A+ Academy – Online Teaching

Topic : physics 6102001

طب تحضيري /جامعة القدس(ابوديس)

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Lecture: 1

Coordinates Systems
and Vectors

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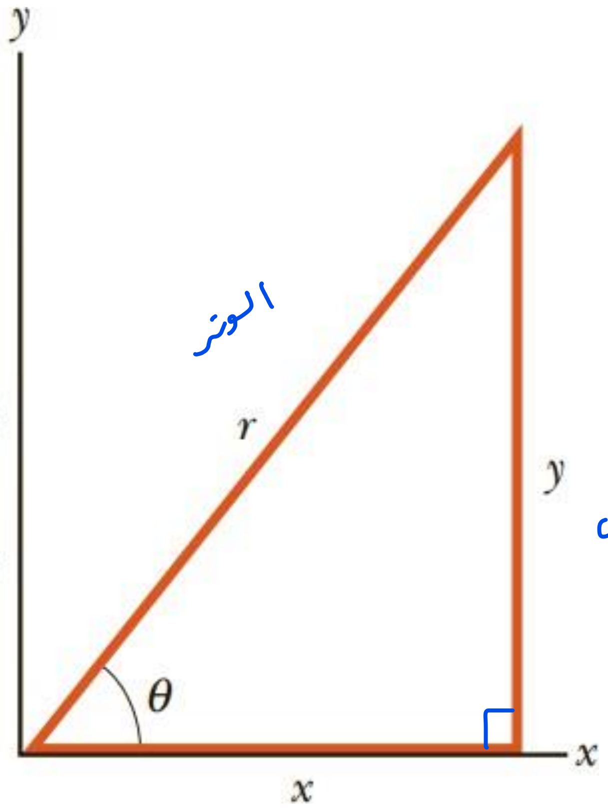
- **Trigonometry Review**

$$\sin\theta = \frac{y}{r}$$

$$\cos\theta = \frac{x}{r}$$

$$\tan\theta = \frac{y}{x}$$



جا θ = $\frac{\text{المقابل}}{\text{الوتر}} = \frac{y}{r}$

جتا θ = $\frac{\text{المجاور}}{\text{الوتر}} = \frac{x}{r}$

ظا θ = $\frac{\text{المقابل}}{\text{المجاور}} = \frac{y}{x}$

Another important relationship

$$\boxed{r^2 = x^2 + y^2}$$

$$r = \sqrt{x^2 + y^2}$$

• Vectors

In two quantities:

فقط مقدار

قياسية 1. Scalar quantity (only magnitude)
Ex: Time, temperature, mass (kg), work, speed, distance

مقدار اتجاه

متجهة 2. Vector quantity (magnitude + direction)
Ex: Displacement, velocity, acceleration, force.

ازاحة

5m to right

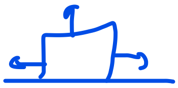
* تقسم الكميات الفيزيائية الى قسمين

7m/s to North

1. كميات قياسية

2 m/s² to left

3 N to right



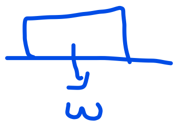
2. كميات متجهة

Example: Which of the following quantity is not vector?
A) velocity B) Weight C) Speed D) Force

Mass (kg)

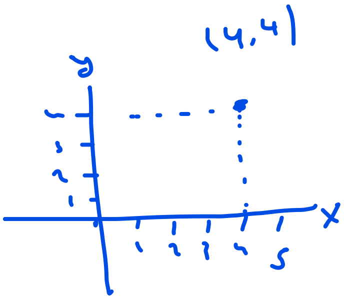
Weight (N)
Force (N)

