Honors Physics – Angular Mechanics Practice Answers

1) $r = 5.55\text{ m}$, $\Delta s = +31.3\text{ m}$

$$\Delta\theta = \frac{\Delta s}{r} = \frac{31.3\text{ m}}{5.55\text{ m}} = \boxed{5.64\text{ rad}}$$

2) $\Delta\theta = +2\pi\text{ rad}$, $\Delta t = 4.56\text{ min}$

$$\omega_{avg} = \frac{\Delta\theta}{\Delta t} = \frac{2\pi\text{ rad}}{(4.56\text{ min})(60\text{ s/min})} = \boxed{2.30 \times 10^{-2}\text{ rad/s}}$$

3) $\Delta t_J = 9.83\text{ h}$, $\alpha_{avg} = -3.0 \times 10^{-8}\text{ rad/s}^2$, $\omega_2 = 0\text{ rad/s}$

$$\omega_1 = \frac{\Delta\theta}{\Delta t_J} = \frac{2\pi\text{ rad}}{(9.83\text{ h})(3600\text{ s/h})} = 1.78 \times 10^{-4}\text{ rad/s}$$

$$\Delta t = \frac{\omega_2 - \omega_1}{\alpha_{avg}} = \frac{0.00\text{ rad/s} - 1.78 \times 10^{-4}\text{ rad/s}}{-3.0 \times 10^{-8}\text{ rad/s}^2}$$

$$\Delta t = \boxed{5.9 \times 10^{3}\text{ s}}$$

4) $\omega_i = 0\text{ rad/s}$, $\omega_f = 3.33\text{ rad/s}$, $\alpha = 0.183\text{ rad/s}^2$

$$\Delta t = \frac{\omega_f - \omega_i}{\alpha} = \frac{3.33\text{ rad/s} - 0\text{ rad/s}}{0.183\text{ rad/s}^2} = \boxed{18.2\text{ s}}$$

5) $\omega_i = 298\text{ rad/s}$, $\alpha = -44.0\text{ rad/s}^2$, $\Delta\theta = 276\text{ rad}$

$$\omega_f^2 = \omega_i^2 + 2\alpha\Delta\theta$$

$$\omega_f = \sqrt{\omega_i^2 + 2\alpha\Delta\theta} = \sqrt{(298\text{ rad/s})^2 + (2)(-44.0\text{ rad/s}^2)(276\text{ rad})}$$

$$\omega_f = \sqrt{8.88 \times 10^4\text{ rad}^2/\text{s}^2 - 2.43 \times 10^4\text{ rad}^2/\text{s}^2} = \sqrt{6.45 \times 10^4\text{ rad}^2/\text{s}^2}_f = \boxed{254\text{ rad/s}}$$

6) $\Delta\theta = 158\text{ rad}$, $\omega_i = 0\text{ rad/s}$, $\omega_f = 70.0\text{ rad/s}$

$$\alpha = \frac{\omega_f^2 - \omega_i^2}{2\Delta\theta} = \frac{(70.0\text{ rad/s})^2 - (0\text{ rad/s})^2}{(2)(158\text{ rad})} = \boxed{15.5\text{ rad/s}^2}$$

7) $\omega = 188.5\text{ rad/s}$, $r = 3.73\text{ cm}$

$$v_t = r\omega = (3.73 \times 10^{-2}\text{ m})(188.5\text{ rad/s}) = \boxed{7.03\text{ m/s}}$$

8) $v_t = 1.5\text{ m/s}$, $\omega = 0.33\text{ rad/s}$

$$r = \frac{v_t}{\omega} = \frac{1.5\text{ m/s}}{0.33\text{ rad/s}} = \boxed{4.5\text{ m}}$$

9) $r = 0.50\text{ m}$, $\Delta v = 5.0\text{ m/s}$, $\Delta t = 8.5\text{ s}$

$$a_t = \frac{\Delta v}{\Delta t} = \frac{5.0\text{ m/s}}{8.5\text{ s}} = 0.59\text{ m/s}^2$$

$$\alpha = \frac{a_t}{r} = \frac{0.59\text{ m/s}^2}{0.50\text{ m}} = \boxed{1.2\text{ rad/s}^2}$$