

Building Physics Books of Knowledge

Grade Level: Eighth Grade Science

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Length of Unit: 7 lessons

I. ABSTRACT

The culminating activity for this physics unit is the creation of a book that showcases the concepts learned in our physics unit. These books will include physics-inspired examples of poetry, geometry, architecture, trigonometry, and physics used in everyday life. Learn to make this interesting, compact book, and how to integrate a science concept with several other Core Knowledge subjects.

II. OVERVIEW

A. Concept Objectives

1. Develop an awareness of the presence of physics concepts in everyday life.
2. Learn the methods for applying physics formulae to everyday problems.
3. Instill confidence that physics is an approachable subject.

B. Content from the *Core Knowledge Sequence*

1. The concept of force: force as a push or pull that produces a change in the state of motion of an object.
2. Unbalanced forces cause a change in velocity
3. Velocity and speed
4. In physics, work is a relation between the force and distance: work is done when force is exerted over a distance.
5. In physics, power is a relation between work and time: a measure of the work done and the time it takes to do it.
6. Review poetry forms

C. Skill Objectives

1. Students define terms related to physics.
2. Students calculate problems using physics formulas.
3. Students compare physical features of post-Industrial Revolution architecture.
4. Students summarize concepts learned in this unit by creating a book

III. BACKGROUND KNOWLEDGE

A. For Teachers

1. Hecht, Eugene *Schaum's Outline of College Physics*. New York: McGraw-Hill Trade, 9th edition (June 1, 1997); ISBN: 0070089418;

B. For Students

1. Padilla, M. *Motion, Forces and Energy*. Massachusetts: Prentice Hall, 2000. 0134344928

IV. RESOURCES

- A. Nye, Bill "Powerful Forces, All Pumped Up" Disney Studios, 1993. ASIN: 6303439322
- B. McKeever, S. *The DK Science Encyclopedia*. New York: DK Publishing, 1994 ISBN: 1-56458-328-7

V. LESSONS

Lesson One: Introduction to Physics Ideas

- A. *Daily Objectives*
1. Concept Objective(s)
 - a. Develop an awareness of the presence of physics concepts in everyday life.
 - b. Learn the methods for applying physics formulae to everyday problems.
 2. Lesson Content
 - a. The concept of force: force as a push or pull that produces a change in the state of motion of an object.
 3. Skill Objective(s)
 - a. Students define terms related to physics.
 - b. Students calculate problems using physics formulas
- B. *Materials*
1. *Motion, Forces and Energy* Textbook
 2. Physics Phormulas (Appendix A)
 3. Long rope
 4. large brass (or otherwise sturdy) ring
 5. A spring scale, optional
- C. *Key Vocabulary*
1. Physics: the science that deals with matter and energy in terms of motion and force.
 2. Vector – A vector is very simply a drawing of a force, as shown by an arrow pointing the direction of the force. A longer arrow is a greater force.
 3. Speed – distance divided by time
- D. *Procedures/Activities*
1. Read through with students the section on motion. Ch.2 sec.1.
 2. Answer in text question to assess for comprehension.
 3. Introduce Physics Phormulas sheet to students, this sheet will be used throughout our studies, so make sure it is in your binder.
 4. Introduce the graphic representation of a force by handing the rope to a student and pulling on your end of the rope until your body forms a sixty-degree angle with the floor. This equals one teachers unit of force. At this point you can use the spring scale to get an exact measure of each force.
 5. Have the same student hold the rope while other people (of various sizes) pull on the rope to the same standards.
 6. Discuss the differences between the different forces on the rope, and show with the rope length the different forces. A rope that was twice as long would represent a teacher who pulled twice as hard as a student.
 7. Have a student hold the large brass ring, and tread the rope through the ring.
 8. Have two different sized students pull as was done before, at different angles , and observe the movement of the ring bearer. This represents both two forces acting at once, and (if done at right angles) the vertical and horizontal angles of a force.
- E. *Assessment/Evaluation*
1. Section questions from the textbook
 2. Have students explain how rope size relates to force size. (Longer rope length represents larger force.)

