement. You notice that it takes 1.20 s for the wheel to come to a complete stop. What is the angular acceleration of the wheel?

Answer:

$$-6.5 \text{ rad/s}^2$$

Extra Exercises:

9.40 What is the centripetal acceleration of the Moon? The period of the Moon's orbit about the Earth is 27.3 days, measured with respect to the fixed stars. The radius of the Moon's orbit is $R_M = 3.85 \cdot 10^8$ m.

Answer:

$$2.73 \times 10^{-3} \text{ m/s}^2$$

A ceiling fan is rotating counterclockwise when viewed from below (looking upward from the ground) and is slowing down. **What are the directions of the angular velocity ω and the angular acceleration α ?**

مروحة سقف تدور عكس اتجاه دوران عقارب الساعة عندما تنظر إليها باتجاه الأعلى من الأرض و كانت تتباطأ،
ما اتجاه كل من السرعة الزاوية ω و التسارع الزاوي α ؟

Angular Velocity ω السرعة الزاوية	Angular Acceleration α التسارع الزاوي
up للأعلى	up للأعلى

Angular Velocity ω السرعة الزاوية	Angular Acceleration α التسارع الزاوي
down للأسفل	down للأسفل



Angular Velocity ω السرعة الزاوية	Angular Acceleration α التسارع الزاوي
down للأسفل	up للأعلى

Angular Velocity ω السرعة الزاوية	Angular Acceleration α التسارع الزاوي
right لليمين	left لليسار

تنزلق عربة أفغوانية في إحدى حدائق الألعاب. أي من الأشكال التالية يعبر بشكل صحيح عن اتجاهات كل من التسارع المماسي والتسارع القطري للعربة؟

A roller coaster slides in one of the theme parks. Which of the following figures correctly represents the directions of the tangential acceleration and the radial acceleration of the roller coaster ?

PHY 1.01.01.023

