Academic Physics

Final Review Packet

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

Unit 1 – Measurement/Introduction

There are no specific questions addressed from this introductory unit

Unit 2 – Motion in 1D

Number of Questions: 19
Chapters in Book: 3 (pgs. 42-61) and 5 (pgs. 80-115)
Key Vocab Words:

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

Problems:

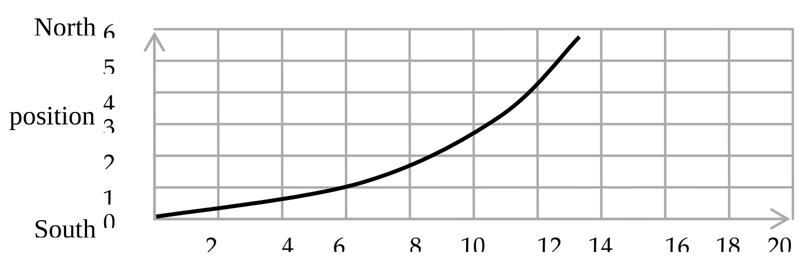
1. An airplane flying at a velocity of 165 m/s accelerates at a rate of 7.0 m/s^2 for 5.0 seconds.
   a) What is the final velocity of the plane?
   b) How far does the plane travel during the 5.0 seconds?

2. 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?

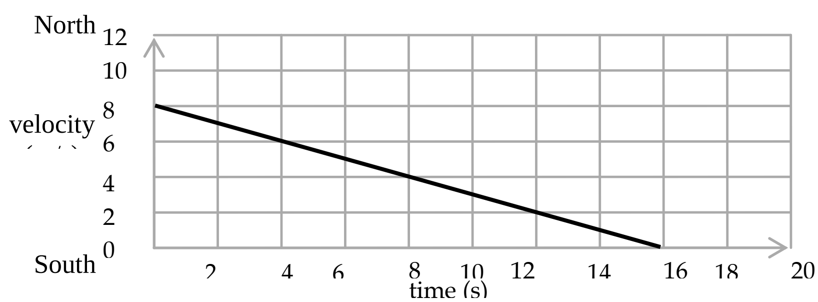
3. A wrecking ball is hanging at rest from a crane when suddenly the cable breaks. The time that it takes to fall to the ground is 2.4 s. How far has the ball traveled during this time?

4. A ball is thrown upward with an initial velocity of 12.0 m/s.
   a) Draw a motion map for the balls movement from the initial throw to the moment it hits the ground. Include both velocity and acceleration arrows.
   b) How much time does it take to reach its maximum height?

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

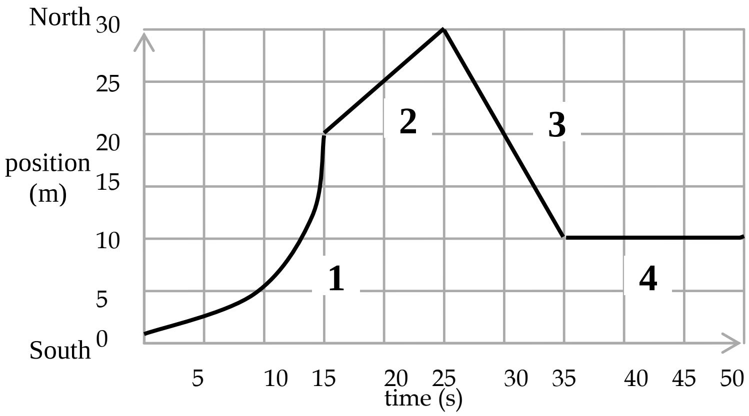


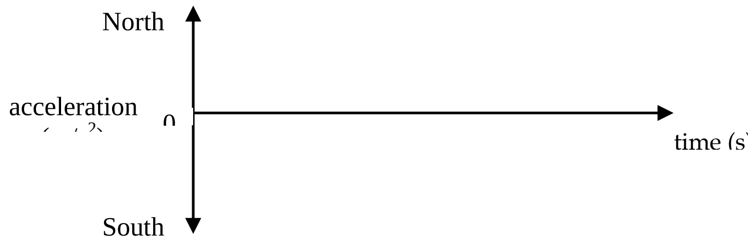
6. Looking at the graph to the right…
   a) Describe the motion of the object.



7. 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).

