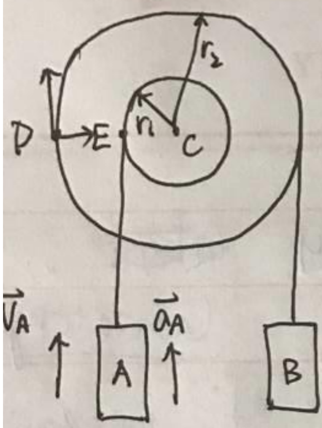


(a) $(\vec{V}_A)_0 = (\vec{V}_E)_0 = 240 \text{ mm/s} \uparrow$

$(\vec{a}_A)_t = (\vec{a}_E)_t = 300 \text{ mm/s}^2 \uparrow$

$r_1 = 120 \text{ mm}$

$(V_E)_0 = r_1 w_0 \quad w_0 = 2 \text{ rad/s}$ ↻

$(a_E)_t = r_1 \alpha \quad \alpha = 2.5 \text{ rad/s}^2$ ↻

$w = w_0 + \alpha t = 2 + 2.5 \times 3 = 9.5 \text{ rad/s}$ ↻

$\theta = w_0 t + \frac{1}{2}\alpha t^2 = 17.25 \text{ rad}$

Number of revolutions $= (17.25 \text{ rad}) \cdot \left(\frac{1 \text{ rev}}{2\pi \text{ rad}}\right)$

$= 2.75 \text{ rev}$

(b) $V_B = r_2 w = 180 \text{ mm} \times 9.5 \text{ rad/s} = 1710 \text{ mm/s} \downarrow$

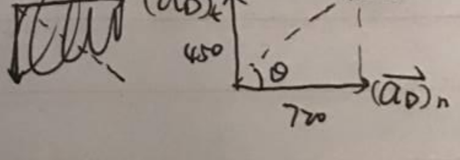
$\Delta y_B = r_2 \theta = 180 \text{ mm} \times 17.25 \text{ rad} = 3105 \text{ mm} \downarrow$

(c) $\vec{a}_D = \overrightarrow{(a_D)_n} + \overrightarrow{(a_D)_t}$

$t = 0$,

$(\vec{a}_D)_n = r_2 w_0^2 = 720 \text{ mm/s}^2 \rightarrow$

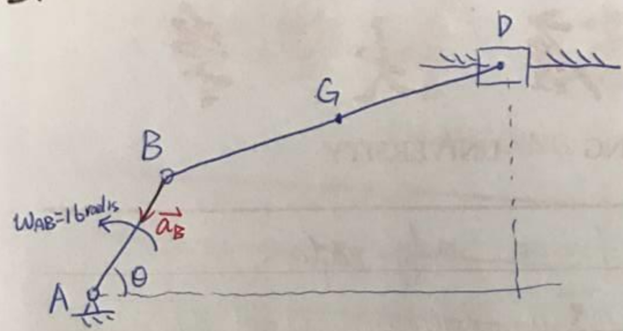
$(\vec{a}_D)_t = r_2 \alpha = 450 \text{ mm/s}^2 \uparrow$



$\theta = 32°$

$\therefore \vec{a}_D = 849.1 \text{ mm/s}^2 \; \angle \theta = 32°$

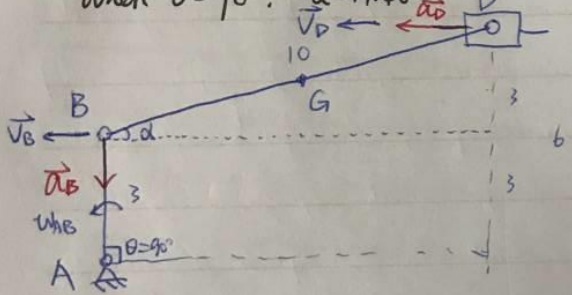
2.



(a) Since $\omega_{AB} = 16$ rad/s is a constant the acceleration of B is therefore directed toward A

$$a_B = r\omega_{AB}^2 = (\tfrac{3}{12}\ ft)(16\ rad/s)^2 = 64\ ft/s^2$$

when $\theta = 90°$, $\alpha = 17.46°$



$$\vec{a_D} = \vec{a_B} + \vec{a_{D/B}}$$

$$\vec{a_D} = \vec{a_B} + \alpha_{BD}\vec{k} \times \vec{r_{D/B}} - \omega_{BD}^2 \vec{r_{D/B}}$$

$$-a_D\vec{i} = -a_B\vec{j} + \alpha_{BD}\vec{k} \times (l\cos\alpha\,\vec{i} + l\sin\alpha\,\vec{j})$$
$$- \omega_{BD}^2 \times (l\cos\alpha\,\vec{i} + l\sin\alpha\,\vec{j})$$