Lesson Two: SOH, CAH, TOA

- A. *Daily Objectives*
1. Concept Objective(s)
 - a. Learn the methods for applying physics formulae to everyday problems.
 2. Lesson Content
 - a. The concept of force: force as a push or pull that produces a change in the state of motion of an object.
 3. Skill Objective(s)
 - a. Students calculate problems using physics formulas.
- B. *Materials*
1. Physics Phormulas sheet (Appendix A)
 2. Physics Problems sheet (Appendix B)
- C. *Key Vocabulary*
1. SIN- trigonometry function that figures out an angle if you already know the length of the opposite and hypotenuse sides.
 2. COS- trigonometry function that figures out an angle if you already know the length of the adjacent and hypotenuse sides.
 3. TAN- trigonometry function that figures out an angle if you already know the length of the opposite and adjacent sides.
 4. Pythagorean Formula- Relation ship of a right triangle such that the length of the longest side squared, is equal to the length of each of the shorter sides squared and added together.
- D. *Procedures/Activities*
1. Write out the 9 letters SOH CAH TOA on the board. Ask students what they think these letters mean.
 2. Tell them that “way back in the dark ages of math” scientists figured out that a triangle was a unique shape. If you knew the length of 2 sides you could figure the length of the third by using the Pythagorean Formula.
 3. They also knew that if you knew the length of only one side, and the size of one angle you could figure the length of all the other sides.
 4. Explain how SOH stands for “The SIN of an angle equals the Opposite side length divided by the Hypotenuse side length.
 5. Explain how CAH stands for “The COS of an angle equals the Adjacent side length divided by the Hypotenuse side length.
 6. Explain how TOA stands for “The TAN of an angle equals the Opposite side length divided by the Adjacent side length.
 7. Practice repeatedly by giving students either two side lengths (and they figure the third side by the Pythagorean formula, or an angle size by any of the trig functions) or an angle size and a side length. (and they figure the side lengths through the trig functions.)
- E. *Assessment/Evaluation*
1. Students should be asked to do at least 10 practice problems showing their ability to work from knowing two sides and figuring an angle, to knowing a side and angle and calculating all three sides. The Questions on Appendix B are a good judge of understanding

Lesson Three: Trig to figure out real life questions

- A. *Daily Objectives*
1. Concept Objective(s)

- a. Develop an awareness of the presence of physics concepts in everyday life.
 - b. Learn the methods for applying physics formulae to everyday problems.
 - c. Instill confidence that physics is an approachable subject.
 - 2. Lesson Content
 - a. The concept of force: force as a push or pull that produces a change in the state of motion of an object.
 - b. Unbalanced forces cause a change in velocity
 - 3. Skill Objective(s)
 - a. Students calculate problems using physics formulas.
- B. *Materials*
 - 1. Physics Questions sheet (Appendix C)
 - 2. NERDS Assistance sheet (Appendix D)
- C. *Key Vocabulary*
 - 1. Newton- the unit of force in metrics. Defined as the force required to give an acceleration of one meter per second per second to a mass of one kilogram.
- D. *Procedures/Activities*
 - 1. Distribute the Physics Questions sheet (has the kite flyer) and the NERDS sheet (Appendix D)
 - 2. Tell students they must draw a picture of each problem before doing the calculations.
 - 3. By drawing the triangles involved, students can more clearly see what they have, what they need and how to get what they want.
 - 4. By using the NERDS format, students who have trouble in math can more easily lay out what they have and how they can sort through all of the formula to figure out what they need.
 - 5. Students work in table groups (4 per table) to figure out questions on Physics Question sheet
- E. *Assessment/Evaluation*
 - 1. Teacher monitors for student understanding during class.

Lesson Four: Buildings, Height and Motion Formulas

- A. *Daily Objectives*
 - 1. Concept Objective(s)
 - a. Develop an awareness of the presence of physics concepts in everyday life.
 - b. Learn the methods for applying physics formulae to everyday problems.
 - c. Instill confidence that physics is an approachable subject.
 - 2. Lesson Content
 - a. The concept of force: force as a push or pull that produces a change in the state of motion of an object.
 - b. Unbalanced forces cause a change in velocity
 - c. Velocity and speed
 - 3. Skill Objective(s)
 - a. Students define terms related to physics.
 - b. Students calculate problems using physics formulas
 - c. Students compare physical features of post-Industrial Revolution architecture.

- B. *Materials*
 - 1. Physics Phormulas (Appendix A)
 - 2. Architecture sheet (Appendix E)
- C. *Key Vocabulary*
 - 1. Acceleration – The rate at which speed increases
- D. *Procedures/Activities*
 - 1. Distribute the Architecture sheet (Appendix E)
 - 2. Have a list of possible post-industrial revolution buildings for the students to research on the internet. Have them choose three and find ten things that make these buildings alike. Builds can include: Empire State Building, Chrysler Building, Eiffel tower, Crystal Palace, Falling Water, Villa Savoye, Notre Dame du Haut, and the Seagram building.
 - 3. Discuss with class the things that make this form of art unique (clean lines, simple, organized shapes)
 - 4. Using the velocity calculation, students are to determine the velocity at which a penny would be traveling if it hit the ground after falling from each building.
 - 5. For example if a penny fell from the 447-meter Empire State Building, it would be traveling 93 m/s on impact (neglecting air resistance. (that’s over 209 miles per hour.
 - 6. Myriad questions can be posed from knowing the height of buildings, such as “how fast would X fall from this building?”, “If a penny falls for 5 seconds, how tall is the building?”, “What is the speed of the penny if it spends 20 seconds falling?” etc.
- E. *Assessment/Evaluation*
 - 1. Teacher monitors for student understanding during class.