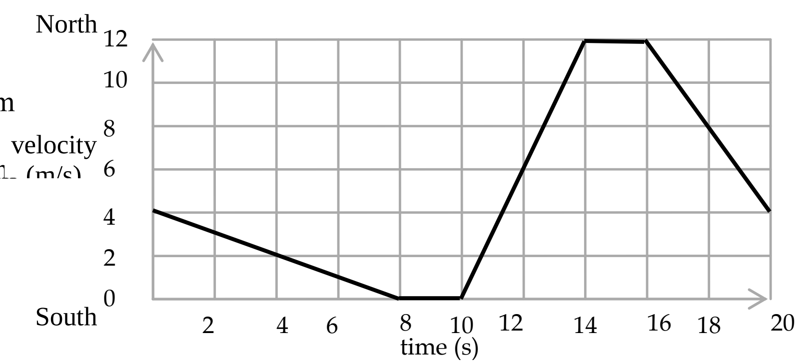
8. Using the position vs. time graph, answer the following questions and construct a velocity vs. time and an acceleration vs. time graph.





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 .

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?



Unit 3 – Newton's Laws

Number of Questions: 19
Chapters in Book: 6 (pgs. 117-147)
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 a bug and a truck windshield collide head-on, explain which one experiences a greater impact force.

2. 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.

3. 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?
   a) If the person in the first question got off and another person double the mass (110 kg) got on, what would the resulting normal force be?

4. What is the momentum of a 0.185-kg softball traveling at 25.5 m/s?

5. 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?

6. 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.

7. 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.

8. If a person gets a bookshelf sliding, and wants to keep it sliding at a <u>constant velocity</u>, they must:
   a) Stop pushing and let inertia keep the shelves sliding.
   b) Apply a force smaller than the kinetic friction.
   c) Apply a force equal to the kinetic friction.
   d) Apply a force greater than the kinetic friction.

9. 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 a horizontal surface at constant velocity; friction is present.

10. What is the gravitational force exerted by a large body, such as Earth called? What is the formula that links this answer to the mass of an object?

11. 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?
   c) What is the tension exerted on the ball?

12. A roller hockey ball is pushed along the road with a force of 5 N. The mass of the ball is 0.8 kg. The force of friction is 2 N.
   a) Draw a free-body diagram and label all the forces.
   b) Calculate the acceleration of the object (if any).

13. A 50.0 kg woman rides in an elevator. While the elevator is accelerating *upward* at 2.5 m/s^2, what is her apparent weight (F_N)?

Unit 4 – Motion in 2D

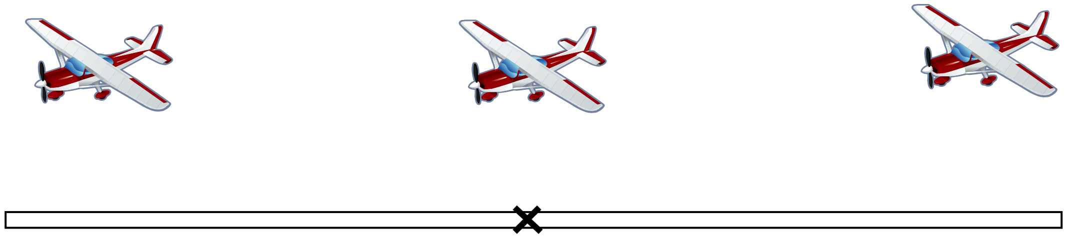
Number of Questions: 5
Chapters in Book: 7 (pgs. 149-173)
Key Vocab Words:
projectile, trajectory, uniform circular motion, centripetal acceleration, centripetal force
Problems:

1. 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? (This problem continues on the next page)

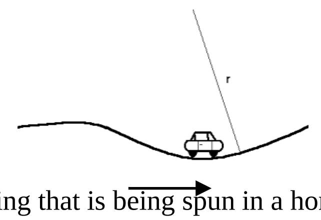
<u>Horizontal</u> **v = k**	**<u>Vertical</u>** **a = k = a_g (free fall)**
v_{ix}	v_{iy}
v_{fx}	v_{fy}
x (range)	**y (height)**
a_x	a_y
t	**t**

2. 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?
   b) Which ball, if either hits the ground first?

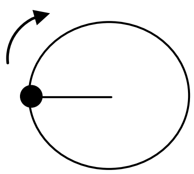
3. Which position should the airplane drop its cargo to hit the target?
   a. A b. B c. C



4. 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?



5. 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.



Unit 5 – Work & Energy

Number of Questions: 12
Chapters in Book: 10-11 (pgs. 223-271)
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?

