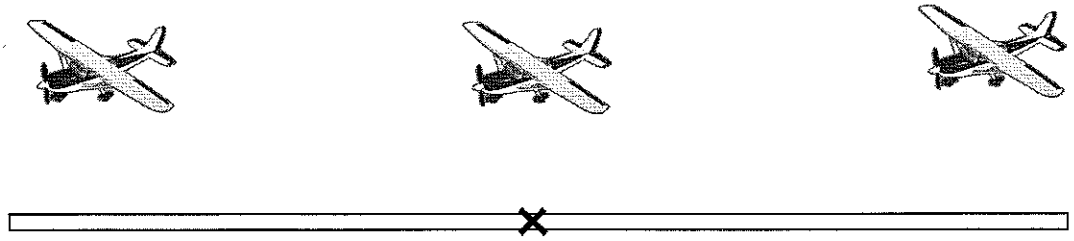
2. A ball rolls with a speed of 2 m/s across a table top that is 1 meter above the floor. Upon reaching the edge of the table, it follows a parabolic path to its landing spot on the floor. How far along the floor is this spot from the table?

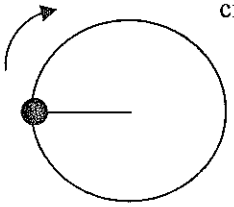
Horizontal $v = k$	**Vertical** $a = k = a_g$ **(free fall)**
v_{ix}	v_{iy}
v_{fx}	v_{fy}
Δx **(range)**	Δy **(height)**
a_x	a_y
t	t

3. Which position should the airplane drop its cargo to hit the target? Draw the path the cargo would take as it moves toward the ground.

a. A b. B c. C

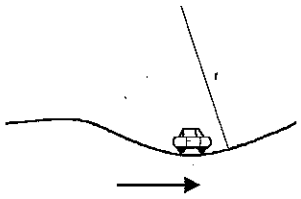


4. The following diagram represents an overhead view of a ball attached to a string that is being spun in a horizontal circle.



a) Indicate the direction of the force acting on the ball.
b) Indicate the direction of the velocity of the ball.
c) Indicate the direction of the acceleration of the ball.
d) If the ball was suddenly released at the point shown (the black dot), indicate which way the ball would travel.
e) Indicate the direction of the centripetal force acting on the ball.

5. While traveling at 13 m/s, a car hits a dip in the road of radius 24 m.



a) Draw the free-body diagram for the driver.
b) What is your centripetal acceleration?
c) What is the magnitude of the normal force acting on you if you are 60 kg?

Unit 5 – Work & Energy

Physics Classroom: Work, Energy & Power

Key Vocab Words:

energy, kinetic energy, work, gravitational potential energy, law of conservation of energy

Problems:

1. A student lifts a box of books that weighs 185 N. The box is lifted 0.800 m. How much work does the student do on the box? $F_g =$ $\Delta y = h =$ $W = F \cdot \Delta x = 185N(.8m) =$

2. Differentiate the following terms: positive work, negative work, no work.

lifting, & adding energy or potential — converting potential to motion — F & Δx not in same direction.

3. In which situation is a person doing work on an object?
   a) A school crossing guard raises a stop sign that weighs 10 N. $F \Delta x$ ✓ $F \uparrow$ $\Delta x \rightarrow$
   b) A student walks 1 m/s while wearing a backpack that weighs 15 N.
   c) A man exerts a 350 N force on a rope attached to a house. does not move
   d) A worker holds a box 1 m off the floor. no Δx