Lesson Five: Power and Work

- A. *Daily Objectives*
 - 1. Concept Objective(s)
 - a. Develop an awareness of the presence of physics concepts in everyday life.
 - b. Learn the methods for applying physics formulae to everyday problems.
 - c. Instill confidence that physics is an approachable subject.
 - 2. Lesson Content
 - a. In physics, work is a relation between the force and distance: work is done when force is exerted over a distance.
 - b. In physics, power is a relation between work and time: a measure of the work done and the time it takes to do it.
 - 3. Skill Objective(s)
 - a. Students define terms related to physics.
 - b. Students calculate problems using physics formulas
- B. *Materials*
 - 1. Stairs
 - 2. large backpack
 - 3. sand
 - 4. coffee cans
 - 5. metronome (or students who will clap at regular intervals)
 - 6. colored paper (or something to mark the steps everyone will step on)

7. Power Sheet (Appendix F) and pencil to calculate work and power.
- C. *Key Vocabulary*
1. Work is a relation between the force and distance: work is done when force is exerted over a distance. $(m \cdot a) \cdot d$
 2. In physics, power is a relation between work and time: a measure of the work done and the time it takes to do it. $[(m \cdot a) \cdot d] / t$
- D. *Procedures/Activities*
1. Give students the definition of work and power.
 2. Tell students that force is equal to mass times acceleration
 3. In our demonstration, students stepping on the first step, then the third step, and then the 6th step will show acceleration. We have roughly $\frac{1}{4}$ meter steps, and the students step on the next step each half second, so our acceleration is $.50 \text{ m/s}^{2+}$, and our distance is 1.5 meters
 4. Non-stepping students will clap every half second (120 beats per minute)
 5. The mass of the students who wish to participate will be measure in kilograms, and if they can move from step to step every half second they will be given a backpack with a coffee can filled with sand.
 6. After each completed run another can will be added. I have students start from a stop at the base of the stairs and only take the three steps. This decreases the chances of someone falling and getting hurt. WARN students about slipping, and only let students in good gym shoes participate.
 7. Once a student has too much weight to maintain their steady acceleration, go back to the last time they completed successfully. This will be their power numbers
 8. The numbers needed are: Weight in kilograms (body plus the sand), acceleration ($.50 \text{ m/s}^2$), the time to complete the task, 1.5 sec, and the distance traveled (1.5 meters). Power in this case will only vary based on weight carried. To calculate the power, take weight carried, multiplied by the acceleration, and that answer multiplied by the distance. This answer is then divided by the time it took to move up the stairs.
- E. *Assessment/Evaluation*
1. Make sure every student can calculate their power, or the power of someone else.

Lesson Six: Poetry and Physics

- A. *Daily Objectives*
1. Concept Objective(s)
 - a. Develop an awareness of the presence of physics concepts in everyday life.
 - b. Learn the methods for applying physics formulae to everyday problems.
 - c. Instill confidence that physics is an approachable subject.
 2. Lesson Content
 - a. Review poetry forms
 3. Skill Objective(s)
 - a. Students define terms related to physics.
- B. *Materials*
1. Poetry and Physics sheet (Appendix G)
- C. *Key Vocabulary*
1. Haiku (3 unrhymed lines of 5, 7, and 5 syllables)
 2. Alliteration (Starting sound repeated)

3. Limerick (AABBA rhyming format, with 8,8,6,6,8 syllables)
 4. Ballad (Simple rhyming stanzas, often intended to be sung)
 5. Onomatopoeia (words that sound like the words they represent)
- D. *Procedures/Activities*
1. Present students with Appendix G, Poetry and Physics.
 2. Review with them the types of poems listed on the sheet, and solicit suggestions for other types of poetry, and how they are used
 3. Have students write at least three examples of physics-related poetry
 4. The key to this lesson is having them think about physics concepts in their lives. The goal is for each student to be unique and creative in thinking about a school topic in a setting that is not related to school.
 5. More than one period might be necessary
- E. *Assessment/Evaluation*
1. Have volunteers share their poetry.

