Physics

Final Review Packet v. 2016

Units 1-9

Please note that the following chapters are meant to direct your studying.
We did not cover every topic in each of the listed section of the Physics Classroom.

Unit 1-2 – Motion in 1D

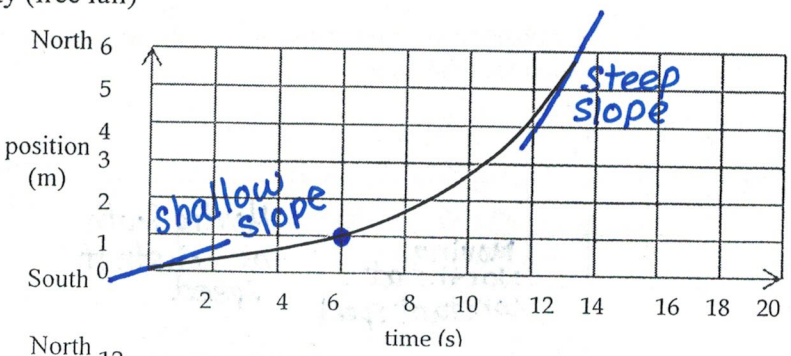
Physics Classroom: 1D Kinematics

Key Vocab Words:

motion diagram, scalar, vector, displacement, distance, average velocity, average speed, instantaneous velocity, average acceleration, acceleration due to gravity (free fall)

Problems:

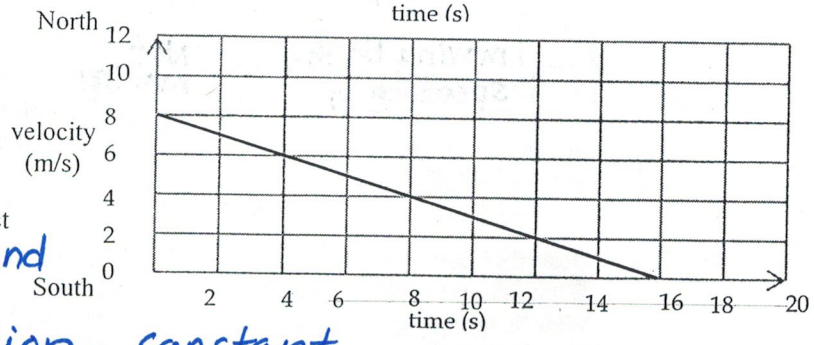
1. Looking at the graph to the right…
   a) Identify the position at 6 seconds.
   b) Describe the motion of the object.



a) +1m North

b) Object moves North and speeds up

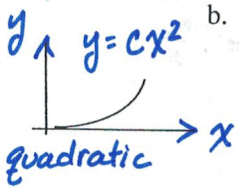
2. Looking at the graph to the right…
   a) Describe the motion of the object.
   b) Describe the acceleration of the object



a) Object moves North and slows down

b) Negative acceleration, constant

3. Identify the type of mathematical relationship for each of the following:

a. 

quadratic

b.

x	y
1.1	2.3
2.1	1.2
3.2	0.8

$y \propto \frac{1}{x}$, inverse

c. F = ma

linear, direct

$F \propto a$

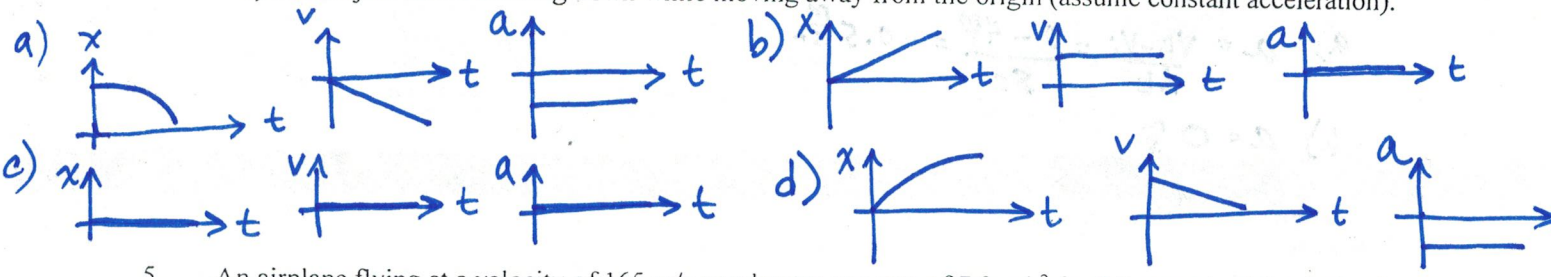
d.

x	y
0	0
1.5	3.0
4.5	9.0

linear direct

$y = 2x$

4. Draw a position vs. time, a velocity vs. time and an acceleration vs. time graph for the following scenarios:
   a) An object that is speeding up while moving toward the origin (assume constant acceleration).
   b) An object moving at a constant velocity.
   c) An object standing still.
   d) An object that is slowing down while moving away from the origin (assume constant acceleration).



