Today 15.1

L18

Today 15.1

L18

Translation
& fixed axis
rotation
of rigid bodies

Today 15.1

Fr:day 15.1, 15.2

L18

L18

Today 15.1

Friday 15.1, 15.2

General plane motion for rigid bodies

Grade calculation at end of semester

Grade calculation at end of semester

Final score = (Exam ave)*

Grade calculation at end of semester

Final score = (Exam ave)*k

of 4 highest exams out of 5

Grade calculation at end of semester

Final score = (Exam ave)*4

Grade calculation at end of semester

$$\text{Final score} = \left[\frac{(\text{Exam ave}) * 4 + (\text{HW ave})}{5}\right]\%$$

Grade calculation at end of semester

$$\text{Final score} = \left[\frac{(\text{Exam ave}) * 4 + (\text{HW ave})}{5}\right]\%$$

If

Grade calculation at end of semester

$$\text{Final score} = \left[\frac{(\text{Exam ave}) * 4 + (\text{HW ave})}{5}\right]\%$$

If $HW_{AVE} = 100$

Grade calculation at end of semester

$$\text{Final score} = \left[\frac{(\text{Exam ave}) * 4 + (\text{HW ave})}{5}\right]\%$$

If $NW_{AVE} = 100$, then

$$\text{Exam ave} = \left[\frac{5 * (\text{Final score}) - 100}{4}\right]\%$$

Grade calculation at end of semester

$$\text{Final score} = \left[\frac{(\text{Exam ave}) * 4 + (\text{HW ave})}{5}\right]\%$$

If $HW_{AVE} = 100$, then

$$\text{Exam ave} = \left[\frac{5 * (\text{Final score}) - 100}{4}\right]\%$$

So If $HW_{AVE} = 100\%$

Grade calculation at end of semester

$$\text{Final score} = \left[\frac{(\text{Exam ave}) * 4 + (\text{HW ave})}{5}\right]\%$$

If $HW_{AVE} = 100$, then

$$\text{Exam ave} = \left[\frac{5 * (\text{Final score}) - 100}{4}\right]\%$$

So If $HW_{AVE} = 100\%$ Final score Exam ave

Grade calculation at end of semester

$$\text{Final score} = \left[\frac{(\text{Exam ave}) * 4 + (\text{HW ave})}{5}\right]\%$$

If $HW_{AVE} = 100$, then

$$\text{Exam ave} = \left[\frac{5 * (\text{Final score}) - 100}{4}\right]\%$$

So If $HW_{AVE} = 100\%$

Final score	Exam ave
A: 90%	87.5%

Grade calculation at end of semester

$$\text{Final score} = \left[\frac{(\text{Exam ave}) * 4 + (\text{HW ave})}{5}\right]\%$$

If $HW_{AVE} = 100$, then

$$\text{Exam ave} = \left[\frac{5 * (\text{Final score}) - 100}{4}\right]\%$$

So If $HW_{AVE} = 100\%$

Final score	Exam ave
A: 90%	87.5%
B: 80%	75%

Grade calculation at end of semester

$$\text{Final score} = \left[\frac{(\text{Exam ave}) * 4 + (\text{HW ave})}{5}\right]\%$$

If $HW_{AVE} = 100$, then

$$\text{Exam ave} = \left[\frac{5 * (\text{Final score}) - 100}{4}\right]\%$$

So If $HW_{AVE} = 100\%$

Final score	Exam ave
A: 90%	87.5%
B: 80%	75%
C: 70%	62.5%

Grade calculation at end of semester

$$\text{Final score} = \left[\frac{(\text{Exam ave}) * 4 + (\text{HW ave})}{5}\right]\%$$

If $HW_{AVE} = 100$, then

$$\text{Exam ave} = \left[\frac{5 * (\text{Final score}) - 100}{4}\right]\%$$

So If $HW_{AVE} = 100\%$

Final score	Exam ave
A: 90%	87.5%
B: 80%	75%
C: 70%	62.5%
D: 60%	50%

Grade calculation at end of semester

$$\text{Final score} = \left[\frac{(\text{Exam ave}) * 4 + (\text{HW ave})}{5}\right]\%$$

If $HW_{AVE} = 100$, then

$$\text{Exam ave} = \left[\frac{5 * (\text{Final score}) - 100}{4}\right]\%$$

So If $HW_{AVE} = 100\%$

Final score	Exam ave
A: 90%	87.5%
B: 80%	75%
C: 70%	62.5%
D: 60%	50%

Keep your homework scores high!

ASU

Grade calculation at end of semester

$$\text{Final score} = \left[\frac{(\text{Exam ave}) * 4 + (\text{HW ave})}{5}\right]\%$$

If $HW_{AVE} = 100$, then

$$\text{Exam ave} = \left[\frac{5 * (\text{Final score}) - 100}{4}\right]\%$$

So If $HW_{AVE} = 100\%$

Final score	Exam ave
A: 90%	87.5%
B: 80%	75%
C: 70%	62.5%
D: 60%	50%

Keep your homework scores high!

ASU

Rigid bodies

Rigid bodies

Definitions:

Translation if no rotation of body

Rigid bodies

Definitions:

Translation if no rotation of body

Rigid bodies

Definitions:

Translation if no rotation of body

Two types of translation

Rigid bodies

Definitions:

Translation if no rotation of body

Two types of translation

* Rectilinear translation

Rigid bodies

Definitions:

Translation if no rotation of body

Two types of translation

* Rectilinear translation

And

Rigid bodies

Definitions:

