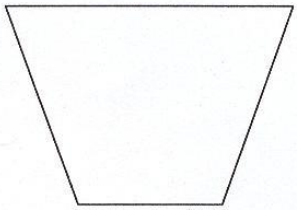
Prob #1

Thickness of Aluminum Foil

Mass of piece of foil = 0.977 g
Density of aluminum = 2.70 g / cm^3
Atomic mass of aluminum = 26.982 g/mole
Avogadro's number = 6.022×10^{23}

1. Determine the area of one side of the piece of aluminum foil. Include and label your measurements on the drawing.



2. On this answer sheet, write a step by step procedure to determine the thickness of the aluminum foil using only the information given and what you measured. Steps must be numbered. You may use equations.

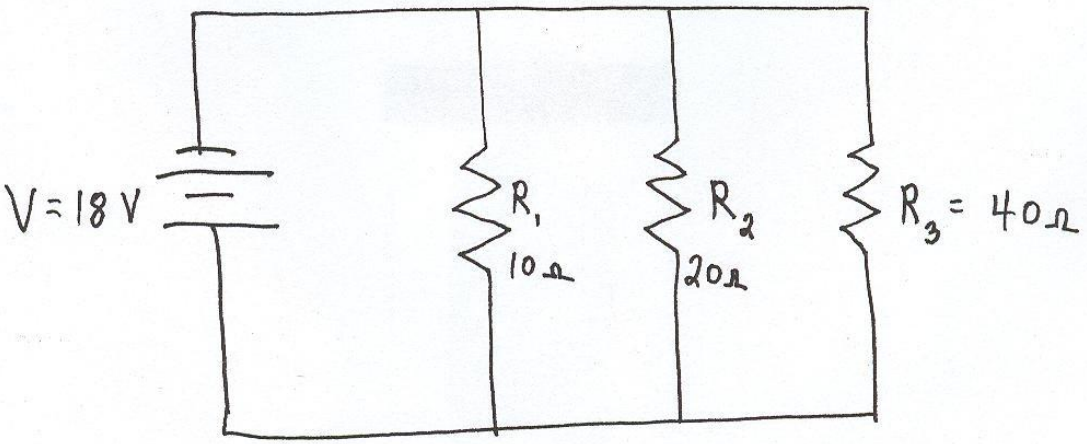
3. Determine the thickness of the aluminum foil. Show your work.

4. Assume that the diameter of an aluminum atom is 2.86×10^{-8} cm. How many aluminum atoms would it take to make the thickness that you determined in the previous question?

5. How many atoms are in the piece of aluminum foil?

Prob #2 **Electric Circuits**

Determine the voltage drop (V), the current (I), and the power (P) for the indicated devices and locations. Be sure to include appropriate units. (5 pts)



6) I (in battery) = _____

7) V_2 = _____

8) P_3 = _____

9) I_1 = _____

10) P (supplied by battery = _____

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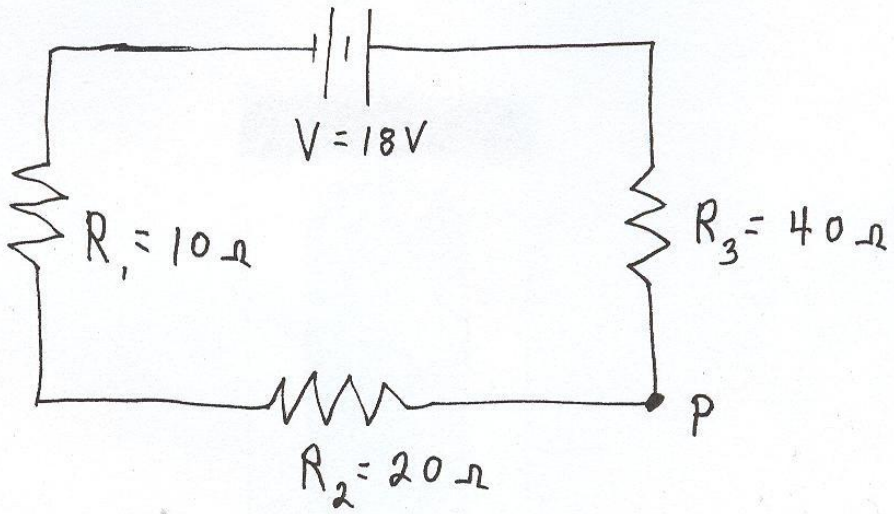


