University of Idaho

⇒ Wed Sept 22 Session 13 - Lecture Chap 16

⇒ Friday Sept 24 Session 14 - Lecture Chapt 16

⇒ Monday Sept 27 Session 15 - Review Exam I
HW#4 Returned

⇒ Wednesday Sept 29 Session 16 - Exam I

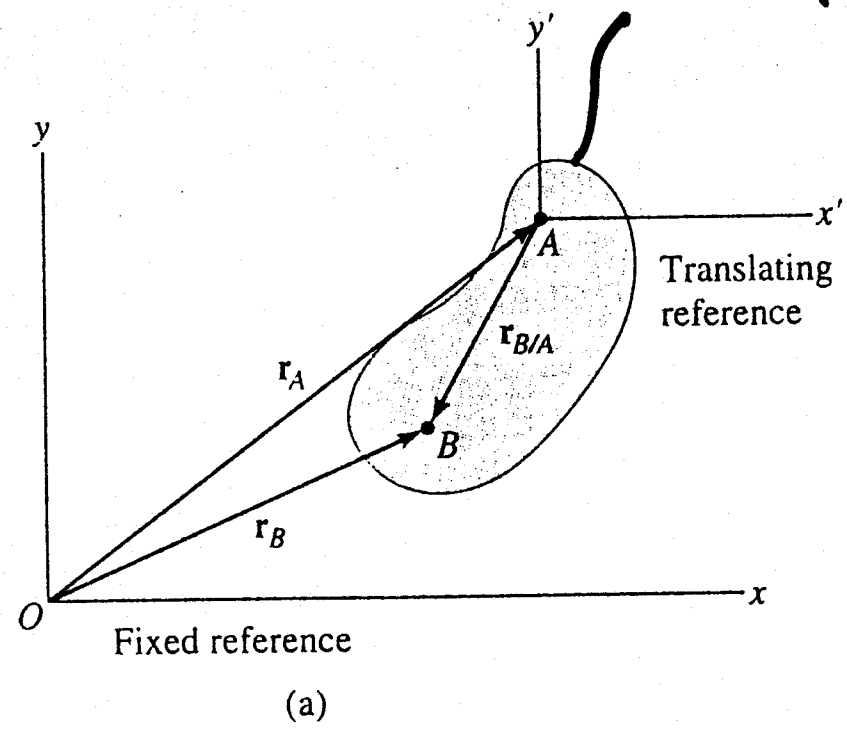
University of Idaho - Have covered Fixed Axis Rotation

Section 16.5 Relative Motion Analysis: Velocity

General Plane Motion - Translation + Rotation

undergoes translation + rotation

13/3



(a)

Fig. 16–10

- xy Fixed coordinate system, $\vec{i}, \vec{j}, \vec{k}$
- x'y' st system, attached to body at pt point A, translates with the body, but does not rotate with the body, $\vec{i}', \vec{j}', \vec{k}'$
- $\vec{i} = \vec{i}'$, $\vec{j} = \vec{j}'$, $\vec{k} = \vec{k}'$

$\vec{r}_A$ = position of A in xy frame

$\vec{r}_B$ = position of B in xy frame

$\vec{r}_{B/A}$ = position of B as viewed from A in x'y' frame.

We wish to determine a relationship between $\vec{v}_A$, $\vec{v}_B$ & $\vec{v}_{B/A}$.