Translation if no rotation of body

Two types of translation

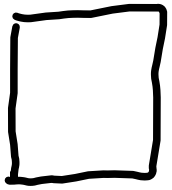
* Rectilinear translation

And

* Curvilinear translation

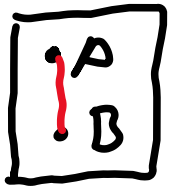
Rectilinear translation

Rectilinear translation

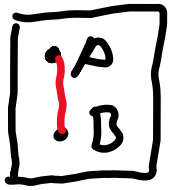


Rectilinear translation

Rectilinear translation

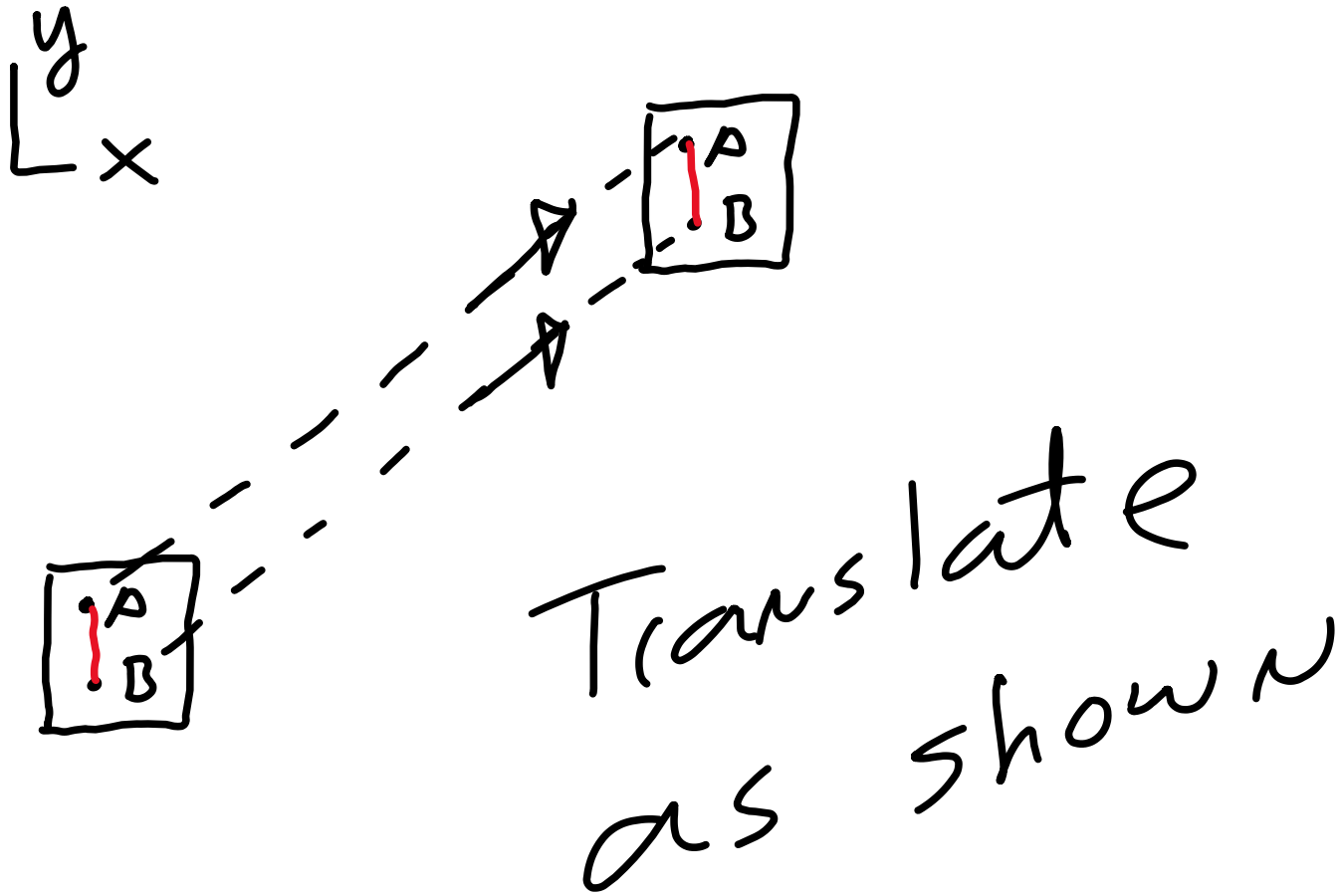


Rectilinear translation

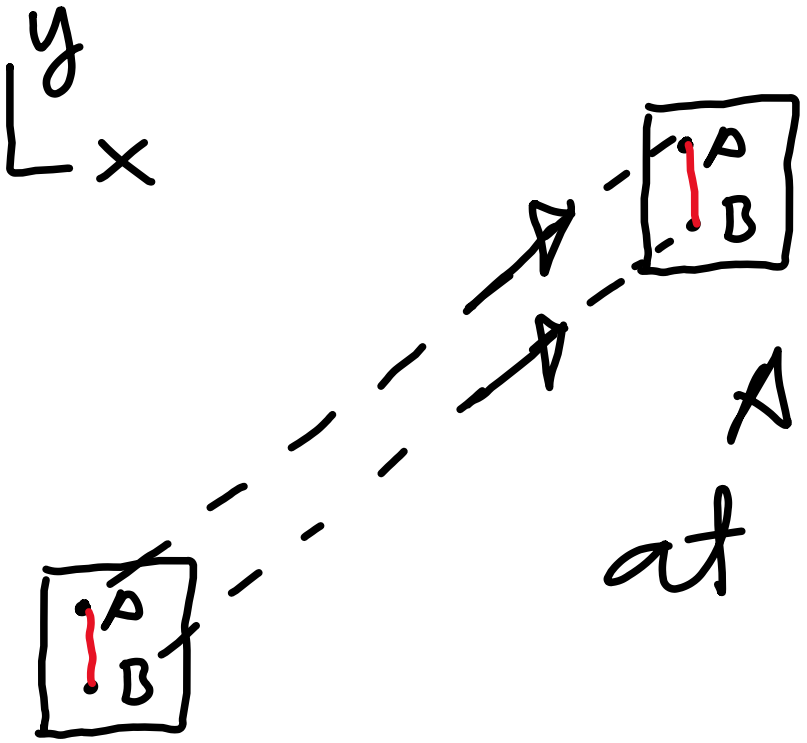


Note: red line connecting points A & B

Rectilinear translation

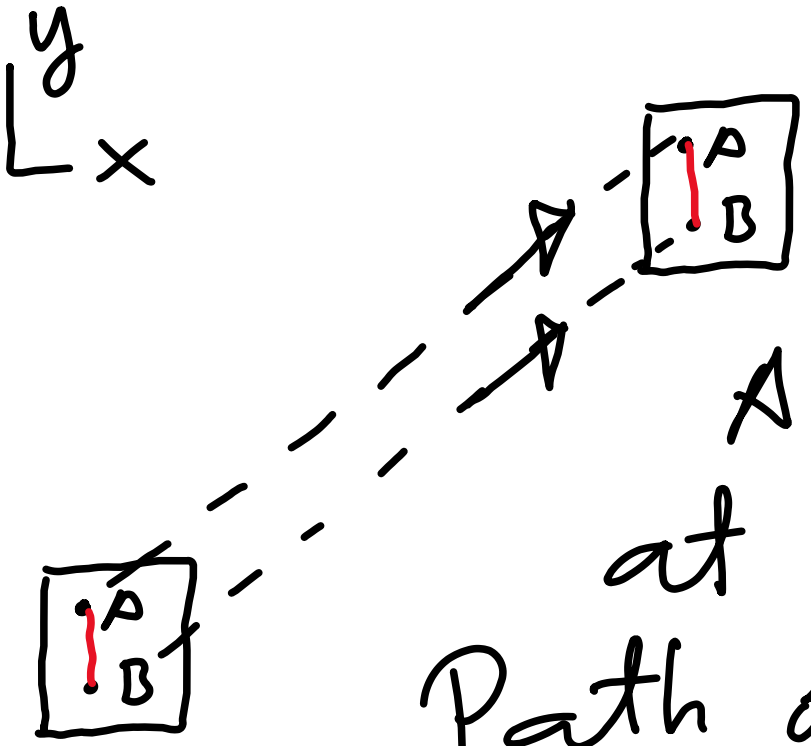


Rectilinear translation



line connecting A & B always at same angle.

Rectilinear translation

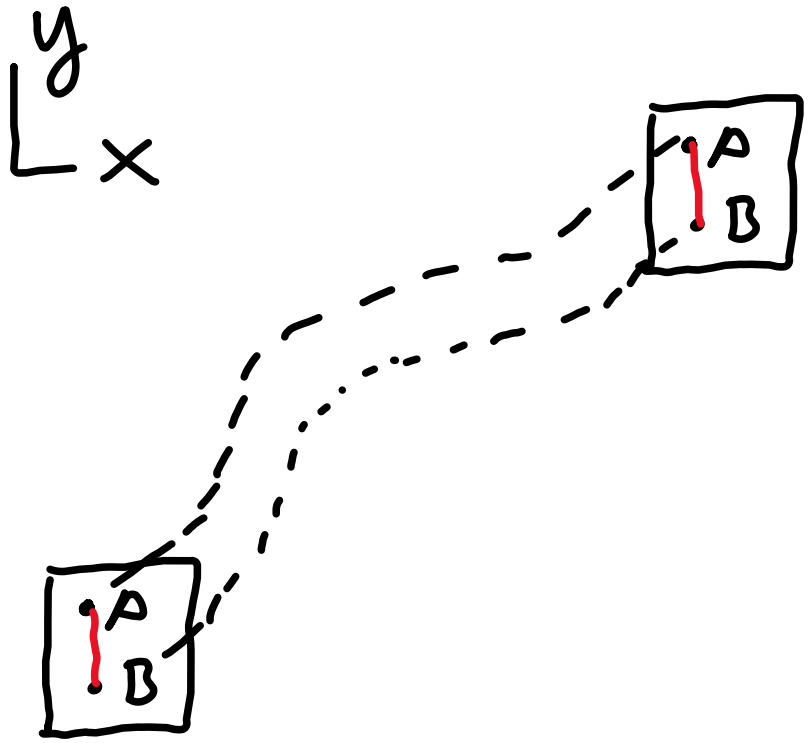


line connecting A & B always at same angle.

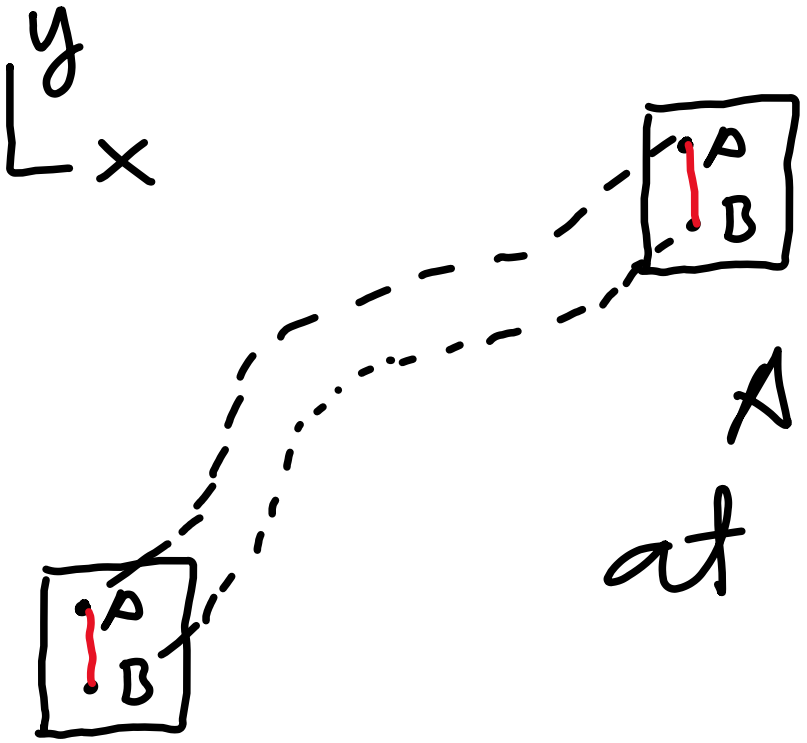
Path of object is a straight line

Curvilinear translation

Curvilinear translation

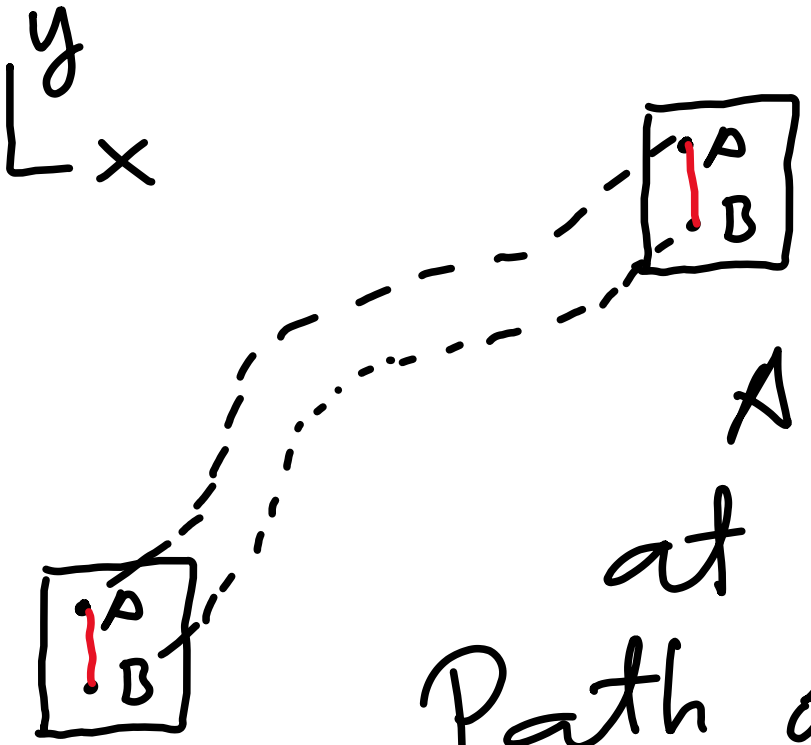


Curvilinear translation



line connecting A & B always at same angle.

