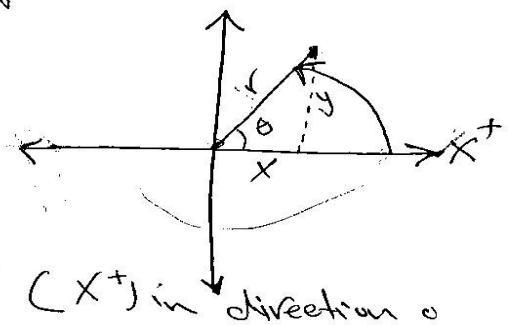
Al-Mustaqbal University College
Department of Medical Instrumentation Techniques Engineering
Class: second stage
Subject: Mathematics II
Lecturer: Dr. Diyar Hussain Habbeb
Lecture: Lec 4

Polar System — lec-8

* The system in which the coordinates represented by (r, θ).

* It possible to convert the cartesian system (x, y) to Polar system as following:

$(x, y) \longrightarrow (r, \theta)$



① $r = \sqrt{x^2 + y^2}$

② $\theta = \tan^{-1}\left(\frac{y}{x}\right)$

θ: The angle between (r) and (X^+) in direction o

r: The distance between the origin and any point.

* It possible to convert the Polar system to cartesian system $[(r, \theta) \longrightarrow (x, y)]$.

① $\cos\theta = \frac{x}{r}$

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

② $\sin\theta = \frac{y}{r}$

$\therefore \boxed{y = r\sin\theta}$

③ $r = \sqrt{x^2 + y^2}$

ملاحظة / دائماً الزاوية تحسب بين r و X^+ وباتجاه عكس عقارب الساعة .

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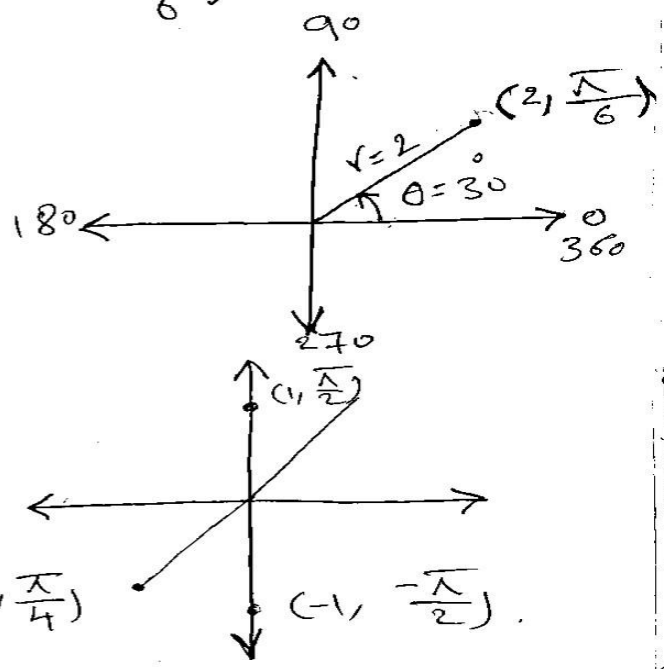
Ex1:- Express the point $(2, \frac{\pi}{6})$?



② Express $(1, \frac{\pi}{2})$
$(\sqrt{2}, \frac{\pi}{4})$
$(-1, -\frac{\pi}{2})$

③ $(r, \theta, z) = (1, \frac{\pi}{2}, 1)$, find cartesian coordinates?

Sol:- $r=1$, $\theta = \frac{\pi}{2}$, $z=1$

$x = r\cos\theta$
$x = 1 * \cos\frac{\pi}{2} = 0$

$y = r\sin\theta$
$y = 1 * \sin\frac{\pi}{2} = 1$

$z = 1$

$\therefore (x, y, z) = (0, 1, 1)$

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Ex:- if the polar coordinates are $(5, 53^\circ)$, find the cartesian coordinates?

Sol:-

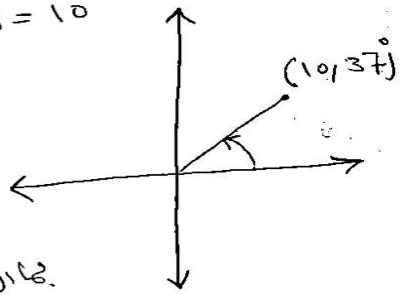
$$x = r\cos\theta$$
$$x = 5 * \cos 53 = 3$$
$$\therefore x = 3$$
$$y = r\sin\theta$$
$$y = 5 * \sin 53 = 4$$
$$\therefore y = 4$$
$$\therefore (x, y) = (3, 4).$$

Ex:- convert the cartesian system $(8, 6)$ to polar system if the point in first, second, third and fourth quarter?

حول النظام الكارتيزي الى النظام القطبي اذا كانت النقطة بالربع الاول الثاني الثالث والرابع

Sol:-

$$r^2 = x^2 + y^2 \Rightarrow r = \sqrt{64 + 36} = 10$$
$$\tan\theta = \frac{y}{x} = \frac{6}{8} = \frac{3}{4}$$
$$\therefore \theta = \tan^{-1}\left(\frac{3}{4}\right) = 37^\circ$$
$$(r, \theta) = (10, 37^\circ)$$



بما ان النقطة بالربع الاول فتبقى θ نفسها المستخرجة من القانون

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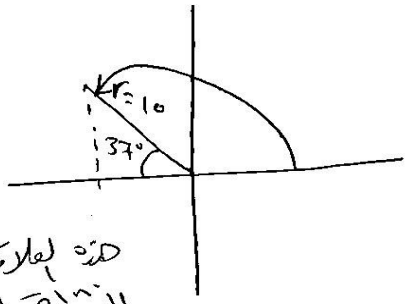
② اذا النقطة بالربع الثاني تقع $(-8, 6)$

