

Instructions: This test has the same format as before. If you need more room please turn the paper over. Point weightings are indicated in parenthesis. For questions that include laboratory data with the precision digit of the measured physical quantity underlined, please use the rules for precision and significant figures. So for this, the last test of the summer poets class, Good Luck! Note: If you would like for me to get materials back to you other than through the campus mail, please indicate how (if you want me to send it to you through the mail, an self addressed envelop and postage is always appreciated, or just give me an address): _____

A. Short Answer Questions. Select the *best* answer for multiple choice questions. (1 point each question unless otherwise indicated.)

b 1. As the angle of incidence increases, the angle between the incident ray and the surface:
a) increases b) decreases c) stays the same



d 2. The image formed by a plane mirror

- a) is not magnified ✓ b) is a virtual image ✓
c) is as far behind the mirror as the object is in front of it ✓
d) all of the above

c 3. If you stand four feet in front of a plane mirror, you see yourself basically in the same way as someone would see you if she were

- a) four feet away from you c) eight feet away from you
b) two feet away from you

a 4. A ray of light in air hits the surface of water at an angle of incidence of 30 degrees. When it passes into the water it

- a) bends toward the perpendicular
b) bends away from the perpendicular
c) does not bend at all



b 5. When looking at a rock in water, it appears ? the surface than it actually is.

- a) farther away from; b) closer to; c) the same distance from.

yes 6. (1 1/2) Can you take a picture of a virtual image? (yes, no)

yes Can you project a real image on a screen? (yes, no)

no Can you project a virtual image on a screen? (yes, no)

335 m/s 7. (1 1/2) In the velocity of sound lab, if the distance between the two nodes is 65.4 cm and the tuning fork frequency is 256 Hz, what would a student calculate for the speed of sound from this data?

$L = 0.654 \frac{m}{2} \quad \lambda = 2L = 1.308 \frac{m}{2}$
 $v = f\lambda = (256 \frac{1}{s})(1.308 \frac{m}{2}) = (335 \frac{m}{s})$

spherical 8. The aberration occurring in lenses which refers to light rays which pass through the outer portion of the lens being focused at a different point than those rays passing through the center is called ?

e, c, g

REVIEW QUESTION: From the periodic table, pick *all* of the following elements that have a deficiency or one electron in its outer shell:

- a) Mg; b) Na; c) Sr; d) Cs; e) Cl; f) S

$\pm 1 \text{ ft}^2$ to the nearest unit

10. REVIEW QUESTION: Find the *precision* of the following area:

Area = $25.2 \text{ ft} \times 8.95 \text{ ft} = 226 \text{ ft}^2$

microphone

11. Sound is converted into an electrical signal by what device?

beats

12. When two tuning forks are struck, differing in frequency of only a couple hertz, the interference that results is a rapid increase and decrease in the loudness of sound known as ?.

(b) lower than

13. REVIEW QUESTION: At a rarefaction, the density of air is ? what it would be in the absence of the rarefaction. Choose from: (a) higher than; (b) lower than; (c) the same as.

2200 ft or 680 m

14. An echo is heard from a surface 4 seconds after the shout. How far away is the smooth surface?

Note: Use the speed of sound in this and subsequent problems as 340 m/s or 1100 ft/sec.

$d = \frac{v \cdot t}{2}$ time = 2s there & 2s back \rightarrow so $d = vt = (1100 \text{ ft/s})(2s) = 2200 \text{ ft}$

smooth

15. What two characteristics of the surface in question #14 would result in the maximum reflection of sound?

massive

There exists an associated solar system

16. What is the significance of the "wobbling" of a star?

frequency
Hertz (cycles)

17. REVIEW QUESTION: A physical quantity designating the number of waves given off by a vibrating object every second is called ?, and is in units of ?.

cochlea

18. The particular part of the ear that is similar to the "resonant tube apparatus" that we used in our laboratory is called the ?.

gamma rays (or X rays)

19. The part of the electromagnetic spectrum that carries the greatest frequency and also greatest energy waves is called ?.

astigmatism

20. An eye defect which occurs because the cornea is not spherically shaped, but instead has a cylindrical shape is called ?.

rods
cones

21. The part of the retina of the eye that plays a big part in allowing a person to use peripheral vision is called ? while the part of the retina of the eye in acute vision is the ?.

22. As the object distance from the eye is changed, the eye, because of its finite size is unable to change the image distance. What remarkable adaptation occurs? The ciliary muscles change the shape of the crystalline lens.

(c) parallel to each other

23. If an object is an infinite distance from a converging or diverging lens, the **incident** light rays strike the lens (a) bending away from each other (b) bending toward each other (c) parallel to each other (d) differently depending upon whether the lens is converging or diverging.

(a) virtual, erect, smaller

24. For a single source of light and a diverging lens, the image produced is always (a) virtual, erect, smaller, (b) virtual, inverted, larger (c) real, inverted, smaller, (d) real, erect, larger (e) non of these.

