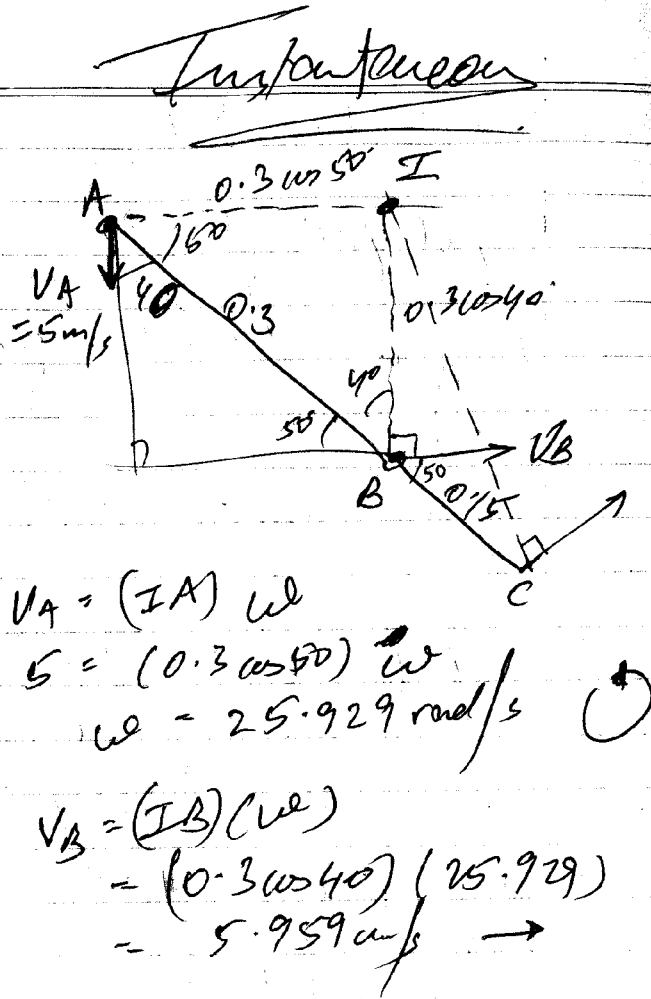


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(1)



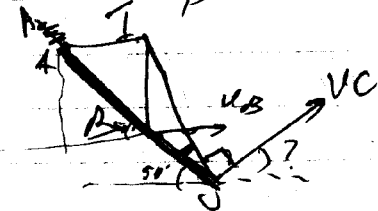
$$IC^2 = IB^2 + BC^2 - 2(IB)(BC) \cos 40$$

$$\therefore IC = 0.358 \text{ m.}$$

$$V_C = (IC) \omega$$

$$= 0.358 \times 25.929$$

$$= 9.283 \text{ m/s}$$



$\angle BCI :$

$$IB^2 = IC^2 + BC^2 - 2(IC)(BC) \cos \angle ICB$$

$$\therefore \angle ICB = 24.345^\circ$$

$$\therefore V_C \text{ with } V_B = 180 - 50 - 24.345$$

$$= 90$$

$$= 15.655^\circ$$

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(2)

$v_B = (I_1 B) \omega_{AB}$
 $v_B = 0.376$
 $= 1.8 \text{ m/s}$

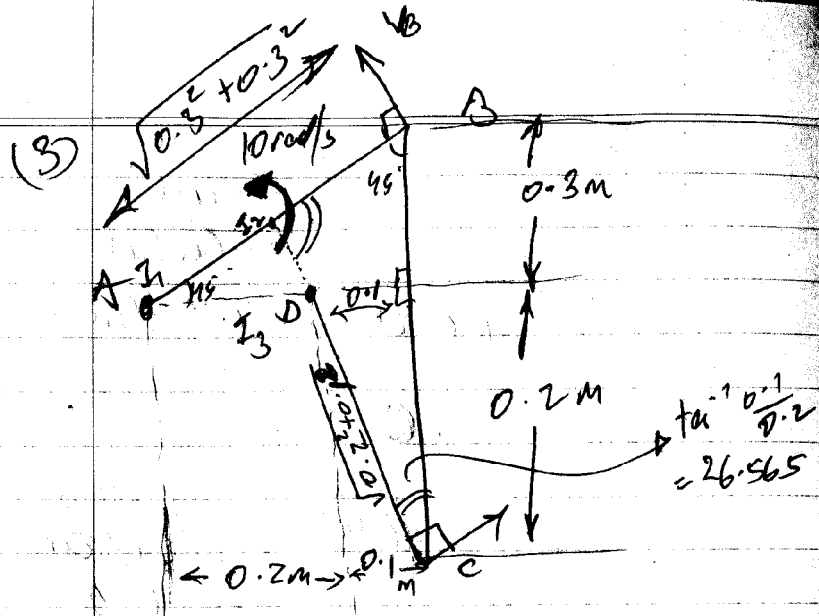
$v_B = I_2 B \omega_{BC}$
 $\therefore \omega_{BC} = \frac{1.8 \times \frac{\pi \times 50^\circ}{180}}{0.25}$
 $= 4.628 \text{ rad/s}$

