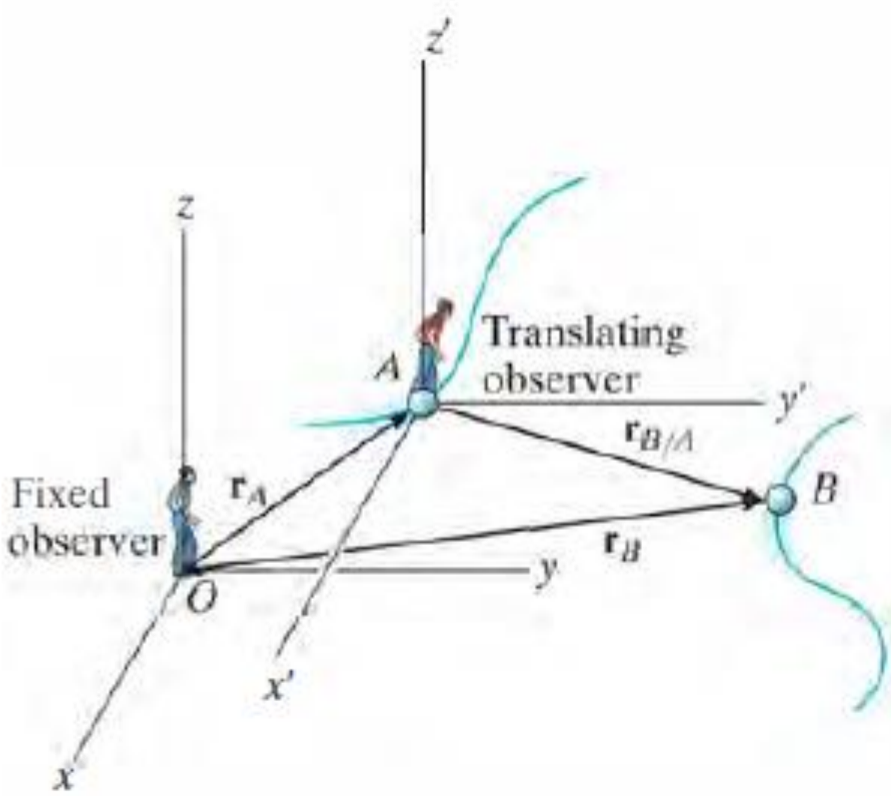
MEC3705 – DYNAMICS

PART I

DYNAMICS OF PARTICLES

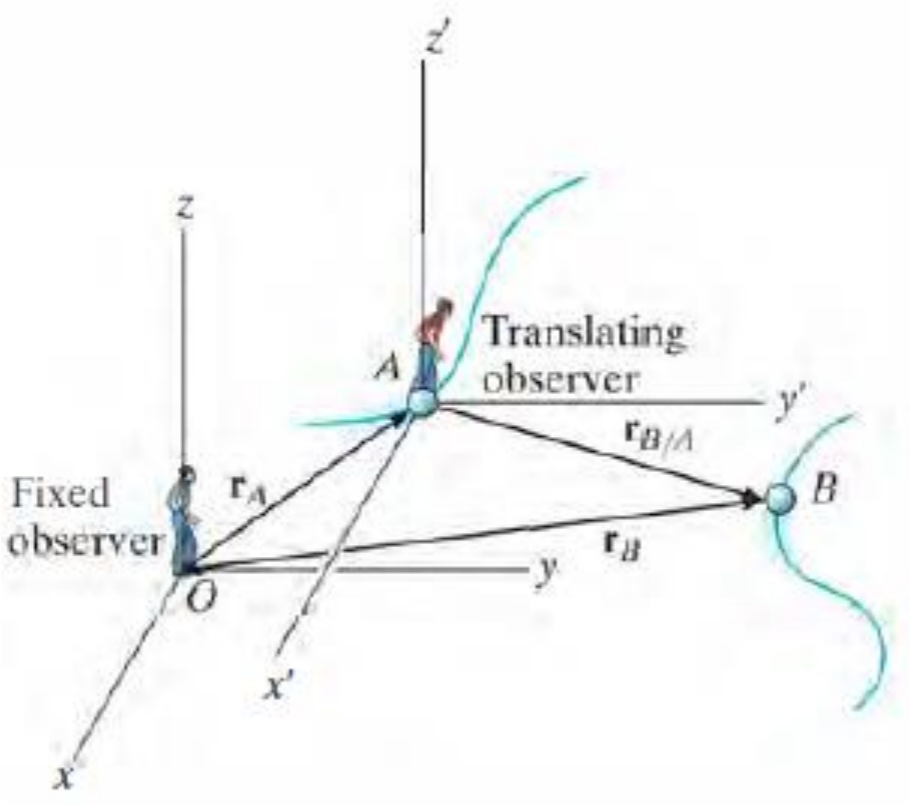
Lecture 3

2.8 RELATIVE MOTION (TRANSLATING AXES)



Relative motion is a critical issue for the pilots of these Navy Blue Angel aircraft, even when the aircraft are not rotating.

2.8 RELATIVE MOTION (TRANSLATING AXES)



2.8 RELATIVE MOTION (TRANSLATING AXES)

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

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