$W = m \times g$

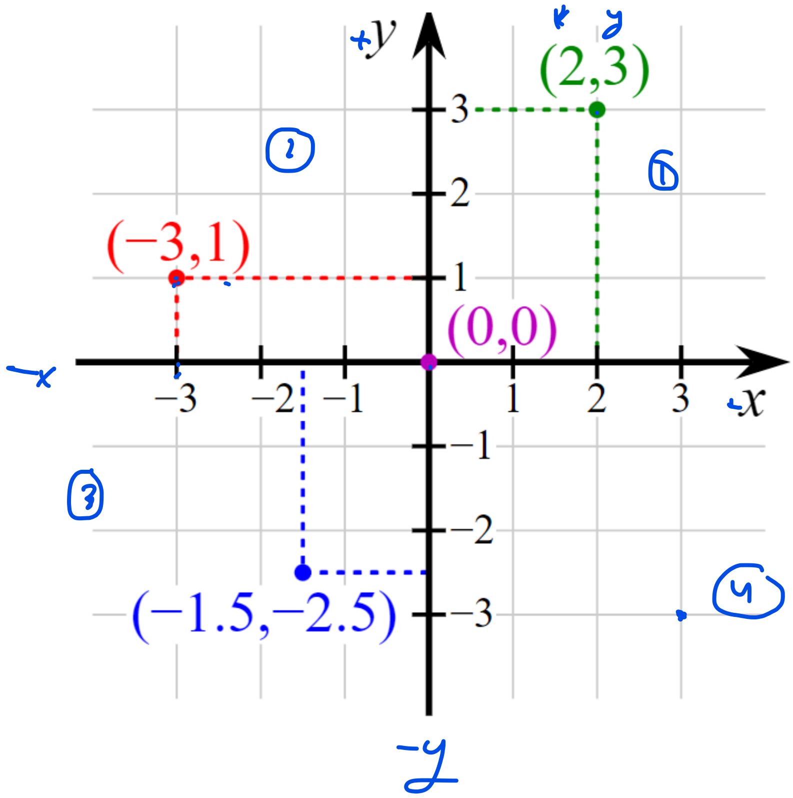


Coordinates Systems

1. Cartesian Coordinate System (reqtangular)



x , y
(2,3) ⟶ (−3, 1)