$v_C = (I_2 C) \omega_{BC}$
 $\omega_{BC} = \frac{1.379}{0.15} = 9.193 \text{ rad/s}$

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$$\begin{aligned}
 V_B &= (I_1 B) (10) \\
 &= 0.4243 \times 10 \\
 &= 4.243 \text{ m/s}
 \end{aligned}$$

$$\begin{aligned}
 \angle B I_2 C &= 180 - 45 - 26.565 \\
 &= 108.435^\circ
 \end{aligned}$$

$$\frac{I_2 B}{\sin 26.565} = \frac{I_2 C}{\sin 45} = \frac{I_3 C}{\sin 108.435}$$

$$\begin{aligned}
 \therefore I_2 B &= 0.236 \text{ m} \\
 I_2 C &= 0.373 \text{ m}
 \end{aligned}$$

~~$$V_C = (I_2 C) \omega_{BC}$$~~

$$V_B = I_2 B (\omega_{BC})$$

$$\therefore \omega_{BC} = \frac{4.243}{0.236} = 17.979 \text{ rad/s}$$

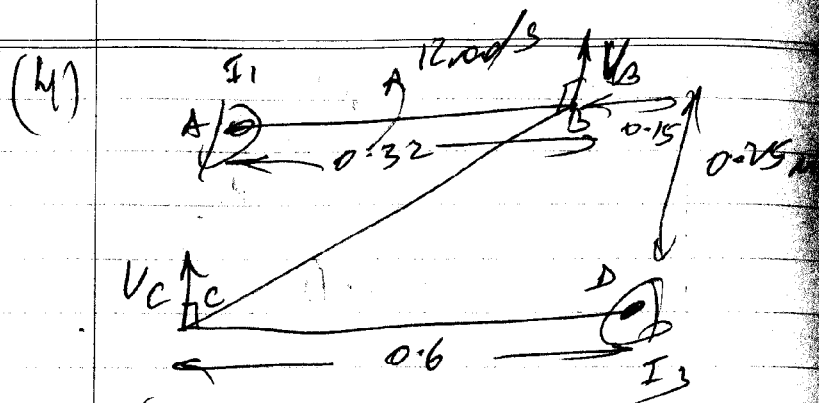
$$\begin{aligned}
 V_C &= (I_2 C) \omega_{BC} \\
 &= (0.373) (17.979) \\
 &= 6.706 \text{ m/s}
 \end{aligned}$$

$$V_C = \omega_{CD} (I_3 C) \quad \therefore \omega_{CD} = 29.990 \text{ rad/s}$$

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$$v_B = (\omega_{AB}) r_{AB}$$

$$= 0.32 \times 12$$

$$= 3.84 \text{ m/s}$$

I_2 is at infinity
 $\therefore \omega_{BC} = 0 \text{ rad/s}$
 & $v_B = v_C$
 $\therefore v_C = 3.84 \text{ m/s}$

$$v_C = (\omega_{CD}) r_{CD}$$

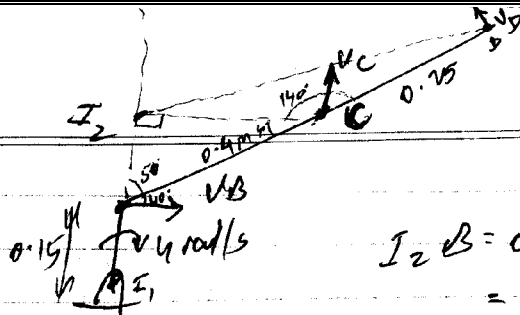
$$\therefore \omega_{CD} = 6.4 \text{ rad/s}$$