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

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.
   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.
   d) A worker holds a box 1 m off the floor.

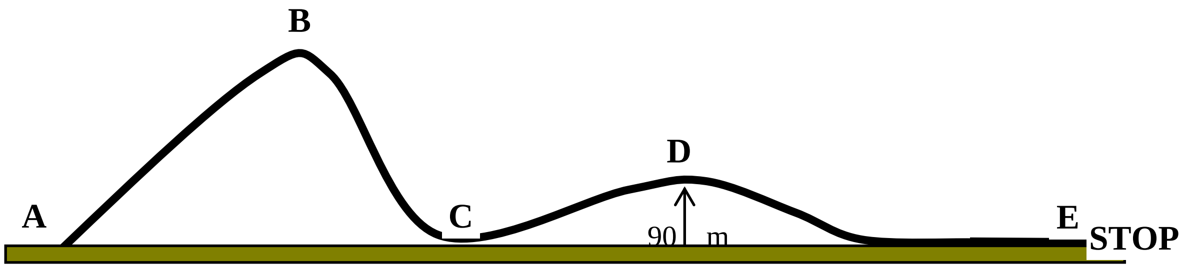
4. Define each of the following scenarios as positive work, negative work or no work.
   a) Lifting a bag of groceries.
   b) A hockey puck pushed across the ice.
   c) Lowering a crate of books to the floor.
   d) Sliding a box across the floor.

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

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?
   b) How much work was done on the car to increase its speed?

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?

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?
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?
e) How fast is the roller coaster car going at the bottom of the first hill?
f) If the next hill has a height of 90 m determine the following: GPE, KE and speed.
g) If a force of 8000 N is applied to stop the car at the end of the ride, what is the stopping distance?

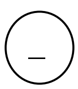
Unit 6 – Electrostatics

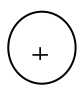
Number of Questions: 6
Chapters in Book: 20-21.1 (pgs. 461-487)
Key Vocab Words:
electrostatics, neutral, insulator, conductor, electroscope, charging by friction, charging by conduction, charging by induction, grounding, electric field, electric field lines
Problems:

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

2. If 1 C = 6.25×10^{18} electrons, how many electrons are present if you have 4 C of charge?

3. Draw the field lines for the following charges.

a)


b)


c)


4. Metal sphere A has a charge of + 8 C charge and metal sphere B has a – 2 C charge. Initially the spheres are isolated from one another. If the two spheres are brought together, touched, and then separated again. What is the final charge on each sphere?

Unit 7 – Electric Circuits

Number of Questions: 13
Chapters in Book: 22-23 (pgs. 507-553)
Key Vocab Words:
electric current, conventional current, electric circuit, resistance, voltage, series circuit, equivalent resistance, parallel circuit, ammeter, voltmeter, kilo-watt hour
Problems:

1. 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?
   b) What is the value of the current in the circuit?
   c) What is the potential drop (**voltage**) across each resistor?
   d) Calculate the power of each resistor.
   e) Calculate the total power in the circuit.
   f) Assuming that the above resistors are lightbulbs of given resistance, what will happen if one is unscrewed?

2. 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?
   b) What is the value of the current in each branch of the circuit?
   c) What is the value of the total current through the circuit?
   d) Calculate the power of each resistor.
   e) Calculate the total power in the circuit.
   f) Assuming that each of the above resistors are lightbulbs of given resistance, what will happen if one is unscrewed?

3. 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?

Unit 8 – Wave Motion

Number of Questions: 15
Chapters in Book: 14-15 (pgs. 327-371)
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

Problems:

1. 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)

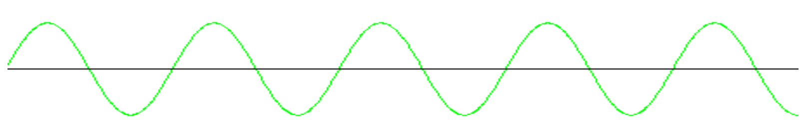
2. If sound travels at 5600 m/s through a steel rod, what is the wavelength, given a wave frequency of 2480 Hz?

3. Look at the image in problem 1, letter c.
   a) What do the light bands represent?
   b) What do the dark bands represent?
   c) What do the gray fuzzy lines represent?

