

مراجعة الدرس الأول من الوحدة التاسعة Coordinates Polar منهج انسابير



تم تحميل هذا الملف من موقع المناهج الإماراتية

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

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

1

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

2

نموذج اختبار تجريبي باللغتين العربية والانجليزية بدون الحل

3

ملخص تجميعية قوانين الفيزياء منهج انسابير

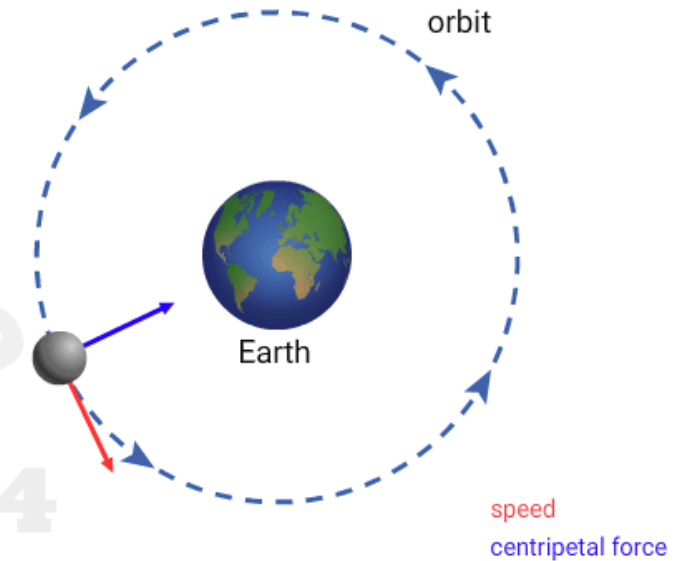
4

ملخص تجميعية قوانين الفيزياء منهج بريدج

5

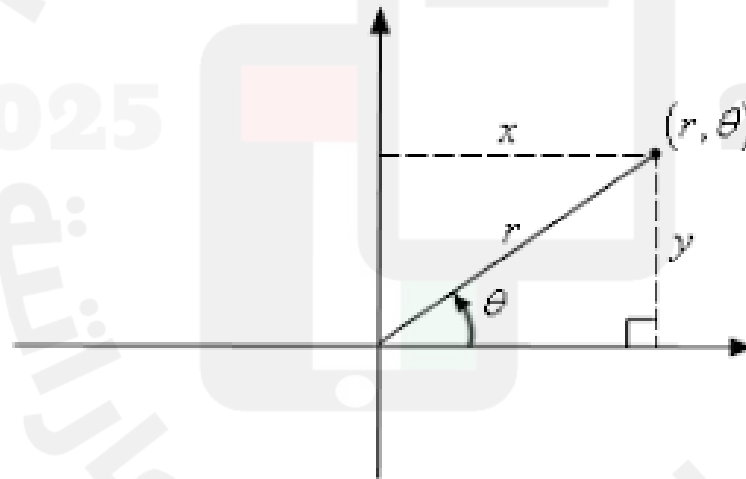
Unit 9:

Circular motion



Section 9.1

Polar Coordinates





Learning Objectives

Section 9.1

Polar Coordinates

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

- 1) Define polar coordinates and distinguish them from Cartesian coordinates.
- 2) Convert coordinates from Cartesian to polar coordinates and vice versa.



Cartesian coordinates

Polar Coordinates

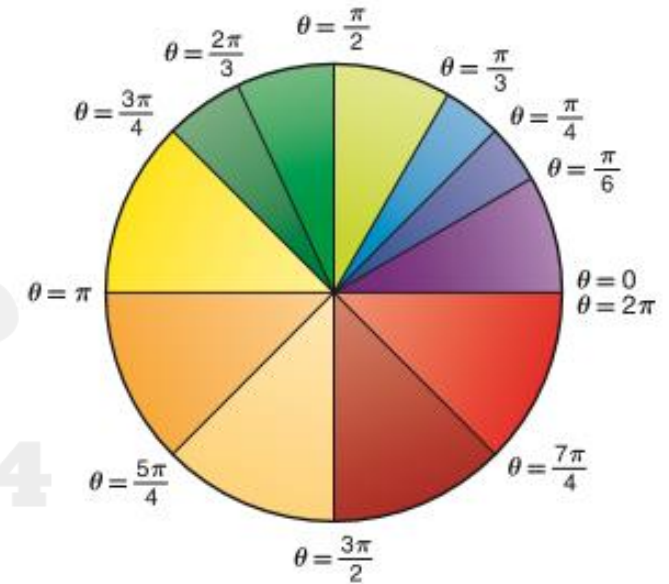
Radial unit vector

Tangential unit vector

- In this chapter, we examine a special case of motion in a two-dimensional plane: **motion of an object along the circumference of a circle.**