5. An airplane flying at a velocity of 165 m/s accelerates at a rate of 7.0 m/s² for 5.0 seconds. What is the final velocity of the plane?

$\vec{a} = \frac{\vec{V}_f - \vec{V}_i}{\Delta t}$ $\quad 7.0\frac{m}{s^2} = \frac{V_f - 165\frac{m}{s}}{5.0s}$ $\quad V_f = (7.0\frac{m}{s^2})(5.0s) + 165\frac{m}{s}$ $\quad \boxed{V_f = 200\frac{m}{s}}$

6. A motorcycle starts from rest and accelerates uniformly for 5.0 seconds. During this time, it travels a distance of 140 meters. At what rate was it accelerating?

$\Delta x = v_i \Delta t + \frac{1}{2} a \Delta t^2$

$140m = 0 + \frac{1}{2} a (5s)^2$

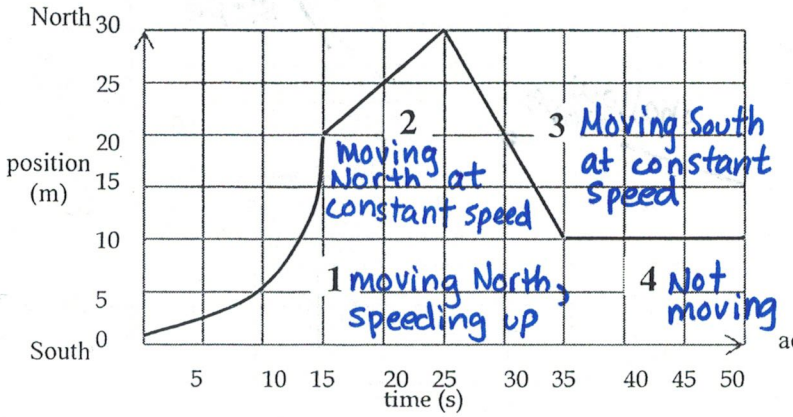
$a = \frac{(140m)(2)}{25s^2} = \boxed{11.2\frac{m}{s^2}}$

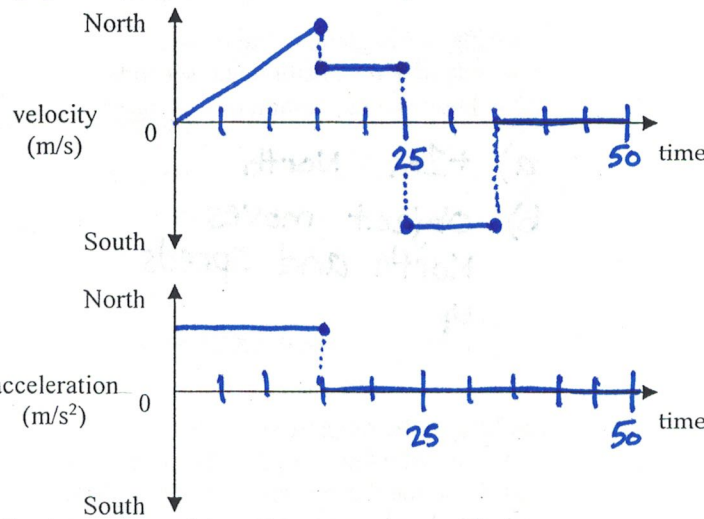
7. A wrecking ball is hanging at rest from a crane when suddenly the cable breaks. The time that it takes to fall to ground is 2.4 s. How far has the ball traveled during this time?

$\Delta\vec{x} = \vec{v}_i\Delta t + \frac{1}{2}\vec{a}(\Delta t)^2$ $\Delta x = 0 + \frac{1}{2}(-9.8\frac{m}{s^2})(2.4s)^2$ $\boxed{\Delta\vec{x} = -28.224\,m}$

8. A ball is thrown upward with an initial velocity of 12.0 m/s.
   a) Draw a position-time graph for the ball's movement from the initial throw to the moment it hits the ground.
   b) What is the velocity at maximum height?
   c) What is the acceleration at maximum height?
   d) How much time does it take to reach its maximum height?

e) Using the position vs. time graph, answer the following questions and construct a velocity vs. time and an acceleration vs. time graph.





   a) Describe motion for each section (1, 2, 3, and 4).
   b) What is the object's average velocity from **15-25** s?
   c) What is the object's average velocity from **25-35** s?
   d) What is the object's average velocity from **35-50** s?
   e) Draw the corresponding velocity vs. time graph.
   f) Draw the corresponding acceleration vs. time graph .

