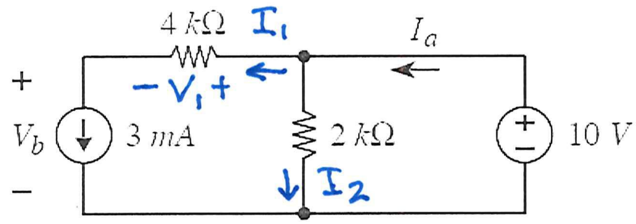
SA1 [5 Marks]. Consider the following circuit:



(a) [2 Marks] Determine the current I_a, flowing through the voltage source.

KCL: $I_1 + I_2 - I_a = 0$

$3mA + \frac{(10V)}{(2k\Omega)} = I_a$

$\therefore I_a = 8mA$

(b) [2 Marks] Determine the voltage V_b, across the current source.

KVL: $V_1 + V_b - 10V = 0$

$(3mA)(4k\Omega) + V_b - 10V = 0$

$\therefore V_b = -2V$

(c) [1 Marks] How much power is absorbed by the current source?

$P = VI = (-2V)(3mA) = -6mW$

ie. The current source supplies power.

SA [5 marks] Find the general solution of the differential equation

$$ty' + y^2 + 1 = 0\,, \quad t > 0\,.$$

SOLUTION: Separate the variables and solve:

$$y' = -\frac{y^2 + 1}{t}$$

$$\int \frac{1}{y^2 + 1}\,dy = -\int \frac{1}{t}\,dt$$

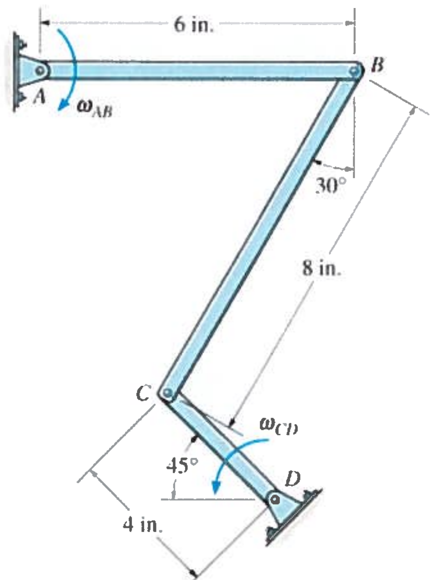
$$\arctan(y) = -\ln(t) + C$$

$$y = \tan(-\ln(t) + C)$$

Name:______________________________ Section:____________________________

Prob 1 [25 Marks]

A. [20 Marks] Use Chasles' Theorem to find the angular velocity of bar CD at the instant shown given that ω_{AB}= -5 rad/s **k**



$\vec{V}_B = \vec{\omega}_{AB} \times \vec{r}_{B/A} = -5\frac{rad}{s}\hat{k} \times 6\,in\,\hat{i} = -30\hat{j}$ in/s

$\vec{V}_C = \vec{V}_B + \vec{V}_{C/B} = -30\hat{j}$ in/s $+ \vec{\omega}_{BC} \times \left(-\frac{\sqrt{3}}{2}(8)\,in\,\hat{j} - 4\,in\,\hat{i}\right)$

$\vec{V}_C = \left(-30\hat{j} - 4\omega_{BC}\hat{j} + 4\sqrt{3}\,\omega_{BC}\hat{i}\right)$ in/s ①

but $\vec{V}_C = \vec{\omega}_{CD} \times \vec{r}_{C/D} = \omega_{CD}\hat{k} \times \left(\frac{4}{\sqrt{2}}\hat{j} - \frac{4}{\sqrt{2}}\hat{i}\right)$

$\vec{V}_C = \left(-\frac{4}{\sqrt{2}}\omega_{CD}\hat{i} - \frac{4}{\sqrt{2}}\omega_{CD}\hat{j}\right)$ in/s sub in ①

$$-\frac{4}{\sqrt{2}}\omega_{CD}\hat{i} - \frac{4}{\sqrt{2}}\omega_{CD}\hat{j} = -30\hat{j} - 4\omega_{BC}\hat{j} + 4\sqrt{3}\,\omega_{BC}\hat{i}$$

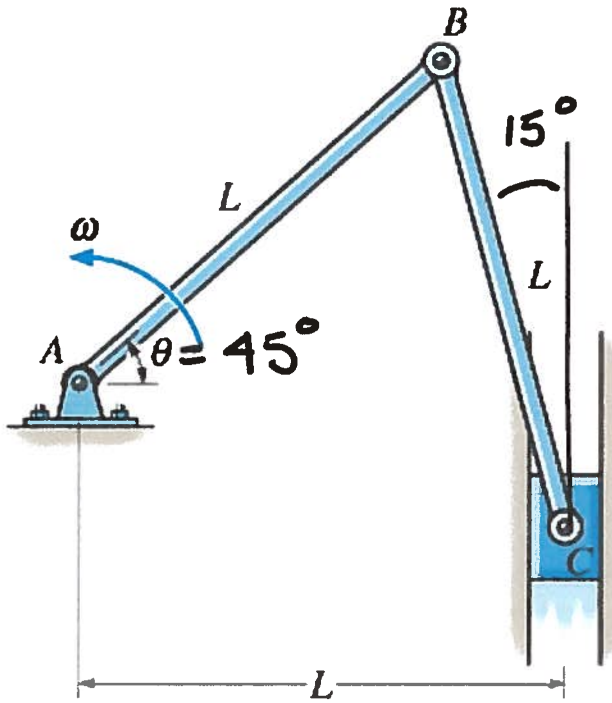
$\hat{i}$: $-\frac{4}{\sqrt{2}}\omega_{CD} = 4\sqrt{3}\,\omega_{BC} \Rightarrow \omega_{CD} = -\sqrt{6}\,\omega_{BC}$ sub in $\hat{j}$ eqN

$\hat{j}$: $-\frac{4}{\sqrt{2}}\omega_{CD} = -30 - 4\left(\frac{\omega_{CD}}{-\sqrt{6}}\right)$

$\Rightarrow \omega_{CD} = 6.72\,\frac{rad}{s} \Rightarrow$ $\underline{\vec{\omega}_{CD} = 6.72\,\hat{k}\,\frac{rad}{s}}$ ANS

Name:______________________________ Section:______________________________

B. [5 Marks] For the figure shown, using a straight edge, draw a vector diagram that shows how the velocity of point C, $\mathbf{v}_C$, relates to the velocity of point B, $\mathbf{v}_B$ and the relative velocity of point C with respect to B, $\mathbf{v}_{C/B}$.



$\vec{V}_C = \vec{V}_B + \vec{V}_{C/B}$