ESPG - MCR - 2302

(1) $v_A = 3\ m/s$

$a_A = 28\ m/s^2$

• Calculando ω $\rightarrow$ $v_A = \omega r_A \rightarrow \omega = \dfrac{v_A}{r_A} = \dfrac{3}{0.5657} = 5.303\ rad/s$

$r_A = \sqrt{0.4^2 + 0.4^2} = 0.5657\ m$

• Calculando v_B $\rightarrow$ $v_B = \omega r_B = (5.303)(0.4472) = 2.371\ m/s$

$r_B = \sqrt{0.4^2 + 0.2^2} = 0.4472\ m$

$\boxed{v_B = 2.371\ m/s}$

• De la aceleración de A:

$a_A = \sqrt{(a_A)_t^2 + (a_A)_n^2}$

$(a_A)_n = \omega^2 r_A = 15.91\ m/s^2$

$(a_A)_t = \sqrt{a_A^2 - (a_A)_n^2} = 23.04\ m/s^2$

$(a_A)_t = \alpha r_A \rightarrow \alpha = \dfrac{(a_A)_t}{r_A} = 40.73\ rad/s^2$

• Para la aceleración de B: $a_B = \sqrt{(a_B)_t^2 + (a_B)_n^2}$

$(a_B)_t = \alpha r_B = (40.73)(0.4472) = 18.21\ m/s^2$

$(a_B)_n = \omega^2 r_B = (5.303)^2(0.4472) = 12.58\ m/s^2$

$\boxed{a_B = 22.13\ m/s^2}$

(2) $\theta = (0.5t^3 + 15t)$ rad | $\omega = \dfrac{d\theta}{dt} = (1.5t^2 + 15)$ rad/s | $\alpha = \dfrac{d\omega}{dt} = (3t)$ rad/s^2

• Evaluando en $t = 3\ s$.

$\omega = 28.5\ rad/s$

$\alpha = 9\ rad/s^2$

• La magnitud de la velocidad de la cubeta es igual a la rapidez de la periferia de la rueda; es decir:

$v_{cubeta} = \omega r = (28.5)(0.75) = 21.375\ ft/s$

$\boxed{\therefore\ \vec{v}_{cubeta} = 21.375\ ft/s\ \uparrow}$

• La magnitud de la aceleración de la cubeta es igual a la componente tangencial de la aceleración de la periferia de la rueda:

$a_{cubeta} = \alpha r = (9)(0.75) = 6.75\ ft/s^2$

$\boxed{\vec{a}_{cubeta} = 6.75\ ft/s^2\ \uparrow}$

(3) $\omega = 600\ rpm = 600\left(\frac{2\pi}{60}\right) = 62.83\ rad/s$

• Calculando las velocidades

$\vec{v}_Q = \vec{\omega} \times \vec{r}_Q = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 0 & 0 & 62.83 \\ 173.2 & 100 & 0 \end{vmatrix}$

$\boxed{\vec{v}_Q = (-6283\,\hat{i} + 10\,882\,\hat{j})\ mm/s}$

$\vec{v}_P = \vec{\omega} \times \vec{r}_P = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 0 & 0 & 62.83 \\ -50 & 86.6 & 0 \end{vmatrix}$

$\boxed{\vec{v}_P = (-5441\,\hat{i} - 3141\,\hat{j})\ mm/s}$

$\vec{v}_M = \vec{\omega} \times \vec{r}_M = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 0 & 0 & 62.83 \\ 123.1 & 186.7 & 0 \end{vmatrix}$

$\boxed{\vec{v}_M = (-11\,730\,\hat{i} + 7734\,\hat{j})\ mm/s}$

• Calculando las aceleraciones; dado que $\omega = const \rightarrow \alpha = 0$

$\vec{a}_Q = -\omega^2 \vec{r}_Q = -(62.83)^2(173.2\,\hat{i} + 100\,\hat{j})$

$\boxed{\therefore\ \vec{a}_Q = (-683\,726\,\hat{i} - 394\,761\,\hat{j})\ mm/s^2}$

$\vec{a}_P = -\omega^2 \vec{r}_P = -(62.83)^2(-50\,\hat{i} + 86.6\,\hat{j})$

$\boxed{\therefore\ \vec{a}_P = (197\,380\,\hat{i} - 341\,863\,\hat{j})\ mm/s^2}$

$\vec{a}_M = -\omega^2 \vec{r}_M = -(62.83)^2(123.1\,\hat{i} + 186.7\,\hat{j})$

$\boxed{\therefore\ \vec{a}_M = (-485\,951\,\hat{i} - 737\,019\,\hat{j})\ mm/s^2}$