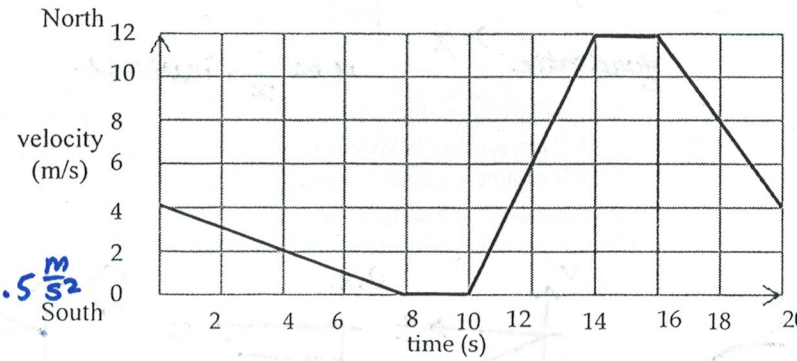
a) see x vs. t graph

b) $\vec{v} = \frac{\Delta\vec{x}}{\Delta t}$ $\vec{v} = \frac{+10m}{10s} = 1\frac{m}{s}$

c) $\vec{v} = \frac{-20m}{10s} =$

d) $\vec{v} = 0\frac{m}{s}$

9. Use the velocity vs. time graph below to answer the questions that follow.



   a) What is the object's acceleration from 0-8 seconds?
   b) What is the object's acceleration from 8-10 seconds?

a) $a = \frac{v_f - v_i}{\Delta t} = \frac{0 - 4\frac{m}{s}}{8s} = -0.5\frac{m}{s^2}$

b) $a = 0\frac{m}{s}$

Unit 3 – Newton's Laws

Physics Classroom: Newton's Laws

Key Vocab Words:

force, free-body diagram, net force, Newton's first law, Newton's second law, inertia, Newton's third law

Problems:

1. If the forces acting upon an object are balanced, then the object…
   a) must not be moving.
   b) must be moving with a constant velocity, or must be at rest
   c) must not be accelerating.
   d) none of these

2. If a bug and a truck windshield collide head-on, explain which one experiences a greater impact force.

They experience the same force, but the less massive bug has a greater acceleration

3. You are a passenger in a car that is moving rapidly down a straight road. As the driver makes a sharp left turn, you are pressed against the right side of the car. Explain why this happens.

Before the turn, you are moving straight. When the car turns, you continue to move straight. Your mass resists the acceleration of the car turning. The tendency of mass to resist acceleration is inertia

4. The block is initially moving at a speed of 5 m/s to the right. If no net force acts on it, what will be its subsequent motion?
   a) The block moves to the right and slows down.
   b) The block moves to the right at the same speed.
   c) The block moves to the right and speeds up.
   d) Its subsequent motion cannot be determined without more information.

No force (or balanced forces) allows object to stay in motion.

5. The block, initially moving to the right at 5 m/s, is acted upon by a net force to the left. How will it continue to move?
   a) The block moves to the right at the same speed.
   b) The block moves to the right and slows down.
   c) The block moves to the right and speeds up.
   d) The block moves to the left and slows down.

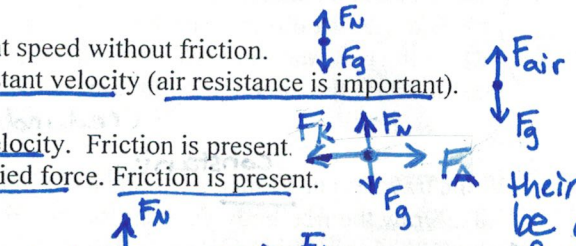
eventually it will stop, turn, and begin moving left. If th force is still present, it will speed

6. If a person gets a bookshelf sliding, and wants to keep it sliding at a constant velocity, they must:
   a) Stop pushing and let inertia keep the shelves sliding. slows down
   b) Apply a force smaller than the kinetic friction. slows down ↑
   c) Apply a force equal to the kinetic friction.
   d) Apply a force greater than the kinetic friction. speeds up

forces must be balanced.

7. Draw free-body diagrams for the following problems. Be sure to draw all the forces with arrows that are of appropriate length to reflect the given descriptions.
   a) Object slides across a horizontal surface at constant speed without friction.
   b) A sky diver falls downward through the air at constant velocity (air resistance is important).
   c) An object is suspended from the ceiling.
   d) An object slides on a horizontal surface at constant velocity. Friction is present.
   e) An wagon accelerates from rest because of an applied force. Friction is present.

