Name: _____ Class: _____ Date: _____ ID: A

STATION 1--LIGHT THE WAY

Modified True/False
Indicate whether the sentence or statement is true or false. If false, change the identified word or phrase to make the sentence or statement true.

____ 1. The process of releasing stored energy as light is called *photoluminescence*. _____

____ 2. The *nucleus* of an atom is(are) responsible for absorbing and re-emitting energy as light. _____

____ 3. We see most objects around us because they *refract* light. _____

Multiple Choice
Identify the letter of the choice that best completes the statement or answers the question.

____ 4. Which statement about the frequency and wavelength of visible light is CORRECT?
a. The frequencies and wavelengths of light are measured using the same units.
b. The frequencies and wavelengths of light are similar to the frequencies and wavelengths of sand.
c. The frequencies of light are incredibly high and the wavelengths of light are tiny.
d. The frequencies of light are low and the wavelengths of light are large.

____ 5. Light travels in straight lines in a medium. Physicists call imaginary lines used to represent light in optical diagrams:
a. light beams.
b. sunbeams.
c. light rays.
d. spectral lines.

____ 6. Of the objects listed, the one that you do NOT see because of reflected light is:
a. a painting.
b. the moon.
c. the sun.
d. the wall of your home.

____ 7. If the distance between a small light source and a screen is doubled, the intensity of light on the screen ____ by ____ times.
a. increases, two
b. decreases, two
c. increases, four
d. decreases, four

____ 8. The color of a light source is related to its:
a. speed.
b. energy.
c. amplitude.
d. frequency multiplied by its wavelength.

Completion
Complete each sentence or statement.

9. A device that measures the wavelength of light using a diffraction grating is called a _____.
10. Light waves that have one direction of vibration may be described as being _____.

Short Answer

11. Why is the speed of light in a vacuum considered to be a special speed?

-

12. As light passes from a vacuum into a material, how are the speed, frequency, and wavelength affected?

-

13. List three characteristics of light.

-

14. Light intensity is the amount light energy falling on a surface every second. Name a metric unit that could be used to measure light intensity.

Problem

15. The speed of light (3×10^8 m/sec) was determined by allowing light to travel 40 kilometers (40,000 m) and measuring the time for it to travel that distance. How much time was required for light to travel that distance?

Name: _____ Class: _____ Date: _____ ID: A

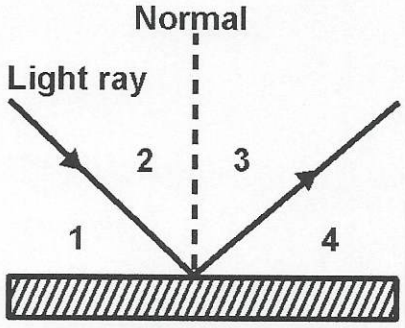
STATION 2--DON'T INTERFERE WITH ME

Modified True/False
Indicate whether the sentence or statement is true or false. If false, change the identified word or phrase to make the sentence or statement true.

____ 1. A lens that is thicker on the edges and thinner in the middle will cause light rays to *converge*.
_____

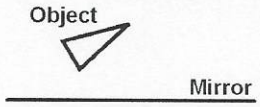
Multiple Choice
Identify the letter of the choice that best completes the statement or answers the question.

____ 2. Referring to the diagram, which angle represents the angle of reflection?



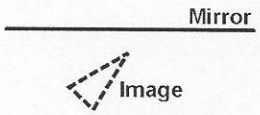
a. 1
b. 2
c. 3
d. 4

____ 3. An object is placed in front of a mirror as shown in the diagram below:

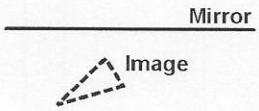


Which diagram represents the image of that object in the mirror?

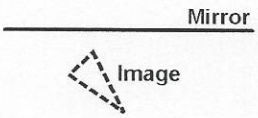
a.



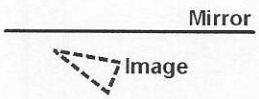
c.