1) I (in battery) = _____

2) V_2 = _____

3) I (at point P) = _____

4) P_1 = _____

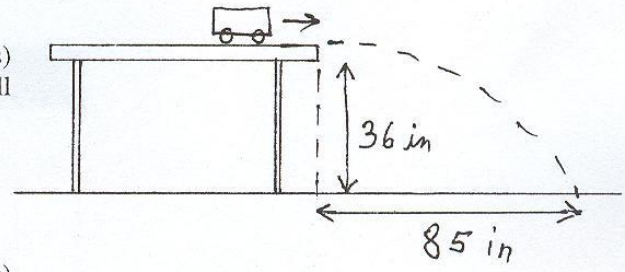
5) P (supplied by battery = _____

1 inch = 2.54 cm
$g = 9.81$ m/s^2

Prob # 3 **Projectiles** page 4

A 75.0-gram cart given an initial speed on a horizontal table rolls offs the edge and lands on the floor as shown. The table is 36.0 inches high and the cart lands 85.0 inches from the table. Neglect all frictional forces. (Diagrams are not drawn to scale!)

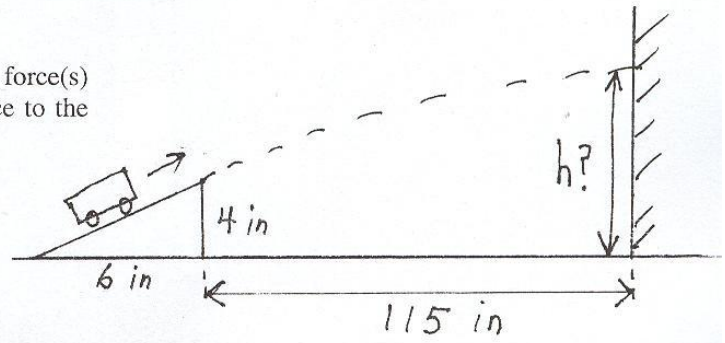
1) Draw a free-body diagram showing the force(s) acting on the cart as it falls to the floor. Label all forces. (1 pt)



2) With what speed did the cart leave the table? (4 pts)

The cart is now launched from a ramp so it leaves the end of the ramp with a speed of 8.00 m/sec. The cart traverses the distance and hits a vertical wall, 115 inches away.

3) Draw a free-body diagram showing the force(s) acting on the cart as it travels the distance to the wall. Label all forces. (1 pt)



4) Where will the cart hit the wall? Determine the height (in meters) above the floor. (4 pts)

stibensk

2 students decided to attack a Chemistry problem one day. The problem asked this question, "If 2.0 grams of magnesium were mixed with 150 mL of 1.0 Molar HCl, which chemical would be "used up" first"?

The first student was very bright and she stated, "this is easy, the magnesium would run out very quickly because the magnesium weighs less than the hydrochloric acid!!". The second students said, "no way the hydrochloric acid will run out first because the HCl is so dilute!"

So you have the envious job of showing me who, indeed was correct. Attached is a sheet that may help you solve some of the questions that need to be answered. Good Luck!

TEAM NAME_____NUMBER_____

Lab Conditions: **20 degrees centigrade**, atmospheric pressure equals 740.0 mm Hg

UNITS MUST BE CORRECT TO RECEIVE CREDIT!!!!!

Magnesium + hydrochloric acid yields magnesium chloride + H_2

1) Balance the reaction: **4 pts** _____

___Mg (s)+ ___ HCl (aq) → ____ $MgCl_2$ (aq) + ___ $H_{2\,(g)}$

If 2.00 grams of magnesium are mixed with 150.0 mL of 1.00 Molar HCl..... (molar mass of Mg=24.305g/mol, HCl = 35.45g/mol)

2) How many moles of hydrogen gas are formed:_____**(4 pts)**

a) Show work:

Circle the limiting reactant in the balanced chemical equation above: **(4 pts)**

3) Using the info from #2 and assuming the partial pressure of hydrogen gas equals atmospheric pressure, what is the Volume of H_2 gas produced: _____**(4 pts)**

(must use PV=nRT) R= 0.0821 L atm/mol K

a) Show work:

4) If the initial experiment produced 23.00 Kilojoules of heat, what would be the enthalpy (ΔH) per mole of hydrogen gas formed? _____ **(4 pts)**

a) Show work:

Tie-Breaker: If each person in the United States donated one gram of gold to the Athens Science Olympiad team. How much would that gold be worth (in dollars) based on the closing of yesterday's stock market? (circle one the best choice)

10^7, 10^8, 10^9, 10^{10}, 10^{11}

Name: _____

Questions 1 through 3 refer to the following:

Soil pH can affect the development of plants. For example, a hydrangea plant produces blue flowers when grown in acidic soil but pink flowers when grown in basic soil. Evergreen plants can show a yellowing of foliage, called chlorosis, when grown in soil that is too basic.

Acidic soil can be neutralized by treating it with calcium hydroxide, $Ca(OH)_2$, commonly called slaked lime. Slaked lime is slightly soluble in water.

1) An evergreen plant has yellowing foliage. The soil surrounding the plant is tested with methyl orange and bromthymol blue. Both indicators turn yellow in the soil tests. Based on the given information, state, in terms of pH value, why the yellowing of the plant is *not* due to chlorosis.

2) Based on the given information, write an equation, using symbols or words, for the neutralization of the ions in acidic soil by the ions released by slaked lime in water.

3) Based on the given information, compare the hydrogen ion concentration to the hydroxide ion concentration in soil when a hydrangea plant produces pink flowers.

4) What color is bromcresol green after it is added to a sample of NaOH(aq)?

Questions 5 and 6 refer to the following:

The health of fish depends on the amount of oxygen dissolved in the water. A dissolved oxygen (DO) concentration between 6 parts per million and 8 parts per million is best for fish health. A DO concentration greater than 1 part per million is necessary for fish survival.

Fish health is also affected by water temperature and concentrations of dissolved ammonia, hydrogen sulfide, chloride compounds, and nitrate compounds. Most freshwater fish thrive in water with a pH between 6.5 and 8.5.

A student's fish tank contains fish, green plants, and 3,800 grams of fish-tank water with 2.7×10^{-2} gram of dissolved oxygen. Phenolphthalein tests colorless and bromthymol blue tests blue in samples of the fish-tank water.

5) When the fish-tank water in the given excerpt has a pH of 8.0, the hydronium ion concentration is 1.0×10^{-8} mole per liter. What is the hydronium ion concentration when the water has a pH of 7.0?

6) Based on the test results for the indicators phenolphthalein and bromthymol blue in the given excerpt, what is the pH range of the fish-tank water?

Questions 7 through 9 refer to the following:

A student used blue litmus paper and phenolphthalein paper as indicators to test the pH of distilled water and five aqueous household solutions. Then the student used a pH meter to measure the pH of the distilled water and each solution. The results of the student's work are recorded in the table below.

Testing Results

Liquid Tested	Color of Blue Litmus Paper	Color of Phenolphthalein Paper	Measured pH Value Using a pH Meter
2% milk	blue	colorless	6.4
distilled water	blue	colorless	7.0
household ammonia	blue	pink	11.5
lemon juice	red	colorless	2.3
tomato juice	red	colorless	4.3
vinegar	red	colorless	3.3

6

7) Identify the liquid tested in the given laboratory experiment that has the *lowest* hydronium ion concentration.

8) Based on the measured pH values recorded in the given table, identify the liquid tested that is 10 times more acidic than vinegar.

9) Explain, in terms of the pH range for color change on the *Common Acid-Base Indicators* chemistry reference table, why litmus is *not* appropriate to differentiate the acidity levels of tomato juice and vinegar in the laboratory experiment shown.

Questions 10 and 11 refer to the following:

Sulfur dioxide, SO_2, is one gas produced when fossil fuels are burned. When this gas reacts with water in the atmosphere, an acid is produced forming acid rain. The pH of the water in a lake changes when acid rain collects in the lake. Two samples of the same rainwater are tested using two indicators. Methyl orange is yellow in one sample of this rainwater. Litmus is red in the other sample of this rainwater.

10) Write the formula for one substance that can neutralize the lake water affected by acid rain described.

11) Identify a possible pH value for the rainwater that was tested in the experiment described.

12) Identify *two* indicators from the *Common Acid-Base Indicators* chemistry reference table that are yellow in solutions with a pH of 5.5.