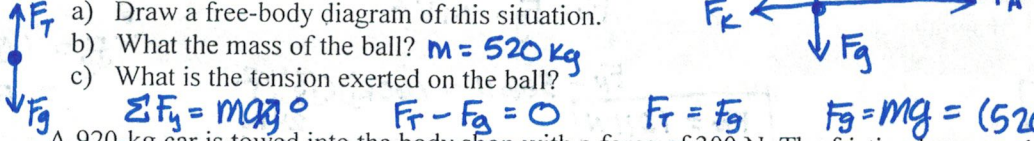
all forces balanced



← unbalanced

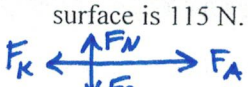
their must be an app force to balance friction

8. A 520-kg wrecking ball is suspended from a cable.
   a) Draw a free-body diagram of this situation.
   b) What the mass of the ball? $m = 520\ kg$
   c) What is the tension exerted on the ball?



$\Sigma F_y = ma_y^0$ $\quad F_T - F_g = 0$ $\quad F_T = F_g$ $\quad F_g = mg = (520\ kg)(9.8\ m/s^2) = 5096$

9. A 920-kg car is towed into the body shop with a force of 300 N. The friction between the car tires and the road surface is 115 N. What is the acceleration of the car?

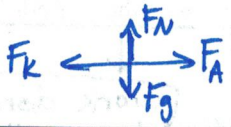


$a_y = 0\ m/s$, question asks for a_x.

$\Sigma F_x = ma_x$ $\quad 300N - 115N = 92$

$F_A - F_K = ma_x$ $\quad a = 0.201$

10. A 55-kg person on a skateboard moves at a constant velocity with a force of 65N. What is the coefficient of friction between the skateboard and the pavement?



$\Sigma F_y = ma_y^0$

$F_N = F_g = (55kg)(9.8\ m/s^2) = 539N$

$\Sigma F_x = ma_x^0$

$F_A - F_K = 0$

$65N - \mu_K F_N = 0$

$65N - \mu_K(539N) =$

$\mu_K = \frac{65N}{539N} =$ 0.

Unit 4 – Motion in 2D

Physics Classroom: Vectors – Motion & Force in 2 Dimensions

Key Vocab Words:

projectile, trajectory, uniform circular motion, centripetal acceleration, centripetal force

Problems:

1. Two balls, one 1.0 kg, the other 3.0 kg, are rolled off the edge of a table at the same speed.
   a) Which ball, if either, travels farther out from the table? same
   b) Which ball, if either hits the ground first? same

mass is not a variable in any motio equations

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 table, it follows a parabolic path to its landing spot on the floor. How far along the floor is this spot from the ta

Horizontal v = k	Vertical a = k = a_g (free fall)
v_{ox} $2\frac{m}{s}$	v_{oy} 0
v_{fx} ?	v_{fy} ?
* Δx (range) ?	Δy (height) $-1m$
a_x 0	a_y $-9.8\frac{m}{s^2}$
t ?	t ?

$\vec{\Delta y} = \vec{v}_{iy}\Delta t + \frac{1}{2}\vec{a}_y(\Delta t)^2$

$-1m = 0 + \frac{1}{2}(-9.8\frac{m}{s^2})(\Delta t)$

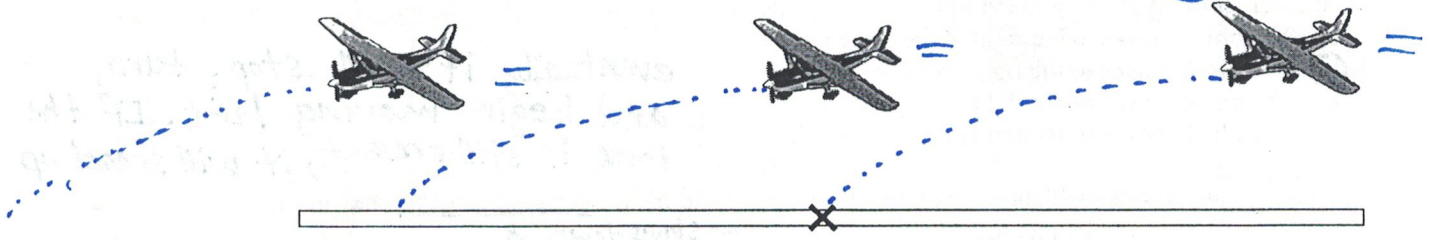
$\Delta t = 0.452s$

$\vec{v}_x = \frac{\vec{\Delta x}}{\Delta t}$, $\Delta x = (2\frac{m}{s})(0.45$

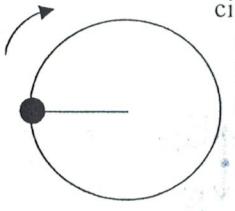
$\Delta x = 0.903$ m

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



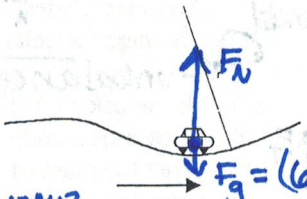
4. The following diagram represents an overhead view of a ball attached to a string that is being spun in a horizontal circle.