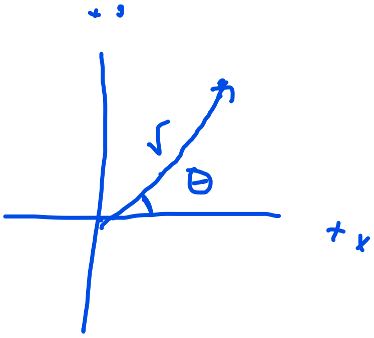
x , y
(−2, 4) ثاني

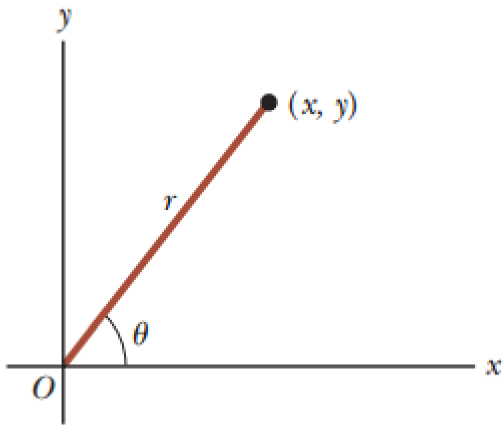
−2, −4 ثالث

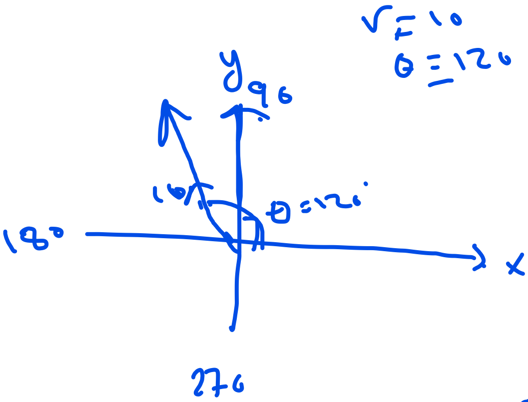
2, −4 رابع

2. Polar Coordinate System

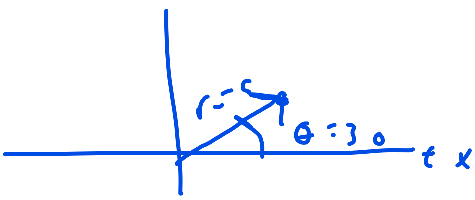
r, θ

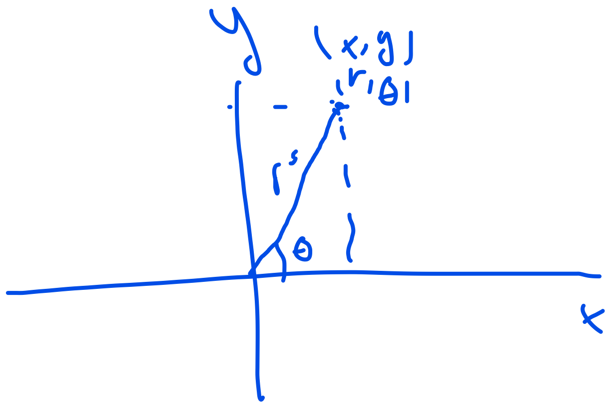






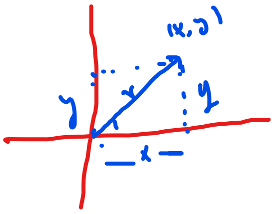
$\theta = 30$
$r = 5$





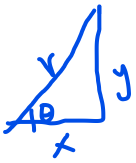
Convert from Cartesian to Polar Coordinate

(x, y) $\quad$ (r, θ)



1 هذا يتظمن معرفة طول المتجهه (مقداره)

$$r = \sqrt{x^2 + y^2}$$



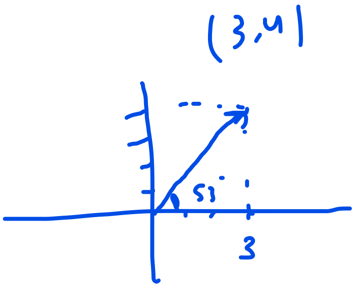
2 الزاوية التي يصنها المتجهه مع محور اكس الموجب

$$\theta = \tan^{-1}\frac{y}{x}$$

$\tan\theta = \frac{y}{x}$

$\theta = \tan^{-1}\left(\frac{y}{x}\right)$

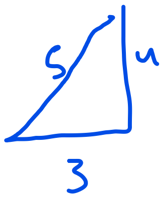
EX(1): The Cartesian coordinates of a point in the xy plane are (x,y) = (3.0, 4.0) m. Find the polar coordinates of this point.



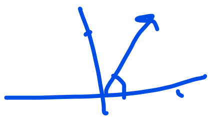
$r = \sqrt{x^2 + y^2}$

$= \sqrt{3^2 + 4^2} = \sqrt{9 + 16}$

$r = \sqrt{25} = 5$



$\theta = \tan^{-1}\left(\frac{4}{3}\right) = 53^\circ$



$(3, 4) \longrightarrow (\overset{r}{5}, \overset{\theta}{53^\circ})$

Ex(2): The Cartesian coordinates of a point in the xy plane are (x,y) = -(3.0,+ 4.0) m. Find the polar coordinates of this point.