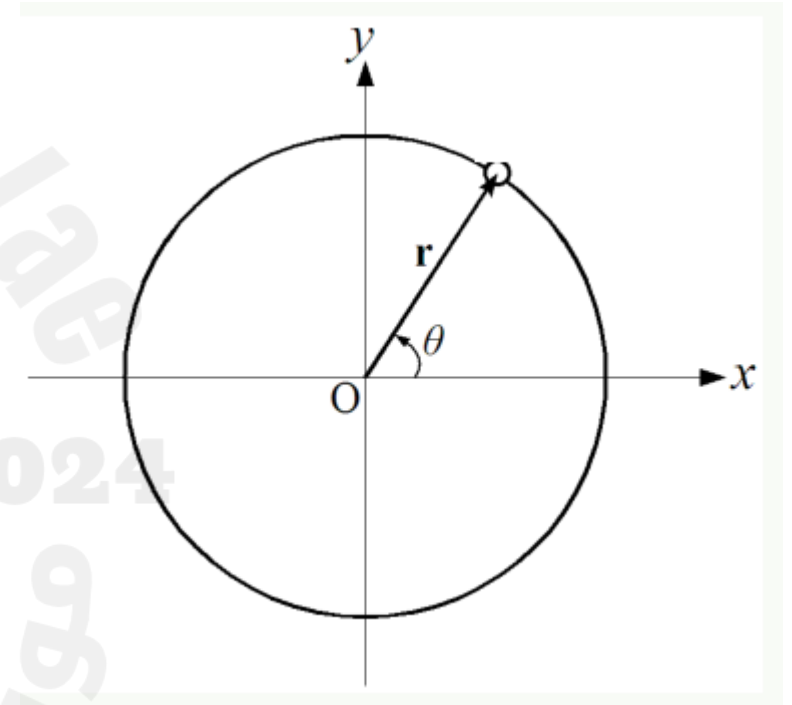
- To be precise, we will only study circular motion of objects that we can consider to be point particles.

- In Chapter 10 on rotation, we will relax this condition and also examine extended bodies.



L.O: Define polar coordinates and distinguish them from Cartesian coordinates.

- During an object's **circular motion**, its x - and y -coordinates change continuously.
- but the distance from the object to the center of the circular path stays the same.
- We can take advantage of this fact by using **polar coordinates** to study circular motion.

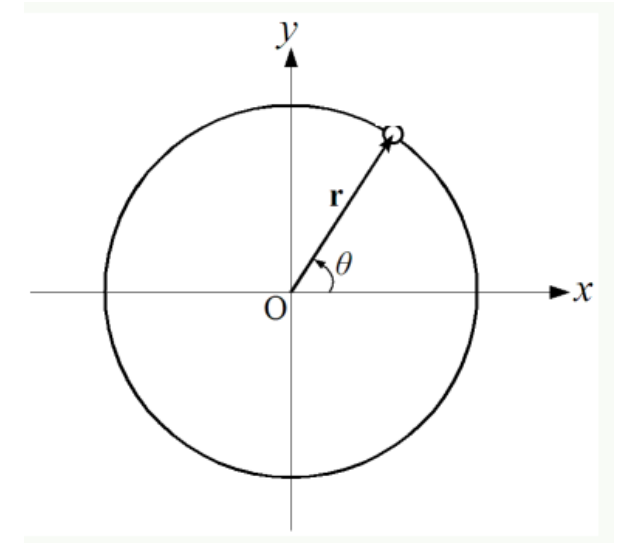


L.O: Define polar coordinates and distinguish them from Cartesian coordinates.