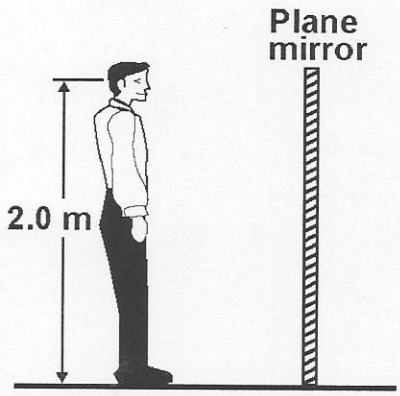
b.



d.



____ 4. A tall person's eye level is at 2.0 meters high and his feet are at 0 meters high:



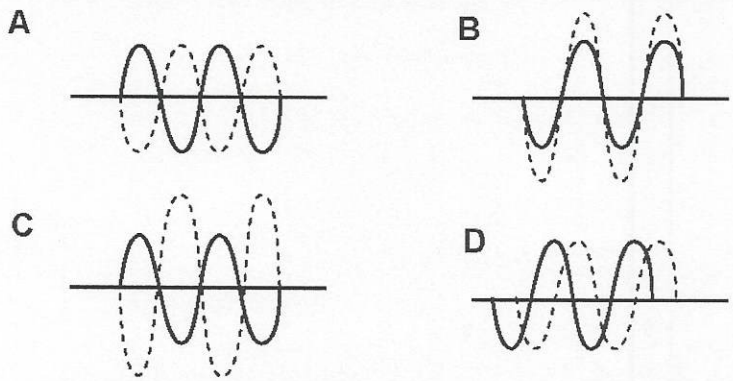
If light rays are reflected so that he is able to see an image of his feet, approximately how far from the floor do these rays strike the mirror?

a. 2.0 m
b. 1.0 m
c. 0.25 m
d. 0 m

____ 5. The image produced by a diverging lens is always:
a. smaller and upside down.
b. larger and upside down.
c. smaller and right-side-up.
d. larger and right-side-up.

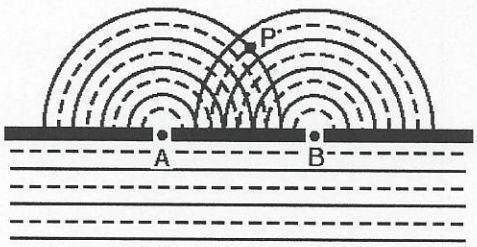
____ 6. Maximum destructive interference between two waves will occur when the waves are out of phase by ____ degrees.
a. 45
b. 90
c. 180
d. 360

____ 7. Which pair of waves produces a resultant wave with the largest amplitude?



a. A
b. B
c. C
d. D

____ 8. The diagram below represents waves of wavelength λ passing through two small openings, A and B, in a barrier. The solid lines represent wave crests and the dashed lines represent wave troughs.



Compared to the distance from B to P, the distance from A to P is:

a. 1λ longer.
b. 2λ longer.
c. $\frac{1}{2}\lambda$ longer.
d. the same.

Short Answer

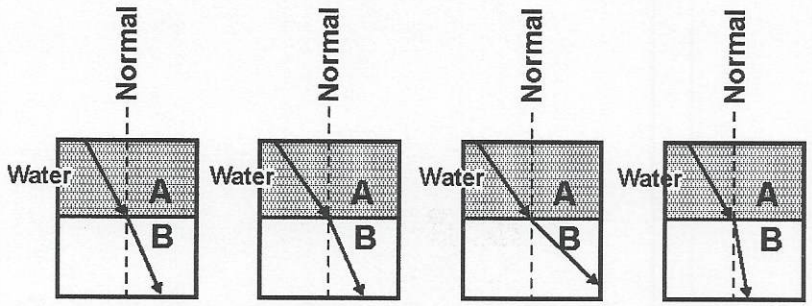
9. Classify each of the following materials as being mostly *transparent*, *translucent*, *absorbing*, or *reflecting*.

1) a black t-shirt
2) tissue paper
3) a shiny stainless steel spoon
4) clear plastic wrap
5) wax paper
6) black velvet curtains

10.