(-3, 4)

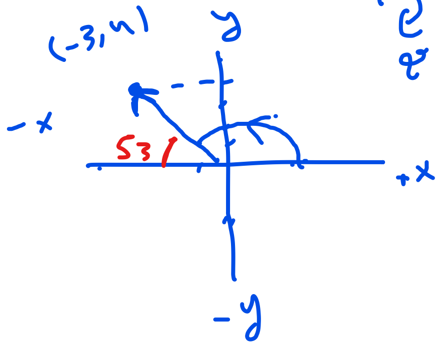
$$r = \sqrt{(-3)^2 + (4)^2} = \sqrt{9+16} = 5$$

$$\theta = \tan^{-1}\left(\frac{4}{-3}\right) = \cancel{-}53^\circ$$

$$\theta = 180 - 53 = 127^\circ$$

(-3, 4) → (5, 127°)

الربع الثاني ← 180 - θ



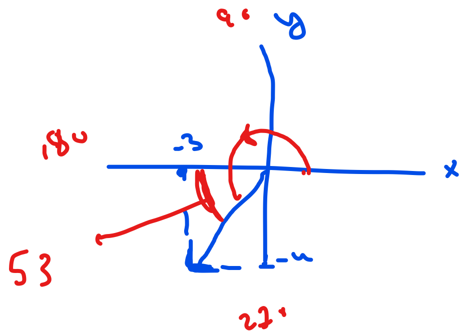
Ex(3): The Cartesian coordinates of a point in the xy plane are (x,y) = (-3.0,- 4.0) m. Find the polar coordinates of this point.

$$r = \sqrt{(-3)^2 + (-4)^2}$$

$$r = \sqrt{9+16} = 5$$

$$\theta = \tan^{-1}\left(\frac{-4}{-3}\right) = 53^\circ$$

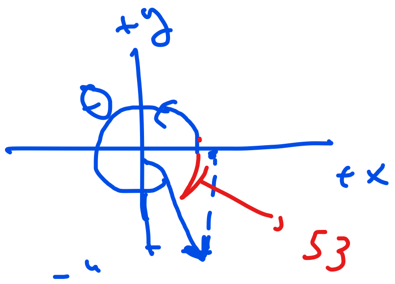
$$\theta = 180 + 53 = 233^\circ$$



Ex(4): The Cartesian coordinates of a point in the xy plane are (x,y) = (-3.0, 4.0) m. Find the polar coordinates of this point.

$(3, -4)$

$r = \sqrt{(3)^2 + (-4)^2} = 5$



$\theta = \tan^{-1}\left(\frac{-4}{3}\right) = -53$

$\theta = 360 - 53 = 307^\circ$

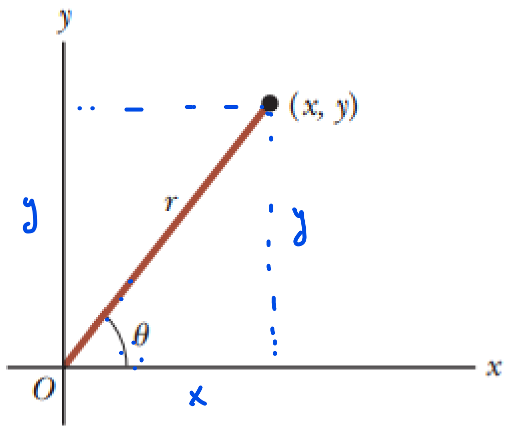
$(3, -4) \longrightarrow (5, 307^\circ)$

Convert from Polar to Cartesian Coordinate

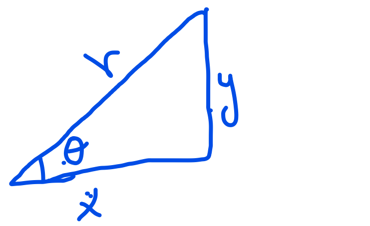
r, θ (x, y)