- The adjacent figure shows the position vector \vec{r} of an object in circular motion.
- This vector changes as a function of time, but its head(tip) always moves along the circumference of a circle.
- We can determine \vec{r} by finding its x and y components .

$$\vec{r} = (x, y)$$

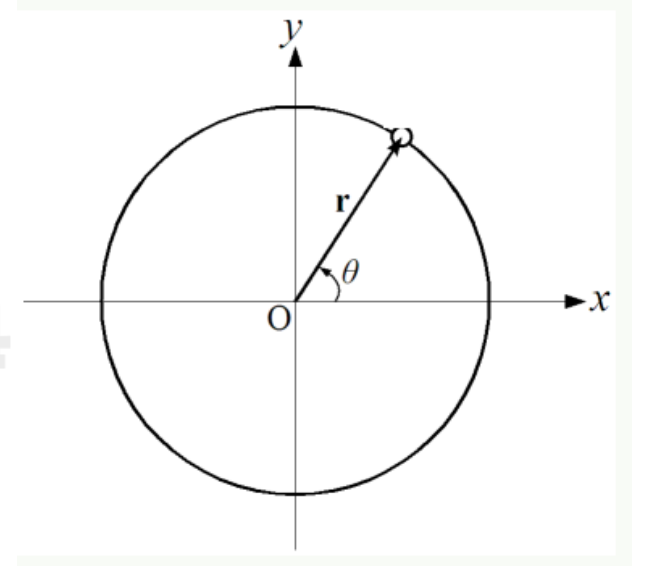
- We can determine the same vector (\vec{r}) by giving two other numbers:
 - The angle of \vec{r} relative to the x- axis.
 - The length of \vec{r} .



L.O: Define polar coordinates and distinguish them from Cartesian coordinates.

Why do we use polar coordinates instead of Cartesian coordinates?

- The major advantage of using polar coordinates for analyzing circular motion is that r never changes.
- It remains the same as long as the tip of the vector \vec{r} moves along the circular path.
- Thus, we can reduce the description of two-dimensional motion on the circumference of a circle to a one-dimensional problem involving the angle θ .

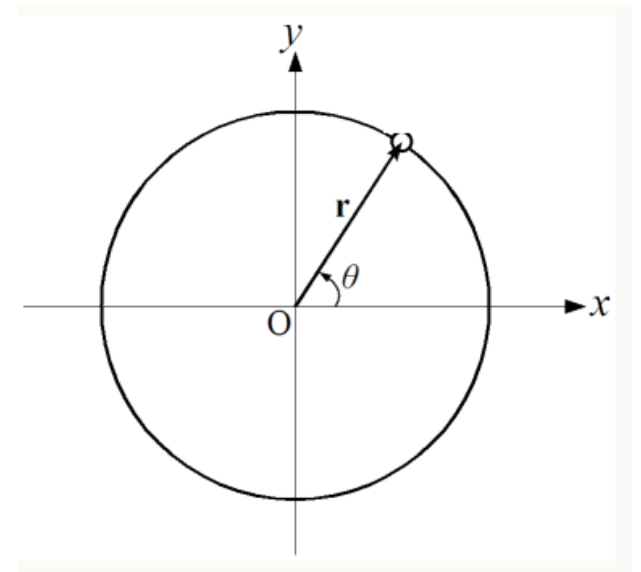


L.O: Convert coordinates from Cartesian to polar coordinates and vice versa.

Trigonometry provides the relationship between the Cartesian coordinates x and y and the polar coordinates θ and r :

$$r = \sqrt{x^2 + y^2} \quad (9.1)$$

$$\theta = \tan^{-1}(y/x). \quad (9.2)$$

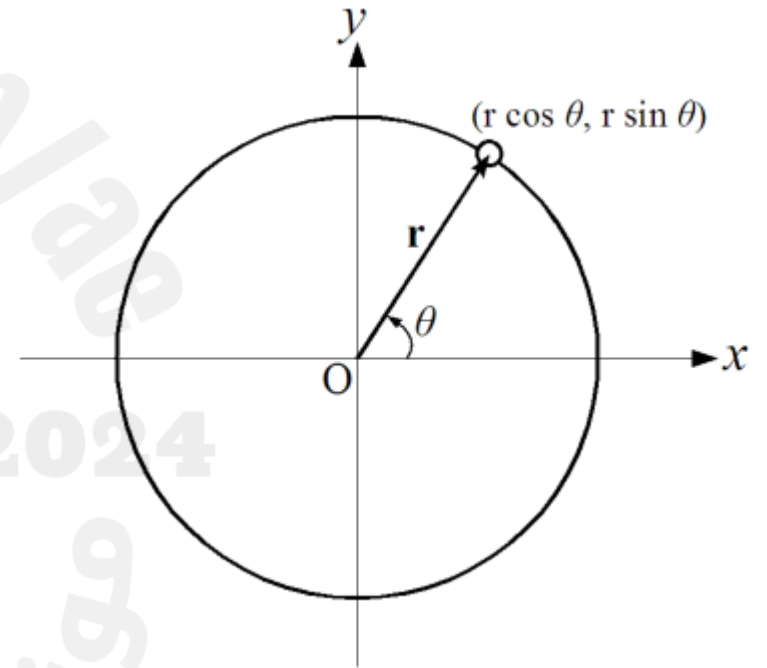


L.O: Convert coordinates from Cartesian to polar coordinates and vice versa.