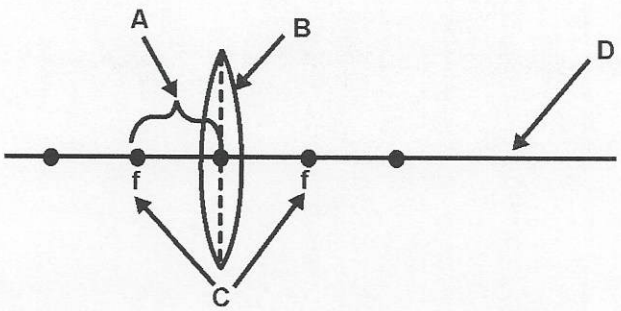
Material	Index of Refraction
Vacuum	1.0
Air	1.0001
Water	1.33
Ice	1.31
Glass	1.5
Diamond	2.42

The diagrams represent light traveling from water (A) into another material (B). Using the chart above, label material B for each diagram as air, water, glass or diamond.



a. _____ b. _____ c. _____ d. _____

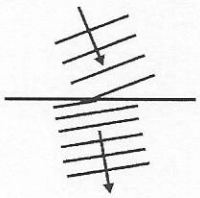
11. Examine the ray diagram of the lens. Identify each part of the diagram, A-D.



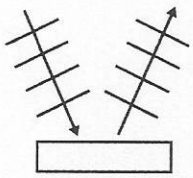
Other

12. Identify the wave interaction represented by each diagram.

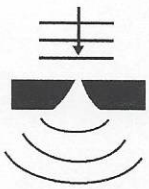
a.



b.



c.



13. Two pulses are traveling on a rope as shown in the diagram. The two pulses meet for an instant.

a. Name the type of interference that occurs at that instant.
b. Draw a diagram that would represent the rope at the instant the pulses meet.

14. Could the index of refraction for a material ever be less than 1.0? Explain.

STATION 2--DON'T INTERFERE WITH ME
Answer Section

MODIFIED TRUE/FALSE

1. ANS: F, diverge

   DIF: intermediate REF: section 23.3

MULTIPLE CHOICE

2. ANS: C DIF: basic REF: section 23.1
3. ANS: B DIF: intermediate REF: section 23.1
4. ANS: B
   To see his feet, the incident ray of light from his feet must strike the mirror and then the reflected ray must reach his eyes. Since the law of reflection states that the angle of incidence must equal the angle of reflection, the incident ray must strike the mirror halfway between his feet at 0 meters and his eyes at 2 meters, or it strikes the mirror at 1.0 meters from the floor.

   DIF: advanced REF: section 23.1
5. ANS: C DIF: advanced REF: section 23.3
6. ANS: C DIF: advanced REF: section 20.3
7. ANS: B DIF: advanced REF: section 20.3
8. ANS: C DIF: advanced REF: section 24.2

SHORT ANSWER

9. ANS:
   1) absorbing
   2) translucent
   3) reflecting
   4) transparent
   5) translucent
   6) absorbing

   DIF: intermediate REF: section 23.1
10. ANS:
    a. water b. glass c. air d. diamond

    DIF: advanced REF: section 23.2

STATION 3- WAVES-R-US

1. Waves transfer _____ (matter, energy, both).

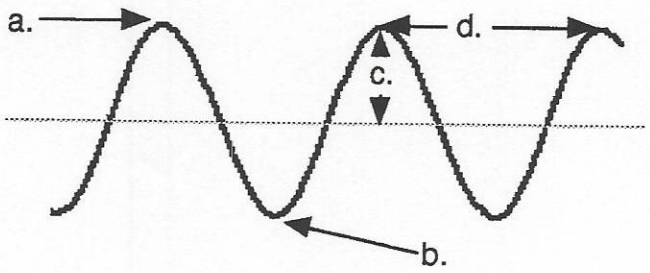
2. The illustration to the right shows a wave. Label each part in the space below: (4 pts)

