

Announcements – 1 Dec 2009

1. Reading assignment modification: Since we didn't talk about "bulk modulus" or "Young's modulus" back in chapter 9, you can skip section 14-5 (8th edition) in Thursday's reading assignment which refers to those two properties.

2. Exam 4 results:

a. 75th percentile = 89.4%

b. 50th percentile (median) = 79.6% mean: 76.3%

c. 25th percentile = 63.7%

3. Final exam info

a. Take in Testing Center any time during Finals week

b. No time limit, no notes, no calculators (can check one out)

c. I plan 40-43 questions

i. 10-11 on new stuff (Chap 13 & 14)

ii. 30-32 on Chapters 1-12 (midterms 1-4)

d. I will shoot for 75-79% average

rough draft now complete

12 } (may change,
31 } but not
75% } by much)

4. Clicker quiz: Vote for option A or option B

a. Option A: Final as planned; I will put a safety net at ~~70%~~ 77%
(curving it up if average/median is less than ~~70%~~ 77%)

b. Option B: Final will **also** replace one of your midterm exam scores if that helps you (computer will choose which one helps most)

i. ...but safety net will be set a little lower, at ~~70%~~ 73%

For reference: 2007 final: 71% 2008 final: 64%. } shooting for 70-75% that year

2009 exam 1: 78%

exam 2: ~~70%~~ 73%

exam 3: 75%

exam 4: 78%

Colton - Lecture 25 - pg 1

} shooting for 75-80% this year

5. Instructor/course evaluations due before Dec 13

<http://studentratings.byu.edu>

→ Please take both the ratings and the comments seriously. I read every single comment, as does the Physics Department promotion/tenure committee.

→ Sorry, no extra credit, I consider it your “civic duty”

6. Soon I will be sending around my own survey, of possible ways to improve the class for next time around. Things like,

- “Should I give one more free late HW?”
- “Should I give only 3 midterms instead of 4?”
- “Should I take out the section on engines even though it’s on the MCAT?”
- “What are some ways you would improve the course if you were the teacher?”
- Etc.

I will make changes based on your feedback!

Clicker quiz: Vote for option A or option B or C

a. Option A: Do the “Colton survey” kind of like a warmup

- i. You put in your CID, so it’s not completely anonymous
- ii. Since I will know who completed the survey, I can give you extra credit (probably 2 points)

b. Option B: Fully anonymous

- i. no CID
- ii. no extra credit either

Option C: partially anonymous & can put in your CID if you want extra credit, but can leave blank if you want anonymity.

Physics 105
Sections 1 and 2
25 Nov 2009

	100.00 99.00 98.00 97.00 A 96.00 95.00 94.00 93.00 92.00 A- 91.00 90.00 89.00 88.00 B+ 87.00 86.00 85.00 84.00 B 83.00 82.00 81.00 B- 80.00 79.00 78.00 77.00 76.00 C+ 75.00 74.00 73.00 72.00 71.00 70.00 C 69.00 68.00 67.00 66.00 65.00 64.00 63.00 C- 62.00 61.00 60.00 59.00 58.00 57.00 56.00 D+		55.00 .. 54.00 . 53.00 D 52.00 51.00 50.00 .. 49.00 D- 48.00 .. 47.00 46.00 45.00 .. 44.00 . F 43.00 42.00 . 41.00 40.00 39.00 38.00 37.00 36.00 35.00 34.00 33.00 . 32.00 31.00 .. 30.00 . (plus a few more below 30)
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Total
 Current
 Grade

	cutoff	#stud	%stud	cumul.%
A	93.00	117	22.76	22.76
A-	89.00	75	14.59	37.35
B+	85.00	70	13.62	50.97
B	81.00	52	10.12	61.09
B-	77.00	54	10.51	71.60
C+	73.00	35	6.81	78.40
C	65.00	38	7.39	85.80
C-	58.00	24	4.67	90.47
D+	54.00	6	1.17	91.63
D	49.00	11	2.14	93.77
D-	45.00	5	0.97	94.75
E	0.00	27	5.25	100.00
Total		514		

Which part of today's assignment was particularly hard or confusing?

there are a lot of different equations and concepts

Physics is like tryptophan in turkey... it makes me sleepy!

