3.1

$f = 512\ Hz$

$A = 0.002\ m = 2\ mm$

$V_{max} = ?$ $\qquad a_{max} = ?$

Solution:

$$\omega = 2\pi f = (2)(3.14)(512) = 3215.4\ rad/s$$

$$V_{max} = \omega A = (3215.4)(0.002) = 6.43\ m/s$$

$$a_{max} = \omega^2 A = (3215.4)^2 (0.002) = 2.07 \times 10^4\ m/s^2$$

---

3.2 $\qquad A = 0.1\ m \qquad V_{Center} = 0.5\ m/s\ ,\ T = ?$

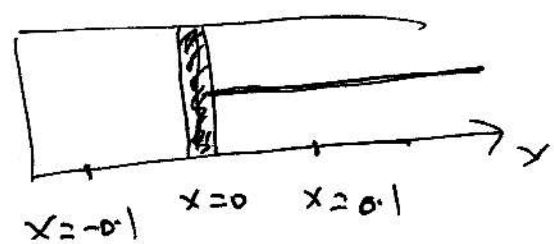
Solution:

$$x = 0.1 \sin \omega t$$

$$V = \dot{x} = (0.1)(\omega)\cos\omega t \Rightarrow V_{center} = (0.1)\omega = 0.5\ m/s$$

$$\omega = 5\ rad/s$$

$$T = \frac{2\pi}{\omega} = 1.26\ s$$



3.3

$t = 0$ , $x = 0.25\ m$ $\dot{x} = 0.1\ m/s$

$x(t) = ?$

Solution:

$f = 10\ Hz \rightarrow \omega = 2\pi f = 20\pi\ \text{rad/s}$

take $x(t) = A \sin(\omega t + \varphi) \Rightarrow \dot{x}(t) = A\omega \cos(\omega t + \varphi)$

$t = 0$ $\quad 0.25 = A \sin\varphi$

$\quad 0.1 = A\omega \cos\varphi$ $\Rightarrow \tan\varphi = 2.5\omega$

$\downarrow$

$\varphi = 89.6^\circ = 1.57\ \text{rad.}$

$\downarrow$

$$A = \frac{0.25}{\sin 89.6} \simeq 0.25$$

$$\boxed{x(t) = 0.25 \sin(20\pi t + 1.57)}$$

Notice that the argument of $\sin(\ldots)$ is in "radians".

3.6

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

$l = 1\ m$ $\quad g_{moon} = \frac{g_{earth}}{6} = \frac{9.8}{6} = 1.63\ m/s^2$

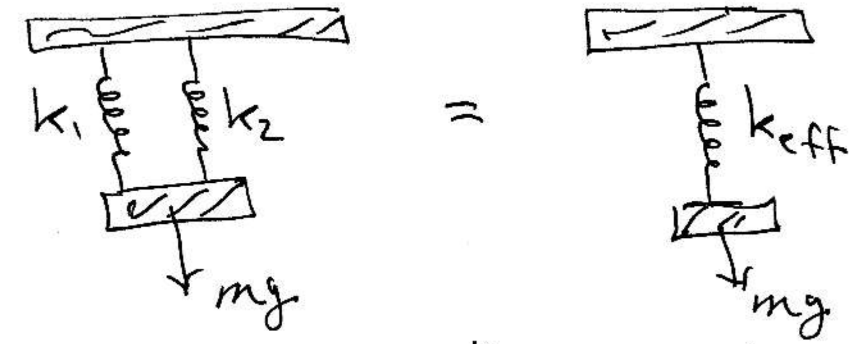
$$\frac{T}{2} = \text{half-period} = \pi \sqrt{\frac{l}{g}} = 3.14 \sqrt{\frac{1}{1.63}}$$

$\boxed{T/2 = 2.5\ s}$ on the moon

(note: on the earth $T/2 \simeq 1\ s$).

## 3.7

**Parallel:**

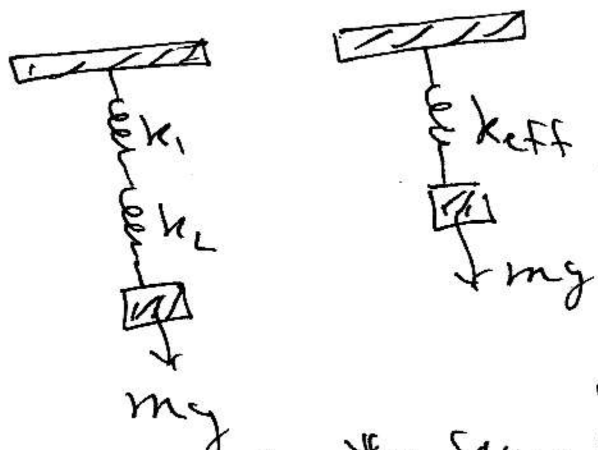



The Weight mg Causes "both" springs to Stretch by the Same amount "x". =>

$$-k_{eff}\, x = -k_1 x - k_2 x$$

$$\Rightarrow \boxed{k_{eff} = k_1 + k_2}$$

**Series**




Forces on the Springs are the Same "mg".

$$\Rightarrow k_1 x_1 = k_2 x_2 = mg$$

Also $k_{eff}\, x = mg$ with $x = x_1 + x_2$ =>

$$k_{eff} = \frac{mg}{x} = \frac{mg}{x_1 + x_2} = \frac{mg}{\frac{mg}{k_1} + \frac{mg}{k_2}} \Rightarrow \boxed{\frac{1}{k_{eff}} = \frac{1}{k_1} + \frac{1}{k_2}}$$