The inverse transformation from polar to Cartesian coordinates can be done by:

$$x = r \cos \theta$$

$$y = r \sin \theta$$



L.O: Convert coordinates from Cartesian to polar coordinates and vice versa.

Radial and tangential unit vectors

\hat{r} : Radial unit vector.

\hat{t} : Tangential unit vector.

The angle between \hat{r} and \hat{x} is the angle θ

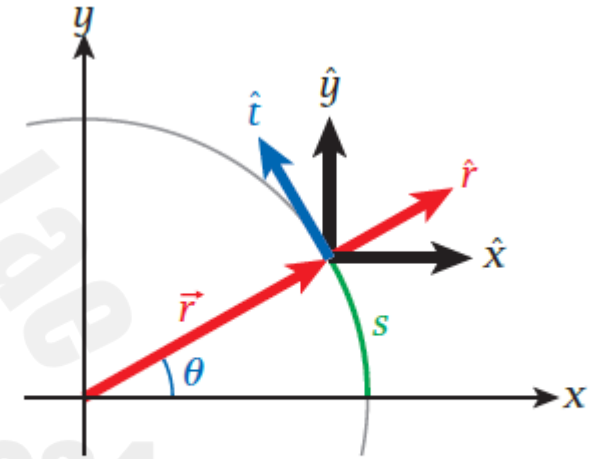


FIGURE 9.3 Polar coordinate system for circular motion.

L.O: Convert coordinates from Cartesian to polar coordinates and vice versa.

The angle between \hat{r} and \hat{x} is the angle θ

- Therefore, the Cartesian components of the radial unit vector can be written as:

$$\hat{r} = (\cos \theta)\hat{x} + (\sin \theta)\hat{y} \equiv (\cos \theta, \sin \theta)$$

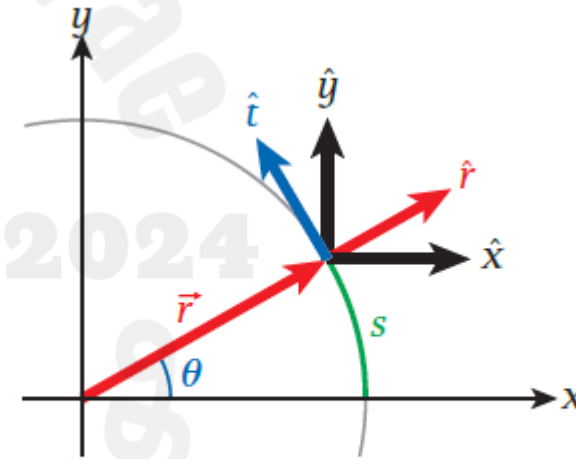


FIGURE 9.3 Polar coordinate system for circular motion.

L.O: Convert coordinates from Cartesian to polar coordinates and vice versa.

- We can obtain the Cartesian components of the tangential unit vector as follows:

The angle between the **tangential unit** vector and the **y-axis** is the angle θ .

$$\hat{t} = (-\sin \theta)\hat{x} + (\cos \theta)\hat{y} \equiv (-\sin \theta, \cos \theta)$$

