Name:	Partner's Name:
Date of lab:	If absent, data obtained from:

Lab "Fire-4": Canned Heat and Fire-Fighting Foam

Objective: Part A- To make a gel which will burn;
Part B- To make a foam which is able to put out fires.

Procedure	Observations

Make complete and accurate observations during the lab.
Observations include: 1) what is happening,
2) the color, appearance, and phase (solid, liquid, gas) of all chemicals,
3) any other observations requested (odor, temperature, etc.).
Check off the Procedure steps as you do them

Day #1
Part A - Making Canned Heat

_____1. Mass a plastic dish (include units): ____________________

_____2. Push TARE.

_____3. Add enough calcium acetate ($Ca(CH_3COO)_2$) to the dish until you have 8.5 g of calcium acetate ($Ca(CH_3COO)_2$). Actual mass (include units): ____________________

_____3.a. Obtain 25 mL of water in a graduated cylinder.

_____4. Dissolve the calcium acetate ($Ca(CH_3COO)_2$) in a 250 mL beaker with the 25 mL of water.

_____5. Pour this solution into an evaporating dish.

_____6. Using a graduated cylinder, add 8.0 mL of ethyl alcohol (CH_3CH_2OH), or isopropyl alcohol ($(CH_3)_2CHOH$) to the evaporating dish. DO NOT STIR. Just observe: ______________________________

_____7. When your teacher turns the lights out, toss a burning match into the evaporating dish: ______________

____

_____8. Blow out the flame.

Part B - Making a Fire-fighting Foam

_____9. Mass a plastic dish (include units): ____________________

_____10. Push TARE.

_____11. Add enough laundry detergent to the dish until you have 1.0 g of laundry detergent).

Actual mass (include units): _____________

_____12. Mass another plastic dish (include units): ____________________

_____13. Push TARE.

_____14. Add enough aluminum sulfate ($Al_2(SO_4)_3 \cdot 18\ H_2O$) to the dish until you have 6.0 g of aluminum sulfate

($Al_2(SO_4)_3 \cdot 18\ H_2O$)). Actual mass (include units): ___________________

_____15. Pour both the laundry detergent and the aluminum sulfate ($Al_2(SO_4)_3 \cdot 18\ H_2O$) into a mortar.

_____16. Grind the 2 powders together.

_____16.a Place the ground powders into a dry 600 mL beaker.

Day #2

_____17. Dissolve both powders in the 600 mL beaker with 50 mL of water and stirring.

_____18. Mass a plastic dish (include units): ____________________

_____19. Push TARE.

_____20. Add enough sodium bicarbonate (baking soda, $NaHCO_3$) to the dish until you have 10.0 g of sodium

bicarbonate (baking soda, $NaHCO_3$)). Actual mass (include units): ________________

_____21. Pour the sodium bicarbonate (baking soda, $NaHCO_3$) into the detergent solution.

Stir it lots and lots: ____

_____22. Light a small piece of crumbled paper on the counter and pour the foam onto the fire:

____

_____23. Clean all equipment and glassware; wipe down your lab area; wash your hands, then take off your safety goggles and have a seat.

===

A Little Background and some Questions.....

Part A - Making Canned Heat

What you made is similar to the canned heat used at buffets to keep the entrees warm (like Sterno burners).

1. What were the reactants used to make your canned heat (names and formulas) ? ______________________

____

Part B - Making a Fire-fighting Foam

A foam is a gas dispersed in a liquid. Foams require a stabilizer to hold the bubbles in place. The stabilizer in this lab was the laundry detergent. Examples of foams are marshmallows, meringues, and shaving creams.

Foams are used as fire fighting agents for certain types of fires.

2. Did a chemical reaction occur when you mixed the laundry detergent and the

   aluminum sulfate ($Al_2(SO_4)_3 \cdot 18\ H_2O$)? ________________________

   How did you determine this ? ____

3. Did a chemical reaction occur when you mixed the sodium bicarbonate (baking soda, $NaHCO_3$)) and the

   laundry detergent solution? ________________________

   How did you determine this ? ____

4. Since the laundry detergent was not involved in the reaction, what were the reactants (names and formulas) ?

   ____

5. What was the probable gas (name and formula) which was formed in making your foam (Hints: 1) You used a

   carbonate, 2) It puts out fires) ? ____

==============================

Review Questions

R-1. What is complete combustion ? ____

____

R-2. Write the **word equation** for the complete combustion of paraffin wax ($C_{25}H_{52}$).