Curvilinear translation

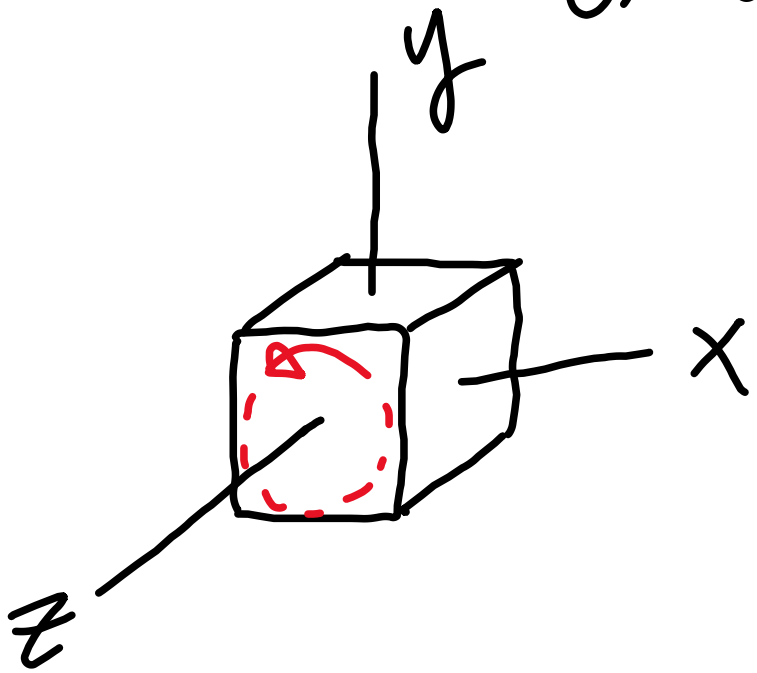


line connecting A & B always at same angle.

Path of object is a curved line

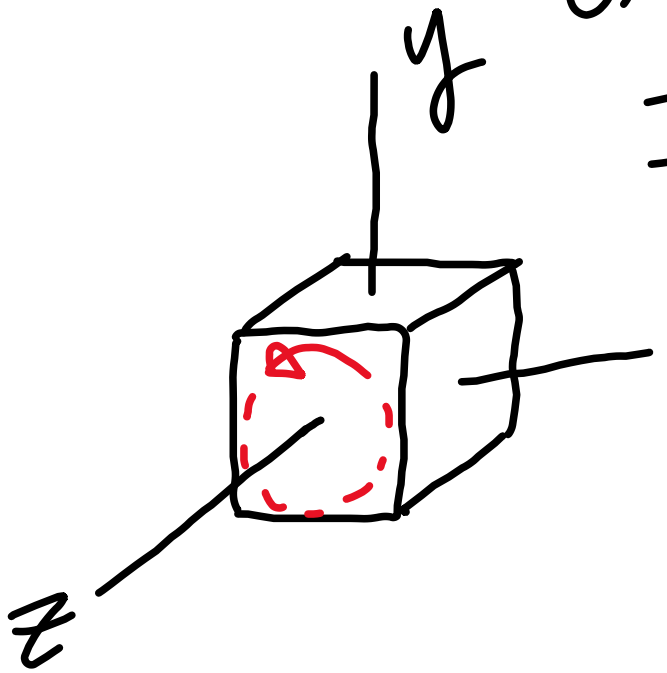
Rotation about fixed axis

Motion along circles centered on axis of rotation.



Rotation about fixed axis

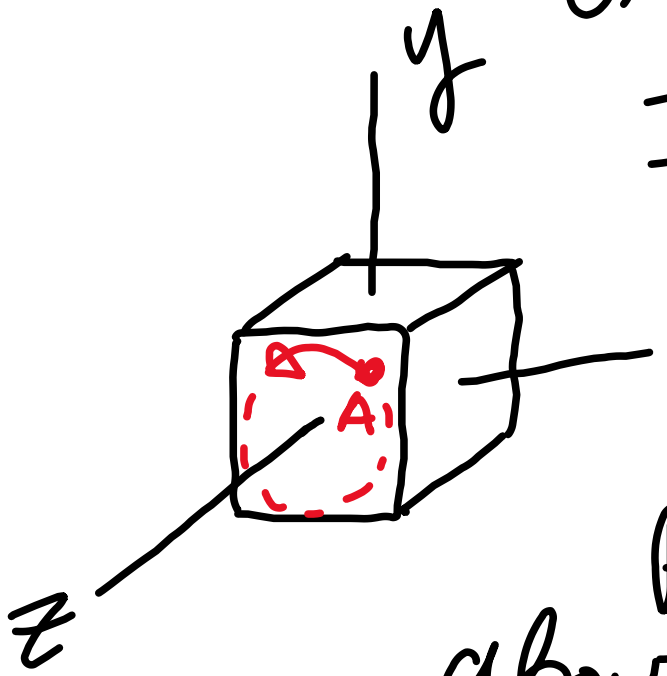
Motion along circles centered on axis of rotation.



In this, a cube is rotated about the z-axis.

Rotation about fixed axis

Motion along circles centered on axis of rotation.



In this, a cube is rotated about the z-axis.