Lesson Seven: Building Physics Books of Knowledge

- A. *Daily Objectives*
1. Concept Objective(s)
 - a. Instill confidence that physics is an approachable subject.
 2. Lesson Content
 - a. The concept of force: force as a push or pull that produces a change in the state of motion of an object.
 - b. Unbalanced forces cause a change in velocity
 - c. Velocity and speed
 - d. In physics, work is a relation between the force and distance: work is done when force is exerted over a distance.
 - e. In physics, power is a relation between work and time: a measure of the work done and the time it takes to do it.
 - f. Review poetry forms
 3. Skill Objective(s)
 - a. Students summarize concepts learned in this unit by creating a book.
- B. *Materials*
1. All materials are listed per student
 2. 5 – 5” squares of heavier weight paper (ex: drawing paper)
 3. 2 – 2 ¾” squares of mat board
 4. 2- 3 ¼” squares of decorative cover paper (ex: rice paper, scrapbook paper, wrapping paper)
 5. 1 glue stick (UHU brand works well)
 6. scissors
 7. Book Making sheet (Appendix H)
- C. *Key Vocabulary*
1. Cootie-Catcher fold- a set of three folds one diagonal, and the other two in half length-wise in the opposite direction. Made to somewhat resemble the cootie-catcher folded paper so familiar to most children
- D. *Procedures/Activities*
1. Teachers: make a book before describing the process to you students
 2. Seeing the end product will give them an idea of where the project is going.

3. Have students decorate their 5” squares of paper with their poetry, examples of measuring height, velocity formulas and examples, power and work samples, and any other artistry they wish to include.
 4. Once they have decorated one side of each paper, they are to fold each sheet as directed on the bookmaking sheet, and alternately glue their pages together.
 5. Students add covers and tie strings to complete their books
 6. Share books with parents, administration, teachers and students
- E. *Assessment/Evaluation*
1. Assess books for comprehension of knowledge.

VI. CULMINATING ACTIVITY

- A. See Lesson Seven

VII. HANDOUTS/WORKSHEETS

- A. Appendices A - H

VIII. BIBLIOGRAPHY

- A. Hecht, Eugene *Schaum's Outline of College Physics*. New York: McGraw-Hill Trade, 9th edition (June 1, 1997); ISBN: 0070089418;
- B. Padilla, M. *Motion, Forces and Energy*. Massachusetts: Prentice Hall, 2000. 0134344928
- C. Nye, Bill “Powerful Forces, All Pumped Up” Disney Studios, 1993. ASIN: 6303439322
- D. McKeever, S. *The DK Science Encyclopedia*. New York: DK Publishing, 1994 ISBN: 1-56458-328-7
- E. Schweitzer, Angie *Bookmaking Handout*. Aurora CO, 2003 Gateway High School (303) 755-7160
- F. <http://www.tour-eiffel.fr/teiffel/uk/ludique/postale/index.html>
- G. <http://www.chryslerbuilding.org/index2.html>
- H. <http://www.aviewoncities.com/nyc/empirestate.htm>

Appendix A
Physics Phormulas
 Getting to the point

Physics: (fiz' iks) n. the science that deals with matter and energy in terms of motion and force.

We are now going to branch out into the topics of force, and motion.

VECTORS – A vector is very simply a drawing of a force. It allows us to picture something that otherwise is not visible. By understanding a vector, we can learn about speed, acceleration, and movement. Vectors can be turned into right triangles with a vertical part and a horizontal part.

In the space below are written the four formulas that help us figure out vectors. The Pythagorean formula and SOH CAH TOA.

$A^2 + B^2 = C^2$

The length of the hypotenuse squared (C) is equal to the two shorter (A and B) sides squared and added together.

SOH →

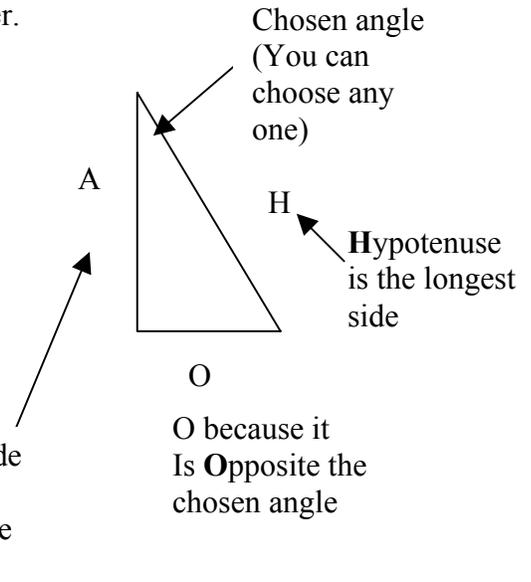
SIN of an angle = $\frac{\text{Opposite length}}{\text{Hypotenuse length}}$

CAH →

COS of an angle = $\frac{\text{Adjacent length}}{\text{Hypotenuse length}}$

TOA →

TAN of an angle = $\frac{\text{Opposite length}}{\text{Adjacent length}}$



If you have two pieces of information, you can find out a third piece of information by finding the formula that has the two known numbers, and the desired information.