____

R-3. Write the **formula equation** for the complete combustion of acetylene (C_2H_2).

____

R-4. Which is hotter, a candle or a lab burner flame ? ______________________________

R-5. Which has the greater surface area, a steel rod or steel wool ? ______________________________

R-6. Calculate the percent of wood which burned up from the following data (include units and show your work).

Mass of burned up wood: 13.4 g

Mass of wood before burning: 56.2 g

R-7. Which would react faster, magnesium ribbon or magnesium powder put into hydrochloric acid (HCl) ? Why ?

R-8. What part of a formula is responsible for the colors given off during flame tests ? ____________________

Name:	Partner's Name:
Date of lab:	If absent, data obtained from:

Lab "Fire-5": A Magic Flame and making Acetylene

Objective: Part A- To make a "magic" flame;
Part B- To learn a procedure for making acetylene

Procedure	Observations

Make complete and accurate observations during the lab.
Observations include: 1) what is happening,
2) the color, appearance, and phase (solid, liquid, gas) of all chemicals,
3) any other observations requested (odor, temperature, etc.).
Check off the Procedure steps as you do them

Part A - A Magic Flame

_____1. Place a wire gauze **without a center** on an iron ring on your ringstand.

_____2. Set the iron ring about 2 cm above the top of your burner.

_____3. Turn on the gas and light the flame **above the gauze, not under the gauze !**

Observe: ____

_____4. Turn off the gas.

_____5. Move the iron ring up to 3 cm and try it again.

_____6. Determine the greatest distance you can move the iron ring up and the flame still lights above the wire gauze: ____________________

Part B - Making Acetylene

_____7. Obtain 4 test tubes all the same size, and a plastic trough.

_____8. Fill the trough about half way with water.

_____9. Fill each test tube all the way to the top with water in the trough.

_____10. Place each test tube upside down in the corners of the trough (they should be full of water at this point).

_____11. Using tongs, drop a piece of calcium carbide (CaC_2) into the beaker, and immediately place one of the test tubes over the piece of calcium carbide (CaC_2).

Appearance of calcium carbide (CaC_2): ______________________________

Reaction observation (what happens, any odor?): ______________________________

____

_____12. When the first test tube is full of gas, lift it out of the water still upside down, and place it on the counter upside down.

_____13. Fill a second test tube to about half full, lift it out of the water still upside down (water will come out and be replaced with air), and place it on the counter upside down.

_____14. Fill a third test tube to about one third full, lift it out of the water still upside down (water will come out and be replaced with air), and place it on the counter upside down.

_____15. Fill a fourth test tube to about one quarter full, lift it out of the water still upside down (water will come out and be replaced with air), and place it on the counter upside down.

_____16. For the second, third and fourth test tubes, place your finger over the mouth of each and shake it for 20 seconds; place them back on the counter still upside down.

_____17. Hold each test tube horizontally, bring a burning splint close to the mouth of the test tube. Wait for each reaction to finish. Place each test tube in the test tube rack. Observe both the reactions which occurred and the appearance of the test tubes (compared to each other).

First test tube (all gas): ______________________________

Second test tube (half gas, half air): ______________________________

Third test tube (third gas, 2/3 air): ______________________________

Fourth test tube (quarter gas, 3/4 air): ______________________________

_____18. Clean all equipment and glassware; wipe down your lab area; wash your hands, then take off your safety goggles and have a seat.

A Little Background and some Questions...

Part A - A Magic Flame

Different materials conduct heat at different rates. Things that heat up quickly (conduct heat well) are good heat conductors. **Things that do not conduct heat well are called insulators.**

1. In order for any material to burn, what must happen to the temperature of that substance ? ______________

____

2. Is it possible for things to ignite simply from getting hot (without a spark or flame present to start it) ? __________

3. So, using the information at the top, and your answers to questions 1 and 2, explain why the flame only burned above the wire gauze and not work its way down to the top of the burner like it normally burns ?