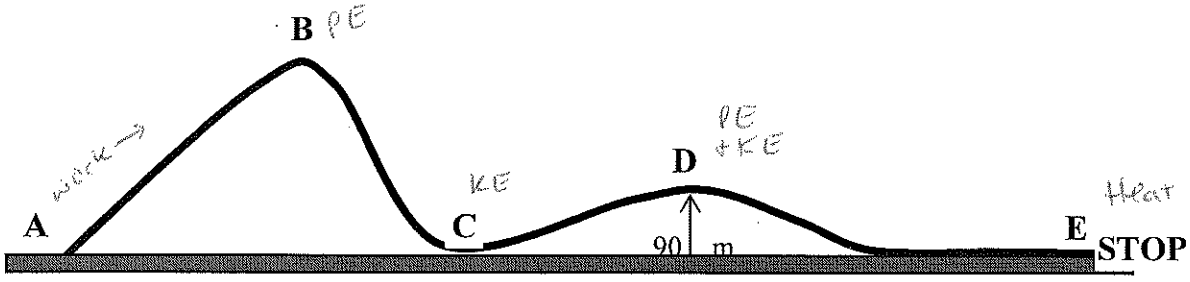
4. Define each of the following scenarios as positive work, negative work or no work.
   a) Lifting a bag of groceries. (+)
   b) A hockey puck pushed across the ice. (+)
   c) Lowering a crate of books to the floor. (−)
   d) Sliding a box across the floor. (+)

5. A 950-kg car moves with a speed of 37 m/s. What is its kinetic energy?
   $KE = \frac{1}{2}mv^2 = \frac{1}{2}(950kg)(37m/s)^2 = 650,275J$

6. An 875-kg compact car speeds up from 22.0 m/s to 44.0 m/s while passing another car.
   a) What were its initial and final energies? $KE_o = \frac{1}{2}(875)(22)^2 = 211,750J$ $KE_a = 847,000J$
   b) How much work was done on the car to increase its speed?
   $\Delta KE = 635,250J = W$

7. A 90-kg rock climber climbs 45 m up to the top of a quarry. What is the change in the climber's gravitational potential energy relative to the ground? $PE = mgh = 90(9.8)(45)$
   $\Delta PE = W = 39,690J$

8. The chain on a roller coaster applies a force of 4000N while pulling an 800 kg roller coaster car up a hill that is 400 m long. Refer to the diagram of the roller coaster below.



   a) Identify each letter on the diagram as Work, KE, GPE and/or Heat.
   b) How much work did the chain do to pull the car to the top of the ride? $W = F\Delta x = 4000(400m) = 1600,000J$
   c) What is the gravitational potential energy at the top of the ride? 1,600,000J
   d) What is the kinetic energy at the bottom of the first hill? 1,600,000J
   e) How fast is the roller coaster car going at the bottom of the first hill? $= \frac{1}{2}(800)v^2$ $(v = 63 m/s)$
   f) If the next hill has a height of 90 m determine the following: GPE, KE and speed. $PE = 705,000J$ $KE = 894,900J$ $v = 42 m/s$
   g) If a force of 8000 N is applied to stop the car at the end of the ride, what is the stopping distance?
   $F = 8000N$ $\Delta x = W/F$ $(\Delta x = 200m)$

Unit 6 – Wave Motion

Physics Classroom: Waves + Sound Waves & Music + Light Waves & Color

Key Vocab Words:

wave, transverse wave, longitudinal wave, trough, crest, wavelength, frequency, principle of superposition, interference, destructive interference, node, constructive interference, antinode, reflection, refraction, diffraction, pitch, Doppler shift, resonance, light, electromagnetic spectrum, primary color, secondary color, dye, pigment, primary pigment, secondary pigment, polarized

Problems:

1. The speed of a wave depends upon (i.e., is causally affected by)…
   a) the properties of the medium through which the wave travels.
   b) the wavelength of the wave.
   c) the frequency of the wave.
   d) both the wavelength and the frequency of the wave.

2. If sound travels at 5600 m/s through a steel rod, what is the wavelength, given a wave frequency of 2480 Hz?
   $v = \lambda f$ $\lambda = 5600/2480 = 2.26m$

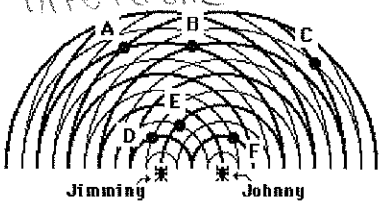
3. **TRUE or FALSE** – In order for John to hear Jill, air molecules must move from the lips of Jill to the ears of John.
   wave!

4. What is the Doppler shift? Provide an example of a time when you experienced this phenomenon.
   ambulance example: higher pitch on approach, lower after passing

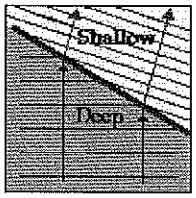
5. Ella Fitzgerald has the ability to break glass when she sings. Why does the glass shatter?
   the glass vibrates at its natural frequency

6. Identify the following images as one of the following: reflection, interference, diffraction or refraction. In addition, describe what each term means.