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(5)



$$I_{2B} = 0.4 \cos 50^\circ = 0.257 \text{ m}$$

$$I_{2C} = 0.4 \cos 40^\circ = 0.306 \text{ m}$$

$$(I_{2D})^2 = (I_{2C})^2 + (CD)^2 - 2(I_{2C})(CD) \cos 40^\circ$$

$$\therefore I_{2D} = \sqrt{0.306^2 + 0.25^2 - 2 \times 0.306 \times 0.25 \cos 40^\circ} = 0.523 \text{ m}$$

$$v_B = (I_{2B}) \omega_{AB}$$

$$\therefore v_B = (0.15)(4) = 0.6 \text{ m/s}$$

$$v_B = (I_{2B}) \omega_{BC}$$

$$\therefore \omega_{BC} = \frac{0.6}{0.257} = 2.335 \text{ rad/s}$$

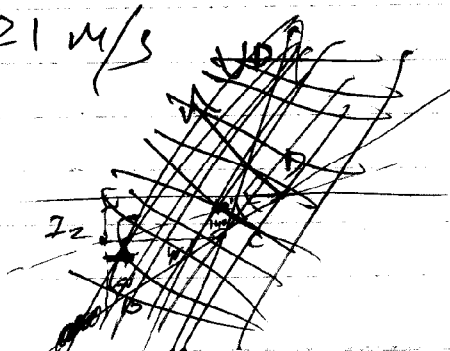
$$v_C = (I_{2C}) \omega_{BC}$$

$$= 0.715 \text{ m/s } (\uparrow)$$

$$v_D = (I_{2D}) \omega_{DC}$$

$$= (0.523)(2.335)$$

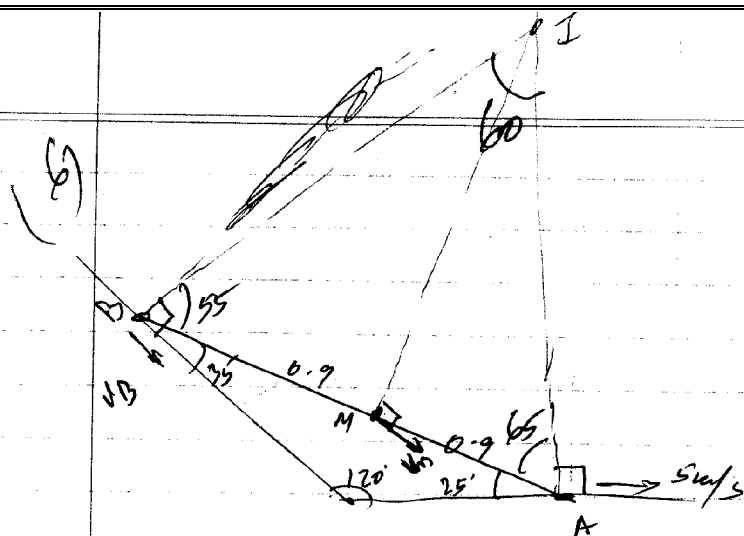
$$= 1.221 \text{ m/s}$$



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$$\frac{\sin 60}{AB} = \frac{\sin 55}{IA} = \frac{\sin 65}{IB}$$