(其中 $a_B = 64\ ft/s^2$, $\alpha = 17.46$, $l = \frac{10}{12}\ ft$)

$$\Rightarrow -a_D\vec{i} = -a_B\vec{j} + \alpha_{BD} l\cos\alpha\,\vec{j} - \alpha_{BD} l\sin\alpha\,\vec{i}$$
$$- \omega_{BD}^2 l\cos\alpha\,\vec{i} - \omega_{BD}^2 l\sin\alpha\,\vec{j}$$

① i: $-a_D = -\alpha_{BD} l\sin\alpha - \omega_{BD}^2 l\cos\alpha$

② j: $0 = -a_B + \alpha_{BD} l\cos\alpha - \omega_{BD}^2 l\sin\alpha$

because $\vec{v_B} = \omega_{AB}\cdot l_{AB} = 4$ ft/s ←

$$\vec{v_D} = \vec{v_B} + \vec{v_{D/B}} = \vec{v_B} + \vec{\omega_{DB}} \times \vec{r_{D/B}}$$

$$-v_D\vec{i} = -v_B\vec{i} + \omega_{DB}\vec{k} \times (l\cos\alpha\,\vec{i} + l\sin\alpha\,\vec{j})$$

i: $-v_D = -v_B - \omega_{DB} l\sin\alpha$

j: $0 = \omega_{DB} l\cos\alpha$

hence $\omega_{DB} = 0$, $v_B = v_D$

∴ ①② ⇒ i: $-a_D = -\alpha_{BD} l\sin\alpha$

j: $0 = -a_B + \alpha_{BD} l\cos\alpha$

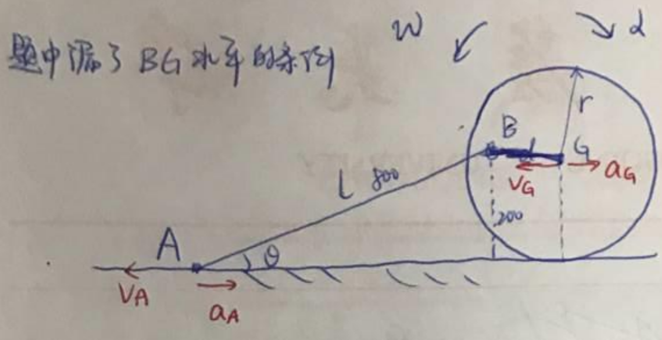
⇒ $\alpha_{BD} = 80.51\ rad/s^2$ ↻

$a_D = 24.15\ ft/s^2$ ←

(b) $$\begin{cases} \vec{a_G} = \vec{a_B} + \vec{a_{G/B}} \\ \vec{a_G} = \vec{a_D} + \vec{a_{G/D}} \end{cases}$$

∴ ∴ ∴

题中漏了BG水平的条件



$L = 0.8\ m$

$d = 0.16\ m$

$r = 0.2\ m$

$w = 8\ rad/s$ G

$\alpha = 2\ rad/s^2$

$V_G = rw = 1.6\ m/s \leftarrow$

$a_G = r\alpha = 0.4\ m/s^2 \rightarrow$

$\vec{V_B} = \vec{V_G} + \vec{V_{B/G}}$

$= \vec{V_G} + \vec{w} \times \vec{r_{B/G}}$

$= -1.6\vec{i} + 8\vec{k} \times (-0.16\vec{i})$

$\vec{V_B} = -1.6\vec{i} - 1.28\vec{j}$

$\vec{V_A} = \vec{V_B} + \vec{V_{A/B}}$

$= \vec{V_B} + \vec{w_{AB}} \times \vec{r_{A/B}}$

$= (-1.6\vec{i} - 1.28\vec{j}) + \vec{w_{AB}}\vec{k} \times (-L\cos\theta\vec{i} - L\sin\theta\vec{i})$

$= (0.2w_{AB} - 1.6)\vec{i} + (-1.28 - 0.7746w_{AB})\vec{j}$

$\because -1.28 - 0.7746w_{AB} = 0$

$\therefore w_{AB} = -1.65\ rad/s$

$\vec{V_A} = 1.93\ m/s \leftarrow$

$\vec{a_B} = \vec{a_G} + \alpha\vec{k} \times \vec{r_{B/G}} - w^2\vec{r_{B/G}}$

$= 0.4\vec{i} + (-2\vec{k}) \times (-0.16\vec{i}) - w^2(-0.16\vec{i})$

$= 10.64\vec{i} + 0.32\vec{j}$

$\vec{a_A} = \vec{a_B} + \vec{\alpha_{AB}} \times \vec{r_{A/B}} - w_{AB}^2 \times \vec{r_{AB}}$

$= (12.76 + 0.2\alpha_{AB})\vec{i} + (0.87 - 0.7746\alpha_{AB})\vec{j}$

$\because 0.87 - 0.7746\alpha_{AB} = 0$

$\therefore \alpha_{AB} = 1.12\ rad/s^2$

$\vec{a_A} = 12.98\vec{i}\ m/s^2 \rightarrow$