PHYS 2311 Ch. 10 HW

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Problem 1.

(a) 0.785 rad, $\frac{\pi}{4}$ rad

(b) 1.0471 rad, $\frac{\pi}{3}$ rad

(c) 1.571 rad, $\frac{\pi}{2}$ rad

(d) 6.283 rad, 2π rad

(e) 7.7667 rad, $\frac{89\pi}{36}$ rad

Problem 4.

$$8500\text{rpm} \cdot \frac{1\,\text{min}}{60\,\text{s}} \cdot \frac{2\,\pi\text{rad}}{1\,\text{rev}} = 890.12\,\text{rad/s} = \omega$$

$$t = 4.0$$

$$\alpha = \frac{\Delta\omega}{\Delta t} = \frac{890.12}{4.0} = \frac{890.12 - 0}{4.0} = \boxed{223\,\text{rad/s}^2}$$

Problem 5.

(a)

$$7200\text{rpm} \cdot \frac{1\,\text{min}}{60\,\text{s}} \cdot \frac{2\,\pi\text{rad}}{1\,\text{rev}} = \boxed{240\pi\,\text{rad/s}}$$

(b)

$$r = 3.00\,\text{cm} = 0.03\,\text{m}$$

$$v = r\omega = (0.03)(240\pi) = \boxed{22.62\,\text{m/s}}$$

(c)

$$22.62 \cdot \frac{1\,\text{b}}{0.5\,\text{µm}} = \boxed{45.24 \times 10^6\,\text{bps}}$$

Problem 6.

$$C = \frac{\text{distance}}{\text{revolutions}} = \frac{3.1}{12.0} = 0.258\,\text{m}$$

$$C = \pi \cdot d = \frac{0.258\,\text{m}}{\pi} = d = 0.822\,\text{m} = \boxed{8.2\,\text{cm}}$$

Problem 19.

$$15000\text{rpm} \cdot \frac{1\,\text{min}}{60\,\text{s}} \cdot \frac{2\,\pi\text{rad}}{1\,\text{rev}} = 1.57\,\text{rad/s}$$

$$\alpha = \frac{\omega_f - \omega_0}{t}$$

$$\alpha = \frac{1570.8\,\text{rad/s} - 0}{220\,\text{s}} = 7.14\,\text{rad/s}^2$$

$$\theta = \omega_0 t + \frac{1}{2}\alpha t^2$$

$$\theta = \frac{1}{2} \times 7.14\,\text{rad/s}^2 \times (220\,\text{s})^2 = 172,960\,\text{rad}$$

$$\text{rev} = \frac{172,960\,\text{rad}}{2\pi\,\text{rad/rev}} = \boxed{27\,855\,\text{rev}}$$

Problem 20.

(a)

$$\theta(t) = \theta_0 + \omega_0 t + \frac{1}{2}\alpha t^2$$

$$\text{rev} = 26 \cdot 2\pi = 52\pi\,\text{rev}$$

$$52\pi = \frac{1}{2}\alpha(60)^2$$

$$\alpha = \frac{(52\pi)(2)}{60^2} = \boxed{0.0909\,\text{rad/s}^2}$$

(b)

$$\omega_f = \omega_0 + \alpha t$$

$$\omega_f = 0 + (0.0909\,\text{rad/s}^2)(60\,\text{s})$$

$$\omega_f = 5.454\,\text{rad/s}$$

$$\omega_f = 5.454\,\text{rad/s} \times \frac{60\,\text{s}}{2\pi\,\text{rad}}$$

$$\omega_f \approx \boxed{52.0\,\text{rpm}}$$

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Problem 21.

(a)

$$\omega_0 = 780\,\text{rev/min} \times \frac{2\pi\,\text{rad}}{60\,\text{s}} = 81.68\,\text{rad/s}$$

$$\theta = 1250\,\text{rev} \times 2\pi\,\text{rad/rev} = 2500\pi\,\text{rad}$$

$$\omega_f^2 = \omega_0^2 + 2\alpha\theta$$

$$0 = (81.68\,\text{rad/s})^2 + 2\alpha(2500\pi\,\text{rad})$$

$$2\alpha(2500\pi) = -(81.68)^2$$

$$\alpha = \frac{-(81.68)^2}{2 \times 2500\pi}$$

$$\alpha \approx \boxed{-0.42\,\text{rad/s}^2}$$

(b)

$$\omega_f = \omega_0 + \alpha t$$

$$0 = 81.68\,\text{rad/s} + (-0.42\,\text{rad/s}^2)t$$

$$t = \frac{81.68\,\text{rad/s}}{0.42\,\text{rad/s}^2}$$

$$t \approx \boxed{192.3\,\text{s}}$$

Problem 25.

(a)

$$\theta = 9.5t - 13.0t^2 + 1.6t^4$$

$$\omega = 9.5 - 26.0t + 6.4t^3$$

(b)

$$\alpha = -26.0 + 19.2t^2$$

(c)

$$\omega(3.0) = 9.5 - 26.0(3.0) + 6.4(3.0)^3 = \boxed{104.3\,\text{rad/s}}$$

$$\alpha(3.0) = -26.0 + 19.2(3.0)^2 = \boxed{146.8\,\text{rad/s}^2}$$

(d)

$$\omega_{avg} = \frac{\Delta\theta}{\Delta t} = \frac{\theta(3.0) - \theta(2.0)}{3.0 - 2.0}$$

$$= \frac{(9.5(3.0) - 13.0(3.0)^2 + 1.6(3.0)^4) - (9.5(2.0) - 13.0(2.0)^2 + 1.6(2.0)^4)}{1.0} = \boxed{48.5\,\text{rad/s}}$$

(e)

$$\alpha_{avg} = \frac{\Delta\omega}{\Delta t} = \frac{\omega(3.0) - \omega(2.0)}{3.0 - 2.0}$$

$$= \frac{(9.5 - 26.0(3.0) + 6.4(3.0)^3) - (9.5 - 26.0(2.0) + 6.4(2.0)^3)}{1.0} = \boxed{95.6\,\mathrm{rad/s^2}}$$

Problem 28.

Problem 29.

Problem 30.

Problem 34.

Problem 35.

Problem 37.

Problem 53.

Problem 54.

Problem 55.

Problem 64.

Problem 67.

Problem 69.