Table K
Common Acids

Formula	Name
$HCl(aq)$	hydrochloric acid
$HNO_3(aq)$	nitric acid
$H_2SO_4(aq)$	sulfuric acid
$H_3PO_4(aq)$	phosphoric acid
$H_2CO_3(aq)$ or $CO_2(aq)$	carbonic acid
$CH_3COOH(aq)$ or $HC_2H_3O_2(aq)$	ethanoic acid (acetic acid)

Table L
Common Bases

Formula	Name
$NaOH(aq)$	sodium hydroxide
$KOH(aq)$	potassium hydroxide
$Ca(OH)_2(aq)$	calcium hydroxide
$NH_3(aq)$	aqueous ammonia

Table M
Common Acid–Base Indicators

Indicator	Approximate pH Range for Color Change	Color Change
methyl orange	3.2–4.4	red to yellow
bromthymol blue	6.0–7.6	yellow to blue
phenolphthalein	8.2–10	colorless to pink
litmus	5.5–8.2	red to blue
bromcresol green	3.8–5.4	yellow to blue
thymol blue	8.0–9.6	yellow to blue

Table N
Selected Radioisotopes

Nuclide	Half-Life	Decay Mode	Nuclide Name
^{198}Au	2.69 d	β^-	gold-198
^{14}C	5730 y	β^-	carbon-14
^{37}Ca	175 ms	β^+	calcium-37
^{60}Co	5.26 y	β^-	cobalt-60
^{137}Cs	30.23 y	β^-	cesium-137
^{53}Fe	8.51 min	β^+	iron-53
^{220}Fr	27.5 s	α	francium-220
^{3}H	12.26 y	β^-	hydrogen-3
^{131}I	8.07 d	β^-	iodine-131
^{37}K	1.23 s	β^+	potassium-37
^{42}K	12.4 h	β^-	potassium-42
^{85}Kr	10.76 y	β^-	krypton-85
^{16}N	7.2 s	β^-	nitrogen-16
^{19}Ne	17.2 s	β^+	neon-19
^{32}P	14.3 d	β^-	phosphorus-32
^{239}Pu	2.44×10^4 y	α	plutonium-239
^{226}Ra	1600 y	α	radium-226
^{222}Rn	3.82 d	α	radon-222
^{90}Sr	28.1 y	β^-	strontium-90
^{99}Tc	2.13×10^5 y	β^-	technetium-99
^{232}Th	1.4×10^{10} y	α	thorium-232
^{233}U	1.62×10^5 y	α	uranium-233
^{235}U	7.1×10^8 y	α	uranium-235
^{238}U	4.51×10^9 y	α	uranium-238

ms = milliseconds; s = seconds; min = minutes; h = hours; d = days; y = years

1) SAMPLE ANSWERS: The pH is between 4.4 and 6.0, which indicates an acidic soil. OR The pH of the soil surrounding the plant is below 6.0. OR For chlorosis, the soil pH must be above 7.

2) SAMPLE ANSWERS: $H_3O^+(aq) + OH^-(aq) \longrightarrow 2H_2O(\ell)$ OR $H^+ + OH^- \longrightarrow HOH$ OR hydrogen ions + hydroxide ions $\longrightarrow$ water OR hydroxide ions + hydronium ions $\longrightarrow$ water

3) SAMPLE ANSWERS: The hydroxide ion concentration is greater than the hydrogen ion concentration. OR The H_3O^+ concentration is less than the OH^- OR $[OH^-] > [H_3O^+]$

4) blue

5) SAMPLE ANSWERS: 1×10^{-7} mol/L OR 0.0000001 mol/L OR 10^{-7} mol/L

6) SAMPLE ANSWERS: 7.6 and 8.2 OR 8.1 and 7.7

7) SAMPLE ANSWERS: household ammonia OR $NH_3(aq)$

8) lemon juice

9) SAMPLE ANSWERS: Because litmus changes color in a pH range of 5.5 to 8.2, litmus cannot be used to differentiate between a pH of 3.3 and 4.3. OR Litmus is red for all pH values below 5.5.

10) SAMPLE ANSWERS: $Ca(OH)_2$ OR KOH OR Na_2CO_3

11) $4.4 \leq pH \leq 5.5$

12) SAMPLE ANSWERS: methyl orange OR bromthymol blue OR thymol blue