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



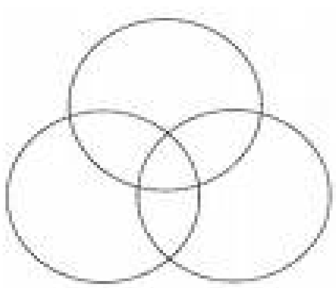
Unit 9 – Optics

Number of Questions: 11
Chapters in Book: 16-19 (pgs. 373-459)
Key Vocab Words:

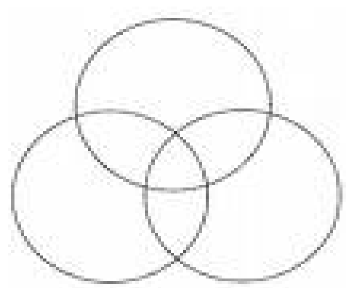
light, electromagnetic spectrum, primary color, secondary color, dye, pigment, primary pigment, secondary pigment, polarized, reflection, refraction, angle of refraction, angle of incidence, plane (flat) mirrors, concave converging mirrors, convex diverging mirrors, convex converging lens, concave diverging lens, real, virtual, inverted, upright.

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

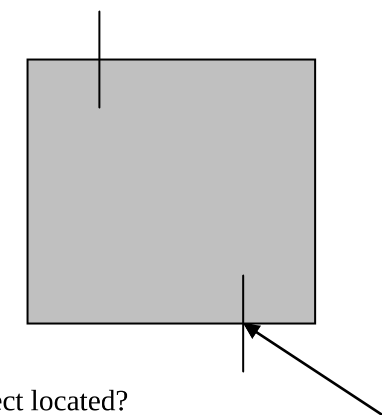
Light



Pigment



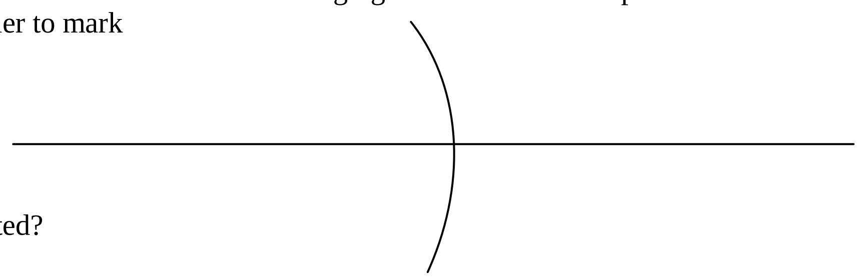
2. a) Define refraction.
   b) Complete the following diagram for light that passes from air to glass (gray square) and then from glass to air. (Hint: How does light bend with a change in speed?) Remember the perpendicular lines represent the normal.



3. 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.

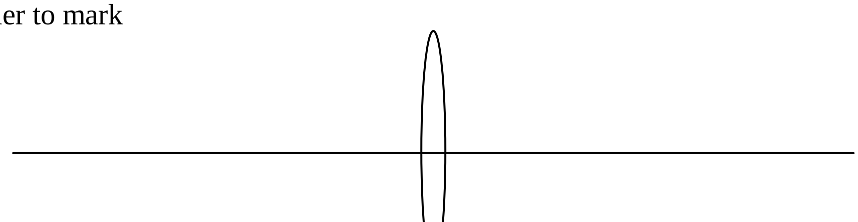
4. Answer the following questions as they pertain to lens:
   a) Describe the physical properties of an image seen in a convex converging lens.
   b) Describe the physical properties of an image seen in a concave diverging lens.

5. 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?

6. 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?

Physics Formulas

Constants $a_g = 9.8\ m/s^2$ $1\ C = 6.25 \times 10^{18}$ electrons $v_{light} = 3.00 \times 10^8\ m/s$

Basic Motion Definitions

$\Delta x = x_f - x_i$

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

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

Motion with Constant Acceleration

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

$v_f = v_i + at$

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

$v_f^2 = v_i^2 + 2ax$

Forces and Newton's Laws

net $F = ma$

$F_g = ma_g$

$F_f = \mu F_N$

Momentum

$p = mv$

Circular Motion

$v = \frac{x}{t} = \frac{2\Pi r}{t}$

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

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

Work & Energy

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

$GPE = ma_g h$

$W = Fx$

$W = \Delta KE = \Delta GPE$

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

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

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

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

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

Lenses & Mirrors

$\frac{1}{f} = \frac{1}{d_o} + \frac{1}{d_i}$

$\frac{h_i}{h_o} = \frac{-d_i}{d_o}$