Point A rotates about this axis as shown

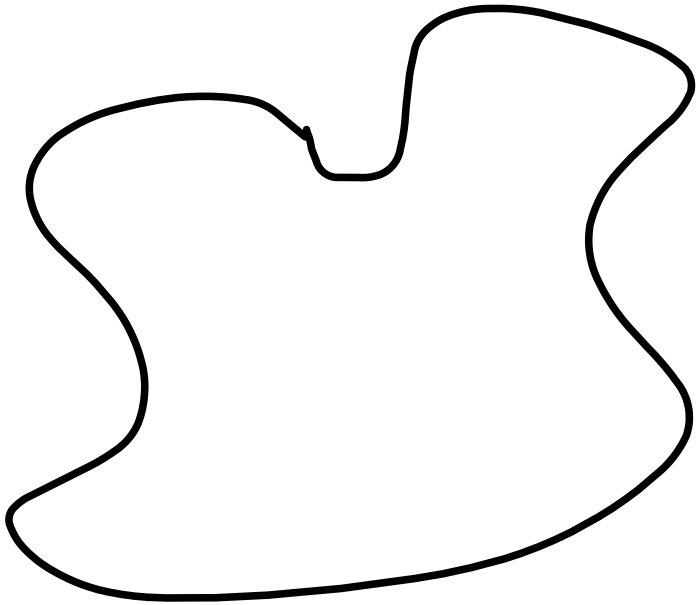
For translation of rigid body

For translation of rigid body

On a rigid body,

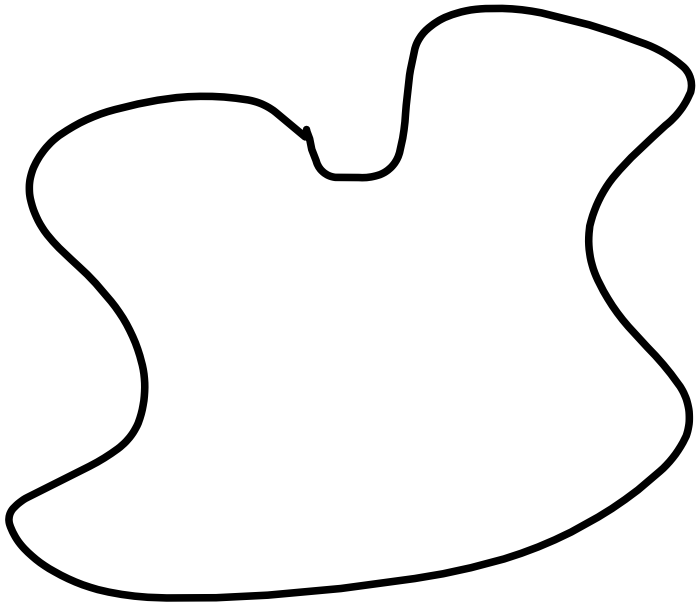
For translation of rigid body

On a rigid body,



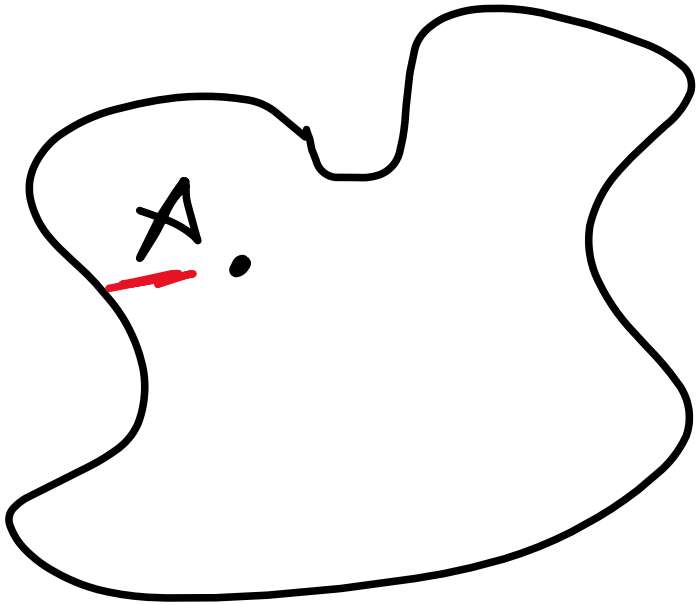
For translation of rigid body

On a rigid body, if we choose <u>any</u> two points A & B



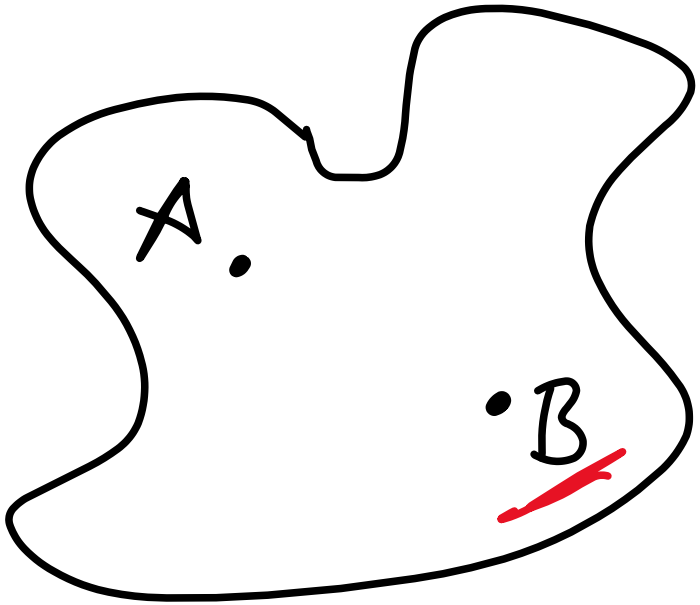
For translation of rigid body

On a rigid body, if we choose any two points A & B



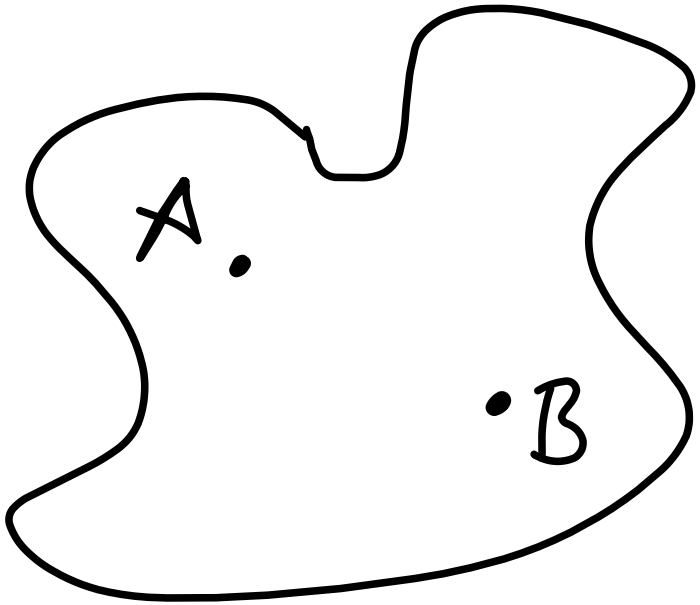
For translation of rigid body

On a rigid body, if we choose any two points A & B



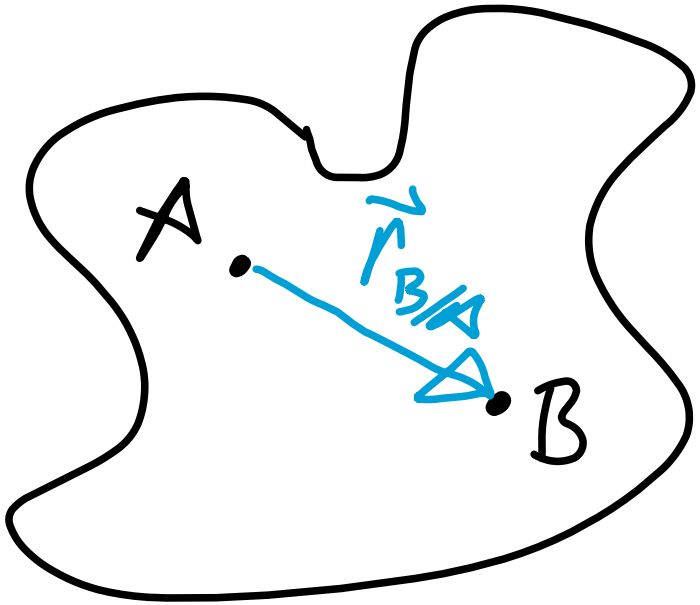
For translation of rigid body

On a rigid body, if we choose <u>any</u> two points A & B, then we can relate the position of B to that of point A as $\vec{r}_B = \vec{r}_A + \vec{r}_{B/A}$



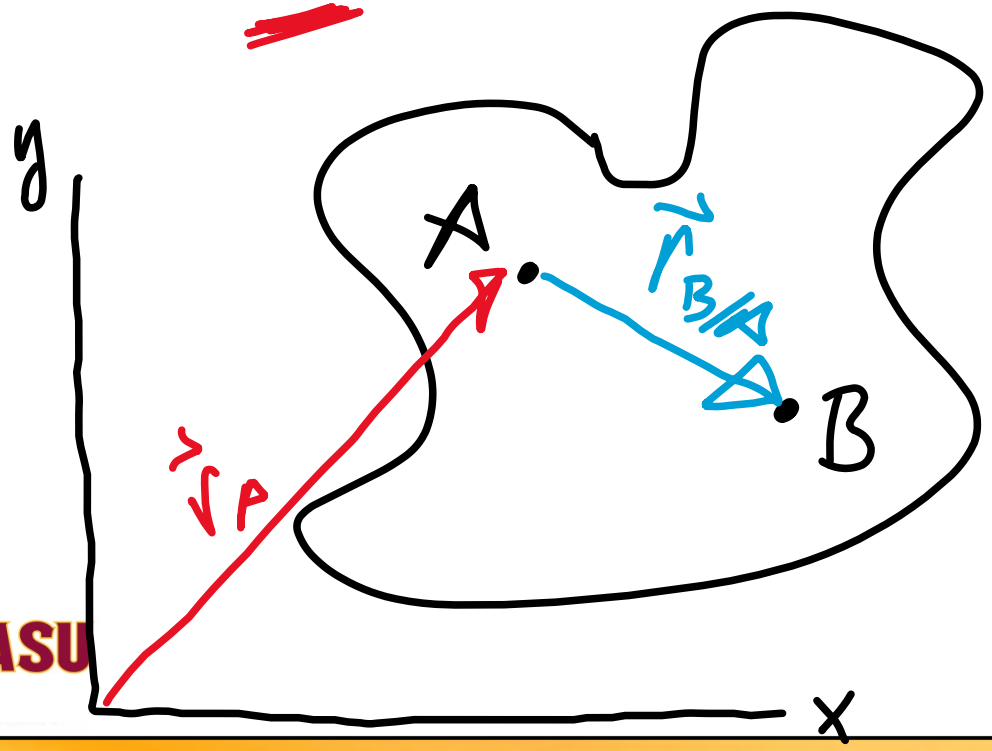
For translation of rigid body

On a rigid body, if we choose any two points A & B, then we can relate the position of B to that of point A as $\vec{r}_B = \vec{r}_A + \vec{r}_{B/A}$



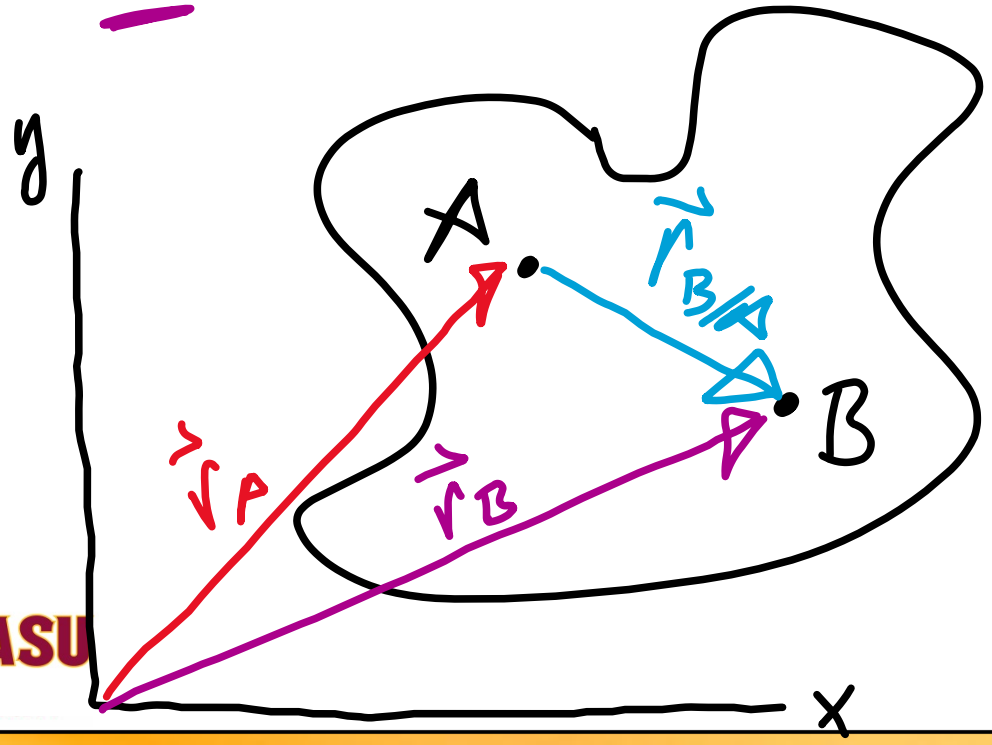
For translation of rigid body

On a rigid body, if we choose <u>any</u> two points A & B, then we can relate the position of B to that of point A as $\vec{r}_B = \vec{r}_A + \vec{r}_{B/A}$