(hint: SIN, COS, and TAN are found on your scientific calculator, and are usually entered as SIN of angle 55°)

MOTION – What follows are several formulas that will help you determine the acceleration, speed, displacement, distance or time that an object traveled.

Distance = d Ex. 10 feet, 25 meters, 26.2 miles
Time = t Ex. 10 mins, 3 seconds, 365 days
Speed = v (for velocity) Ex. 55 miles per hour, 10 feet per second
Starting speed (at time zero) = V_o
Finish speed = V_f

Thus the formula for speed is:

$$\text{speed} = \frac{\text{distance}}{\text{time}}$$

AVERAGE VELOCITY – the average velocity is the final velocity minus starting velocity divided by two.

$$\bar{v} = \frac{v_f - v_o}{2}$$

ACCELERATION – is a measurement of how much something speeds up or slows down. This is found by taking the final speed, subtracting the starting speed and dividing by the time it took. Or...

$$a \text{ (acceleration)} = \frac{v_f - v_o}{t}$$

DISPLACEMENT – is how far you have gone compared to your starting point.

$$x = \bar{v} \text{ times } t$$

TWO MORE THAT MIGHT HELP

$$(v_f)^2 = (v_o)^2 + 2ax$$

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

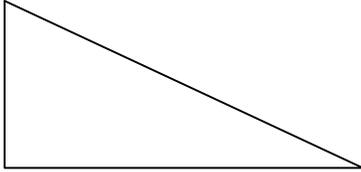
WORK = Force over time

POWER = Force over distance

Appendix B

For the following problems, please label the sides of the triangle. Assume all triangles are right triangles. Remember, A and B are the short sides of the triangle, and C is the hypotenuse in Pythagoras' Theorem.

1.

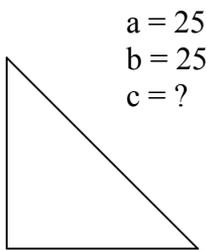


2.

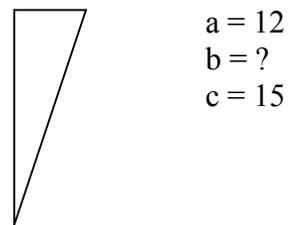


For the following problems, label the sides, and determine the length of the sides using the Pythagorean theorem.

3.

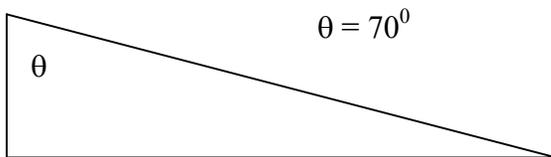


4.

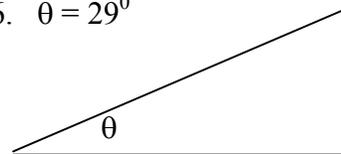


For the following problems, label the sides and determine the length of the sides using the triangle angle theorem.

5.



6. $\theta = 29^\circ$



SOH CAH TOA

If you know this, you will always know which formula to use.

$$\sin \theta = \frac{\text{Opp}}{\text{Hyp}}$$

$$\cos \theta = \frac{\text{Adj}}{\text{Hyp}}$$

$$\tan \theta = \frac{\text{Opp}}{\text{Adj}}$$

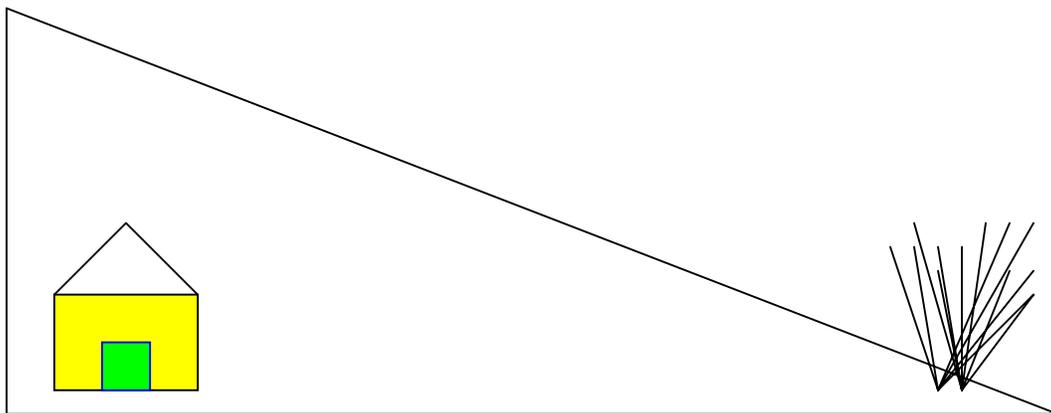
If you know two angles and a side, you can figure out any other side.