هذا يتضمن معرفة قيمه

X,Y



$$\boxed{\begin{aligned} x &= r\cos\theta \\ y &= r\sin\theta \end{aligned}}$$

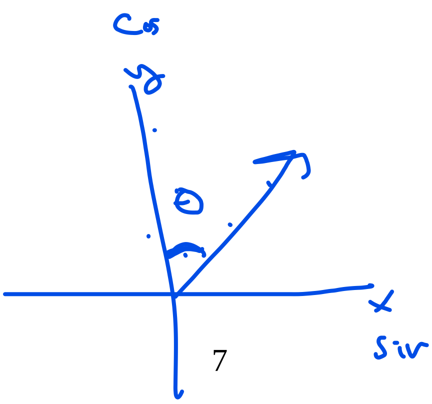


$\cos\theta = \frac{x}{r}$

$\boxed{x = r\cos\theta}$

$\sin\theta = \frac{y}{r}$

$y = r\sin\theta$



$x = r\sin\theta$

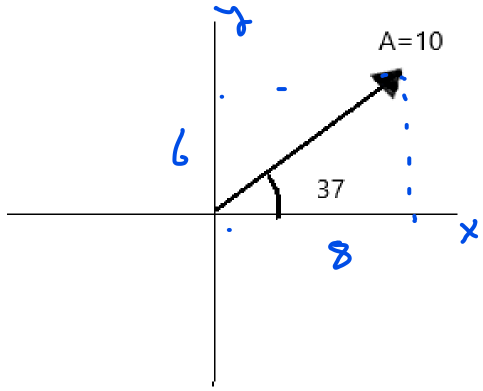
$y = r\cos\theta$

Ex (5): The polar coordinates of a point in are given by r = 10 and ϴ = 37. Find the Cartesian coordinates of this point.

$r = 10 , \theta = 37$

$x = r\cos\theta = 10\cos 37 = 10(0.8) = 8$

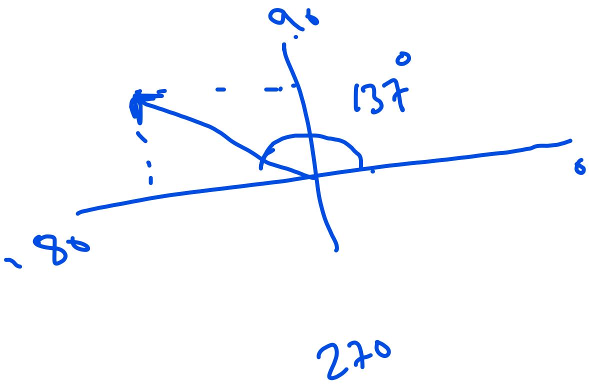
$y = r\sin\theta = 10\sin 37 = 10 \; 0.6 = 6$



$(10, 37^\circ) \longrightarrow (8, 6)$

Ex (6): The polar coordinates of a point in are given by r = 15 and ϴ = 137. Find the Cartesian coordinates of this point.

$r = 15$



$x = r\cos\theta$

$= 15\cos 137$

$x = -11$

$y = r\sin 137$

$y = 15\sin 137 = 10.2$

$(r = 15, \theta = 137)$ polar

↓

$(-11, 10.2)$ Carti

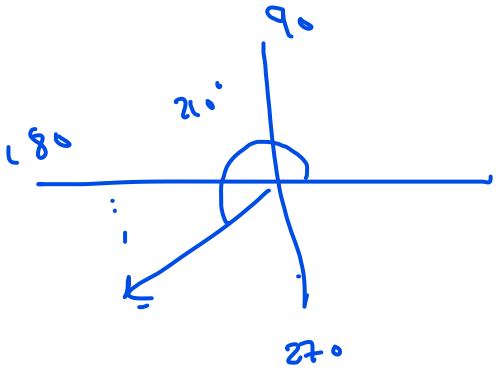
Ex (7): The polar coordinates of a point in are given by r = 10 and Ɵ = 210. Find the Cartesian coordinates of this point.

$x = r\cos\theta = 10\cos 210 = -8.6$

$y = r\sin\theta = 10\sin 210 = -5$

$(-8.6,\ -5)$

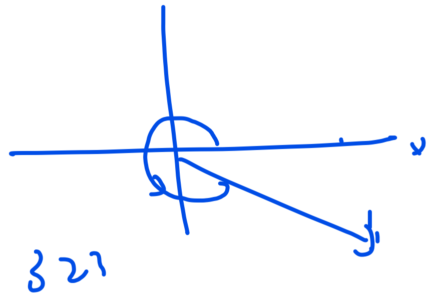
$\quad x \qquad\quad y$



Ex (8): The polar coordinates of a point in are given by r = 10 and Ɵ = 323. Find the Cartesian coordinates of this point.