$$\therefore IA = 1.703 \text{ m}$$

$$IB = 1.9884 \text{ m}$$

$$V_A = (IA) \omega$$

$$5 = (1.703) \omega$$

$$\therefore \omega = 2.936 \text{ rad/s} \rightarrow$$

$$V_B = (IB) \omega$$

$$= 1.9884 (2.936) = 5.831 \text{ m/s}$$

$$I_{AM}$$

$$I_M = \sqrt{IA^2 + MA^2 - 2(IA)(MA) \cos 65^\circ}$$

$$= 1.554 \text{ m}$$

$$V_M = (I_M) \omega$$

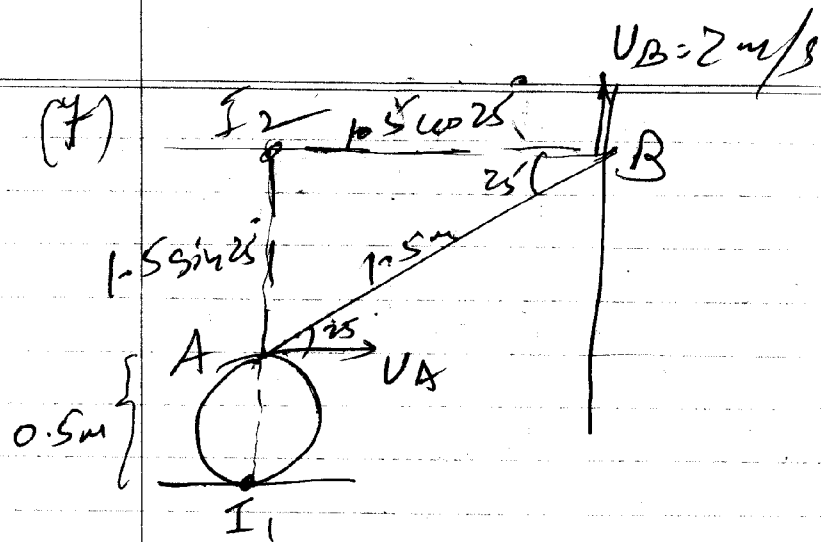
$$= 1.554 (2.936)$$

$$= 4.563 \text{ m/s}$$

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$$V_B = (I_2 B) \omega_2$$

$$2 = (1.5 \cos 25) \omega_2$$

$$\therefore \omega_2 = 1.47 \text{ rad/s}$$

$$\begin{aligned} V_A &= (I_2 A) \omega_2 \\ &= (1.5 \sin 25) (1.47) \\ &= 0.933 \text{ m/s} \end{aligned}$$

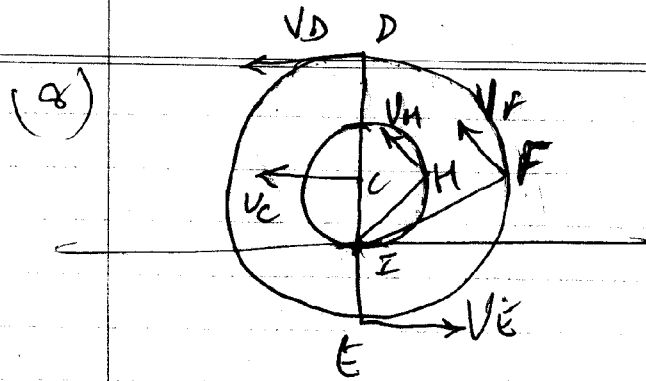
$$V_A = (I_1 A) \omega_1$$

$$\begin{aligned} \omega_1 &= \frac{0.933}{0.5} \\ &= 1.866 \text{ rad/s} \end{aligned}$$

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$$IC = 0.2 \text{ m}$$

$$ID = 0.2 + 0.38 = 0.58 \text{ m}$$

$$IH = \sqrt{0.2^2 + 0.2^2} = 0.283 \text{ m}$$

$$IF = \sqrt{0.2^2 + 0.38^2} = 0.429 \text{ m}$$

$$IE = 0.38 - 0.2 = 0.18$$

$$V_C = (IC) \omega$$

$$V_H = (IH) \omega$$

$$\omega = 20 \text{ rad/s}$$

$$V_D = (ID) \omega$$

$$= (0.58)(20) = 11.6 \text{ m/s}$$

$$V_E = (IE) \omega$$

$$= (0.18)(20) = 3.6 \text{ m/s}$$

$$V_F = (IF) \omega$$

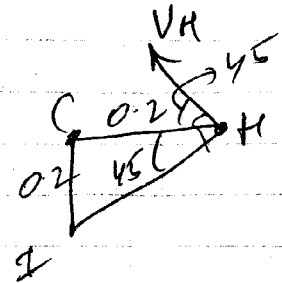
$$= (0.429)(20) = 8.58 \text{ m/s}$$

$\theta_F = 62.241^\circ$

$$V_H = (IH) \omega$$

$$= (0.283)(20) = 5.66 \text{ m/s}$$

$$\theta_H = 45^\circ$$



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(9)

$\omega_3 = \frac{50}{60} \text{ Hz}$
 $\omega_3 = 2.4 \text{ rev/s}$
 $= 25.236 \text{ rad/s}$

