Physics 20 - Lesson 25
Simple Harmonic Motion – Springs

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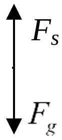
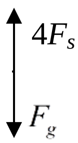
1) /4



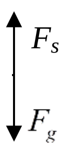
$$\text{since } F_{NET} = 0$$
$$\therefore F_s = F_g$$
$$kx = mg$$
$$k = \frac{mg}{x}$$
$$k = \frac{(0.500kg)(9.81\,{}^{m}\!/\!{}_{s^2})}{(0.79m)}$$
$$\boxed{k = 6.2\,{}^{N}\!/\!{}_{m}}$$

2) /3



$$4F_s = F_g$$
$$4kx = mg$$
$$k = \frac{mg}{4x}$$
$$k = \frac{(275kg)(9.81\,{}^{m}\!/\!{}_{s^2})}{4(0.0500m)}$$
$$\boxed{k = 1.35\times10^4\,{}^{N}\!/\!{}_{m}}$$

3) /3



$$F_s = F_g$$
$$kx = mg$$
$$m = \frac{kx}{g}$$
$$m = \frac{(85\,{}^{N}\!/\!{}_{m})(0.95m)}{(9.81\,{}^{m}\!/\!{}_{s^2})}$$
$$\boxed{m = 8.2kg}$$

4) A possible point of confusion for this situation is that the force on the two springs is the same. Some people mistakenly get the idea that some of the force is "absorbed" by the first spring before it gets to the second spring, but the same tension force exists throughout the springs.

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$$F_{s1} = k_1 x_1[\text{down}] \qquad x_1 = -\frac{F_{s1}}{k_1} \qquad x_1 = -\frac{40.0N}{25\,{}^{N}\!/\!_{m}} \qquad x_1 = -1.6m$$

$$F_{s2} = k_2 x_2[\text{down}] \qquad x_2 = -\frac{F_{s2}}{k_2} \qquad x_2 = -\frac{40.0N}{60\,{}^{N}\!/\!_{m}} \qquad x_2 = -0.67m$$

$$x = x_1 + x_2 \qquad x = -1.6m + -0.67m \qquad \boxed{x = -2.3m}$$

5)

a) The period does not depend on the amplitude. If it did, (x) displacement would be a variable in the equation.

/3 b) There is an inverse relationship between (k) and (T). Therefore, as the spring constant increases the period decreases.

c) There is a direct relationship between (m) and (T), therefore as mass increases the period also increases.

6)

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$$T = 2\pi\sqrt{\frac{m}{k}} \qquad T = 2\pi\sqrt{\frac{4.5kg}{45\,{}^{N}\!/\!_{m}}} \qquad \boxed{T = 2.0\,s}$$

$$150 \times T = 150(2.0s) = \boxed{298\,s}$$

7)

/4

$$m = 1.650kg$$

$$T = \frac{480s}{300} \qquad T = 1.6s$$

$$T = 2\pi\sqrt{\frac{m}{k}} \rightarrow T^2 = \frac{4\pi^2 m}{k}$$

$$\therefore k = \frac{4\pi^2 m}{T^2}$$

$$k = \frac{4\pi^2(1.650kg)}{(1.6s)^2}$$

$$\boxed{k = 25.4\,{}^{N}\!/\!_{m}}$$

8)

/6

first calculate k

since $F_{NET} = 0$

$$\therefore F_s = F_g$$

$$kx = mg$$

$$k = \frac{mg}{x}$$

$$k = \frac{(5.75kg)(9.81\,{}^{m}\!/\!_{s^2})}{(0.95m)}$$

$$k = 59.4\,{}^{N}\!/\!_{m}$$

$$T = 2\pi\sqrt{\frac{m}{k}} \qquad T = 2\pi\sqrt{\frac{5.75kg}{59.4\,{}^{N}\!/\!_{m}}} \qquad T = 1.95\,s$$

$$500 \times T = 500(1.95s) = \boxed{977s}$$