a) Indicate the direction of the force acting on the ball. inward →
b) Indicate the direction of the velocity of the ball. upward ↑
c) Indicate the direction of the acceleration of the ball. inward → (same as force)
d) If the ball was suddenly released at the point shown (the black dot), indicate which way the ball would travel. straight up
e) Indicate the direction of the centripetal force acting on the ball. inward → (redundant question)

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? $a_c = \frac{v^2}{r}$

$a_c = \frac{(13\frac{m}{s})^2}{24m} = 7.04\frac{m}{s^2}$

c) What is the magnitude of the normal force acting on you if you are 60 kg?

$\Sigma F_c = ma_c$

$F_N - F_g = m\frac{v^2}{r}$

$F_N - 588N = (60kg)\frac{(13\frac{m}{s})^2}{24m}$

$F_N = 1011N$

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? $W = P_f - P_i = mgh - 0 = (185N)(0.800m) = 148J$ (Work done by applied force to lift)

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

positive work: Force acts in same direction as object moves; energy increases

negative work: opposite; energy decreases

no work: perpendicular; no change in energy

3. In which situation is a person doing work on an object?

+: positive work
−: negative work
0: no work

a) A school crossing guard raises a stop sign that weighs 10 N. +
b) A student walks 1 m/s while wearing a backpack that weighs 15 N. 0 ← trick question. will be discussed in class.
c) A man exerts a 350 N force on a rope attached to a house. 0
d) A worker holds a box 1 m off the floor. 0

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

5. A 950-kg car moves with a speed of 37 m/s. What is its kinetic energy?

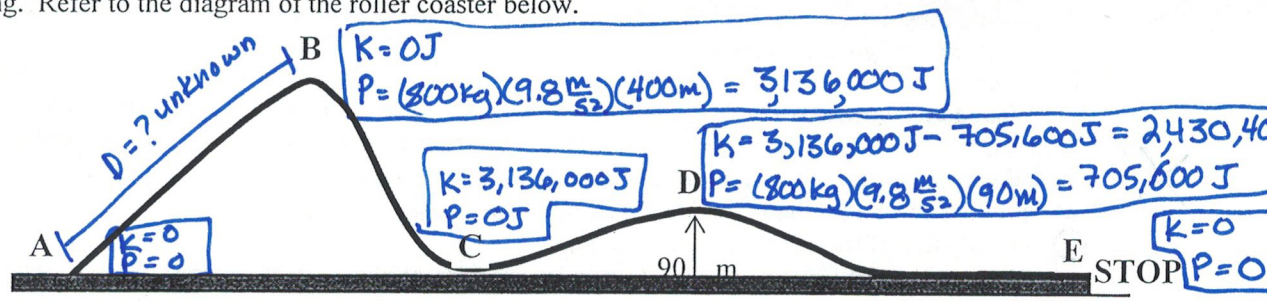
$K = \frac{1}{2}mv^2 = \frac{1}{2}(950\,kg)(37\,\frac{m}{s})^2 =$ **650,275 J**

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? $K_i = \frac{1}{2}(875\,kg)(22\,\frac{m}{s})^2 =$ **211,750 J**, $K_f =$ **847**
   b) How much work was done on the car to increase its speed? $W_{(TOTAL)} = K_f - K_i =$ **635,250 J**

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?

$P_f = mgh = (90\,kg)(9.8\,\frac{m}{s^2})(45\,m) =$ **39,690 J** $(P_i = 0)$

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.



W (applied force) = 3,136,000 J ← b) How much work did the chain do to pull the car to the top of the ride?

$K = \frac{1}{2}mv^2$

$v = 88.5\,\frac{m}{s}$ ← e) How fast is the roller coaster car going at the bottom of the first hill?

$v = 77.9\,\frac{m}{s}$ ← f) If the next hill has a height of 90 m determine the following: GPE, KE and speed.

a) Identify each letter on the diagram as Work, KE, GPE and/or Heat. ✓

c) What is the gravitational potential energy at the top of the ride? ✓

d) What is the kinetic energy at the bottom of the first hill? ✓

$W_{friction} = -3,136,00$

3,136,000 J of energy transferr to environmer as heat

g) If a force of 8000 N is applied to stop the car at the end of the ride, what is the stopping distance?

$W = \pm FD \quad -3,136,000\,J = (-8000\,N)(D)$ **D = 392 m**

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.