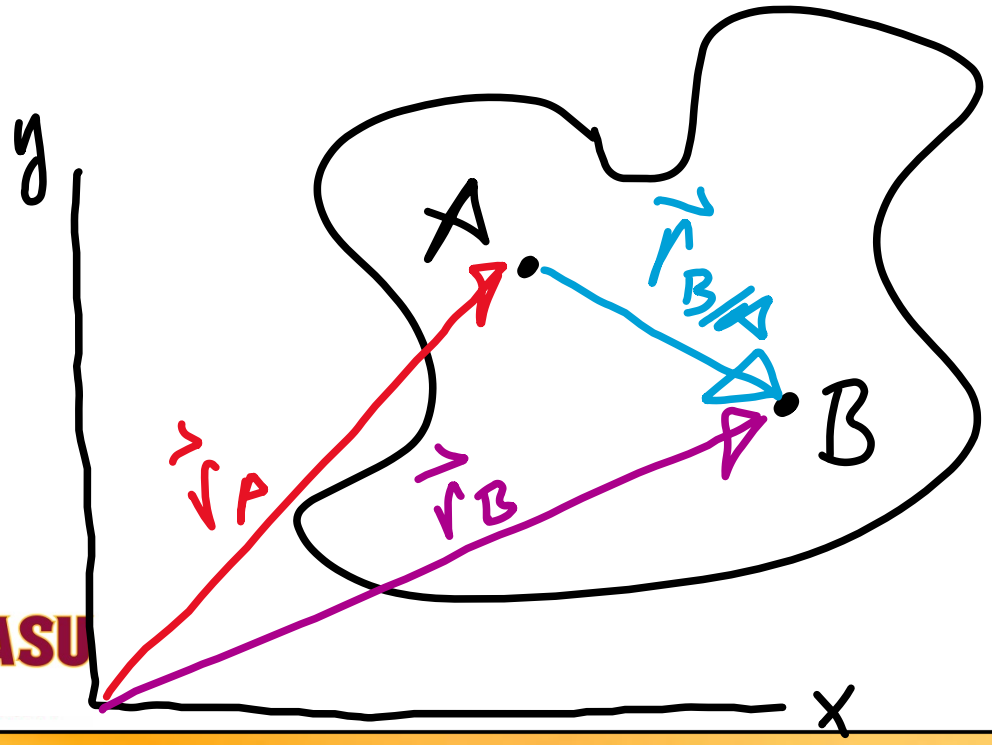
For translation of rigid body

On a rigid body, if we choose <u>any</u> two points A & B, then we can relate the position of B to that of point A as $\vec{r}_B = \vec{r}_A + \vec{r}_{B/A}$



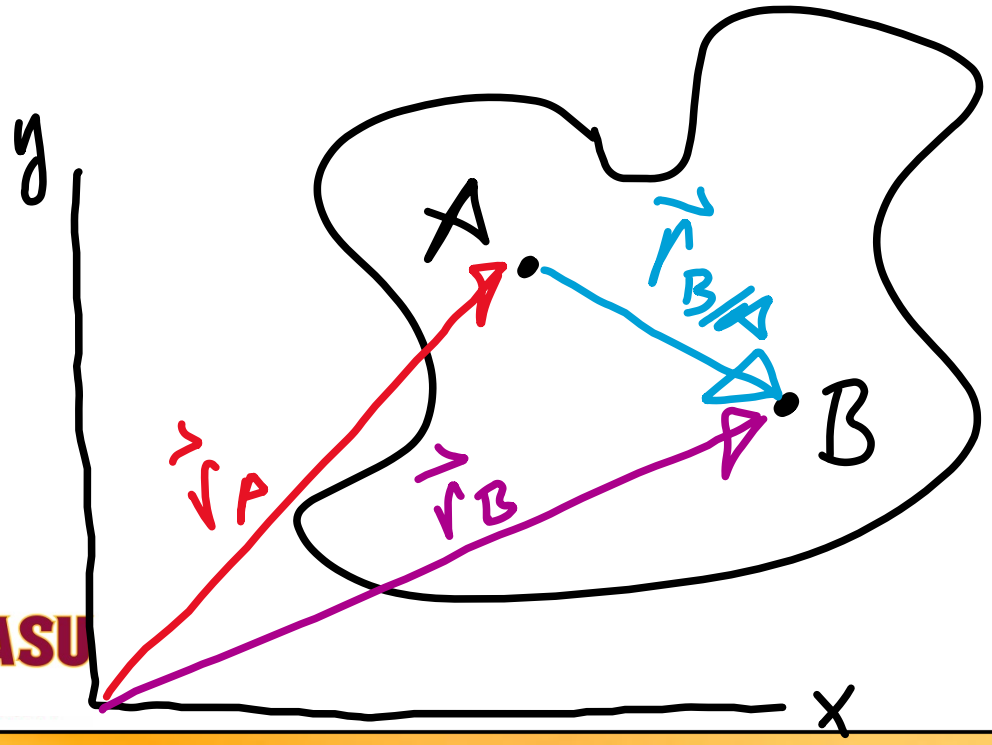
For translation of rigid body

On a rigid body, if we choose <u>any</u> two points A & B, then we can relate the position of B to that of point A as $\vec{r}_B = \vec{r}_A + \vec{r}_{B/A}$. Since A & B are fixed on rigid body $|\vec{r}_{B/A}| = \text{const.}$



For translation of rigid body

On a rigid body, if we choose <u>any</u> two points A & B, then we can relate the position of B to that of point A as $\vec{r}_B = \vec{r}_A + \vec{r}_{B/A}$. Since A & B are fixed on rigid body $|\vec{r}_{B/A}| = \text{const.}$ & Since no rotation $\frac{d\vec{r}_{B/A}}{dt} = 0$



For translation of rigid body

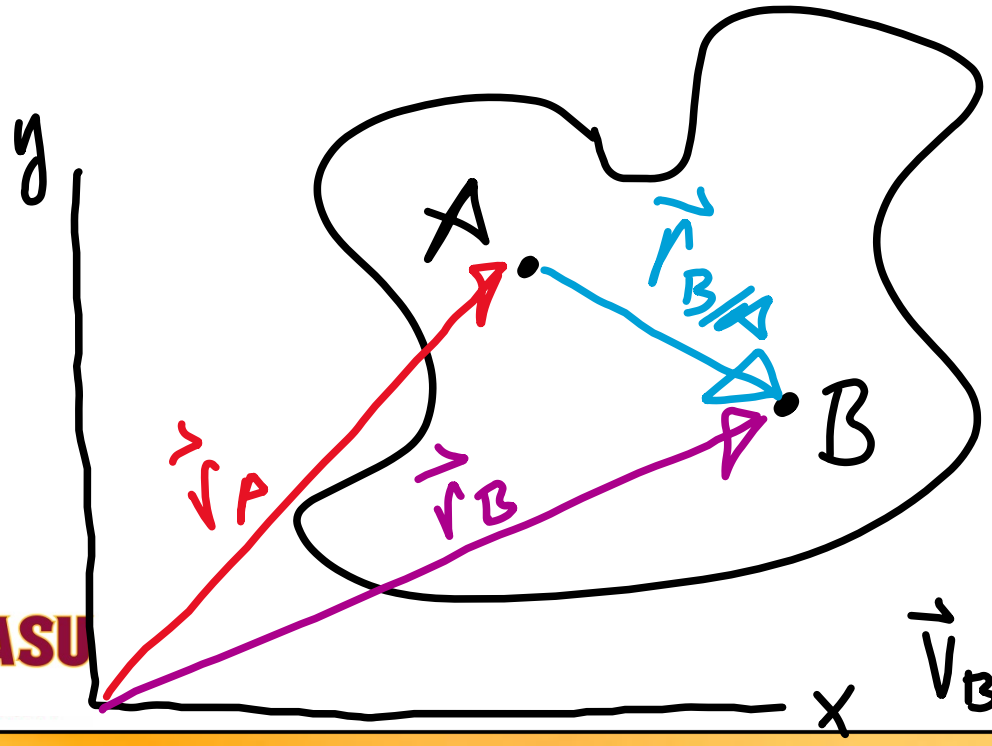
On a rigid body, if we choose <u>any</u> two points A & B, then we can relate the position of B to that of point A as $\vec{r}_B = \vec{r}_A + \vec{r}_{B/A}$. Since A & B are fixed on rigid body

$|\vec{r}_{B/A}| = \text{const.}$ &

Since no rotation

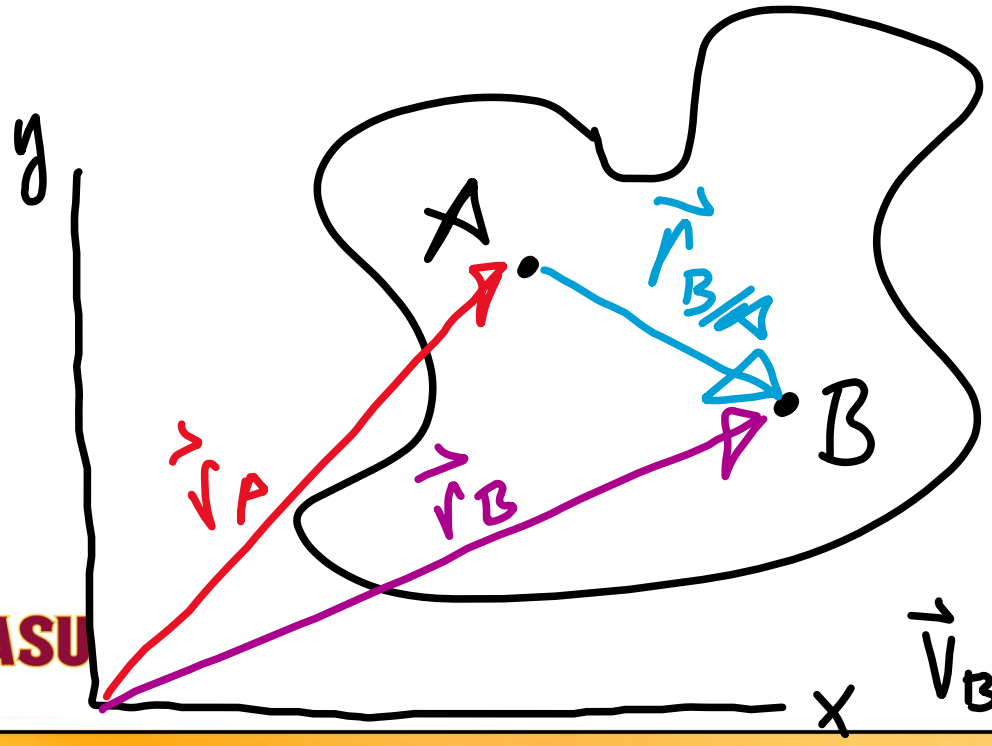
$\frac{d\vec{r}_{B/A}}{dt} = 0$ so

$\vec{V}_B = \vec{V}_A$



For translation of rigid body

On a rigid body, if we choose <u>any</u> two points A & B, then we can relate the position of B to that of point A as $\vec{r}_B = \vec{r}_A + \vec{r}_{B/A}$. Since A & B are fixed on rigid body $|\vec{r}_{B/A}| = \text{const.}$ & since no rotation $\frac{d\vec{r}_{B/A}}{dt} = 0$ so $\vec{v}_B = \vec{v}_A$ & $\vec{a}_B = \vec{a}_A$