7. If you know θ is 12° , and the hypotenuse is 12 miles, how long is the opposite side?

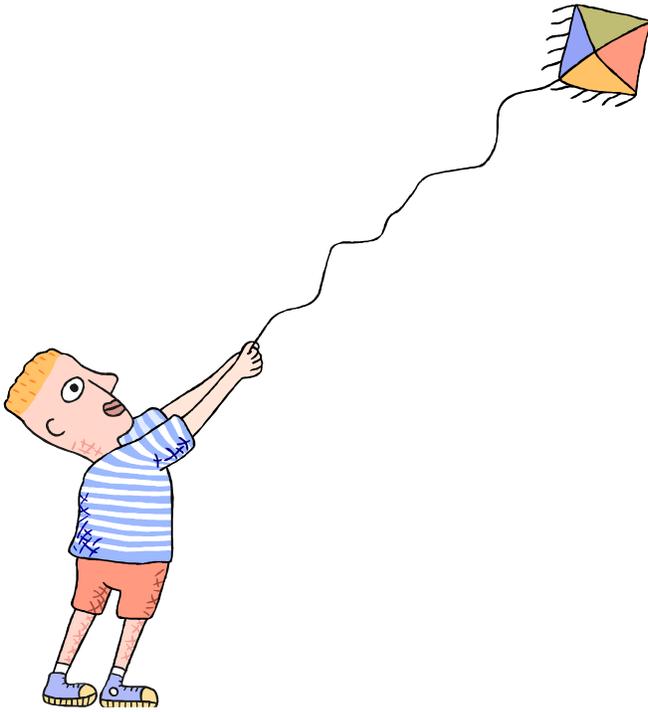
8. If you know θ is 75° , and the adjacent side is 324 nanometers, how long is the opposite side?

9. The adjacent side is desired, and the opposite side is 12,000 ft long, with θ being 89° .

10. Mr. Larson has a right triangular yard, as pictured below. He wants to know how many square feet of fencing he will need to buy to enclose his entire yard. He knows the longest side is 145 feet long, and the angle near the broken sprinkler is 23° . How much fence will Mr. Larson need to buy?

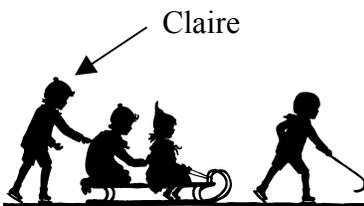


Appendix C



Randy is pulled by his kite. The force is equal to 100 N. If the angle between his arms and the ground is 40° , what is the force that pulls Randy in the x direction? What is the force of the kite in the y-direction?

If the wagon is being pulled by a ghost at a force of 50 N, what is the force in both the x and y directions. The angle between the handle and the ground is 30° .

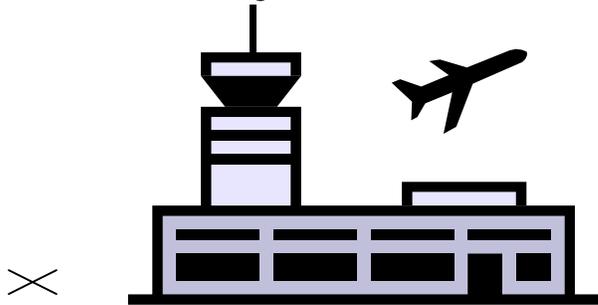


Claire pushes her little sisters on the sled. If she pushes at an angle of 60° , and a force of 30 N, what is the actual force forward (x-direction) that she pushes her sisters?



Super Business Man takes off to calculate more taxes. He flies at an angle of 45° to the ground. How far must he travel before he is 1 mile off the ground?

If a plane takes off at an angle of 36° , and flies for 1200 feet, how far off the ground is it?



How tall is the air traffic control tower if you are standing on the "X" 100 meters away and the angle to the top of the tower is 30 degrees?

Appendix D

How to Solve Physics Problems

A step-by-step approach

The first thing you will need to do is draw 5 boxes, like so...

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The second step involves labeling the boxes, like so...