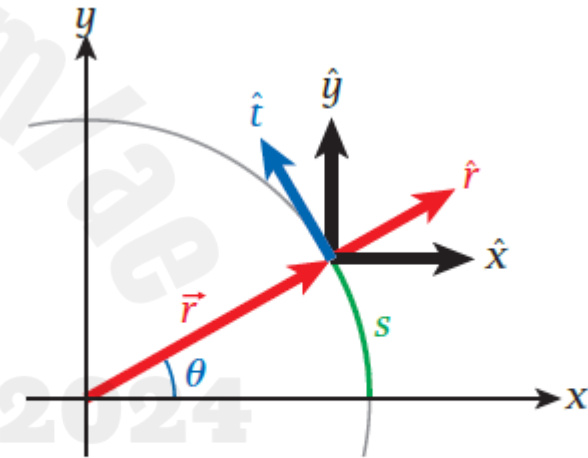
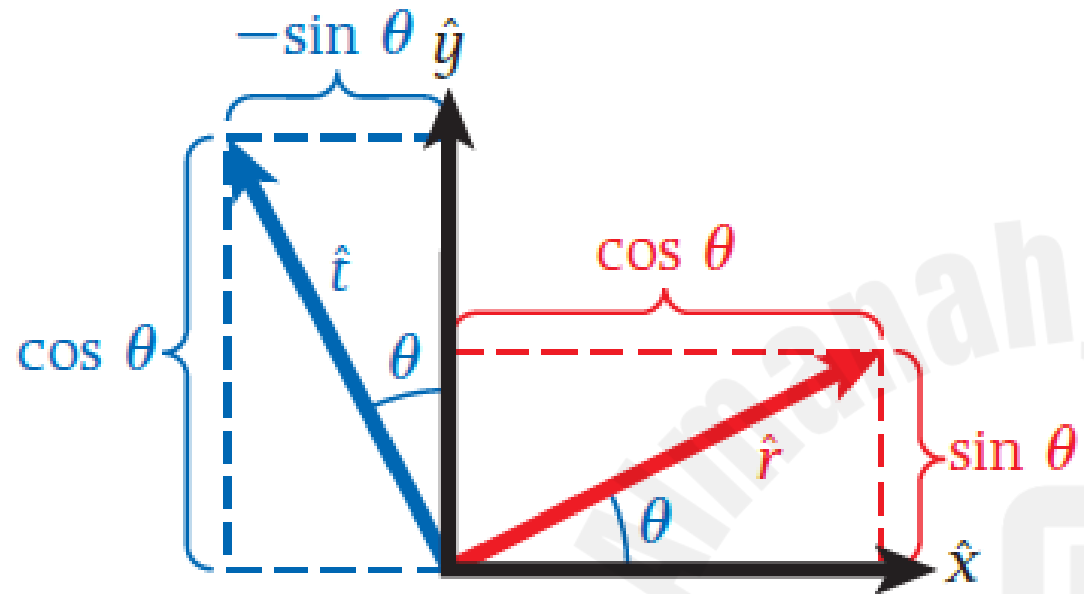


FIGURE 9.3 Polar coordinate system for circular motion.

L.O: Convert coordinates from Cartesian to polar coordinates and vice versa.



$$\hat{r} = (\cos \theta, \sin \theta)$$

$$\hat{t} = (-\sin \theta, \cos \theta)$$

FIGURE 9.4 Relationship between the radial and tangential unit vectors shown in Figure 9.3, the Cartesian unit vectors, and the sine and cosine of the angle.

note that the tangential and radial unit vectors are always perpendicular to each other

L.O: Convert coordinates from Cartesian to polar coordinates and vice versa.

WS # 4:

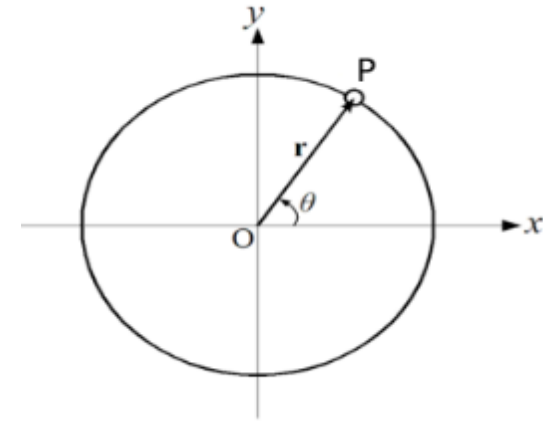
- How to convert from Cartesian coordinates to polar coordinates?

$$r = \sqrt{x^2 + y^2}$$
$$\theta = \tan^{-1}(y/x).$$

- How to convert from polar coordinates to Cartesian coordinates?

$$x = r \cos \theta$$
$$y = r \sin \theta$$

WS # 4



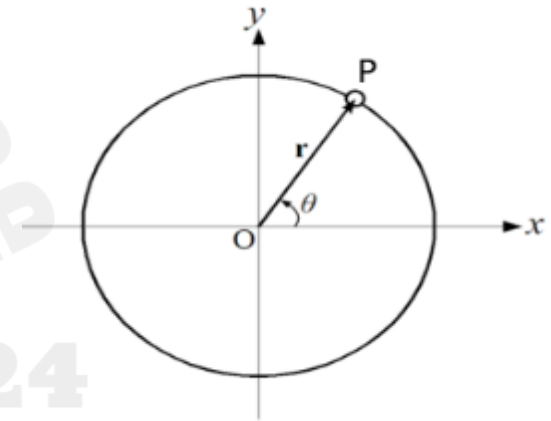
L.O: Convert coordinates from Cartesian to polar coordinates and vice versa.