$x = r\cos\theta = 10\cos 323 = 8$

$y = r\sin\theta = 10\sin 323 = -6$



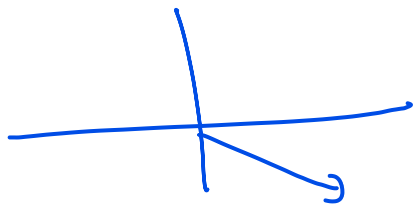
$(8,\ -6)$

$(x,\ y)$

للتأكد

$r = \sqrt{8^2 + (-6)^2} = 10$

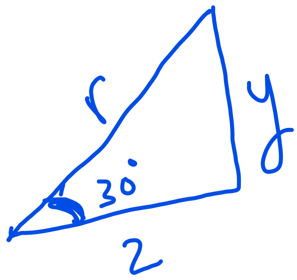
$\theta = \tan^{-1}\left(\frac{-6}{8}\right) = -37$



$360 - 37$

Ex (9): The rectangular coordinates of a point are given by (2, *y*), and its polar coordinates are (*r*, 30°). Determine
(a) the value of *r* and (b) the value of *y*

$(2, y) \longrightarrow (r, 30^\circ)$



(a)

$x = r\cos\theta$

$2 = r\cos 30$

$r = \dfrac{2}{\cos 30} = 2.3$

(b)

$y = r\sin\theta = 2.3 \times \sin 30$

$\boxed{y = 1.15}$

Home work

Q:1	Which one of the following is an example of a vector quantity? A) distance B) velocity C) mass D) area
Q:2	The Cartesian coordinates of a point in the xy plane are (x,y) = (- 6. 0, 4.0) m. Find the polar coordinates of this point. A) 10m, 33.7^{o} B) 10m, 146.3^{o} C) 5m, 146.3^{o} D) 5m, 33.7^{o}
Q:3	The polar coordinates of a point are r = 5.50 m and Θ= 240°. What are the Cartesian coordinates of this point as (x,y)? A) (-4.7 , -2.7) B) (7.4 , 4.7) C) (4.7, 7.7) D) (-2.74 , - 4.7)
Q:4	Point A has magnitude 8.0 m at an angle of 30 degrees below the +x axis. The y component of A is A) 6.9 m B) -6.9 m C) 4.0 m D) -4.0 m
Q:5	The x-component of a vector is 7.2m and the y-component of it is 3.8m. What is the angle that the vector makes with the x-axis. A) 27.8^{o} B) 62.2^{o} C) 58.1^{o} D) 31.9^{o}
Q:6	The rectangular coordinates of a point are given by (x, 5), and its polar coordinates are (r, 60°). Determine r A) 10 B) 5.8 C) 7 D) 15
Q:7	In the previous question determine the value of x A) 3.4 B)4.6 C) 2.9 D) 5.2
Q:8	The Cartesian coordinates of a point in the xy plane are (x,y) = (- 2. 0, -5.0) m. Find the polar coordinates of this point. A) 5.4 m, 68.2^{o} B) 5.4 m, 248^{o} C) 5.4 m, 338^{o} D) 10.4 m, 248^{o}
Q:9	The polar coordinates of a point are r = 10.0 m and Θ= 100°. What are the Cartesian coordinates of this point? A) (-1.7 , 9.8) B) (1.8 , 9.8) C) (-1.8 , -9.8) D) (1.8 , -9.8)
Q:10	The polar coordinates of a point are r = 5.50 m and Θ= 180°. What are the Cartesian coordinates of this point? A) (5.5 , 0) B) (-5.5 , 0) C) (0 ,5.5) D) (0, -5.5)

1	2	3	4	5	6	7	8	9	10
B	B	D	D	A	B	C	B		