$v = \lambda f, \quad (5600\,\frac{m}{s}) = \lambda(2480$

$\lambda = 2.258\,m$

2. If sound travels at 5600 m/s through a steel rod, what is the wavelength, given a wave frequency of 2480 Hz?

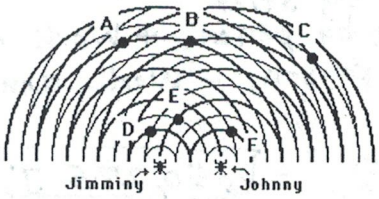
3. **TRUE** or **FALSE** – In order for John to hear Jill, air molecules must move from the lips of Jill to the ears of John.

~~4.~~ What is the Doppler shift? Provide an example of a time when you experienced this phenomenon.

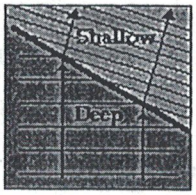
~~5.~~ Ella Fitzgerald has the ability to break glass when she sings. Why does the glass shatter?

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

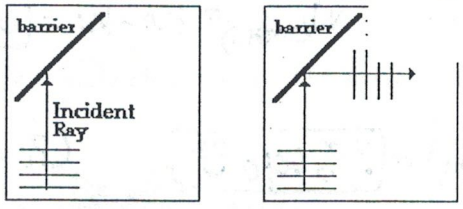
a)



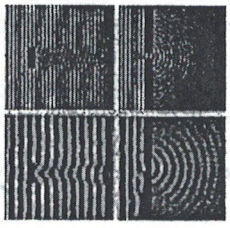
c)



b)



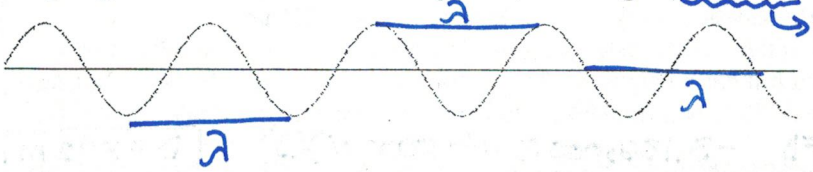
d)



7. Look at the image in problem 6, letter d.
   a) What do the light bands represent?
   b) What do the dark bands represent?
   c) What do the gray fuzzy lines represent?

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.

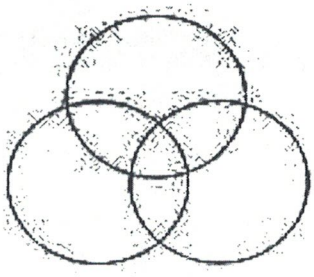
9. Label the following diagram. Include these terms: amplitude, wavelength (all 3 ways to indicate wavelength), node, antinode.



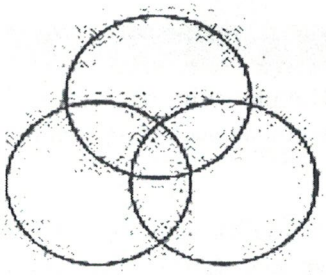
there are more than 3 ways to measure wavele

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

Light

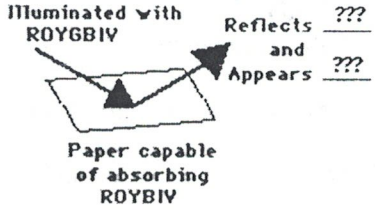


Pigment

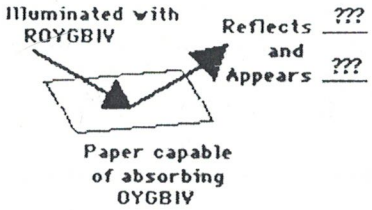


11. The diagrams depict a sheet of paper being illuminated with white light (ROYGBIV). The papers are impregnated with a chemical capable of absorbing one or more of the colors of white light. In each case, determine which color(s) of light are reflected by the paper and what color the paper will appear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

Example A



Example B



12. Explain the difference between a transverse and longitudinal wave. Provide an example of each.

↳ medium ↓ oscillates perpendicular to wave mot
medium oscillates parallel to wave moti

13. How do you create cyan light?

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

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

Unit 7 – Optics

Physics Classroom: Reflection…+ Refraction…

Key Vocab Words:

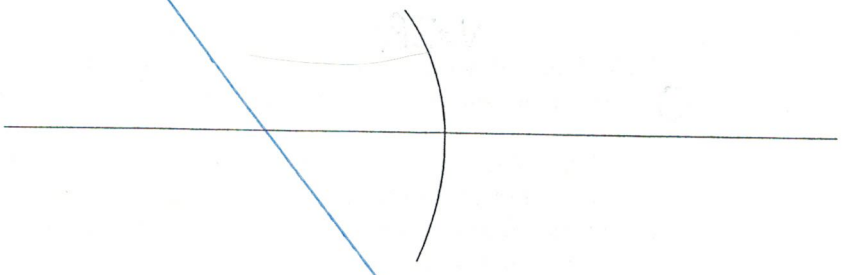
reflection, refraction, angle of refraction, angle of incidence, plane (flat) mirrors, concave converging mirrors, convex diverging mirrors, convex converging lens, concave diverging lens, real, virtual, inverted, upright.