   a. _____

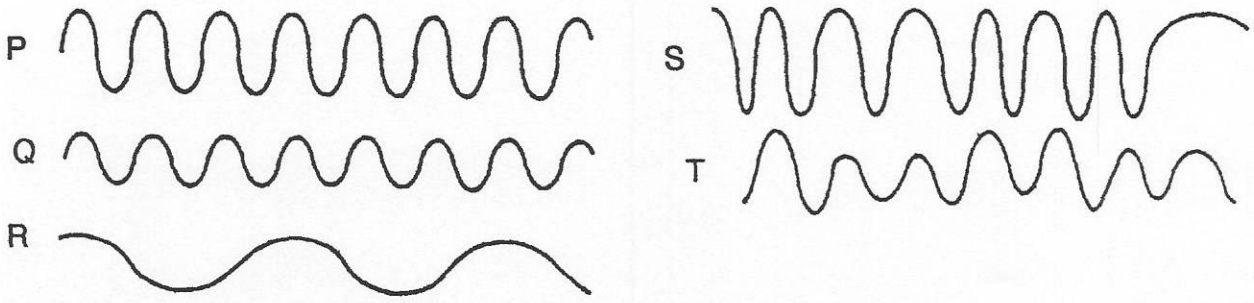
   b. _____

   c. _____

   d. _____



3. Use the five illustrations of waves drawn below to answer the following questions: (5 pts)



   (a) Waves P and Q have the same _____, but wave P has twice the _____ of wave Q.

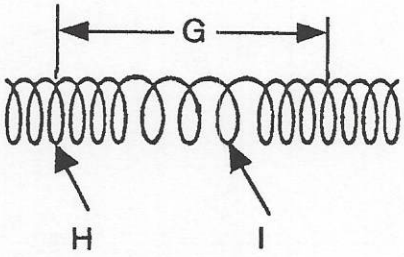
   (b) Waves Q and R have the same _____, but wave R ~~has~~ more than twice the _____ of wave Q.

   (c) Wave _____ shows a steady frequency but changing amplitude.

   (d) Wave _____ shows steady amplitude but a changing frequency.

   (e) Waves _____ and _____ have a low amplitude and a steady frequency.

4. The following questions refer to the diagram to the right:

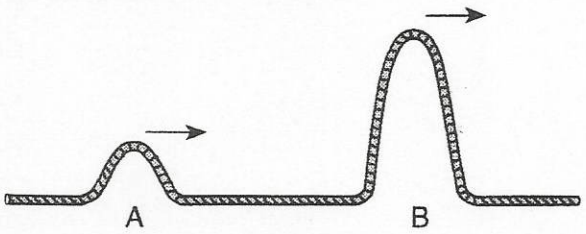


   (a) Is this wave transverse or longitudinal?

   (b) Letter H represents a _____ and letter I represents a _____.

   (c) Letter G represents a _____.

5. The diagram below shows two pulses, A and B, moving to the right along a uniform rope.



Compared to pulse A, pulse B has

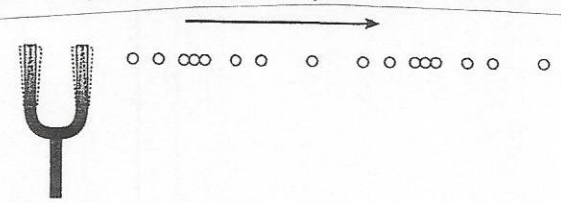
(a) a slower speed and more energy

(b) a faster speed and less energy

(c) a faster speed and the same energy

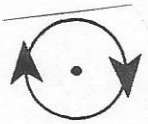
(d) the same speed and more energy

7. The diagram below shows a tuning fork vibrating in air. The dots represent air molecules as the sound wave moves toward the right.



Which diagram best represents the direction of the motion of the air molecules?

a.

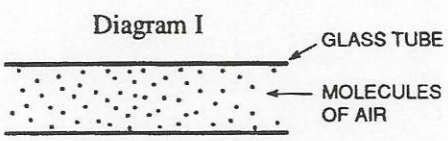


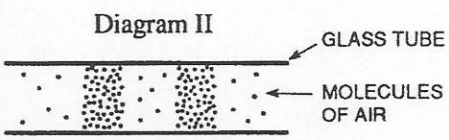
c.

b.

d.

