Physics 20 - Lesson 24
Simple Harmonic Motion – Pendulum

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1) /3

a) the period of a pendulum is not affected by the amplitude of the pendulum's swing
b) the pendulum equation indicates that the period (T) depends on the inverse of the square root of g, therefore as g increases T decreases and as g decreases T increases
c) the period of a pendulum does not depend on the mass of the pendulum bob

2) /4

$$T = \frac{480s + 20s}{400 times}$$
$$T = 1.25s$$

$$f = \frac{1}{T} = \frac{1}{1.25s}$$
$$\boxed{f = 0.80Hz}$$

3) /5

$$T = 2\pi\sqrt{\frac{l}{g}}$$
$$T = 2\pi\sqrt{\frac{1.35m}{9.81 m/s^2}}$$
$$T = 2.33s$$

$$2.5\,\text{min} = 150s$$
$$\frac{150s}{2.3s} = \boxed{64\,\text{swings}}$$

4) /4

$$40\,\text{min} = 240s$$
$$T = \frac{240s}{400}$$
$$T = 0.60s$$

$$T = 2\pi\sqrt{\frac{l}{g}} \rightarrow T^2 = 4\pi^2\frac{l}{g}$$
$$l = \frac{gT^2}{4\pi^2}$$
$$l = \frac{(9.81m/s^2)(0.60s)^2}{4\pi^2}$$
$$\boxed{l = 0.089m}$$

5) /4

$$l = 0.80m$$
$$T = \frac{162.15s}{50}$$
$$T = 3.243s$$

$$T = 2\pi\sqrt{\frac{l}{g}} \rightarrow T^2 = 4\pi^2\frac{l}{g}$$
$$g = \frac{4\pi^2 l}{T^2}$$
$$g = \frac{4\pi^2(0.80m)}{(3.243s)^2}$$
$$\boxed{g = 3.0 m/s^2}$$

6) /3

$g = 1.62\,{}^{m}/_{s^2}$

$T = 5.00s$

$$T = 2\pi\sqrt{\frac{l}{g}} \rightarrow T^2 = 4\pi^2\frac{l}{g}$$

$$l = \frac{gT^2}{4\pi^2}$$

$$l = \frac{1.62\,{}^{m}/_{s^2}(5.00s)^2}{4\pi^2}$$

$$\boxed{l = 1.03m}$$

7) /6

$$a_g = G\frac{m_1}{r^2}$$

$$a_g = 6.67\times10^{-11}\,{}^{Nm^2}/_{kg^2}\frac{(5.98\times10^{24}\,kg)}{(6.37\times10^{6}\,m + 12.31\times10^{3}\,m)^2}$$

$$a_g = 9.79\,{}^{m}/_{s^2}$$

$$T = 2\pi\sqrt{\frac{l}{g}}$$

$$T = 2\pi\sqrt{\frac{0.200m}{9.79\,{}^{m}/_{s^2}}}$$

$$\boxed{T = 0.898s}$$