

Circular Motion 1

① a) $v = 36 \text{ km/h} = 10 \text{ m/s}$

$$v = \frac{2\pi r}{T}$$

$$T = \frac{2\pi r}{v} = \frac{2\pi(50)}{10} = 31.416 \text{ s}$$

↑

Time to go 360°

$$\text{Time to go } 90^\circ = \frac{31.416}{4} = \boxed{7.854 \text{ s}}$$

b) $a = \frac{v^2}{r} = \frac{10^2}{50} = \boxed{2 \text{ m/s}^2 \text{ [TTC]}}$

② a) $f = \frac{\# \text{ rev}}{\text{time}} = \frac{1}{20} = \boxed{0.05 \text{ Hz}}$

b) $T = \frac{1}{f} = \frac{1}{0.05} = \boxed{20 \text{ s}}$

c) $v = \frac{2\pi r}{T} = \frac{2\pi(50)}{20} = \boxed{15.708 \text{ m/s}}$
 $\boxed{\text{[tangent to curve]}}$

$$\textcircled{3} \quad a) \quad f = 10 \text{ Hz}$$

$$T = \frac{1}{f} = \frac{1}{10} = 0.1 \text{ s}$$

$$v = \frac{2\pi r}{T} = 2\pi \frac{(0.03 \text{ m})}{0.1} = \boxed{1.885 \text{ m/s}}$$

$$b) \quad a = \frac{v^2}{r} = \frac{1.885^2}{0.03} = \boxed{118.435 \text{ m/s}^2} \text{ [TTC]}$$

$$\textcircled{4} \quad a = \frac{v^2}{r}$$

$$r = \frac{v^2}{a} = \frac{80^2}{48} = \boxed{133.3 \text{ m}}$$

$$\textcircled{5} \quad v = \frac{2\pi r}{T} = 2\pi \frac{(7.7)}{4} = 12.095 \text{ m/s}$$

$$a = \frac{v^2}{r} = \frac{(12.095)^2}{7.7} = 19.0 \text{ m/s}^2$$

$$\begin{array}{l} \text{Top: } \boxed{19.0 \text{ m/s}^2 \text{ [Down]}} \\ \text{Bottom: } \boxed{19.0 \text{ m/s}^2 \text{ [Up]}} \end{array}$$

⑥

$$a = \frac{v^2}{r}$$

$$v = \sqrt{a \cdot r}$$
$$= \sqrt{(9.8)(750)}$$

$$v = 85.732 \text{ m/s}$$

$$v = \frac{2\pi r}{T}$$

$$T = \frac{2\pi r}{v}$$

$$= \frac{2\pi(750)}{85.732}$$

$$T = \boxed{55.0 \text{ s}}$$

⑦

$$a = 7g = 7(9.8) = 68.6 \text{ m/s}^2$$

$$v = 540 \text{ km/h} = 150 \text{ m/s}$$

$$a = \frac{v^2}{r}$$

$$r = \frac{v^2}{a} = \frac{150^2}{68.6} = \boxed{328 \text{ m}}$$

⑧

$$a = \frac{v^2}{r} = \frac{500^2}{4000} = 62.5 \text{ m/s}^2$$

$$\frac{62.5}{9.8} = \boxed{6.38 \text{ g's}}$$