8. Diagram I shows a glass tube containing undisturbed air molecules. Diagram II shows the same glass tube when a wave passes through it.





Which type of wave produced the disturbance shown in diagram II?

a. torsional
b. transverse
c. longitudinal
d. elliptical
e. surface

9. Which of the following is NOT a property of waves?

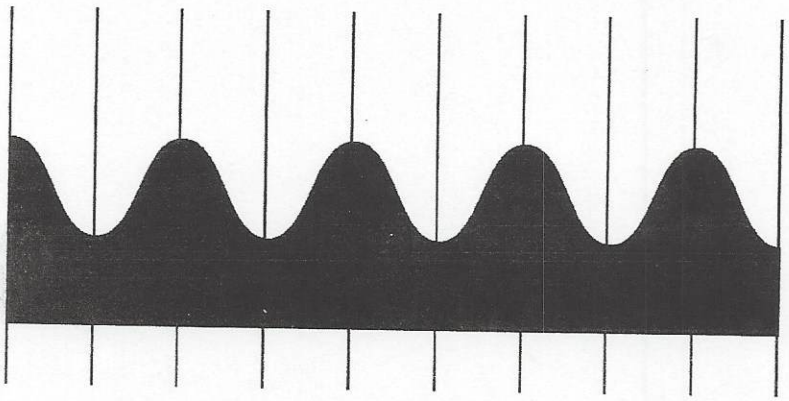
a. Frequency
b. Amplitude
c. Speed
d. Weight

10. True or false. The energy of waves is proportional to the speed of a wave.

11. All of the following waves travel at 3×10^8 meters per second EXCEPT:

a. light waves
b. microwaves
c. sound waves
d. X-rays

12. How many waves are represented in this diagram? _____



Name: _____ Class: _____ Date: _____ ID: A

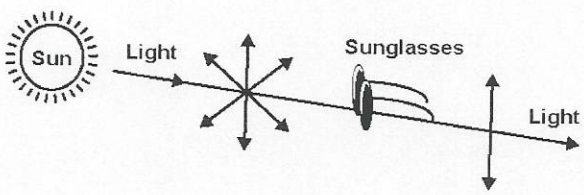
STATION 4---WAVES IN THE REAL WORLD

Multiple Choice
Identify the letter of the choice that best completes the statement or answers the question.

____ 1. Ultrasound is useful for all of the following EXCEPT:
a. examining a beating heart.
b. placing mp3 files on a CD.
c. detecting structural damage in materials.
d. determining the gender of an unborn child.

____ 2. A large explosion generally can be "felt" some distance away and is the source of a low frequency sound because it causes a variation in the:
a. air temperature.
b. air pressure.
c. mass of air molecules.
d. weight of air molecules.

____ 3. The diagram below represents sunglasses being used to eliminate glare:



The phenomenon represented in the diagram is:
a. dispersion.
b. polarization.
c. refraction.
d. reflection.

____ 4. Vibrating strings and similar systems have resonance patterns that occur at:
a. frequency intervals of 12 hertz.
b. amplitude intervals of one meter.
c. multiples of the fundamental frequency.
d. frequency intervals equal to wave speed times wavelength.

____ 5. If your fingertip repeatedly touches the surface of water in a container at regular intervals, the action will produce:
a. planes waves.
b. circular waves.
c. crests only.
d. troughs only.

____ 6. Theaters often use heavy curtains to reduce echoes during performances. The function of the curtains is to ____ sound.
a. refract
b. reflect
c. diffract
d. absorb

____ 7. You are still able to hear sounds coming from a room when the door is open only a tiny crack due to:
a. reflection.
b. refraction.
c. diffraction.
d. absorption.

