TAM 212 – Dynamics

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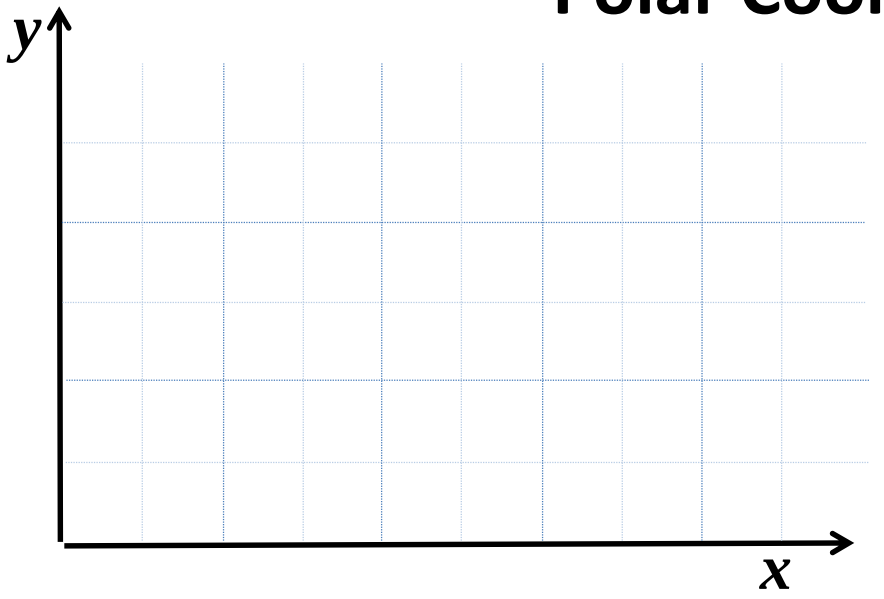
Summer 2019

Lecture Objectives

- Coordinate systems
  - Cartesian
  - **Polar**
- Bases
  - Cartesian
  - **Polar**
  - Normal-tangential
- Transformation between bases

Polar Coordinates



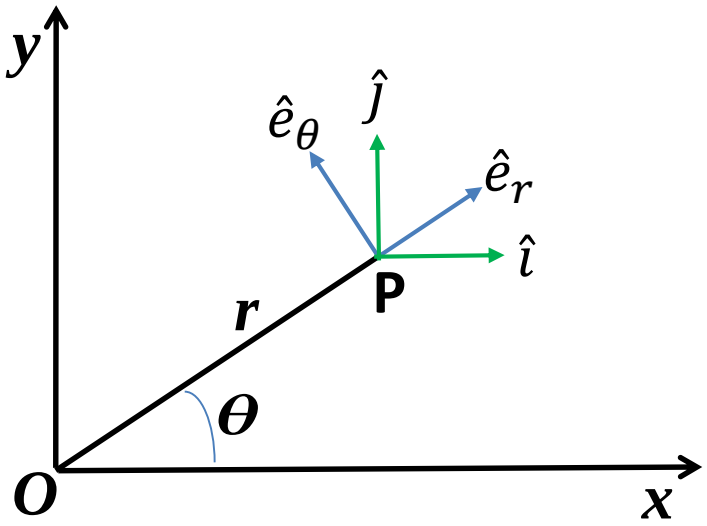
Position of P is $x = 4m$
$y = 3m$

or

= direction that P moves if we increase x and keep y fixed
= direction that P moves if we increase y and keep x fixed

= direction that P moves if we increase r and keep θ fixed
= direction that P moves if we increase θ and keep r fixed