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

A translating reference system which has no acceleration is known as an inertial system

Sample Problem 2/12

2.9 CONSTRAINED MOTION OF CONNECTED PARTICLES

- Sometimes motions are constrained by interconnecting members such as Figure 2/18

$$L = x + \frac{\pi r_2}{2} + 2y + \pi r_1 + b$$

- With L, r2, r1, and b all constants

$$0 = \dot{x} + 2\dot{y} \; or \; v_A = 2v_B$$

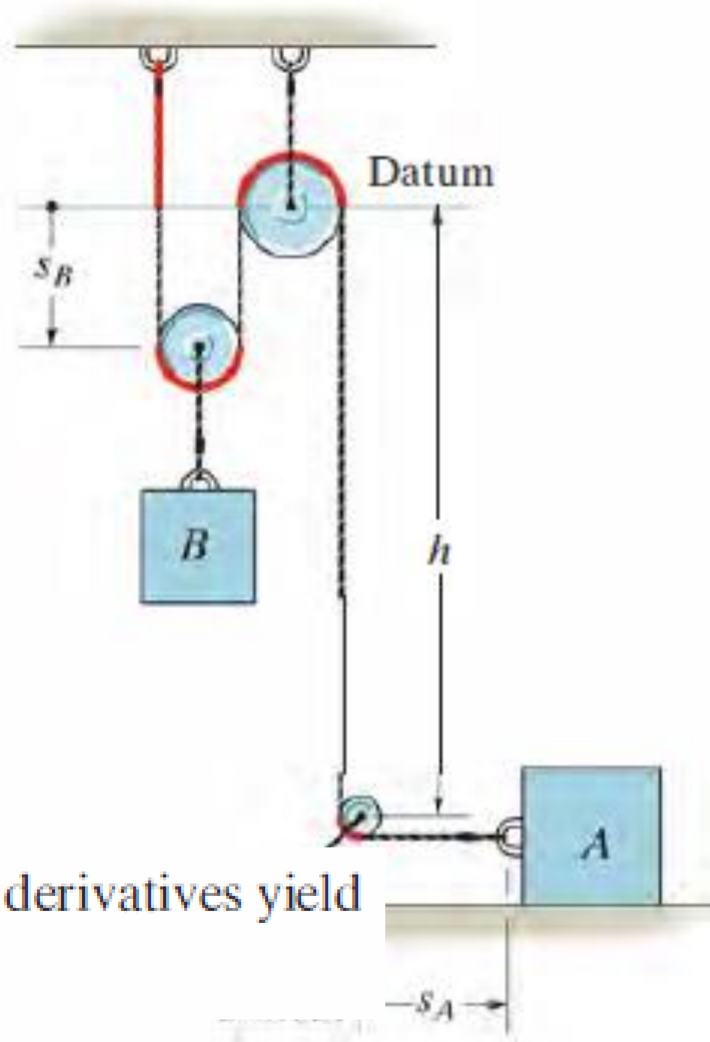
$$0 = \ddot{x} + 2\ddot{y} \; or \; a_A = 2a_B$$