$I_{1C} = \sqrt{0.4^2 + 0.4^2} = 0.566 \text{ m}$
 $I_{2C} = \sqrt{0.8^2 + 0.8^2} = 1.131 \text{ m}$
 $I_{2B} = 0.8 + 0.5 = 1.3 \text{ m}$
 $I_{3B} = 0.5 \text{ m}$

$v_B = (I_{3B}) \omega_3$
 $= (0.5) (25.236) = 2.618 \text{ m/s}$

$v_B = (I_{2B}) \omega_2$
 $2.618 = (1.3) \omega_2$
 $\omega_2 = 2.014 \text{ rad/s}$

$v_C = (I_{2C}) \omega_2$
 $= (1.131) (2.014)$
 $= 2.278 \text{ m/s}$

$v_C = (I_{1C}) \omega_1$
 $2.278 = (0.566) \omega_1$
 $\therefore \omega_1 = 4.025 \text{ rad/s}$

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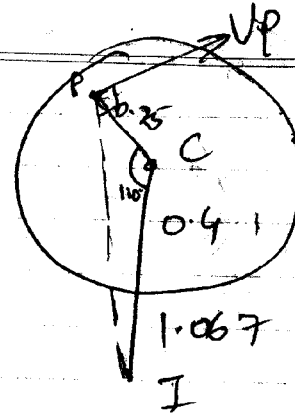
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(10) (a)

$v = r\omega$ $v = r\omega$
 $4 = (0.8 - x)\omega$ $4 = x\omega$
 $\therefore \frac{4}{x} = \frac{0.8 - x}{x}$
 $\therefore x = 0.291 \text{ m}$ $\omega = 13.745 \text{ rad/s}$

(b)

$v = r\omega$ $v = r\omega$
 $4 = (0.8 + x)\omega$ $4 = x\omega$
 $\frac{4}{x} = \frac{0.8 + x}{x}$
 $\therefore x = 1.067 \text{ m}$
 $\omega = 3.749 \text{ rad/s}$



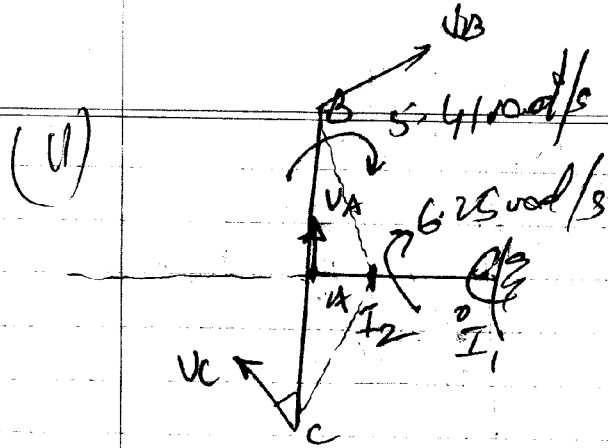
$IP = \sqrt{IC^2 + CP^2} = \frac{(IP)(CP)}{\cos(110^\circ)}$
 $= 1.570$

$VP = (IP)\omega$
 $= (1.570)(3.749)$
 $= 5.886 \text{ m/s}$

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$$I_1 A = 0.2$$
$$v_A = (I_1 A) \omega_1$$
$$= (0.2)(6.25)$$
$$= 1.25 \text{ m/s}$$

$$v_A = (I_2 A) \omega_2$$
$$1.25 = (I_2 A)(5.41)$$
$$I_2 A = 0.231 \text{ m}$$

$$I_2 C = \sqrt{I_2 A^2 + AC^2}$$
$$= 0.275 \text{ m}$$

$$I_2 B = \sqrt{I_2 A^2 + AB^2}$$
$$= 0.462 \text{ m}$$

$$v_B = (I_2 B) \omega_2$$
$$= (0.462)(5.41)$$
$$= 2.499 \text{ m/s}$$

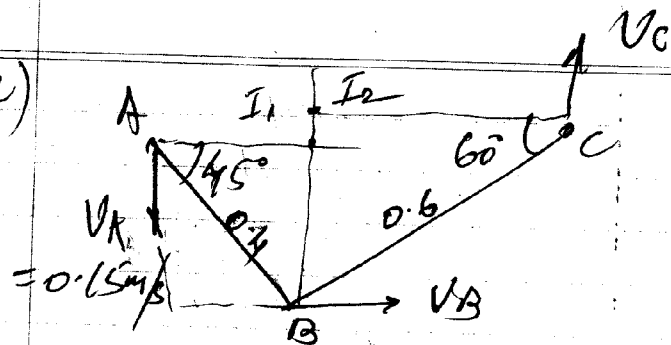
$$v_C = (I_2 C) \omega_2$$
$$= (0.275)(5.41)$$
$$= 1.488 \text{ m/s}$$