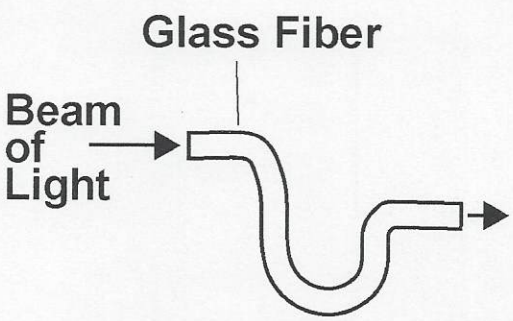
____ 8. Two large waves on the ocean come together on the ocean's surface to form a gigantic wave. The interaction responsible for this is called:
a. frequency amplification.
b. constructive interference.
c. destructive interference.
d. amplitude destruction.

____ 9. Devices like a guitar, a piano, and a microwave oven function using controlled:
a. standing waves.
b. destructive interference.
c. frequency amplification.
d. amplitude reduction.

____ 10. A glass window is best described as a(n) ____ material.
a. transparent
b. translucent
c. absorbing
d. reflecting

____ 11. A black asphalt road is best described as a(n) ____ material.
a. transparent
b. translucent
c. absorbing
d. reflecting

____ 12.

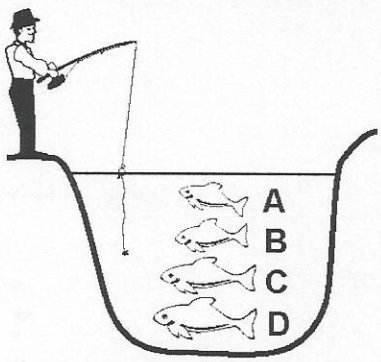


The diagram shows a beam of light passing through a curved glass fiber. This is possible due to the effect of:
a. dispersion.
b. total internal reflection.
c. polarization.
d. diffraction.

Material	Index of Refraction
Vacuum	1.0
Air	1.0001
Water	1.33
Ice	1.31
Glass	1.5
Diamond	2.42

Table 23-1A

____ 13. The illustration shows the image of four fish in a pond:



If a fish is actually located at position B, at which position would the IMAGE of that fish appear for a person looking into the pond while standing on the side of the pond? Refer to Table 23-1A.

a. A
b. B
c. C
d. D

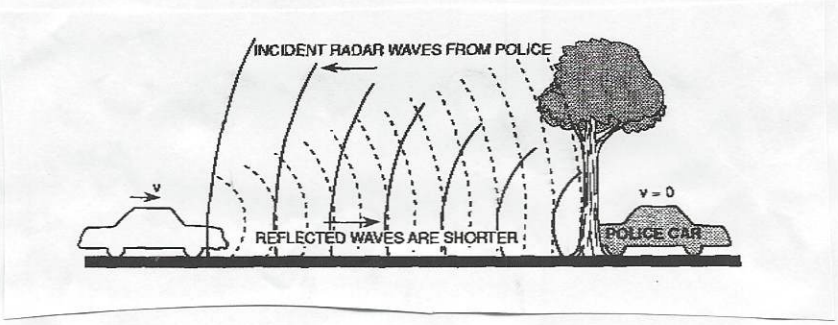
____ 14. The type of image that can be projected on a screen is always:

a. virtual.
b. real.
c. enlarged.
d. smaller.

Short Answer

15. List the following waves in order of their speeds from fastest to slowest and give their approximate speed.
a. sound waves
b. light waves
c. water waves

16. The diagram below shows radar waves being emitted from a stationary police car and reflected by a moving car back to the police car.



The difference in apparant frequency between the incident and reflected waves is an example of:

_____

Problem

17. On a July day, the waves in the Outer Banks of North Carolina hit the beach every 13 seconds. If the distance between each wave crest is 25 meters, what is the speed of the waves as they travel toward the beach?

Essay

18. Explain why a hot dog on a dry paper plate becomes hot in a microwave oven but the paper plate becomes hot only where it is in contact with the hot dog.

