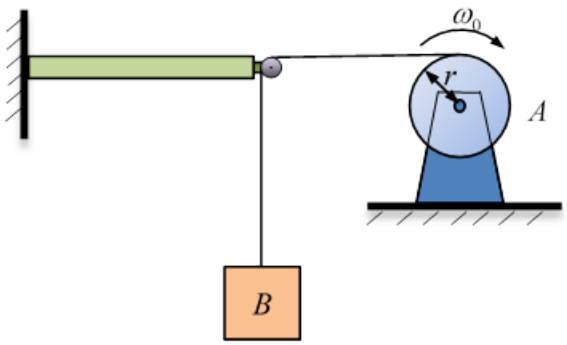
3-10. Motor A has a normally distributed initial angular velocity $\omega_0 \sim N(2, 0.2^2)$ rad/s. Then it accelerates with $\alpha_A = (0.9t^2 + 0.3)$ rad/s^2, where t is in seconds. If $r = 0.5$ m, what the probability that the velocity of block B is less than 2.4 m/s when $t = 2$ s.



$$\omega_A = \omega_0 + \int_0^t \alpha_A dt$$

$$\omega_A = \omega_0 + \int_0^t (0.9t^2 + 0.3)dt = \omega_0 + (0.3t^3 + 0.3t)\Big|_0^2 = \omega_0 + 3$$

$$v_B = \omega_A r = \omega_0 r + 3r$$

$$\mu_{v_B} = \mu_{\omega_0} r + 3r = 2(0.5) + 3(0.5) = 2.5 \text{ m/s}$$

$$\sigma_{v_B} = \sigma_{\omega_0} r = 0.2(0.5) = 0.1 \text{ m/s}$$

$$\Pr\{v_B < 2.4\} = \Phi\left(\frac{2.4 - \mu_{v_B}}{\sigma_{v_B}}\right) = \Phi\left(\frac{2.4 - 2.5}{0.1}\right) = 0.16$$