Real 16 cm (b) (c)

cyan

25. In the theory of color, if red is subtracted from the color spectrum, the result is named ?.

green

26. In the theory of color, if red and blue is subtracted from the color spectrum, the result is named ?.

red, green, blue, white

(2) In the theory of color, the three additive primaries are called ?, ?, and ?; if these three colors are added together the resulting color is theoretically ?.

yellow, magenta, cyan, black

(2) In the theory of color, the three subtractive primaries are called ?, ?, and ?; if these three colors are added together the resulting color is theoretically ?.

mixed

B. Longer Answer Questions:

1. (4) REVIEW QUESTION: Define "standing waves." Also define resonance. Compare "standing waves" and resonance.

2. (4) DEFINE:

dispersion

cataracts

ultraviolet

archeobacteria

3. (3) What are cones? Use the theory of color to describe why some people are "blue-green" color-blind.

4. (4) REVIEW QUESTION: Define and distinguish between a longitudinal wave and a transverse wave and give two examples of each.

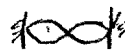
5. (3) Distinguish between pitch, quality of sound, and loudness of a sound wave, and relate these sound characteristics directly to the physical quantitative description of the wave. (Hint: Remember the oscilloscope demonstration on Tuesday.)

6. (2) REVIEW QUESTION: (a) Sketch the second overtone writing down the sequence of nodes (N) and antinodes (A) for a vibrating string

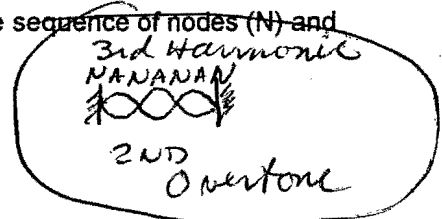
1st HARM



2nd HARM



1st overtone



(b) (2) Define and distinguish between nodes and antinodes for

Nodes & antinodes only occur for resonance!

(i) a closed pipe such as we used in the sound lab



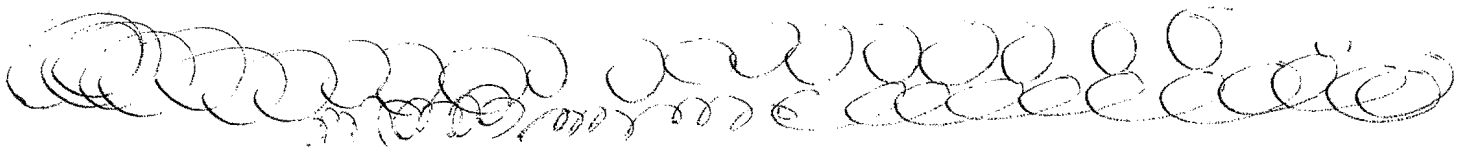
An Antinode occurs at the open end \Rightarrow this is where air molecules are vibrating back & forth with the greatest amplitude.

(ii) a vibrating string



A node occurs at water-air surface, molecules can't move through boundary.
 Point of no motion.
 "Maximum motion back & forth!"

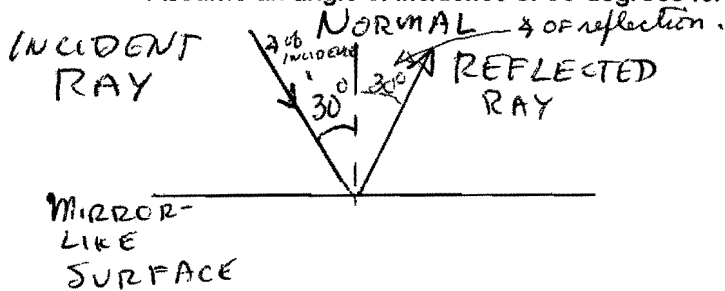
7. (3) Define and give an example of the "Doppler effect".



8. (4) Discuss what happens when a plane moves faster than the speed of sound and how its design must be modified and why. Also discuss or use a series of diagrams to show what is heard by a person on the ground when a plane flies overhead that is flying faster than the speed of sound. And finally, what is the "Mach Number?"

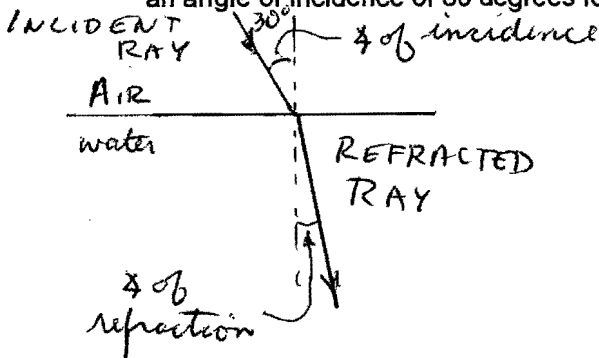
9. (4) (a) (2) Discuss those acoustical factors that are important in the design of a music hall--such as the Ordway or Orchestra Hall. Don't forget to include in your discussion "reflection of sound," "absorption of sound," and "reverberation time." (b) (1) Why is it that there are separate halls for orchestras and theaters? (c) (1) What acoustical problems exist for the St. Paul Cathedral in downtown St. Paul?