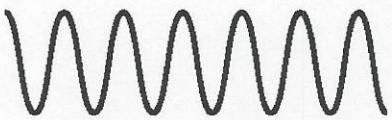
Name: _____ Class: _____ Date: _____ ID: A

STATION 5--CATCH AN E-M OR SOUND WAVE

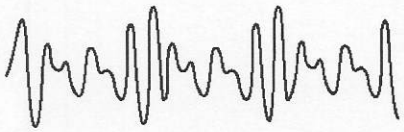
Multiple Choice

Identify the letter of the choice that best completes the statement or answers the question.

____ 1. The four diagrams below represent the amplitude of sounds produced versus time. Which diagram represents a complex sound?



a.



c.

b.

d.

____ 2. The oscillation of air pressure can result in ____ waves.
a. transverse
b. light
c. longitudinal
d. circular

____ 3. Which of the following has the shortest wavelength?
a. A rumble of thunder at 20 hertz
b. An average male singer at 500 hertz
c. The highest note on a piano at 5,000 hertz
d. The whine of a jet turbine at 10,000 hertz.

____ 4. The electromagnetic waves with the shortest wavelength are:
a. microwaves.
b. gamma rays.
c. radio waves.
d. visible light waves.

____ 5. All of the following waves travel at 3×10^8 meters per second EXCEPT:
a. light waves.
b. sound waves.
c. microwaves.
d. X rays.

____ 6. As atoms gain energy due to a temperature increase, the color of the light emitted by the atoms may change from:
a. blue to green.
b. red to yellow.
c. green to orange.
d. violet to red.

____ 7. Which of the following colors of light has the highest energy?
a. Red
b. Yellow
c. Blue
d. Violet

Short Answer

8. List the speed of sound in each of the following media in order from fastest to slowest.
a. Water at 20ºC
b. Air at 20ºC
c. Helium at 20ºC
d. Steel at 20ºC
e. Air at 0ºC

_____ _____ _____ _____ _____

9. In a motion picture, an asteroid on collision-course with Earth is struck by a missile before reaching Earth's atmosphere. The asteroid explodes with a loud noise. Explain why this is not an accurate representation.

-

10. How are electromagnetic waves created?

-

Essay

11. The starter at a track meet shoots a blank pistol to start a 100-meter race. The timers at the other end of the track are told to start their watches when they see the smoke from the pistol, not when they hear the discharge. Explain why they should be given this instruction.

Name: _____ Class: _____ Date: _____ ID: A

STATION 6

COLOR MY WORLD

Modified True/False

Indicate whether the sentence or statement is true or false. If false, change the identified word or phrase to make the sentence or statement true.

____ 1. The additive primary colors are *red, yellow, and blue*. _____

Multiple Choice

Identify the letter of the choice that best completes the statement or answers the question.

____ 2. Color televisions produce images by mixing dots of:
   a. red, white, and blue.
   b. red, yellow, and blue.
   c. red, green, and blue.
   d. magenta, yellow, and cyan.

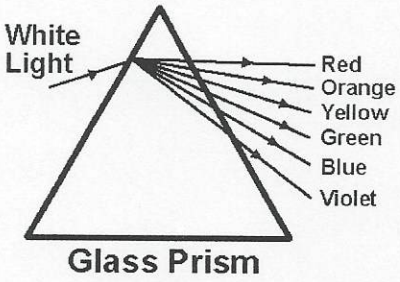
____ 3. The subtractive primary colors are:
   a. red, white, and blue.
   b. cyan, magenta, and yellow.
   c. red, yellow, and blue.
   d. red, green, and blue.

____ 4. An object that appears red in sunlight is illuminated only by blue light. It will appear to be:
   a. black.
   b. white.
   c. red.
   d. violet.

____ 5. When white light illuminates a green leaf, ____ are the two colors of light that are mainly absorbed.
   a. green and yellow
   b. green and red
   c. red and blue
   d. blue and yellow

____ 6. Our vision is based on:
   a. the CMYK color process.
   b. the additive color process.
   c. the subtractive color process.
   d. constructive interference.

____ 7.



The diagram best illustrates:
a. scattering and diffraction.
b. reflection and interference.
c. transmission and Doppler effect.
d. refraction and dispersion.