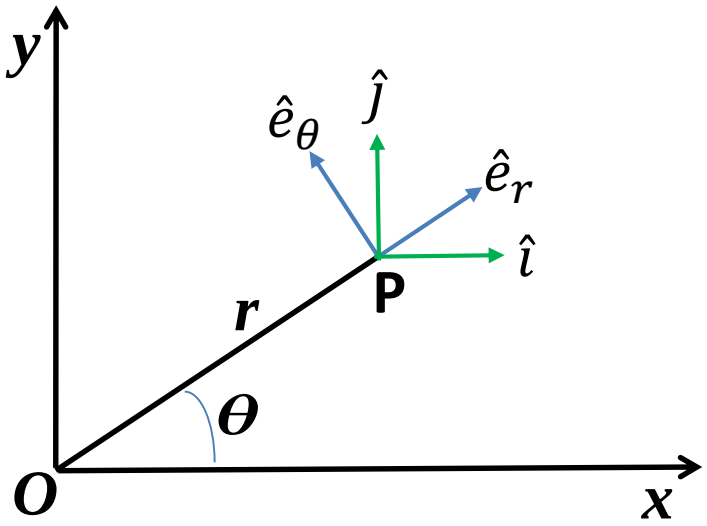
Polar coordinates and polar basis



$\hat{e}_r = \_\_\_\_\_\hat{\imath} + \_\_\_\_\_\hat{j}$

$\hat{e}_\theta = \_\_\_\_\_\hat{\imath} + \_\_\_\_\_\hat{j}$

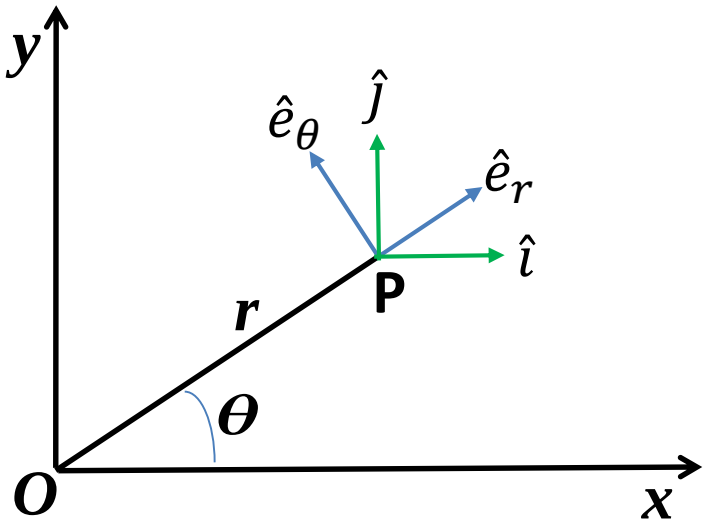
Cartesian coordinates and polar basis



$\hat{\imath} =$ _____ $\hat{e}_r +$ _____ $\hat{e}_\theta$

$\hat{\jmath} =$ _____ $\hat{e}_r +$ _____ $\hat{e}_\theta$

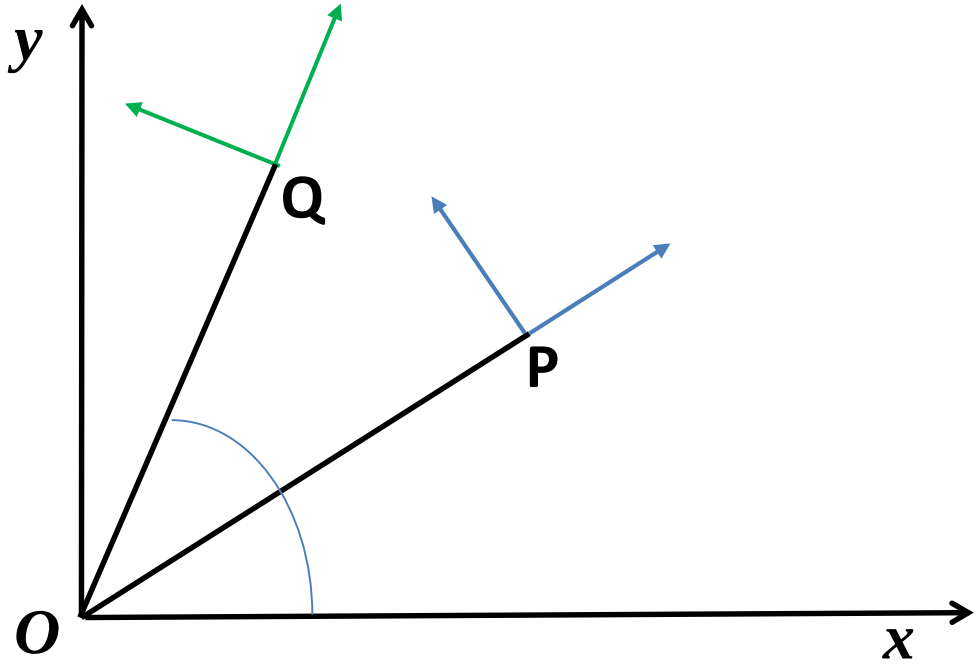
Example



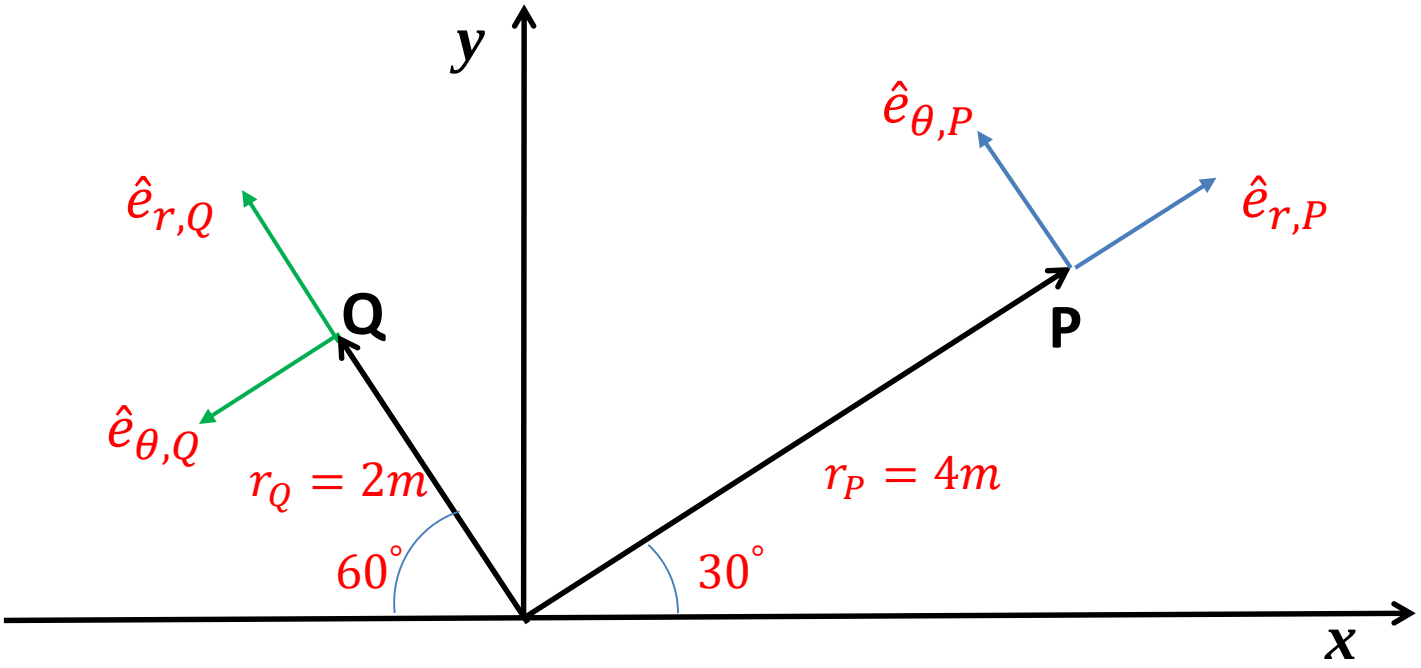
$\vec{r} = 4m\,\hat{\imath} + 3m\,\hat{\jmath} = x\hat{\imath} + y\hat{\jmath}$