10. (a)(4) What is the "Law of reflection?" Illustrate by drawing in an appropriate surface, rays, and angles. Assume an angle of incidence of 30 degrees for your incident ray in your diagram.



- LAW of Reflection:
- ① The \angle of incidence = \angle of reflection
 - ② The Incident Ray, Normal, and Reflected Ray all lie in the same plane!

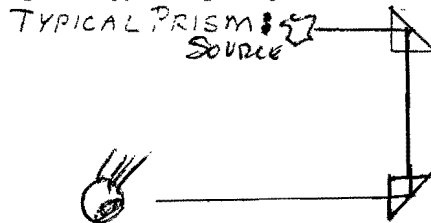
11. (4) What is the "Law of Refraction?" Illustrate by drawing in an appropriate surface, rays, and angles. Assume an angle of incidence of 30 degrees for your incident ray in your diagram.



- LAW of Refraction:
- ① As a light ray passes from a less optically dense substance (like air) to a more "dense" " (like water) it's bent toward normal!
 - As a light ray moves from a more optically dense substance (like water) to a less " " (" air) it's bent away from the normal.
 - ② The incident ray, normal, & refracted ray all lie in the same plane.

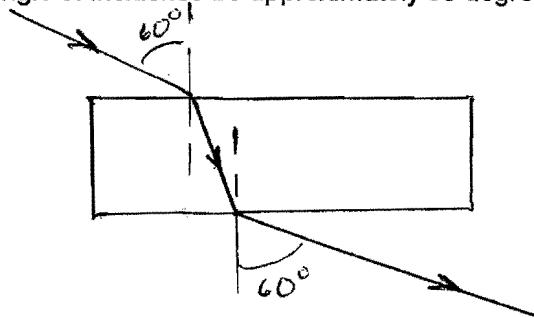
12. (4) (a) Define "critical angle". Use a series of diagrams if helpful in your explanation. (b) What is "total internal reflection", and how does it relate to critical angle? (c) List two examples of the use of total internal reflection.

13. (2) In class we illustrated by a ray diagram how one could use two prisms as a periscope as is used in a navy submarine. This question is similar to that. Please illustrate by a ray diagram how two right-angle prisms could be used to see behind oneself. Start with the source giving off a typical light ray and trace its path into the correctly aligned prisms and then into the eye.



VIRTUAL
IMAGE OF
SOURCE.

14. (+2 bonus) Start with an object and trace a typical light ray which passes through a thick parallel piece of glass. Let your angle of incidence be approximately 60 degrees.



NOTE: The emerging ray comes out parallel to the incoming ray!

15.(4) List 4 of the many characteristics necessary for a carbon-oxygen-water type of life according to Dr. Bracewell of Stanford University.

16. (4) (a) Draw a diagram of the human eye and identify the crystalline lens, the ciliary muscles, the retina, the cornea. (b) Mention or illustrate what happens for (i) a myopic eye, and (ii) a hyperopic eye and include what is used to correct for each of these conditions.

16. (4) A poet in performing her pendulum lab took the following data: (i) a 9.0 in length pendulum took 52 seconds for 60 cycles; (ii) a 16.0 in length pendulum took 69.6 seconds for 60 cycles.

- (a) Find the period for each case.
 (b) If she found the period to be proportional to the square root of the length, find the constant of proportionality.

(a) i. Period = $\frac{52 \text{ s}}{60 \text{ cycles}} = 0.87 \frac{\text{s}}{\text{cycle}}$

ii. Period = $\frac{69.6 \text{ s}}{60 \text{ cycles}} = 1.16 \frac{\text{s}}{\text{cycle}}$

(b) $T = c \sqrt{L}$
 (i) $c = \frac{T}{\sqrt{L}} = \frac{0.87 \text{ s}}{\sqrt{9.0 \text{ in}}} = 0.29 \frac{\text{s}}{\sqrt{\text{in}}}$

(ii) $c = \frac{T}{\sqrt{L}} = \frac{1.16 \text{ s}}{\sqrt{16.0 \text{ in}}} = 0.29 \frac{\text{s}}{\sqrt{\text{in}}}$

17. (4) Describe how the acceleration due to gravity can be measured by using two photocells and a timer.

18. (4) Describe how one can use a tuning fork and a resonance tube apparatus in order to measure the speed of sound.

19. (4) In the lens lab the following graph was obtained.

(a) Write down the mathematical equation that accompanies this graph. $y = mx + b$

$\frac{1}{I} = 0.63 \frac{1}{O} + 0.050 \frac{1}{\text{cm}}$

(b) What is the focal length of the lens?

$f = \frac{1}{b} = \frac{1}{0.050 \text{ cm}} = 20 \text{ cm}$

HAVE A GREAT REMAINING SUMMER, EVERYONE! JA.