General comments:

At this point in the class, how much can your grade vary (especially moving upwards)?

my test 3 score is still listed out of 92 points. is this a problem?
have the free body diagrams been graded yet? *Sadly, not quite*

If i have a 76.6 will that be rounded up to a B-? *No guarantees*

Will there be TA reviews for the final as well? *Yes*

Problems from topics covered in previous tests on the next test: I understand that you put some of these problems on each test because they were missed by many students on the last test and you want us to learn from our mistakes. That is fine, but I think that if that many people missed it to begin with, it is probably something that should be covered in lecture again, at least briefly, to help people actually learn it. This would be more fair than simply putting a similar problem on the next test and hoping people have learned it by then.

Exam solutions posted to the website!

“Simple harmonic motion”

→ *Sinusoidal vibrations*

Demo: weight on spring

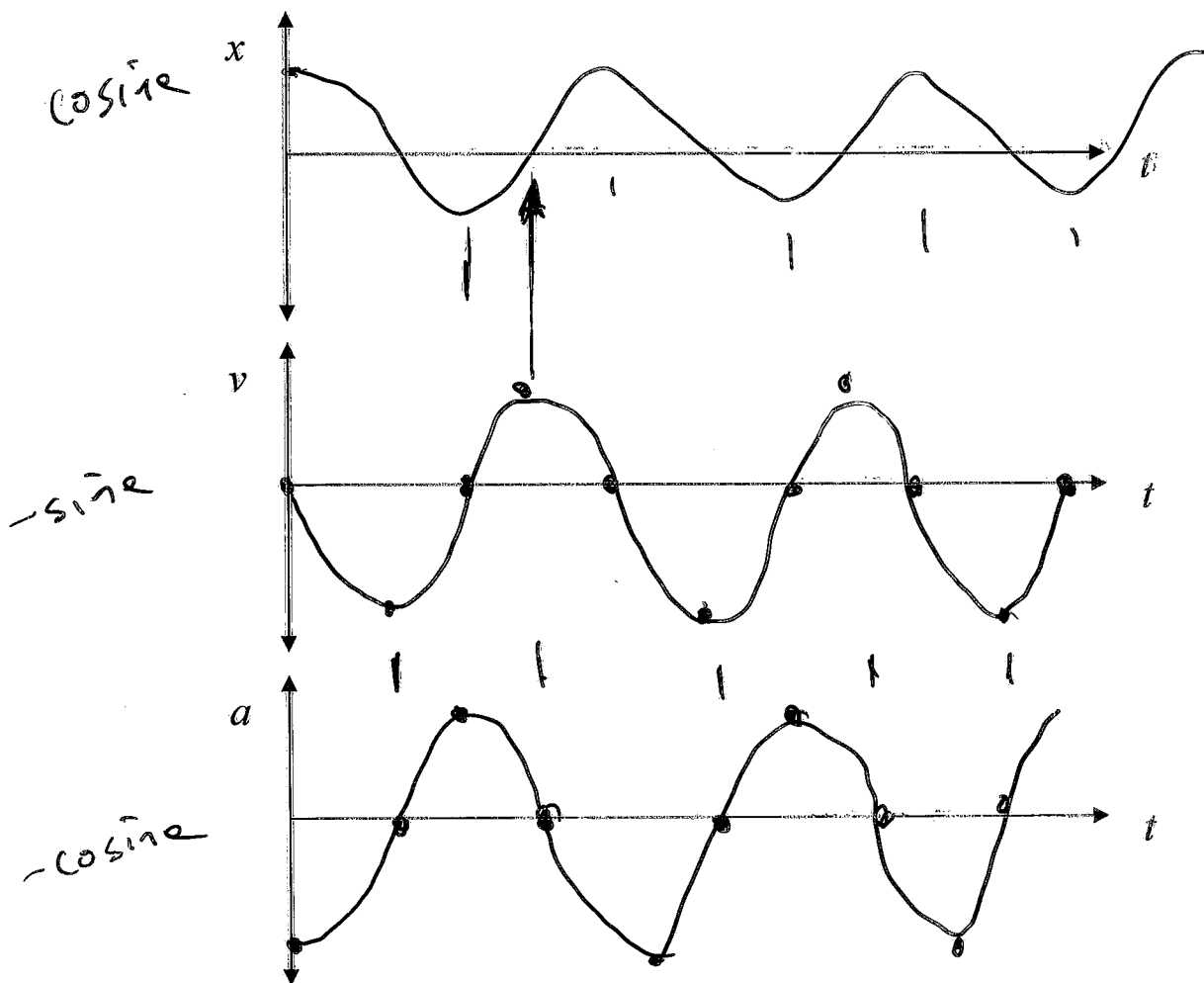
Occurs when an object has a **spring-like** restoring force:

$$F \sim \text{displacement}$$

Result: $x = A \cos(\omega t)$

→ or $x = A \sin(\omega t)$ or $x = A \cos(\omega t + \phi)$...what's the difference?

A = “amplitude”, how far from origin it travels



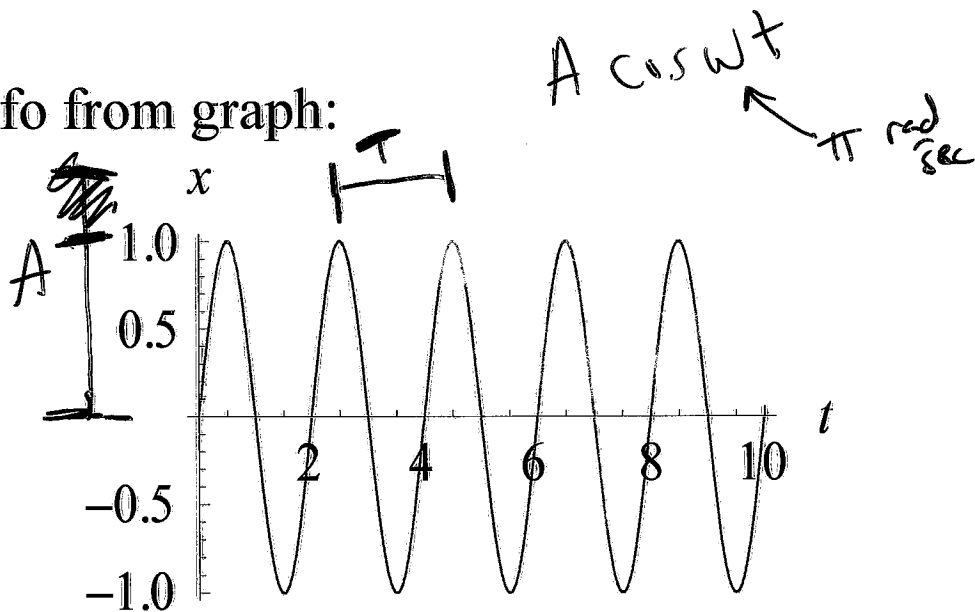
Quick proof, using simple calculus (sorry):

$$x = \epsilon \cos \omega t$$

$$\frac{dx}{dt} = v = -\sin \omega t (\omega)$$

$$\frac{dv}{dt} = a = -\cos \omega t (\omega^2)$$

Reading info from graph:



Amplitude $A = \underline{1 \text{ m}}$

Period $T = \underline{2 \text{ sec}}$

Frequency $f = \underline{1/T = 1/2 \text{ cycles/sec (Hz)}}$

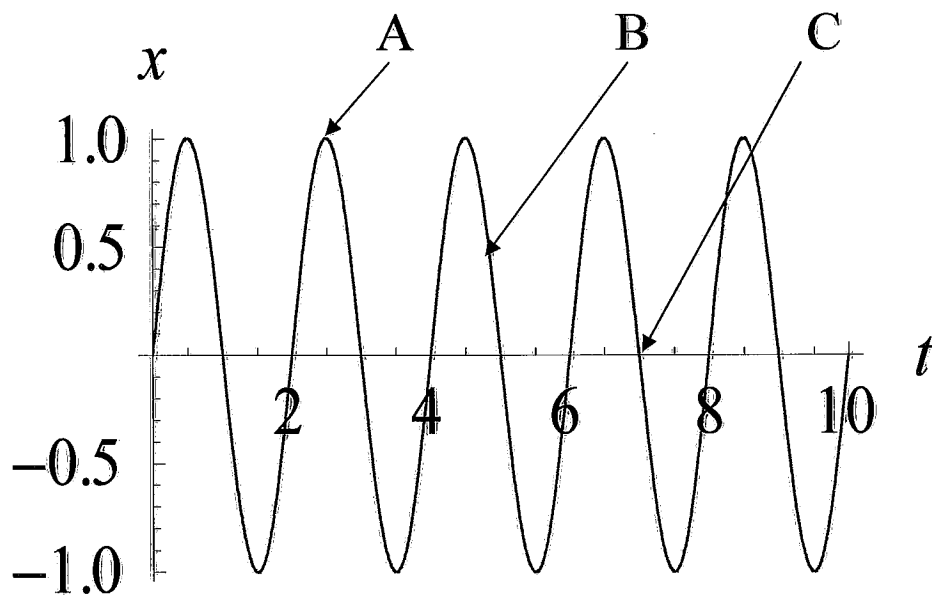
Angular frequency $\omega = \underline{2\pi (1/2) = \pi \text{ rad/sec}}$

$$f = \frac{\omega}{2\pi}$$

$$\omega = 2\pi \times f$$

Angular frequency?? Where's the angle?

Demo: SHM/Circular motion analogy



Clicker quiz 1: Where does it have the most kinetic energy?

- a. position A
- b. position B
- c. position C

largest speed

Clicker quiz 2: Where does it have the most potential energy?

- a. position A
- b. position B
- c. position C

$$PE = \frac{1}{2} kx^2$$

largest x

Clicker quiz 3 (from warmup): Where does it have the largest acceleration?

- a. position A
- b. position B
- c. position C

also where largest x

Springs

Demo: spring with mass

Frequency, period:

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

$k =$ spring constant
 $m =$ mass that's oscillating

$$T = \frac{2\pi}{\omega} = 2\pi \sqrt{\frac{m}{k}}$$

Pendulums

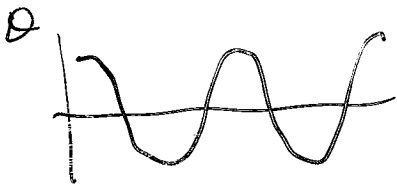
Demo: pendulum

Frequency, period:

$$\omega = \sqrt{g/l}$$

$g = 9.8 \frac{m}{s^2}$
 $l =$ length of string

(plotting θ vs t)



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

Clicker quiz: Does period depend on amplitude?

- a. yes
- b. no
- c. it depends

No difference if angles are small ($\theta \lesssim 30^\circ$)

mass

From warmup: Consider a mass m hanging on a spring. We pull the weight downward and then release it so that it oscillates up and down. If we repeat this on the moon with the same weight and the same spring, the frequency of the oscillation will be:

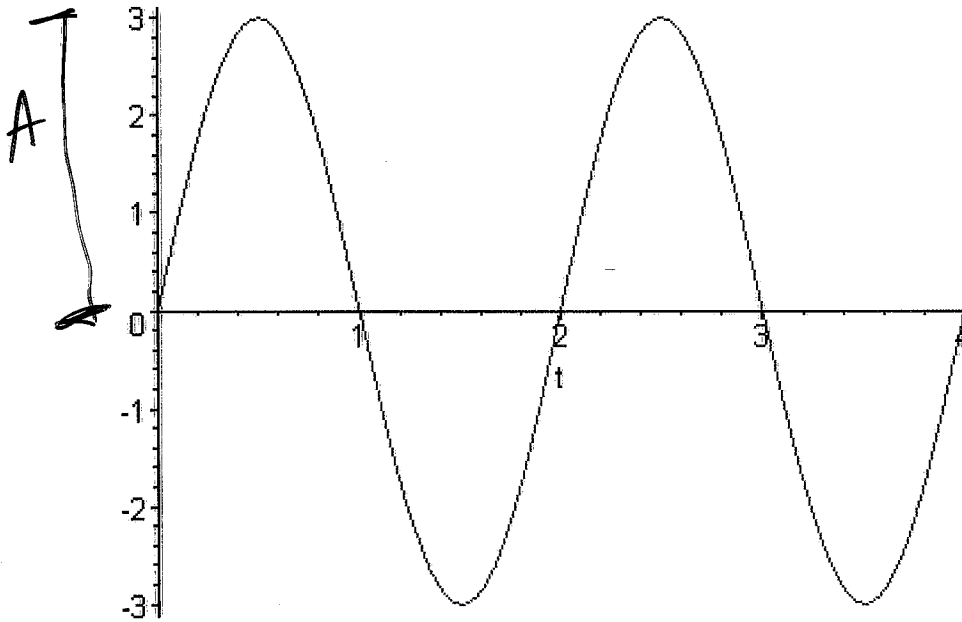
- a. larger
- b. smaller
- c. the same

$g_{moon} < g_{earth}$

mass

$T = 2 \text{ sec.}$

Clicker quiz: Given the oscillation picture below,



$A \sin \omega t$
3

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

what's the correct equation to describe the position vs. time?

- a. $x(t) = 6 \cos(t)$
- b. $x(t) = 3 \sin(2t)$
- c. $x(t) = 6 \sin(2t)$
- d. $x(t) = 3 \sin(\pi t)$
- e. $x(t) = 3 \cos(\pi t)$

$3 \sin \pi t$

Worked Problem: A 70 kg trapeze artist swings on a long trapeze and takes 5 seconds to return to his starting spot.



How long will it take a woman of mass 50kg to make the same swing? 5 sec

How long will it take for the 70 kg man to swing from his starting place to when he first reaches the bottom?

5/4 sec

How long is the rope? _____ m

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

$$\frac{5}{2\pi} = \sqrt{\frac{L}{9.8}}$$

$$\left(\frac{5}{2\pi}\right)^2 = \frac{L}{9.8}$$

$$L = \left(\frac{5}{2\pi}\right)^2 \times 9.8 = 6.21 \text{ m}$$

length for period of 2 seconds:
1 m

From warmup: Ralph is confused about pendulums. He read in the textbook that the period T of a pendulum depends on its length L and on the acceleration of gravity g , but does not depend on its mass. Ralph thinks that heavier pendulums should swing with a longer period. After all, if he puts a heavier weight on the end of the spring, it oscillates more slowly. Can you help Ralph understand this?

Answer from the class:

264-----

The more massive something is, the more force is required to make it accelerate.

The more massive something is, the more force gravity exerts on it.

These two cancel each other out making mass irrelevant.

Like freefall

$$\sum F = m a$$

$$m g = m a$$

Waves



→ Oscillating motion that transfers *energy* but not mass

Direction: where the energy is going

Medium: what is doing the “waving”

Oscillation: how the medium is moving

Transverse—Oscillation is \perp to the direction of the wave

Longitudinal—Oscillation is $//$ to the direction of the wave

Demo: Suspended slinky

Web Demo: <http://www.gmi.edu/~drussell/Demos/waves/wavemotion.html>

Examples:

Slinky (demo)

Rope (demo)

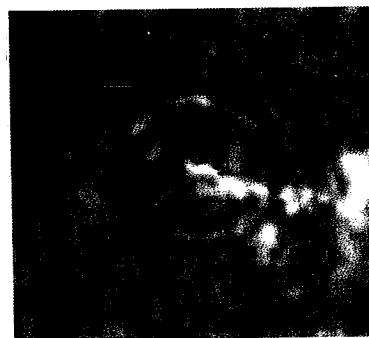
Shive wave machine (demo)