$$\vec{r}_B = \vec{r}_A + \vec{r}_{B/A}$$

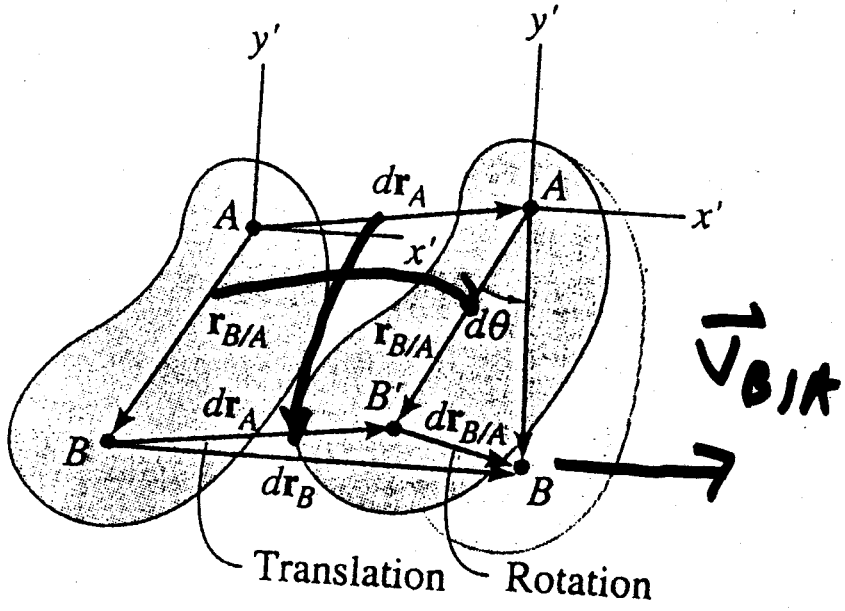
$$\frac{d\vec{r}_B}{dt} = \frac{d\vec{r}_A}{dt} + \frac{d\vec{r}_{B/A}}{dt}$$

$$\vec{v}_B = \vec{v}_A + \vec{v}_{B/A}$$

$$d\vec{r}_B = d\vec{r}_A + d\vec{r}_{B/A}$$

$$\boxed{\vec{v}_B = \vec{v}_A + \vec{\omega} \times \vec{r}_{B/A}}$$

$$\vec{\omega} = \omega \vec{k} = \frac{d\theta}{dt}\vec{k}$$



(c)

(relative velocity equation)
x'y' coord system attached to pt A, translates but does not rotate.

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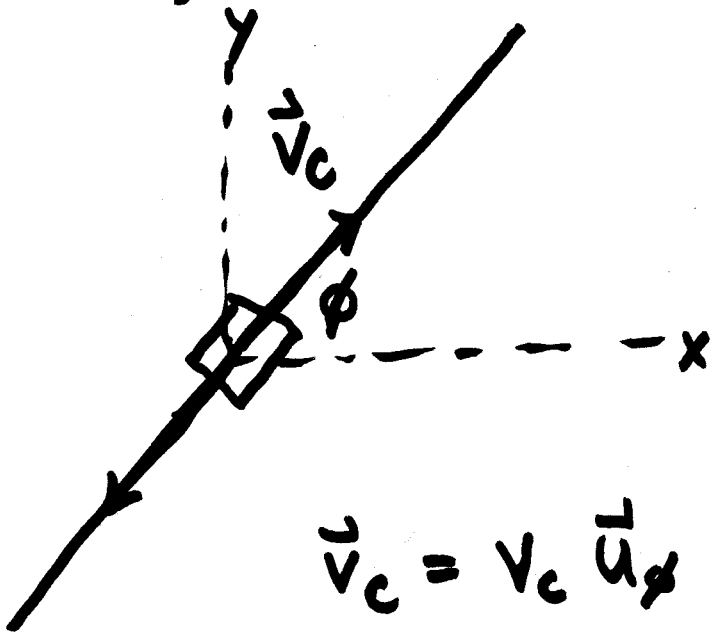

$$\vec{v}_c = v_c \vec{u}_\phi$$

$$= v_c \left[\cos\phi \vec{i} + \sin\phi \vec{j}\right]$$

$$|\vec{u}_\phi| = \sqrt{\cos^2\phi + \sin^2\phi} = 1$$

$$\vec{u}_\phi = \cos\phi \vec{i} + \sin\phi \vec{j}$$