Problems:

1. Answer the following questions as they pertain to mirrors:
    a) Describe the physical properties of the image seen in a plane mirror.
    b) Describe the physical properties of a virtual image.
    c) An object produces a virtual image in a concave mirror. Where is the object located?
    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.
    e) Describe the image seen in a convex diverging mirror.

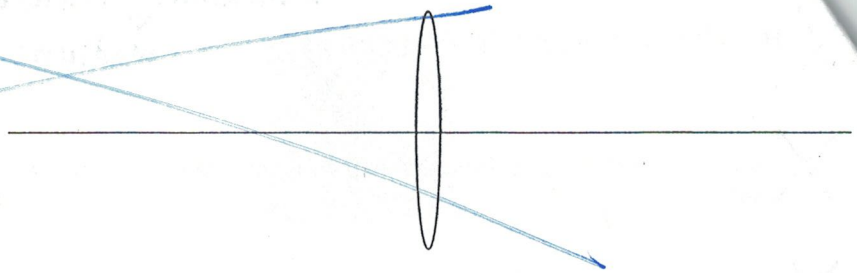
2. Answer the following questions as they pertain to lens:
    a) Describe the physical properties of an image seen in a convex converging lens.
    b) Describe the physical properties of an image seen in a concave diverging lens.

3. An object 2.4-cm high is placed 12.0 cm from a concave converging mirror with a focal point of 3.0 cm.
    a) Draw a ray diagram. Use a ruler to mark f and 2f at equal spacing.



    b) Where will the image be located?
    c) How high is the image?

4. An object that is 4.0 cm high is placed 14.0 cm from a convex converging lens that has a focal length of 9.0 cm.
   a) Draw a ray diagram. Use a ruler to mark f and 2f at equal spacing.



   b) Where will the image be located?
   c) How high is the image?

Unit 8 – Electrostatics

Physics Classroom: Static Electricity

Key Vocab Words:

electrostatics, neutral, insulator, conductor, electroscope, charging by friction, charging by conduction, charging by induction, grounding, electric field, electric field lines

Problems:

1. Describe the steps one would take to charge an object by each of the following ways: friction, conduction, and induction.

2. **TRUE or FALSE** – An object that is positively charged contains all protons and no electrons.

3. **TRUE or FALSE** – An object that is negatively charged could contain only electrons with no accompanying proto

4. **TRUE or FALSE** – An object that is electrically neutral contains only neutrons.

5. A physics student is investigating the charge on several objects and makes findings below. The student knows that object **A is negatively charged and object B is electrically neutral.** What can be concluded about the charge on objects C, D, E and F?

Conclusion
A: −
B: 0
C: −
D: −
E: +
F: +

C cannot be neutral

C same charge as D

F opposite charge as A

Object C	Object D	Object E	Object F
attracts B	repels C	attracts D repels F	attracts A

E same charge as F, D opposite E

6. A rubber balloon possesses a positive charge. If brought near and toucned to the door of a wooden cabinet it sticks t the door. This does not occur with an uncharged balloon. Explain what happens to allow the balloon to stick.

charged balloon causes electrons in door to rotate towards the balloon. Atoms in door become polarized ⊕ ⊖ ⊕

Unit 9 – Electric Circuits

Physics Classroom: Current Electricity

door is insulator so electrons Sta

Key Vocab Words:

electric current, conventional current, electric circuit, resistance, voltage, series circuit, equivalent resistance, parallel circuit, ammeter, voltmeter, kilo-watt hour

nea
thei
nucl

Problems:

V=IR

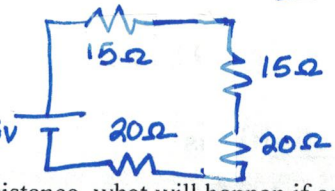
1. Which of the following will cause the current through an electrical circuit to decrease?
   (a.) decrease the voltage b. decrease the resistance c. increase the voltage (d.) increase the resistance

2. A circuit is wired with a power supply, a resistor and an ammeter (for measuring current). The ammeter reads a current of 24 mA (milliAmps). Determine the new current if the voltage of the power supply was…
   a) Increased by a factor of 2 and the resistance was held constant. I×2 ⇒ V×2
   b) Increased by a factor of 2 and the resistance was increased by a factor of 2. I×2 & R×2 ⇒ V×4
   c) Increased by a factor of 3 and the resistance was decreased by a factor of 2. I×3 & R×$\frac{1}{2}$ ⇒ V×$\frac{3}{2}$

V=IR

3. Two 15.0-Ω resistors and two 20.0-Ω resistors (for a total of 4 resistors) are connected in series and placed across a 35.0-V battery.

