Solutions to MCQ 5

Question 1 $\quad r = 9\ cm \qquad v = 6\ m/s$

a) $\omega = \frac{v}{r} = \frac{6\ m/s}{0.09\ m} = 66.7\ rad/s$

b) length $= \Delta s$ and $\Delta s = r\,\Delta\theta$

(B) but $\Delta\theta = \omega \Delta t = (66.7\ rad/s)(3) = 200$ radians

$\Rightarrow \Delta s = r\,\Delta\theta = (0.09)(200) = 18\ m$

Question 2 $\quad r = 25\ cm,\ \omega_i = 120\ rpm,\ \omega_f = 660\ rpm$

$\Delta t = 9\ s$

a) $\omega_f = \omega_i + \alpha\,\Delta t$

(B) $\frac{660 \times 2\pi}{60} = \frac{120 \times 2\pi}{60} + \alpha\,(9) \rightarrow \boxed{\alpha = 6.28\ rad/s^2}$

b) $a_T = r\alpha = (0.25)(6.28) = 1.57\ m/s^2$

Question 3 (C)

Question 4 (D)

Question 5

$r = 5.2 \times 10^7$ m $T = 52$ hours $M = ?$

$$T = 2\pi \sqrt{\frac{r^3}{GM}} = 2\pi \sqrt{\frac{(5.2\times10^7)^3}{6.67\times10^{-11} \times M}}$$

(A)

$$52 \times 3600 = 2\pi \sqrt{\frac{(5.2\times10^7)^3}{6.67\times10^{-11} \times M}}$$

Solving for $M = 2.4 \times 10^{24}$ kg

Question 6

$$V = \sqrt{\frac{GM}{r}} = \sqrt{\frac{6.67\times10^{-11} \times 6\times10^{24}}{7.5\times10^7}}$$

(B)

$V = 2310$ m/s

Question 7 $r = 1$ m $\omega = 50$ rpm $m = 0.22$ kg

$$T = \frac{mv^2}{r} = mr\omega^2$$

$$= (0.22)(1)\left(\frac{50\times2\pi}{60}\right)^2 = \boxed{6 \text{ N}}$$

(C)

Question 8

$V = 600\ km/h = 600 \times \frac{1000\ m}{3600} = 167\ m/s$

$r = 2.5\ km = 2500\ m$

(C)

$a_c = a_r = \frac{V^2}{r} = \frac{(167)^2}{2500} = 11\ m/s^2$

Question 9

(D)