NEED	EXAMINE	RECORD	DECIDE/ DRAW	SOLVE
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The clever among you will notice that these boxes should be easy to remember, based on the first letter of each box. NERDS, that's right, NERDS.

N 1. NEEDS: Identify the one piece of information you are looking to find. It is usually stated clearly in the problem.

E 2. EXAMINE: Look at the whole problem to find all available information.

R 3. RECORD: Write down all of the available information.

D 4. DECIDE / DRAW: Find the formula that includes both what you need, and the information you have. If you still have a problem, draw a diagram.

S 5. SOLVE: Replace the variables in the problem with the information you have.
Solve the problem.

KEY:

- Remember that Whatever you do on one side you must do to the other, It is just a math fact.
- Double check, do you need to make conversions????????????????????

Using NERDS to Solve Problems

The following is a step-by-step example of the NERDS approach.

1. **Problem 1:** Racecar Driver Stanley enjoyed drag racing for the thrill, and the prize money. He likes to brag that he once crossed the finish line at 1775 meters per second. If he started from a dead stop, and traveled 10,000 meters (about 6.2 miles) What was his average speed?

The first thing you will need to do is draw 5 boxes, like so...

--	--	--	--	--

The second step involves labeling the boxes, like so...

NEED	EXAMINE	RECORD	DECIDE	SOLVE
------	---------	--------	--------	-------

N 1. **NEEDS:** Identify the one piece of information you are looking to find. It is

usually stated clearly in the problem.

E 2. **EXAMINE:** Look at the whole problem to find all available information.

R 3. **RECORD:** Write down all of the available information.

D 4. **DECIDE:** Find the formula that includes both what you need, and the

information you have.

S 5. **SOLVE:** Replace the variables in the problem with the information you have.

Solve the problem.

The next step involves filling in all of the known information

NEED	EXAMINE	RECORD	DECIDE	SOLVE
— v		$V_f =$ 1775m/s $x =$ $10,000\text{m}$ $V_o = 0$	$\bar{V} = \frac{V_f - V_o}{2}$	$\bar{V} = \frac{1775 - 0}{2}$ $\bar{V} = 887.5$ m/s

Helpful hints:

x = displacement
 much time did this take?

Question 2: how

v = velocity
 acceleration?
 t = time
 run 8 meters per second, and
 a = acceleration
 what is the time of your race?
 d = distance

Question 3: What was the

Question 4: You

run 40 meters,

Appendix E

Post-Industrial Revolution ARCHITECTURE

Eiffel Tower – 320 m



photo courtesy: <http://www.tour-eiffel.fr/teiffel/uk/tourisme/postale/index.html>

Chrysler building – 324 m.



photo courtesy: <http://www.chryslerbuilding.org/index2.html>

Empire State Building – 448 m.

Photo courtesy: <http://www.aviewoncities.com/nyc/empirestate.htm>



If you were to drop a penny from each of these buildings, how fast would they be going upon impact with the ground? Use the formula: $(v_f)^2 = (v_0)^2 + 2ax$

Where V_f = the final velocity

V_0 = the velocity at time 0 (the start, which is usually zero)

A = acceleration due to gravity = 9.8 m/s^2

X = height from ground

t = time to fall

1. Eiffel tower
2. Chrysler Building
3. Empire state Building
4. Draw a diagram of the Eiffel tower with you on the ground. Draw a triangle to show how you would measure the height of this structure if you had only a protractor, and you knew that one of your steps equaled 4 feet.
5. How many seconds would a penny take to hit the ground from this height? Use the formula:

$$x = v_0 t + \frac{at^2}{2}$$

Appendix F

Power and Work

Force is measured by the following formula

$$\text{Force} = \text{Mass} \times \text{acceleration}$$

Work is the force exerted over a distance. Work is represented by the formula

$$\text{Work} = \text{Force} \times \text{distance}$$

If the force increases, or the distance increases, the amount of work increases. If you push a boulder 2 miles you have done more work than if you pushed it two feet. Likewise, if you push with greater force (going 20 feet in 10 seconds instead of 10 minutes) you have also increased the amount of work.

Power is a measure of work done. Power is represented by the formula:

$$\text{Power} = \text{work} \div \text{Time}$$

Or

$$(\text{Force} \times \text{distance}) \div \text{Time}$$

For our coffee can power test, you will need the following

Acceleration: $.5 \text{ m/s}^2$

Mass: your weight in kg, plus the weight of sand you carry (lbs. To kg = weight in lbs. Divided by 2.2 kg/lb.)

Time: 1.5 sec.