WS # 4:

WS # 4 / Q.1

In the adjacent figure, if the specified point P has a position specified by the Cartesian coordinates (4,5)m .

Write the position of this point in polar coordinates.



1. What is the advantage of using polar coordinates for analyzing circular motion?

- I. The position vector r remains the same
- II. It reduces two dimensional motion on the circumference to one-dimension involving θ
- III. The x and y coordinates do not change with time

- A. I only
- B. II only
- C. III only
- D. I and II

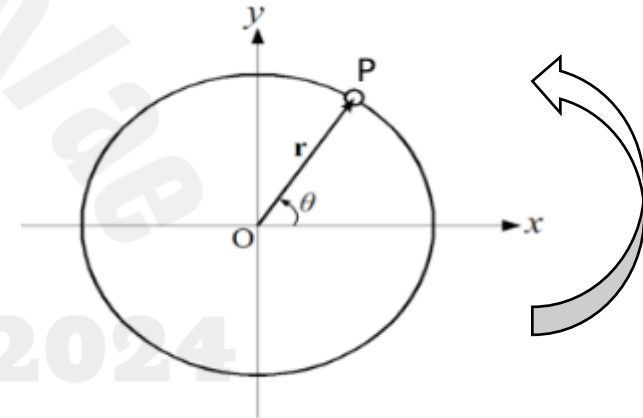
L.O: Convert coordinates from Cartesian to polar coordinates and vice versa.

WS # 4:

WS # 4 / Q.3

Based on the adjacent figure and the data from the previous question:

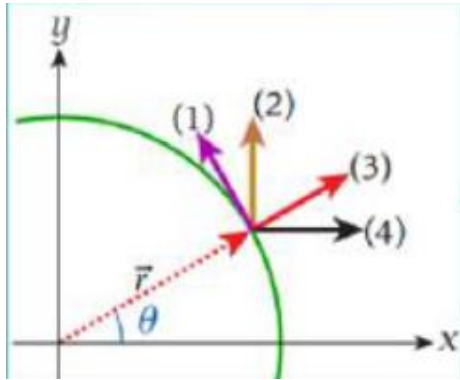
1. Draw on the figure at point P both the radial unit vector and the tangential unit vector.
2. Write the Cartesian coordinates of the radial unit vector and the tangential unit vector.



L.O: Convert coordinates from Cartesian to polar coordinates and vice versa.

WS # 4:

WS # 4 / Q.4



في نظام الإحداثيات القطبية للحركة الدائرية، أي من المتجهات على الشكل يمثل \hat{t} ؟

In the polar coordinate system for circular motion, which of the **vectors** in the figure represents \hat{t} ?

- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4

L.O: Convert coordinates from Cartesian to polar coordinates and vice versa.

WS # 4:

WS # 4 / Q.5

How can you verify that the radial and tangential unit vectors are perpendicular to each other?

$$\hat{r} \cdot \hat{t} = (\cos \theta, \sin \theta) \cdot (-\sin \theta, \cos \theta) = -\cos \theta \sin \theta + \sin \theta \cos \theta = 0.$$

L.O: Convert coordinates from Cartesian to polar coordinates and vice versa.

WS # 4:

WS # 4 / Q.6

Verify that the length of the radial and tangential unit vectors is equal to 1.



- There is a major difference between unit vectors for polar coordinates and unit vectors for Cartesian coordinates, which is:
- Cartesian unit vectors remain constant in time, while radial and tangential unit vectors change direction during circular motion.
- This is because these two vectors depend on the angle θ which is based on the time of the circular motion.

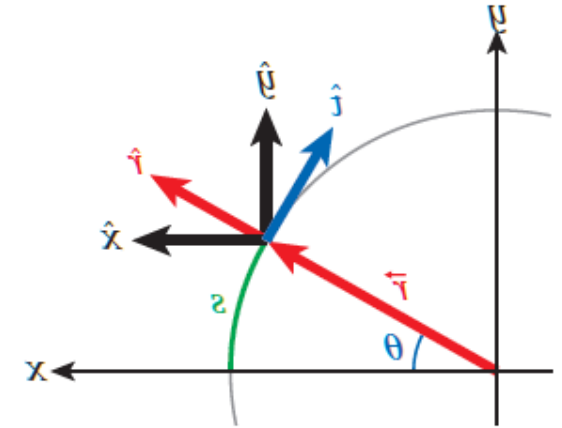


FIGURE 3.3 Polar coordinate system for circular motion.