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(12)



$$I_1 A = 0.4 \cos 45^\circ = 0.2828 \text{ m}$$

$$I_1 B = 0.4 \sin 45^\circ = 0.2828 \text{ m}$$

$$I_2 C = 0.6 \cos 60^\circ = 0.3 \text{ m}$$

$$I_2 B = 0.6 \sin 60^\circ = 0.520 \text{ m}$$

$$V_A = (I_1 A) \omega_1$$

$$0.15 = (0.2828) \omega_1$$

$$\omega_1 = 0.530 \text{ rad/s}$$

$$\begin{aligned} V_B &= (I_1 B) \omega_1 \\ &= (0.2828) (0.530) \\ &= 0.150 \text{ m/s } (\rightarrow) \end{aligned}$$

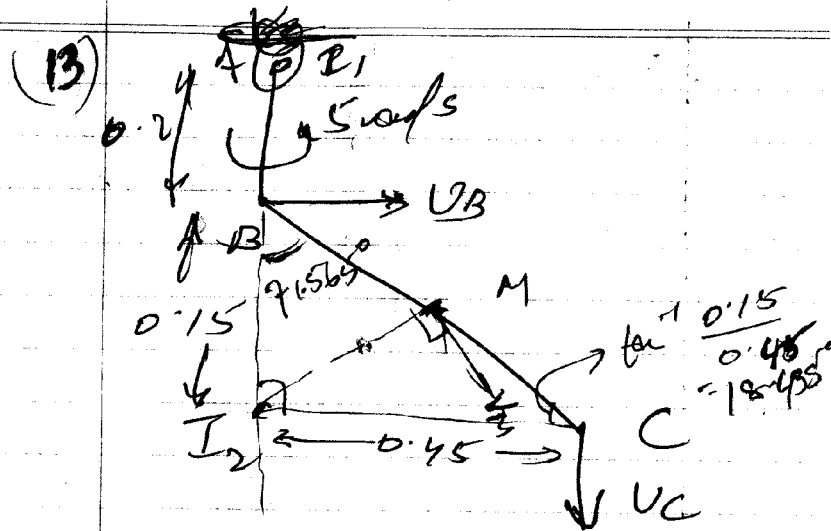
$$\begin{aligned} V_B &= (I_2 B) \omega_2 \\ 0.15 &= (0.520) \omega_2 \\ \omega_2 &= 0.288 \text{ rad/s} \end{aligned}$$

$$\begin{aligned} V_C &= (I_2 C) \omega_2 \\ &= (0.3) (0.288) \\ &= 0.0864 \text{ m/s } (\uparrow) \end{aligned}$$

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$$I_1 B = 0.2 \text{ m}$$

$$I_2 B = 0.15 \text{ m}$$

$$I_2 C = 0.45 \text{ m}$$

$$U_B = (I_1 B) \omega_1$$

$$= (0.2)(5)$$

$$= 1 \text{ m/s} (\rightarrow)$$

$$U_B = (I_2 B) \omega_2$$

$$1 = (0.15) \omega_2$$

$$\omega_2 = 6.667 \text{ rad/s}$$

$$U_C = (I_2 C) \omega_2$$

$$= (0.45)(6.667)$$

$$= 3 \text{ m/s} (\downarrow)$$

$$BC = \sqrt{I_2 B^2 + I_2 C^2} = 0.474 \text{ m}$$

$$BM = \frac{BC}{2} = 0.237 \text{ m}$$

$$\Delta I_2 BM: I_2 M = \sqrt{I_2 B^2 + M B^2}$$

$$= \sqrt{I_2 B^2 + \frac{I_2 C^2}{4}}$$

$$= \sqrt{0.15^2 + \frac{0.45^2}{4}}$$

$$= 0.237 \text{ m}$$

$$U_M = (I_2 M) \omega_2$$

$$= 1.58 \text{ m/s}$$

Best One Can Get