2. Kinematic Analysis

Quick Review of ME 208 Dynamics

2/9 Constrained Motion of Interconnected Particles

Number of Coordinates

Number of Constraint Equations

Degree of Freedom (Number of *Independent* Coordinates)

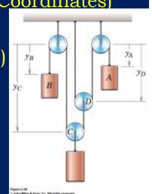
Coordinates: y_A, y_B, y_C and y_D (4)

Constraints: Two ropes of constant length (2)

$L_{left} = y_B + y_C + (y_C - y_D) + C_1$

$L_{right} = y_A + 2y_D + C_2$

Degree of Freedom (the variables you can select *as you like*): $(4 - 2 = 2)$



2. Kinematic Analysis

Quick Review of ME 208 Dynamics

5/3 Absolute Motion Analysis

Write a geometric relation (which is actually the constraint equation) for the point of interest.

$x_C = s - r\sin\theta = r\theta - r\sin\theta = r(\theta - \sin\theta)$

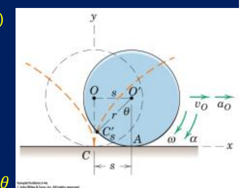
$y_C = r - r\cos\theta = r(1 - \cos\theta)$

$\dot{x}_C = \dfrac{dx_C}{dt} = v_C{}^x = r\dot{\theta}(1 - \cos\theta)$

$\dot{y}_C = \dfrac{dy_C}{dt} = v_C{}^y = r\dot{\theta}\sin\theta$

$\ddot{x}_C = \dfrac{d^2x_C}{dt^2} = a_C{}^x = r\ddot{\theta}(1 - \cos\theta) + r\dot{\theta}^2\sin\theta$

$\ddot{y}_C = \dfrac{d^2y_C}{dt^2} = a_C{}^y = r\ddot{\theta}\sin\theta + r\dot{\theta}^2\cos\theta$



2. Kinematic Analysis

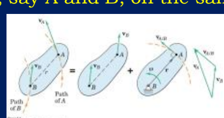
Quick Review of ME 208 Dynamics

5/4 Relative Velocity, 5/6 Relative Acceleration

Select two points, say A and B, on the same rigid body.

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

$\vec{v}_{A/B} = \vec{\omega} \times \vec{r}_{A/B}$



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

$\vec{a}_{A/B} = \vec{a}_{A/B}{}^t + \vec{a}_{A/B}{}^n$

$\vec{a}_{A/B}{}^t = \vec{\alpha} \times \vec{r}_{A/B}$

$\vec{a}_{A/B}{}^n = \vec{\omega} \times (\vec{\omega} \times \vec{r}_{A/B}) = -\omega^2 \vec{r}_{A/B}$