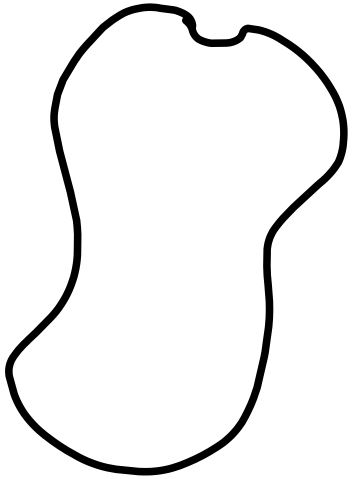
For rotation about a fixed axis

For rotation about a fixed axis

* On a rigid body

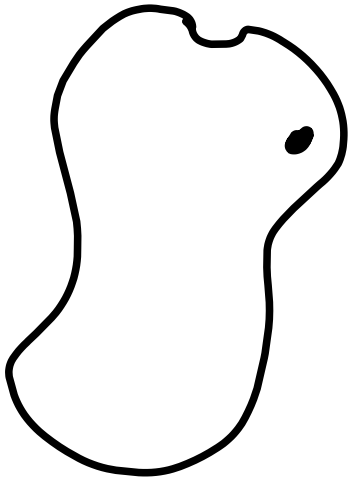
For rotation about a fixed axis

* On a rigid body



For rotation about a fixed axis

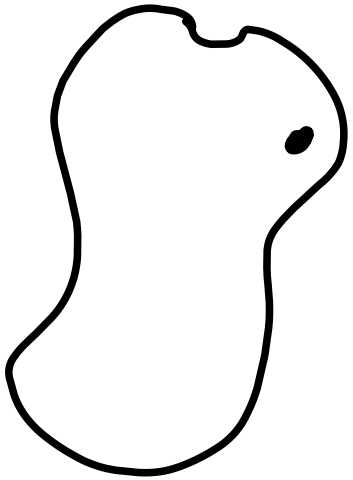
* On a rigid body take a point



For rotation about a fixed axis

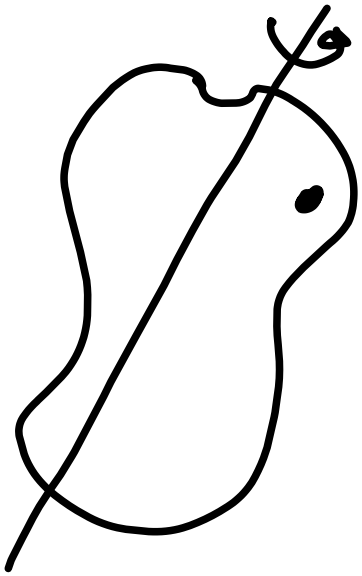
* On a rigid body take a point

For rotation about a fixed axis



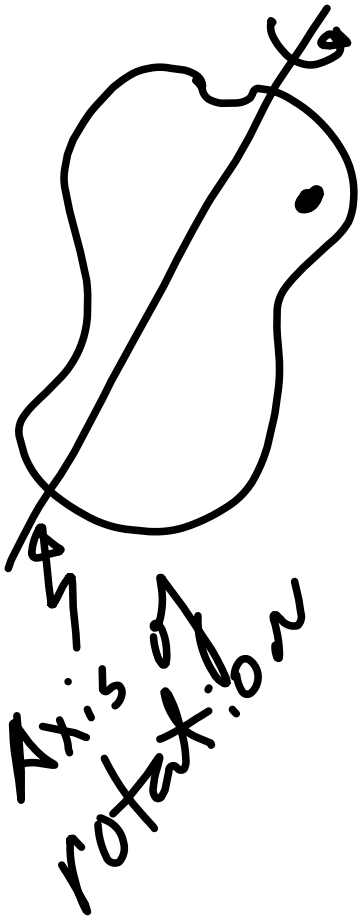
* On a rigid body take a point
* Along the axis of rotation

For rotation about a fixed axis



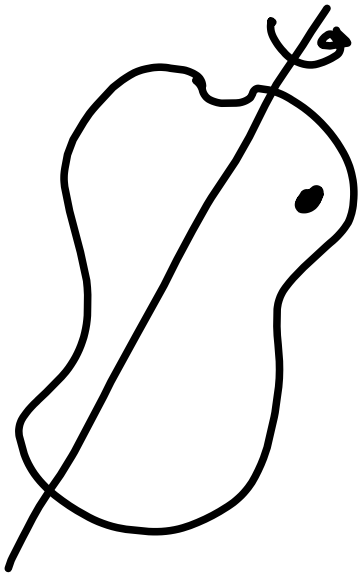
* On a rigid body take a point
* Along the axis of rotation

For rotation about a fixed axis



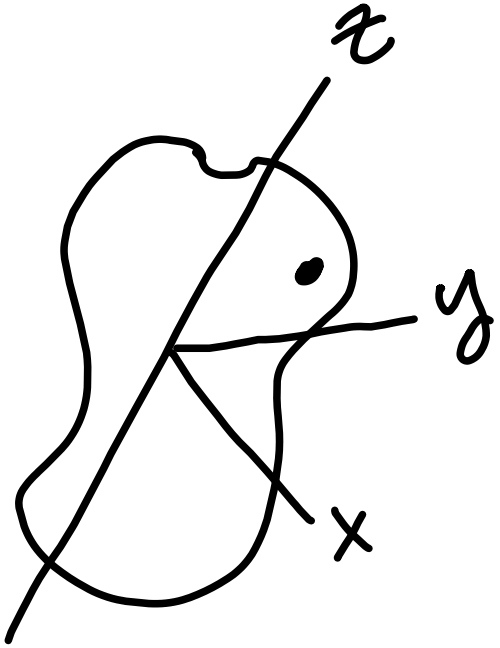
* On a rigid body take a point
* Along the axis of rotation

For rotation about a fixed axis



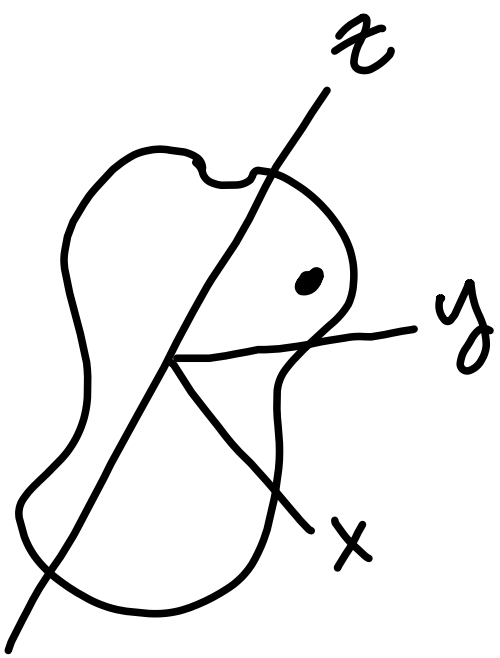
* On a rigid body take a point
* Along the axis of rotation Define the z-axis

For rotation about a fixed axis



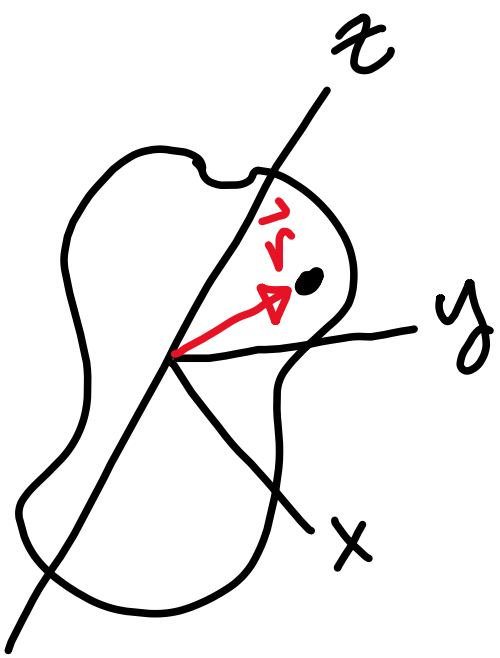
* On a rigid body take a point
* Along the axis of rotation Define the z-axis

For rotation about a fixed axis



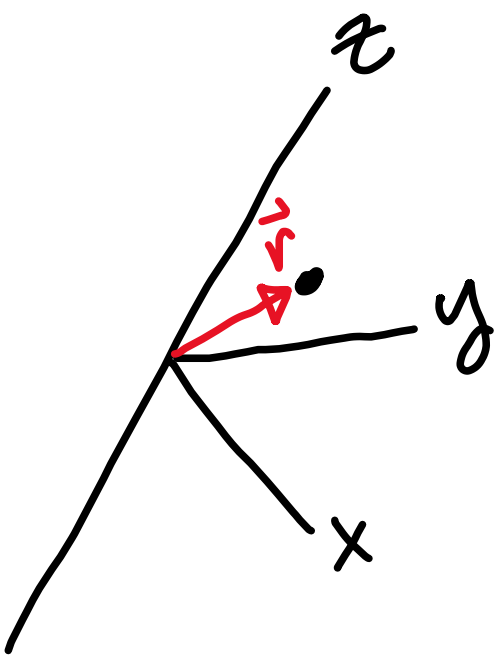
* On a rigid body take a point
* Along the axis of rotation Define the z-axis
* angle $\vec{r}$ makes with z-axis is φ