Sound

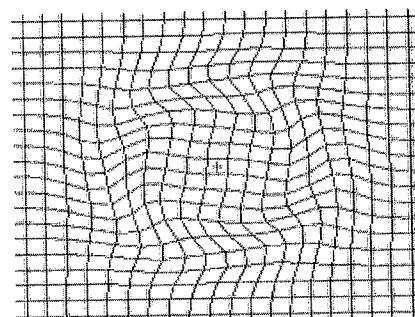
Earthquake (P & S)

Water

Light



surface
of the Sun



Wikipedia:
“S-wave”
(spherical)

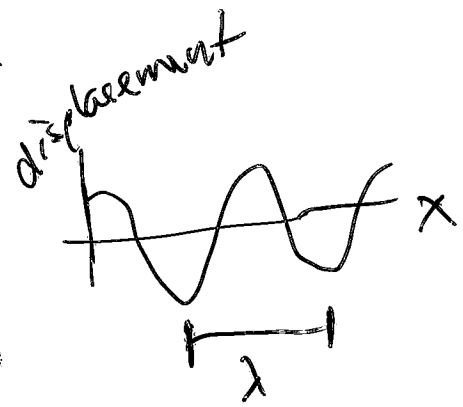
shear

v f λ lambda
Speed, frequency, wavelength

m/s

wave/s

m/wave



$$\frac{m}{s} = \frac{\text{wave}}{sec} \times \frac{m}{\text{wave}}$$

$$v = f\lambda$$

$$Hz = \frac{1}{s}$$

Worked Problem: AM 1320 broadcasts the Utah Jazz games ☺ at a frequency of 1320 kHz. Radio waves travel at the speed of light, 3×10^8 m/s. (a) What is the wavelength of the AM1320 radio waves? (b) What is the period?

$$\lambda = \frac{v}{f} = \frac{3 \cdot 10^8 \text{ m/s}}{1320 \cdot 10^3 \text{ 1/s}}$$

$$= \boxed{227 \text{ m}}$$

$$T = \frac{1}{f} = \frac{1}{1320 \cdot 10^3 \text{ 1/s}} = \boxed{7.58 \cdot 10^{-7} \text{ seconds}}$$

What will changing the tension do?

(Web demo, continued)

$$v = \sqrt{\frac{T}{\mu}}$$

For waves on a rope/string/etc
"linear ~~mass~~ mass density" $\frac{\text{mass}}{\text{length}}$
(book uses symbol F for tension in this section)
(I don't know why)

From warmup: Two students play with an extra-long Slinky. The student on the left end sends waves to the other student by shaking her end back and forth. After the waves die down, both students take a step backwards and try it again. How will the speed of the waves now compare to the previous waves?

- a. They will be faster
- b. They will be slower
- c. They will go the same speed

Demo: rubber tubing

Question: What happens when you increase the wave speed while keeping the wavelength constant?

$$v = f \lambda$$

increased \swarrow \searrow constant \downarrow increases!

Demo: violin

Clicker quiz: Two guitar strings of the same length have the same tension, but one has four times the mass of the other. The speed of a wave on the heavier guitar string is _____ that of the lighter string.

- a. $\frac{1}{4}$
- b. $\frac{1}{2}$
- c. the same as
- d. $2\times$
- e. $4\times$

$$v_1 = \sqrt{\frac{T}{\mu_1}} = \sqrt{\frac{\mu_2}{\mu_1}}$$

$$v_2 = \sqrt{\frac{T}{\mu_2}} = \sqrt{\frac{1}{4}} = \frac{1}{2}$$

Clicker quiz: A boy shakes a rope, moving his hand up and down. He sends a wave crest out every 0.5 seconds. He sees the wave crests move away with a distance between them of 25 cm. How fast is the wave moving?

- a. 0-10 cm/s
- b. 10-20 cm/s
- c. 20-30 cm/s
- d. 30-40 cm/s
- e. more than 40 cm/s

$v = f \lambda$

$= (2 \frac{1}{s})(25 \text{ cm})$

$= 50 \frac{\text{cm}}{\text{s}}$

period!

$f = \frac{1}{T}$

$= 2 \text{ Hz}$