- Since the results do not depend on the lengths or pulley radii, we should be able to analyze the motion without considering them

2.9 CONSTRAINED MOTION OF CONNECTED PARTICLES

- Example

$$2s_B + h + s_A = l$$



(a)

Since l and h are constant during the motion, the two time derivatives yield

$$2v_B = -v_A \qquad 2a_B = -a_A$$

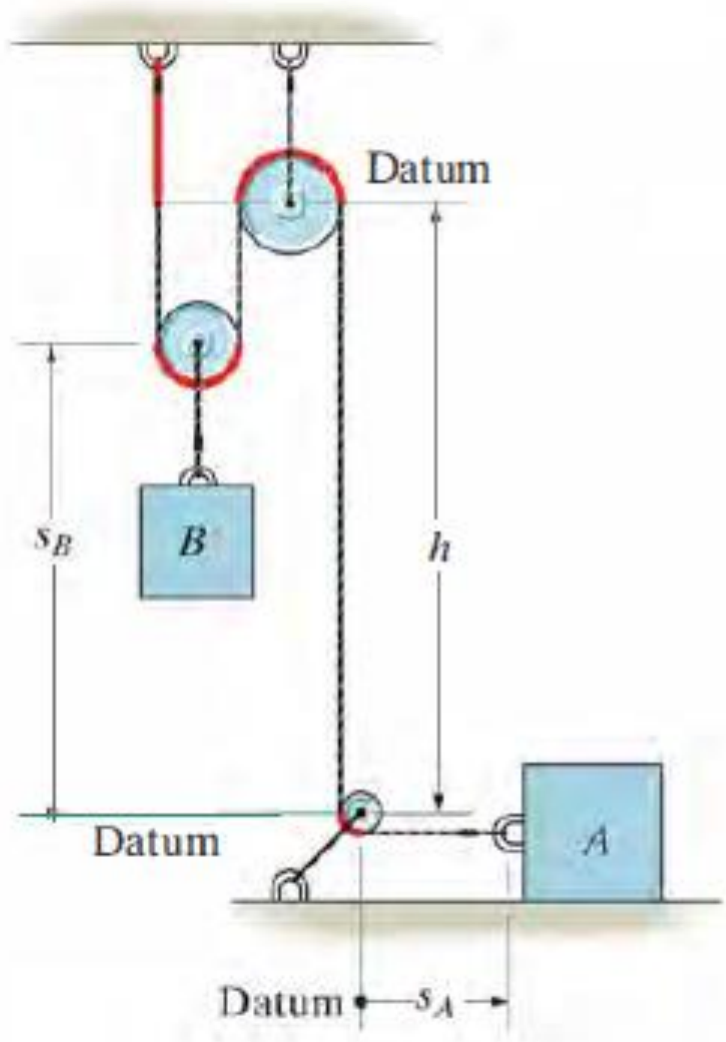
2.9 CONSTRAINED MOTION OF CONNECTED PARTICLES

- Example

$$2(h - s_B) + h + s_A = l$$

Time differentiation yields

$$2v_B = v_A \qquad 2a_B = a_A$$



(b)

KINEMATICS – SPACE CURVILINEAR, CONSTRAINED CONNECTED PARTICLES

Sample problem 2/14

Sample Problem 2/15

2/10 Problem Formulation

(a) Type of Motion

(b) Reference Fixity

(c) Coordinates

(d) Approximations

(e) Mathematical methods

References

- J.L. Meriam and L. G. Krage, Dynamics second edition
- R.C. Hibbeller, Engineering Mechanics, Dynamics 12th Edition, Prentice Hall