For rotation about a fixed axis



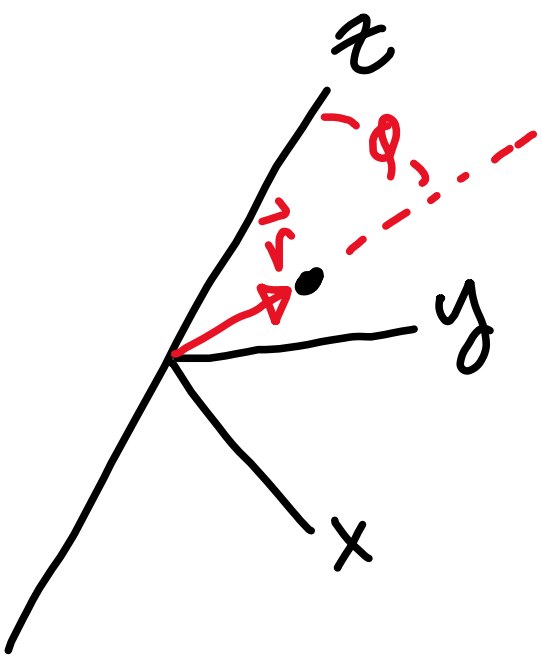
* On a rigid body take a point
* Along the axis of rotation Define the z-axis
* angle $\vec{r}$ makes with z-axis is φ

For rotation about a fixed axis



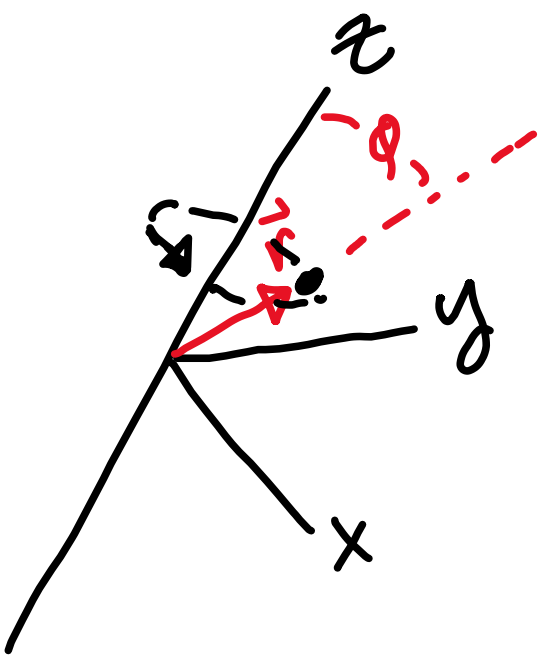
* On a rigid body take a point
* Along the axis of rotation Define the z-axis
* angle $\vec{r}$ makes with z-axis is φ

For rotation about a fixed axis



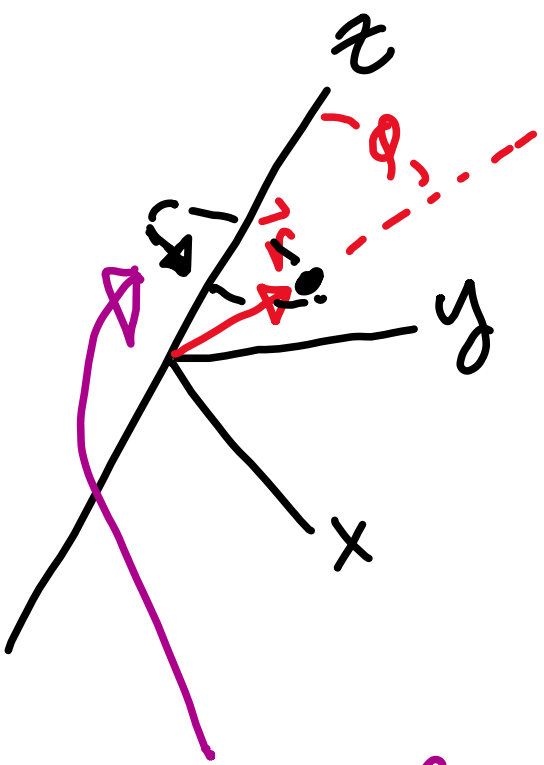
* On a rigid body take a point
* Along the axis of rotation Define the z-axis
* angle $\vec{r}$ makes with z-axis is φ

For rotation about a fixed axis



* On a rigid body take a point
* Along the axis of rotation Define the z-axis
* angle $\vec{r}$ makes with z-axis is φ

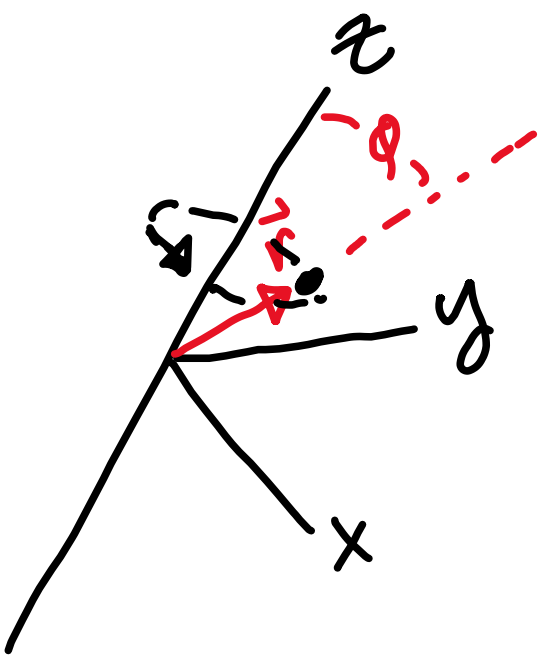
For rotation about a fixed axis



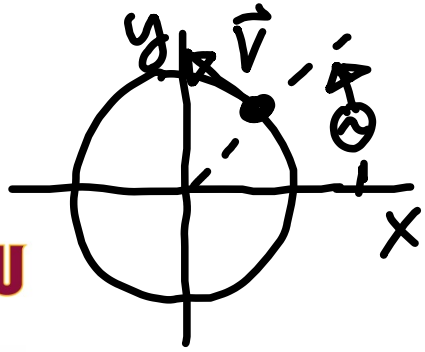
* On a rigid body take a point
* Along the axis of rotation Define the z-axis
* angle $\vec{r}$ makes with z-axis is φ

Circular path swept by point of interest about axis of rotation

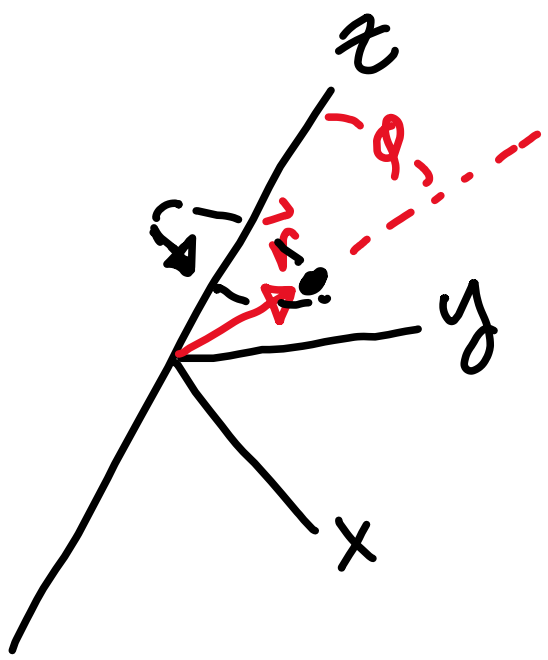
For rotation about a fixed axis



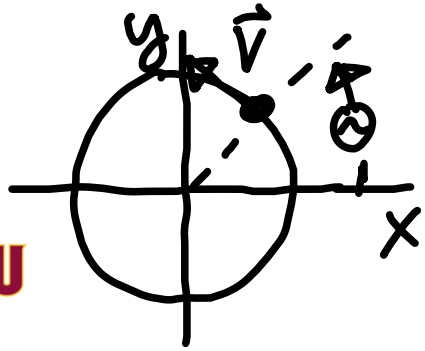
* On a rigid body take a point
* Along the axis of rotation Define the z-axis
* angle $\vec{r}$ makes with z-axis is φ
* Angle on xy-plane between $\vec{r}$ & X-axis is Θ



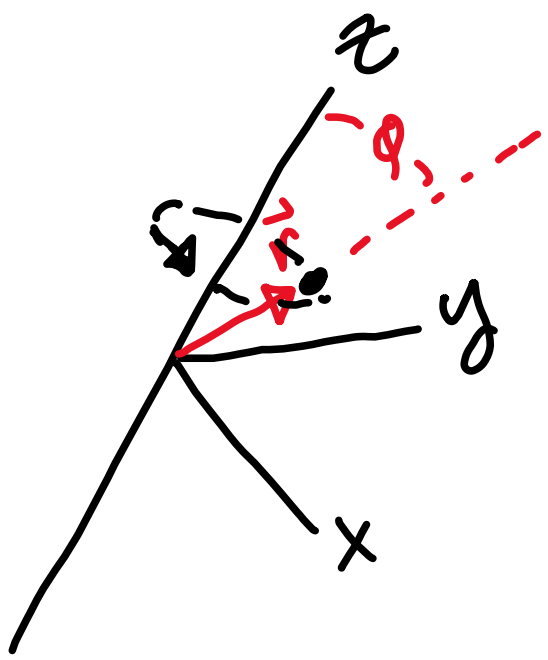
For rotation about a fixed axis



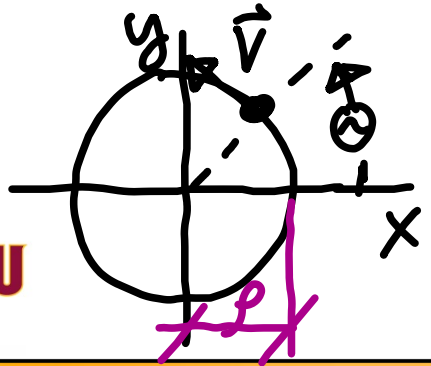
* On a rigid body take a point
* Along the axis of rotation Define the z-axis
* angle $\vec{r}$ makes with z-axis is φ
* Angle on xy-plane between $\vec{r}$ & x-axis is Θ
* radius of curvature is ρ