$\vec{r} = \_\_\_\_\_\,\hat{e}_r + \_\_\_\_\_\,\hat{e}_\theta$

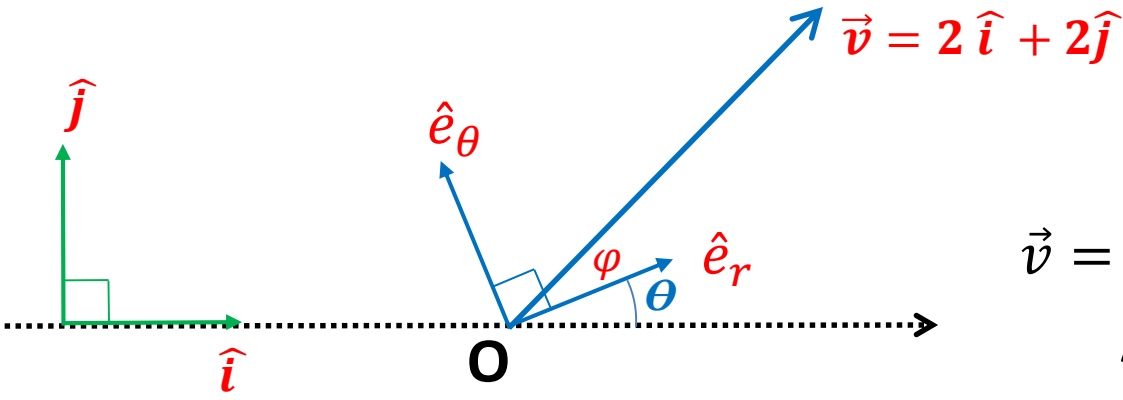
Polar coordinates and change of basis



Example


y
x
Q
P
$\hat{e}_{r,Q}$
$\hat{e}_{\theta,Q}$
$\hat{e}_{\theta,P}$
$\hat{e}_{r,P}$
$r_Q = 2m$
$r_P = 4m$
60°
30°

Change of basis



$\vec{v} =$ ____?____ $\hat{e}_r +$ _____ $\hat{e}_\theta$

A. $\vec{v} \times \hat{e}_r$

B. $\vec{v} \cdot \hat{e}_r$

C. $v \cos\theta$

D. $v \sin\theta$

E. $\text{proj}(\vec{v}, \hat{e}_r)$

Homework for Tonight

- First PL homework tomorrow (Thursday, June 13)
- First quiz starts tomorrow (Thursday, June 13)!
  - Sign up via CBTF website