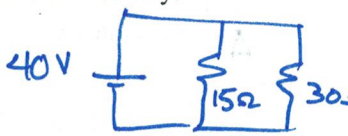
a) What is the equivalent resistance of the circuit? 70Ω
b) What is the value of the current in the circuit? 0.5 A
c) What is the potential drop (**voltage**) across each resistor? 7.5V across each 15Ω, 10V across each 20Ω
d) Calculate the power of each resistor.
e) Calculate the total power in the circuit. $P = IV =$ 17.5W
f) Assuming that the above resistors are light bulbs of given resistance, what will happen if one is unscrewed? all will go dark.



V = IR

4. A 15.0-Ω resistors and a 30.0-Ω resistor are connected in parallel and placed across a 40.0-V battery.

a) What is the equivalent resistance of the circuit? 10Ω
b) What is the value of the current in each branch of the circuit? 2.6A through 15Ω, 1.3A through 30Ω
c) What is the value of the total current through the circuit? 4A
d) Calculate the power of each resistor. $P = \frac{V^2}{R} =$ 106.6W, 53.3 W
e) Calculate the total power in the circuit.
f) Assuming that each of the above resistors are light bulbs of given resistance, what will happen if one is unscrewed? other will stay lit



5. A coffee pot, rated at 950 W, is plugged into a 120-V source and left on for 4 hours

a) How much energy (in kWh) does the coffee pot use? (1000 W = 1 kW).
b) If it costs $0.14 for every kilowatt-hour, how much does it cost to run the coffee pot?

a) $P = \frac{U}{\Delta t}$, $U = P\Delta t$

$U = (0.950\ kW)(4\ hrs) =$ 3.8 kW·hrs

b) $(3.8\ kW \cdot hrs) \times (\$0.14 / kW \cdot hr) =$ $0.54

round up with money

Physics Formulas

Constants $g = 9.8\ m/s^2$ $v_{light} = 3.00 \times 10^8\ m/s$

Basic Motion Definitions

$s = \frac{d}{t}$

$v = \frac{\Delta x}{\Delta t}$

$a = \frac{\Delta v}{\Delta t}$

Motion with Constant Acceleration

~~$\Delta x = v_0 t + \frac{1}{2} a t^2$~~ $\Delta x = v_i \Delta t + \frac{1}{2} a (\Delta t)^2$

~~$v_f = v_0 + at$~~

~~$\Delta x = \frac{1}{2}(v_f + v_i) t$~~ $\Delta x = \frac{1}{2}(v_f + v_i)\Delta t$

~~$v_f^2 = v_0^2 + 2a\Delta x$~~ $v_f^2 = v_i^2 + \frac{1}{2} a \Delta x$

$a = \frac{v_f - v_i}{\Delta t}$

Forces and Newton's Laws

~~$F_{net} = ma$~~ $\Sigma F = ma$

~~$F_g = ma_g$~~ $F_g = mg$

~~$F_f = \mu F_N$~~ $F_k = \mu_k F_N$

~~Momentum~~

~~$p = mv$~~ $F_s = \mu_s F_N$ (max)

Circular Motion

~~$v = \frac{d}{t} = \frac{2\pi r}{T} = 2\pi r f$~~ $v = \frac{2\pi r}{T}$

$a_c = \frac{v^2}{r}$ ✓

~~net $F_c = ma_c = \frac{m v^2}{r}$~~ $\Sigma F_c = ma_c$

Work & Energy

~~$KE = \frac{1}{2} mv^2$~~ $K = \frac{1}{2} mv^2$

~~$GPE = mgh$~~ $P = mgh$

~~$W = Fx$~~ $W = \pm FD$

~~$W = \Delta KE = \Delta GPE$~~ $W = K_f - K_i$, $W = P_f - P_i$ (total) (applied force to lift)

Wave Motion

$v = \lambda f$ ✓

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

Electric Circuits

OHMS' LAW $V = IR$

SERIES ~~$I_{total} = I_1 = I_2 = I_3$~~

$R_{total} = R_1 + R_2 + R_3$

~~$V_{total} = V_1 + V_2 + V_3$~~

PARALLEL ~~$I_{total} = I_1 + I_2 + I_3$~~

~~$\frac{1}{R_{total}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$~~ $R_{eq} = \frac{1}{\frac{1}{R_1} + \dots}$

~~$V_{total} = V_1 = V_2 = V_3$~~

POWER $P = IV = I^2R = \frac{V^2}{R}$

ENERGY $E = Pt = IVt = I^2Rt = \frac{V^2 t}{R}$

Lenses & Mirrors

$\frac{1}{f} = \frac{1}{d_o} + \frac{1}{d_i}$ $\frac{h_i}{h_o} = \frac{-d_i}{d_o}$