Name: Key

Homework Week # 11

Simple Harmonic Motion
Due Thurs 11/07/19

Reading

C&J Physics:	**Tues – Ch. 10: 1-4**	**Thurs – Ch. 10: 5-8**
OS Coll Phys:	**Tues – Ch. 16: 1-4**	**Thurs – Ch. 16: 4-8**

Problems

Problem 1. **10.1** +2

Problem 2. **10.2**

Problem 3. **10.5**

Problem 4. **10.15**

Problem 5. **10.16**

Problem 6. **10.17**

Problem 7. **10.18** +2

+6 pts total for completion

+

10

Don't Turn In

Read and Practice

- **Analyzing graphs and**
- **Using the trig functions on your calculator**

for examples and problems in Section 8.1 from the Openstax Algebra and Trignometry book: https://openstax.org/details/books/algebra-and-trigonometry. **Especially** if you haven't taken a trig class or it's been a long time.

Prob. 1 10.1

A spring is known to compress 1.91 cm when a force of 89.0 N is applied. What's the force required for a compression of 5.08 cm?

$$F_{el} = kx \longrightarrow k = \frac{F_{el}}{x} \quad +1$$

$$k = \frac{89.0\,N}{1.91\,cm} = 46.6\ \frac{N}{cm}$$

$$F_2 = kx_2 = \left(\frac{89.0\,N}{1.91\,cm}\right)(5.08\ cm) \quad +1$$

$$\boxed{F_2 = 237\ N}$$

Prob. 2 10.2

Utilize different data to analyze a spring similar to 10.1, but now report k as well!

$F_1 = 4.50\,N$, $x_1 = 20.0\,cm$, $x_2 = 30.0\,cm$

$$F_{el} = kx \; ; \quad x = x_f - x_o$$

↙ read data given to obtain

(a) $$k = \frac{F_1}{x_1} = \frac{4.50\,N}{20.0\,cm}$$

$$\boxed{k = 0.225\,\frac{N}{cm}}$$

(b) $$F_2 = kx_2 = \left(0.225\,\frac{N}{cm}\right)(30.0\,cm)$$

$$\boxed{F_2 = 6.75\,N}$$

Prob. 3 10.5

Same procedure as Prob. 2, but values given are

$F_1 = 670N$, $x_1 = 0.79cm$

$F_2 = ?$, $x_2 = 0.34cm$

(a) Calc. $k = \frac{F}{x}$ for a spring

$$k = \frac{670N}{0.79cm} = 848 \frac{N}{cm}$$

(b) Calc. $F_2 = k x_2$

$$F_2 = \left(\frac{670}{0.79} \frac{N}{cm}\right)(0.34\ cm)$$

$$F_2 = 288N$$

Prob 4 10.15

Suppose an eardrum oscillates with shm with an amplitude of 6.3×10^{-7} m and a maximum speed of 2.9×10^{-3} m/s.

(a) What is f of this shm.

(b) what is a_{max} of this shm.

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shm:

$v = -A\omega \sin(\omega t)$

$a = -A\omega^2 \cos(\omega t)$; $\omega = 2\pi f$

$v_m = A\omega$

$a_m = A\omega^2$

(a) $\omega = \frac{v_m}{A}$ $\quad f = \frac{\omega}{2\pi} = \frac{v_m}{2\pi A} =$ **733 Hz**

(b) $a_{max} = A\omega^2 = A\left(\frac{v_{max}}{A}\right)^2 = \frac{v_{max}^2}{A} =$ **$13.3 \frac{m}{s^2}$**

Prob. 5 10.16

Given frequency f data, determine

(a) period T in s

(b) frequency f in Hz

(c) angular frequency ω

Data:

1,000 rev in $t = 50.0\ ms$

(a) T = time for 1 rev $= \frac{50.0\ ms}{1000} \cdot \frac{1\ s}{1000\ ms}$

$$\boxed{T = 5.2 \times 10^{-5}\ s} = 52\ \mu s$$

(b) $f = \frac{1}{T} = \frac{1}{5.2 \times 10^{-5}\ s} = \frac{1}{5.2} \times 10^{5}\ \frac{1}{s}$

