Solutions to HW25, Chapter 15

NOTE! The problems in masteringphysics.com had their numbers altered slightly for each individual student. The solutions below use the same numbers as those used in the book for that problem!

15.6. Model: The oscillation is the result of simple harmonic motion.
Solve: **(a)** The amplitude $A = 20$ cm.
(b) The time to complete one cycle is the period, hence $T = 8.0$ s and

$$f = \frac{1}{T} = \frac{1}{8.0 \text{ s}} = 0.125 \text{ Hz} \approx 0.13 \text{ Hz}$$

(c) The position of an object undergoing simple harmonic motion is $x(t) = A\cos(\omega t + \phi_0)$. At $t = 0$ s, $x_0 = -10$ cm, thus

$$-10 \text{ cm} = (20 \text{ cm})\cos[\omega(0 \text{ s}) + \phi_0]$$

$$\Rightarrow \cos\phi_0 = \frac{-10 \text{ cm}}{20 \text{ cm}} = -\frac{1}{2} \Rightarrow \phi_0 = \cos^{-1}\left(-\frac{1}{2}\right) = \pm\frac{2\pi}{3} \text{ rad or } \pm 120^\circ$$

Since the oscillation is originally moving to the left, $\phi_0 = +120^\circ$.

15.11. Solve: The position of the object is given by the equation

$$x(t) = A\cos(\omega t + \phi_0) = A\cos(2\pi f t + \phi_0)$$

We can find the phase constant ϕ_0 from the initial condition:

$$0 \text{ cm} = (4.0 \text{ cm})\cos\phi_0 \Rightarrow \cos\phi_0 = 0 \Rightarrow \phi_0 = \cos^{-1}(0) = \pm\tfrac{1}{2}\pi \text{ rad}$$

Since the object is moving to the right, the object is in the lower half of the circular motion diagram. Hence, $\phi_0 = -\frac{1}{2}\pi$ rad. The final result, with $f = 4.0$ Hz, is

$$x(t) = (4.0 \text{ cm})\cos[(8.0\pi \text{ rad/s})t - \tfrac{1}{2}\pi \text{ rad}]$$