Distance: 1.5 meters

To find your power fill in below:

$$\frac{\text{Mass} \times \text{acceleration} \times \text{distance}}{\text{time}}$$

Appendix G

The Meeting of Poetry and Physics

Creativity and calculation all rolled into one

Types of poetry and examples:

Limerick (AABBA rhyming format, with 8,8,6,6,8 syllables)

There stands near the school a big tree (8)
To determine the height's for me(8)
I pulled out my ruler (6)
Protractors seem cooler (6)
The height in feet is thirty-three. (8)

Alliteration (Starting sound repeated)

Angles are always accurate

True trigonometric tabulations tell tantalizing tales.

Haiku (3 unrhymed lines of 5, 7, and 5 syllables)

That building is tall
Drop a penny from the top
High velocity

Cinquain

Subject (one word)
2 adjectives
3 verbs
A phrase of 5 words or less
Summary or synonym to subject (one word)

Acceleration
Speeding, descending
Fall, Drop, Cascade
A rush to earth
Crash

Ballad (Simple rhyming stanzas, often intended to be sung)

To the tune of "Yankee Doodle"

I went to the country to drive my Porsche
The road was nice and twisty.
I ran my Porsche into a tree
And hit with a force of 50 (thousand Newtons)

Onomatopoeia (words that sound like the words they represent)
Shushing down slopes, and *whizzing* past trees,
The skier went airborne with the greatest of ease.

Appendix H

Bookmaking

Materials Needed (per book):

Qty. 5 - 5" squares of heavier weight paper (eg: drawing paper)

Qty. 2 - 2 $\frac{3}{4}$ " squares of mat board

Qty. 2 - 3 $\frac{1}{4}$ " - 3 $\frac{1}{2}$ " squares of decorative cover paper (eg: rice paper or scrapbook paper)

Qty. 1 - approximately 18" of colored ribbon

Glue sticks (UHU brand is archival)

Scissors

Bone folder (optional)

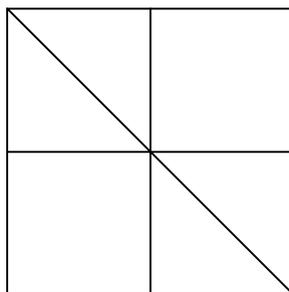
Step 1:

Fold each square of heavy paper diagonally

Step 2:

Unfold each square and fold in half vertically and horizontally in the opposite direction of diagonal fold.

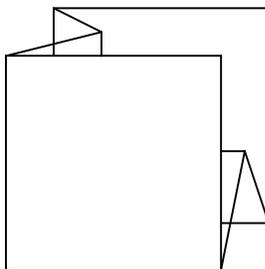
Each sheet should look like this when unfolded:



Step 3:

Bring opposite corners of folded diagonal together and flatten edges (cootie-catcher style).

The result should be something like this:



Step 4:

Glue flat surfaces of folded papers together (square to square). You can either glue so they open in the same direction to create a "star" or alternate directions to create a "snake".

Set pages aside for now, we will come back to these later.

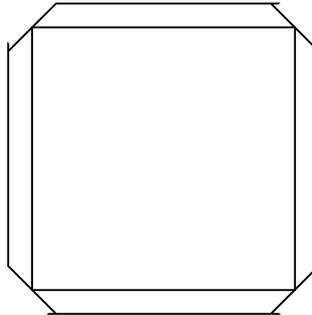
Step 5:

Create covers by gluing (making sure it is centered) the mat board onto the back of the decorative paper (there will be about $\frac{1}{4}$ " extra all around).

Step 6:

Fold corners of excess decorative paper at a diagonal and trim off just past the crease that is created.

Your covers should look like this when the step is done:

Front**Back****Step 7:**

Fold flaps created in step 6 around the board and glue down to the inside surface of the mat board.

Step 8:

Find midpoint of the strip of ribbon and glue down to center of the back cover, glue down the remaining ribbon across the cover either straight or at a diagonal. This will be used to tie your book closed when you are done.

Step 9:

Glue one cover to each end of the pages you glued together in Step 4.

Step 10:

Use the ribbon to tie your book shut and you are done. ☺ Enjoy what you have created

Additional notes:

It is easier to write in the pages before they are glued together. Feel free to vary the number of pages you use in your book. The general plan can be adapted to make larger books as well. The mat board pieces will measure about $\frac{1}{4}$ " larger than half the measurement of the paper being used for the pages. The decorative paper will end up being $\frac{1}{2}$ " larger than the mat board. ie: pages = 12" x 12", mat board = 6" x 6", decorative paper = 6 $\frac{1}{2}$ " x 6 $\frac{1}{2}$ "

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