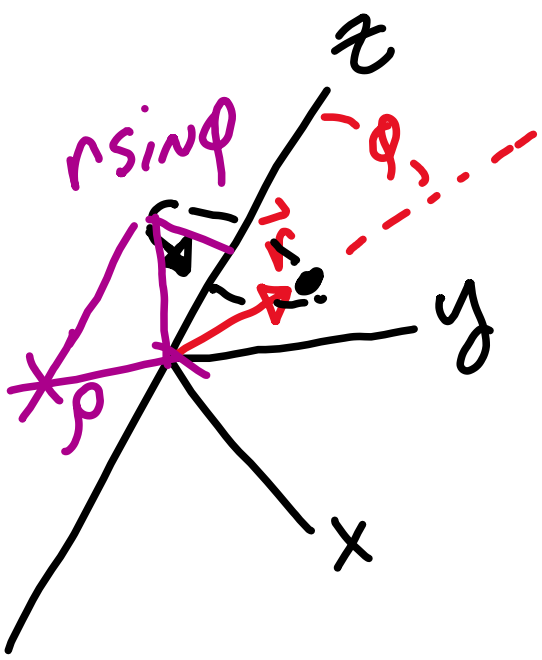
For rotation about a fixed axis



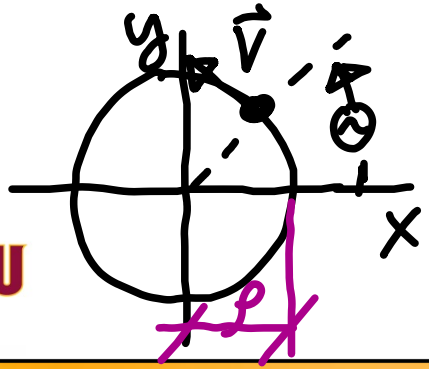
* On a rigid body take a point
* Along the axis of rotation Define the z-axis
* angle $\vec{r}$ makes with z-axis is φ
* Angle on xy-plane between $\vec{r}$ & x-axis is Θ
* radius of curvature is ρ



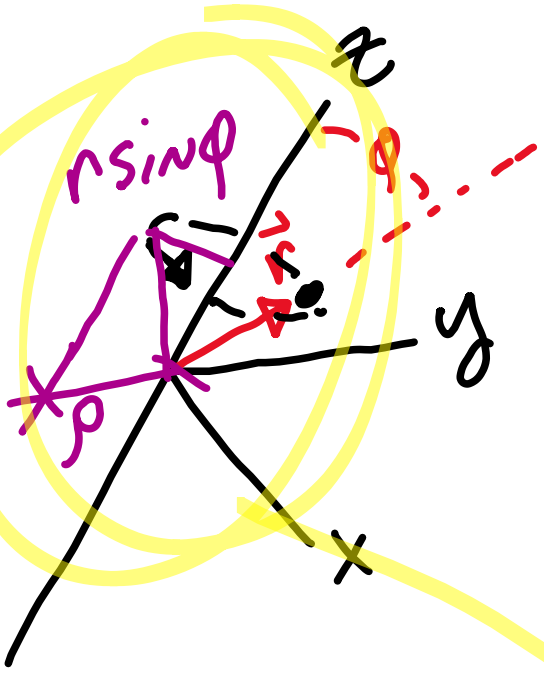
For rotation about a fixed axis



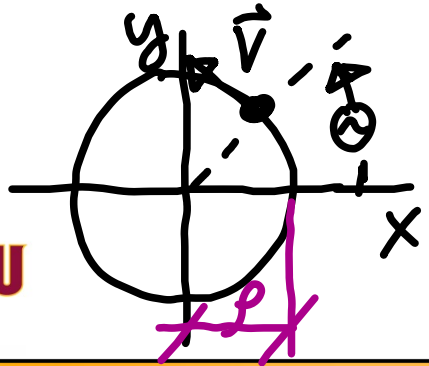
* On a rigid body take a point
* Along the axis of rotation Define the z-axis
* angle $\vec{r}$ makes with z-axis is φ
* Angle on xy-plane between $\vec{r}$ & x-axis is Θ
* radius of curvature is ρ & $\rho = r\sin\varphi$



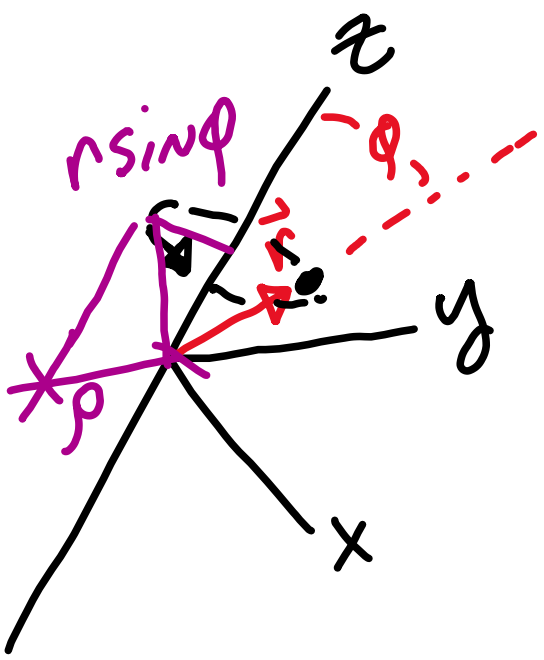
For rotation about a fixed axis



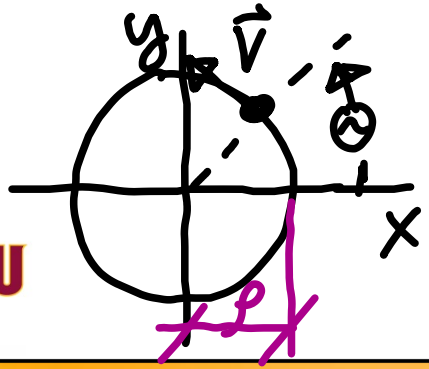
* On a rigid body take a point
* Along the axis of rotation Define the z-axis
* angle $\vec{r}$ makes with z-axis is φ
* Angle on xy-plane between $\vec{r}$ & x-axis is Θ
* radius of curvature is ρ & $\rho = r\sin\varphi$



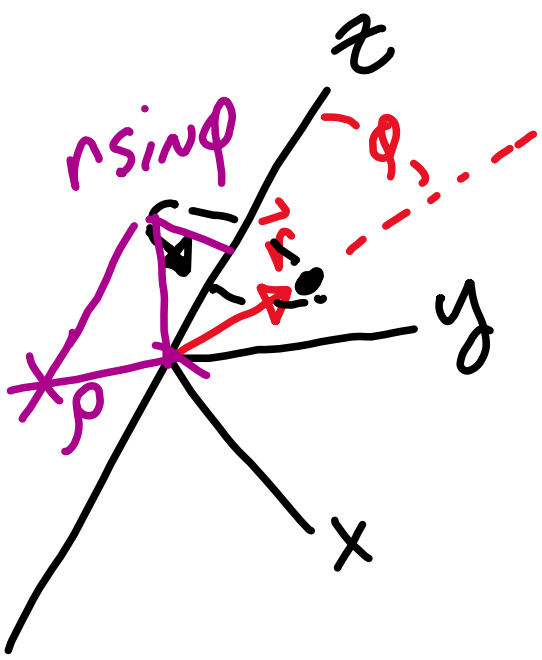
For rotation about a fixed axis



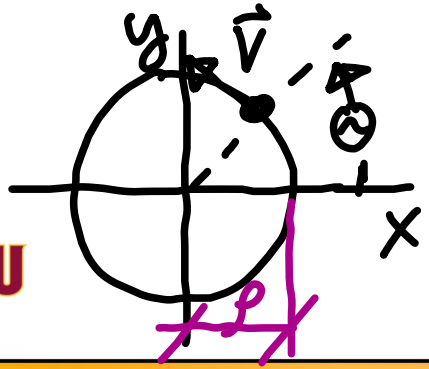
* On a rigid body take a point
* Along the axis of rotation Define the z-axis
* angle $\vec{r}$ makes with z-axis is φ
* Angle on xy-plane between $\vec{r}$ & x-axis is Θ
* radius of curvature is ρ & $\rho = r\sin\varphi$
* Take $\vec{\omega} \equiv \dot{\Theta}\hat{k}$



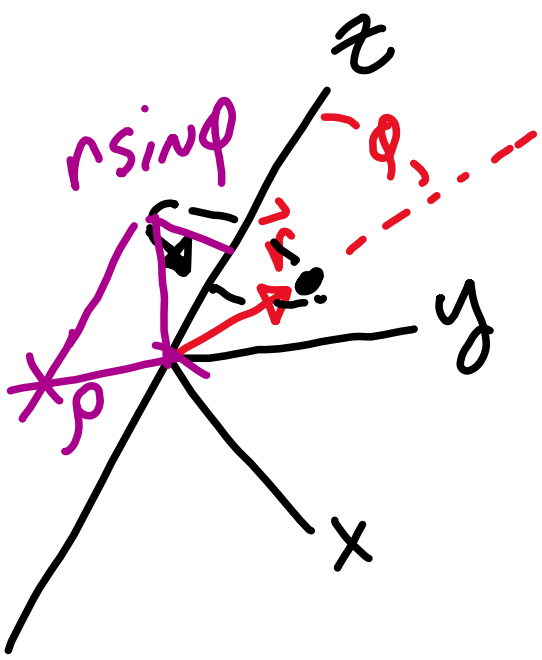
For rotation about a fixed axis



* On a rigid body take a point
* Along the axis of rotation Define the z-axis
* angle $\vec{r}$ makes with z-axis is φ
* Angle on xy-plane between $\vec{r}$ & x-axis is Θ
* radius of curvature is ρ & $\rho = r\sin\varphi$
* Take $\vec{\omega} \equiv \dot{\Theta}\hat{k}$ Now $v = \rho\dot{\Theta}$



For rotation about a fixed axis



* On a rigid body take a point
* Along the axis of rotation Define the z-axis
* angle $\vec{r}$ makes with z-axis is φ
* Angle on xy-plane between $\vec{r}$ & x-axis is Θ
* radius of curvature is ρ & $\rho = r\sin\varphi$
* Take $\vec{\omega} \equiv \dot{\Theta}\hat{k}$ Now $v = \rho\dot{\Theta}$
$\Rightarrow v = \omega r \sin\varphi$