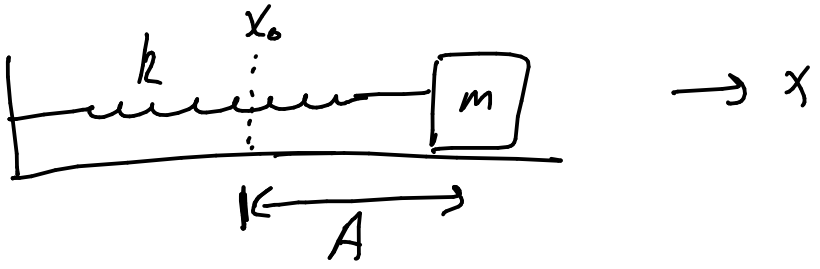
$$f = 0.192 \times 10^{5}\ Hz \quad ; \frac{1}{s} = Hz$$

$$\boxed{f = 19.2 \times 10^{3}\ Hz} = 19.2\ kHz$$

(c) $\omega = 2\pi f = \boxed{121 \times 10^{3}\ \frac{rad}{s}}$

Prob. 6 10.17

Spring-mass system with $m = 0.750\ kg$, $k = 82.0\ N/m$, and $A = +0.120\ m$ when + means to the right.



(a) Calc. $F_{max} = kA$ = **9.84 N**

(b) Calc $\omega = \sqrt{\frac{k}{m}}$ = **10.5 $\frac{rad}{s}$**

(c) Calc. $V_{max} = A\omega$ = **1.25 $\frac{m}{s}$**

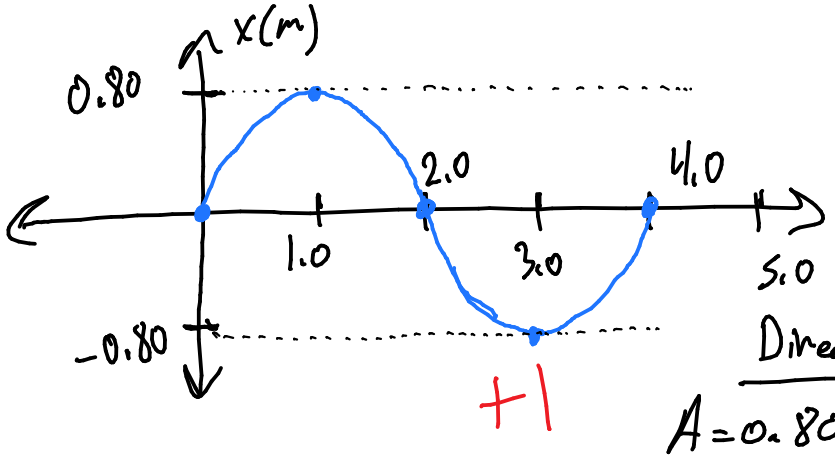
(d) Calc. $a_{max} = A\omega^2$ = **13.1 $\frac{m}{s^2}$**

Prob. 7 10.18

A spring-mass system with $m = 0.80\,kg$ is set into shm and the following data was recorded.

spring-mass system

$$\omega = \sqrt{\frac{k}{m}}$$



+1

Note

$x = A\sin\omega t$

$V = +A\omega\cos\omega t$

$a = -A\omega^2\sin\omega t$

Directly from Graph

$A = 0.80\,m$, $T = 4.0\,s$

(a) $\boxed{A = 0.80\,m}$ (a, b, c) +1

(b) $\omega = 2\pi f = \frac{2\pi}{T}$

$\boxed{\omega = 1.57\,\frac{rad}{s}}$

(c) $\omega = \sqrt{\frac{k}{m}}$ means

$k = m\omega^2$

$\boxed{k = 1.97\,\frac{N}{m}}$

$\boxed{(d)\ V_{1.0s} = 0}$

(e) $a_{1.0s} = a_{max} = A\omega^2$

$\boxed{a_{1.0s} = 1.97\,\frac{m}{s^2}}$