

Circular Motion Problems

4-6, 9-10, 17-22

Period and Frequency

$$4) f = \frac{10 \text{ cycles}}{50 \text{ seconds}} = \frac{\text{cycles}}{\text{time}} = 0.2 \frac{\text{cycles}}{\text{sec}} = 0.2 \text{ Hz}$$

$$T = \text{period} = \frac{1}{f} = \frac{1}{0.2 \frac{\text{cyc}}{\text{sec}}} = 5 \text{ sec}$$

$$5) f = 12 \text{ Hz} = 12 \frac{\text{cyc}}{\text{sec}}$$

$$\text{Period? } T = \frac{1}{f} = \frac{1}{12 \frac{\text{cyc}}{\text{sec}}} = 0.08 \text{ sec}$$

b) Time for 46 rotations?

$$46^{\text{rot}} \times 0.08 \frac{\text{sec}}{\text{rot}} = 7.2 \text{ sec}$$

$$6) f = 500 \text{ Hz} = 500 \frac{\text{cyc}}{\text{sec}}$$

a) Period?

$$T = \frac{1}{f} = \frac{1}{500 \frac{\text{cyc}}{\text{sec}}} = 0.002 \text{ sec}$$

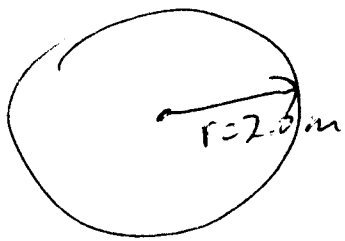
Time for 7 rotations?

$$7_{\text{rot}} \times 0.002 \frac{\text{sec}}{\text{rot}} = 0.014 \text{ sec}$$

Circular Motion Problems

Velocity + Acceleration

9)



$$T = 10.0 \text{ s}$$

$$m = 0.05 \text{ kg}$$

a)

$$f = \frac{1}{T} = \frac{1}{10.0 \text{ s}} = 0.10 \frac{\text{cycles}}{\text{sec}} = 0.1 \text{ Hz}$$

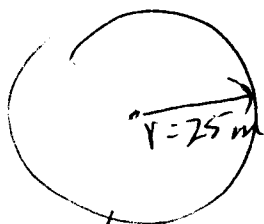
b) velocity?

$$v = \frac{2\pi r}{T} = \frac{(2\pi \cdot 2.0 \text{ m})}{10.0 \text{ s}} = 1.3 \frac{\text{m}}{\text{s}}$$

c) acceleration?

$$a = \frac{v^2}{r} = \frac{(1.3 \frac{\text{m}}{\text{s}})^2}{2.0 \text{ m}} = \frac{1.579 \frac{\text{m}^2}{\text{s}^2}}{2.0 \text{ m}} = 0.79 \frac{\text{m}}{\text{s}^2}$$

10)



$$m = 500 \text{ kg}$$

$$v = 250 \frac{\text{m}}{\text{s}}$$

a) Period? ~~$T = \frac{1}{f}$~~ Use $v = \frac{2\pi r}{T}$, so $T = \frac{2\pi r}{v}$

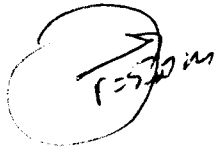
$$T = \frac{2\pi \cdot 25 \text{ m}}{250 \frac{\text{m}}{\text{s}}} = \frac{157 \text{ m}}{250 \frac{\text{m}}{\text{s}}} = 0.63 \text{ s}$$

b) frequency? $f = \frac{1}{T} = \frac{1}{0.63 \text{ s}} = 1.59 \frac{\text{cycles}}{\text{sec}} = 1.59 \text{ Hz}$

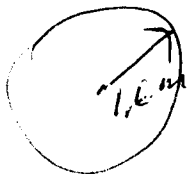
c) acceleration? $a = \frac{v^2}{r} = \frac{(2\pi r)^2}{T^2 r} = \frac{4\pi^2 r^2}{T^2 r} = \frac{4\pi^2 \cdot 25 \text{ m}}{(0.63 \text{ s})^2} = 2497 \frac{\text{m}}{\text{s}^2}$

Dynamics of UCM

17) $a = 12 \frac{m}{s^2}$ $r = 5.0 m$ $v = ?$

 $a = \frac{v^2}{r}$, so $v = \sqrt{a \cdot r} = \sqrt{12 \frac{m}{s^2} \cdot 5.0 m} = 7.7 \frac{m}{s}$

18) $m = 5.0 kg$ $v = 15 \frac{m}{s}$ $r = 1.6 m$

 Use $F = \frac{mv^2}{r} = \frac{5.0 kg \cdot (15 \frac{m}{s})^2}{1.6 m} = 703 \frac{m \cdot kg}{s^2} = 703 N$

19) $v = 37 \frac{m}{s}$, $r = 45 m$, $a = ?$

Use $a = \frac{v^2}{r} = \frac{(37 \frac{m}{s})^2}{45 m} = 30.4 \frac{m}{s^2}$

20) $a_c = 2.0 \frac{m}{s^2}$ $v_{tan} = 0.35 \frac{m}{s}$ $r = ?$

$a = \frac{v^2}{r}$, so $r = \frac{v^2}{a} = \frac{(0.35 \frac{m}{s})^2}{2.0 \frac{m}{s^2}} = 0.06 m$

21) $m = 52 kg$, $v = 17 \frac{m}{s}$, $r = 1.6 m$, $\vec{F} = ?$

Use $F = \frac{mv^2}{r} = \frac{52 kg \cdot (17 \frac{m}{s})^2}{1.6 m} = 9393 N$

22) $m = 6.4 kg$, $F = 135 N$ $v = 45 \frac{m}{s}$, $r = ?$

Use $F = \frac{mv^2}{r}$, so $r = \frac{mv^2}{F} = \frac{6.4 kg \cdot (45 \frac{m}{s})^2}{135 \frac{kg \cdot m}{s^2}} = 102 m$

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