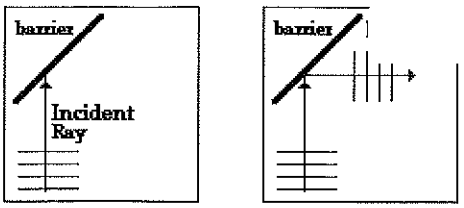
a) Interference



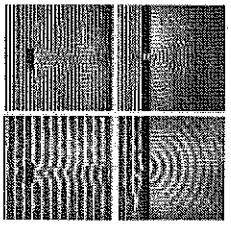
c) refraction



b) reflection



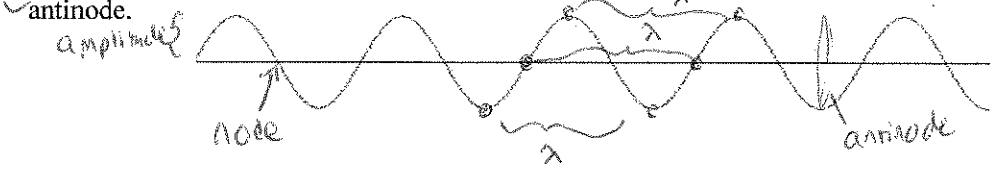
d) diffraction



7. Look at the image in problem 6, letter d.
   a) What do the light bands represent? peaks (crests)
   b) What do the dark bands represent? troughs (valleys)
   c) What do the gray fuzzy lines represent? destructive interference

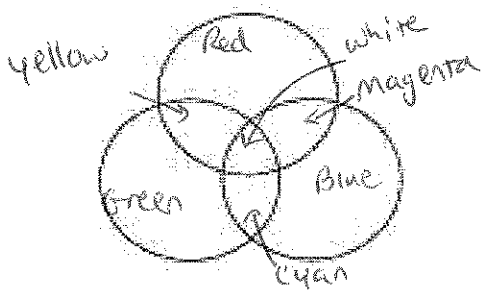
8. A sound wave is different than a light wave in that a sound wave is…
   a) produced by an oscillating object and a light wave is not.
   b) not capable of traveling through a vacuum.
   c) not capable of diffracting and light wave is.
   d) Capable of existing with a variety of frequencies and a light wave has a single frequency.

9. Label the following diagram. Include these terms: amplitude, wavelength (all 3 ways to indicate wavelength), node, antinode.

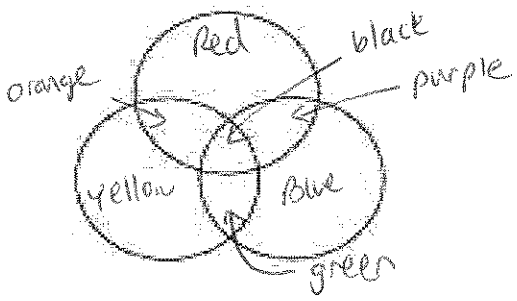


10. Fill in the diagrams for the mixing of light and the mixing of pigments:

Light

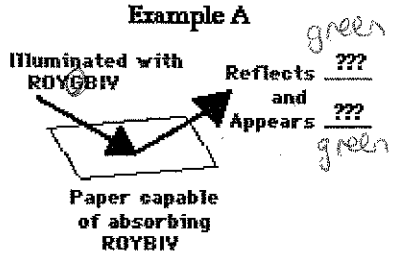


Pigment

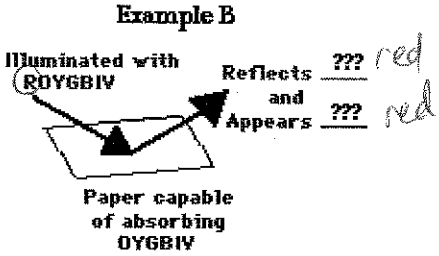


11. The diagrams depict a sheet of paper being illuminated with white light (ROYGBIV). The papers are impregnated with a chemical capable of absorbing one or more of the colors of white light. In each case, determine which color(s) of light are reflected by the paper and what color the paper will appear to an observer.