$r = 10$

$\theta = \tan^{-1}\left(\frac{6}{-8}\right) = \tan^{-1}\left(\frac{3}{-4}\right)$

$\therefore \theta = \tan^{-1}\left(\frac{3}{4}\right) = 37^\circ$



θ القطبية $= 180 - \theta$ من القانون

هذه العلاقة تستخدم لإيجاد الزاوية القطبية اذا كانت النقطة بالربع الثاني

$\therefore \theta_2 = 180 - 37$

$\therefore \theta = 143^\circ$

$(r, \theta) = (10, 143^\circ)$

③ اذا كانت النقطة $(8, 6)$ بالربع الثالث تقع $(-8, -6)$

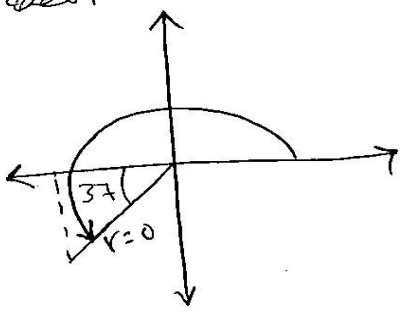
$r = \sqrt{x^2 + y^2} = 10$

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

θ القطبية $= 180 + \theta$ من القانون ← عندما تكون النقطة بالربع الثالث

$\therefore \theta_2 = 180 + 37 = 217^\circ$

$\therefore (r, \theta) = (10, 217^\circ)$



④

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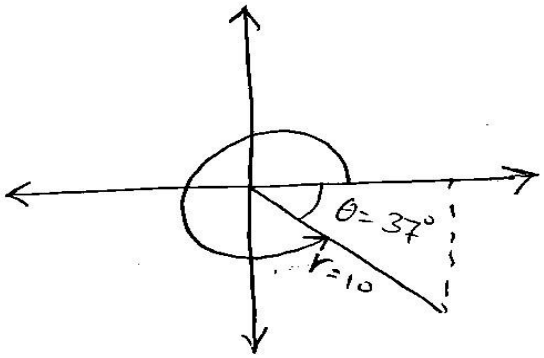
④ اذا كانت النقطة $(8, 6)$ بالربع الرابع تصبح $(8, \bar{6})$:

$r = 10$

$\theta = 37°$



θ المضبطة $= 360 - \theta$ من القانون

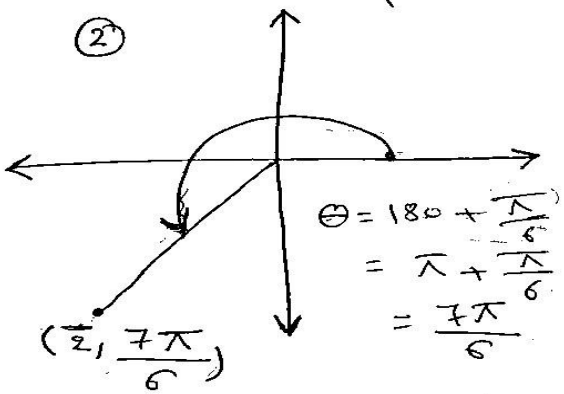
$\theta = 360 - 37 =$

$\therefore \theta = 323°$

$(r, \theta) = (10, 323°)$.

Ex: Draw all possibilities of the system $(2, \frac{\pi}{6})$

②



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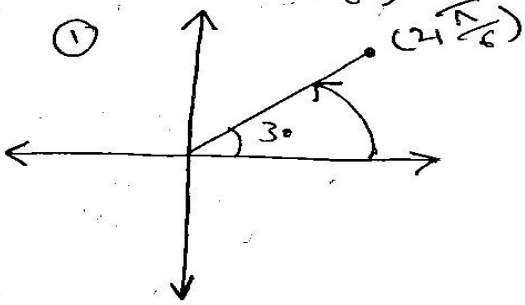

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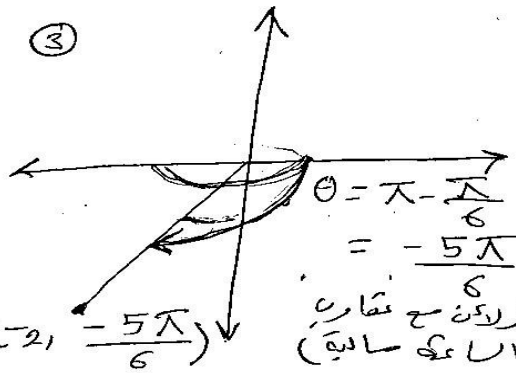

(الزاوية مع عقارب الساعة سالبة)

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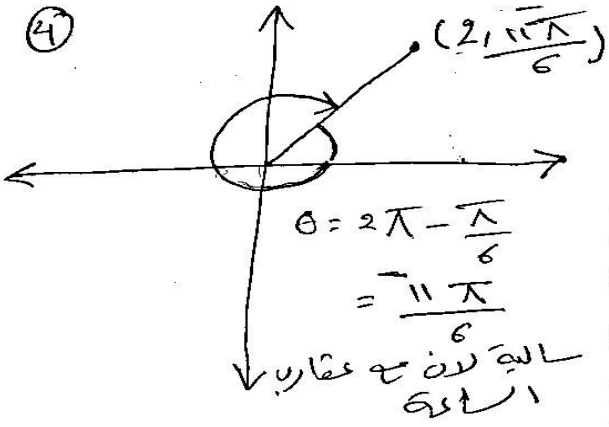
④



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