____ 8. The color of light that is refracted most when it passes through a prism is:
a. red.
b. orange.
c. green.
d. blue.

____ 9. The color of light for which the index of refraction is greatest is:
a. blue.
b. green.
c. yellow.
d. red.

____ 10. Looking through a spectrometer, you see a line of light at 410 nanometers. This means the wavelength of the light is 410 nanometers. The color of this light is:
a. red.
b. yellow.
c. green.
d. violet.

Essay

11. Explain the difference between the image of a yellow banana on a computer screen and an image of the banana on a piece of paper.

Other

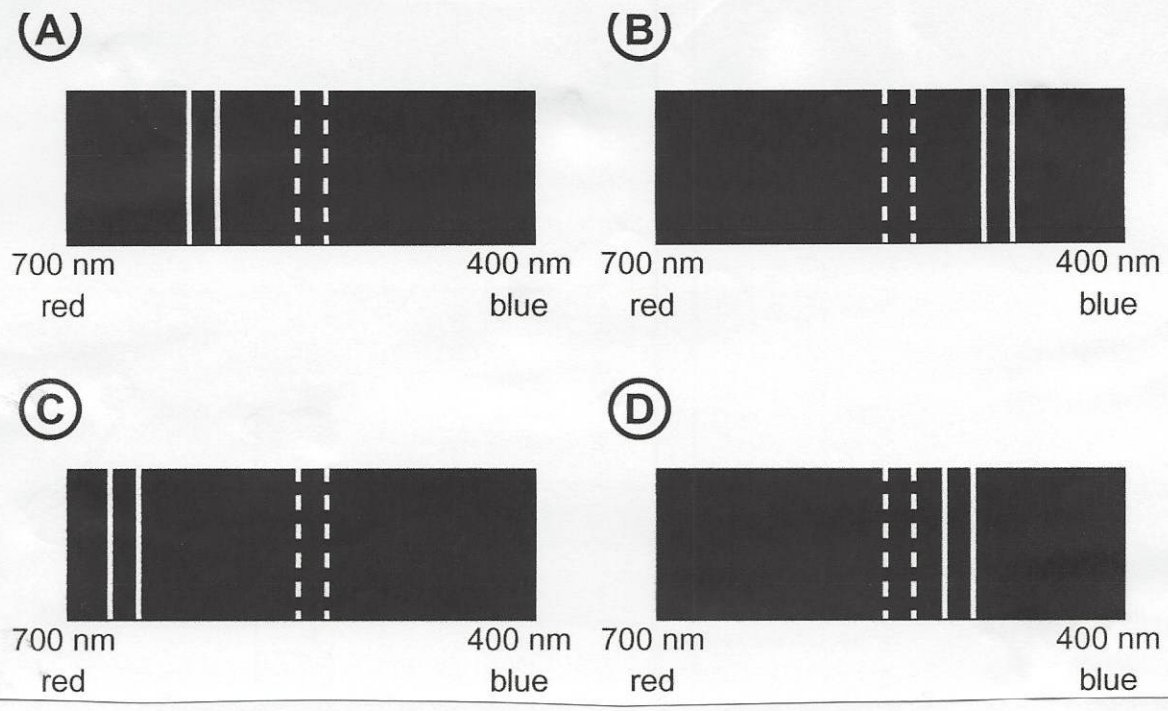
12. The graphic below shows the spectral lines emitted by four moving objects. The specral lines for when the object is stationary are shown as dotted lines on each spectrum. Use the graphic to help you answer the following questions.

_____a. Which of the spectra show an object that is moving toward you?

_____b. Which of the spectra show an object that is moving away from you?

_____c. Which of the spectra show an object that is moving the fastest away from you?

_____d. Which of the spectra show an object that is moving the fastest toward you?



Use the colors below for this page.

Red
Blue
Cyan
White
Black
Magenta
Green
Yellow

Demonstrate your understanding of color addition by completing the following color equations:

13. Red + Blue =

14. Red + Blue + Green =

Demonstrate your understanding of color subtraction by completing the following color equations:

15. White – Blue=

16. Yellow – Red=