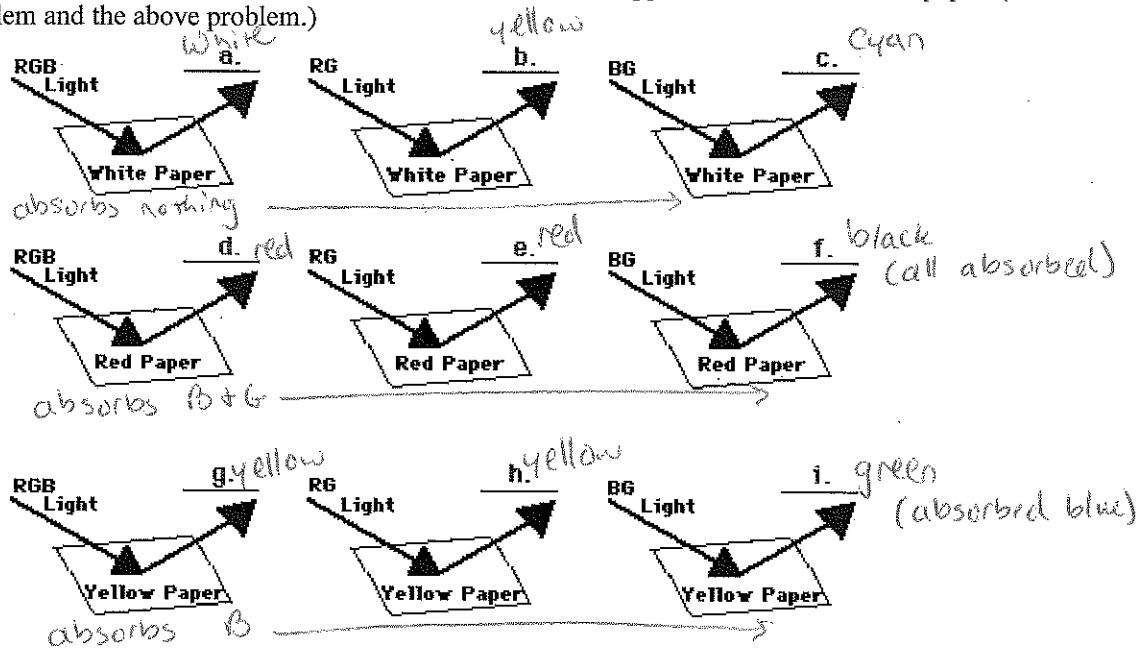
Example A



Example B



12. In the diagrams below, several sheets of paper are illuminated by different primary colors of light (R for red, B for blue, and G for green). Indicate what primary colors of light will be reflected and the appearance of the sheet of paper. (Note the similarity between this problem and the above problem.)



13. How do you create cyan light?

Blue + Green

14. Suppose the light passes through two polarizing filters whose polarization axes are parallel to each other. What would be the result? dimmer light

15. Consider the visible light spectrum (ROYGBIV)...
    a) Which color has the greatest frequency? violet
    b) Which color has the greatest wavelength? red

Unit 7 – Optics

Physics Classroom: Reflection…+ Refraction…

Key Vocab Words:

reflection, refraction, angle of refraction, angle of incidence, plane (flat) mirrors, concave converging mirrors, convex diverging mirrors, convex converging lens, concave diverging lens, real, virtual, inverted, upright.

Problems:

1. Answer the following questions as they pertain to mirrors:
    a) Describe the physical properties of the image seen in a plane mirror. upright + virtual, same size + location
    b) Describe the physical properties of a virtual image. upright
    c) An object produces a virtual image in a concave mirror. Where is the object located? in front of f.
    d) An object is located beyond the center of curvature (2f) of a concave converging mirror. Locate and describe the physical properties of the image. same location + size, real + inverted
    e) Describe the image seen in a convex diverging mirror.

2. Answer the following questions as they pertain to lens:
    a) Describe the physical properties of an image seen in a convex converging lens. → inverted + small if real. upright + large if virtual.
    b) Describe the physical properties of an image seen in a concave diverging lens.