____

____

____

Part B - Making Acetylene

4. When you dropped the calcium carbide (CaC_2) into the water, what did you observe that indicated that a chemical

reaction most likely occurred ? _______________________________

5. What did the calcium carbide (CaC_2) react with (name and formula) ? _______________________

6. The gas that was produced was acetylene (ethyne, C_2H_2).

What is acetylene (ethyne, C_2H_2) commonly used for ? _______________________________

7. Rank the test tubes from best burning to worst burning:

Best burning:_______________________

Worst burning: _______________________

8. Consequently, what must be present for acetylene to burn better (name and formula) ? ______________

9. Write the **word equation** for the combustion of acetylene:

____

10. Write the **formula equation** for the combustion of acetylene:

____

Review Questions

R-1. In a normal chemical process, is it possible to gain mass ? ____________ to lose mass ? ___________

R-2. What type of reaction is the burning of a candle, decomposition or combustion? _________________

R-3. Write the **word equation** for the combustion of methane (CH_4).

____________ + ______________---------> ______________ + ______________

R-4. Where should you put a test tube in a lab burner flame for minimal heating ? _________________

R-5. You observed in this lab that the totally acetylene (ethyne, C_2H_2) test tube did not burn well. However, in the "Fire-1" lab, a welding flame was by far the hottest flame.

Explain how this is possible. ______________________________

____

R-6. What is the relationship between surface area and the rate of burning ? ______________________________

____

R-7. What part of the chemical name of compounds causes the colors in fireworks ? ______________________________

R-8. What is a foam ? ______________________________

R-9. What does foam contain which do not let the bubbles (gas) in the liquid escape ? ______________________________

R-10. What gas was produced in your fire-fighting foam (name and formula) ? ______________________________

Name:	Partner's Name:
Date of lab:	If absent, data obtained from:

Lab "Fire-6": Heat from a Candle

Objective: To be able to calculate the amount of heat from a burning candle.

Procedure	Observations

Make complete and accurate observations during the lab.
Observations include: 1) what is happening,
2) the color, appearance, and phase (solid, liquid, gas) of all chemicals,
3) any other observations requested (odor, temperature, etc.).
Check off the Procedure steps as you do them

_____1. Obtain a candle (paraffin, $C_{25}H_{52}$).

_____2. Attach the candle to a glass plate.

_____3. Mass the candle and glass plate all at the same time (include units):_______________

_____4. Using a graduated cylinder, place exactly 100 mL of cool to cold water in a 125 mL flask.

_____5. Place a thermometer in the flask. Take the temperature of the water (include units): _________________

_____6. Set up the apparatus as demonstrated by your teacher (the candle and glass plate on the base of a ring stand, a shield with holes in the bottom for air flow, and a 125 mL flask clamped to the ring stand). The bottom of the flask must be **3 cm** above the height of the top of the candle.

_____7. The teacher will light the candle with long tongs.

_____8. The burning candle will heat the water in the flask.

_____9. Let the candle burn for **exactly** 7 minutes. With a clamp, hold the thermometer in the water but not touching the glass during this time.

_____10. Blow out the flame.

_____11. Record the highest temperature reached by the water (include units):___________________

_____12. Mass the candle and glass plate (include units): ___________________

_____13. Clean all equipment and glassware; wipe down your lab area; wash your hands, then take off your safety goggles and have a seat.

A Little Background and some Questions...

This type of lab, heating water from a burning substance will be done a few times throughout the year. Please become familiar with these calculations for future labs.

1. Complete the following Data Tables:

Mass Data Table

1	Mass candle & glass plate before heating	
2	Mass candle & glass plate after heating	
3	Calculate the mass of burned up candle	

Temperature Data Table

1	Temperature of water at start	
2	Highest temperature of water reached	
3	Calculate the temperature change of water	

2. In this lab you burned a candle. **The heat given off by the burning candle was used to heat 100 mL of water.** This is the method used to determine how much heat energy is in any given material (however, the equipment is much more complex). **Heat energy is expressed in Joules.**

Because our equipment was crude, there were several things that were heated by the burning candle. Please indicate at least 3 items (other than the water in the flask or the candle itself) that were heated:

1) ______________________________

2) ______________________________

3) ______________________________

3. The formula for calculating the amount of heat energy (joules) is:

Heat Energy (Joules) = (mass of water (g)) (temperature change of water (^oC))(4.18)

Remember: 1.0 mL of water = 1.0 grams of water

3. a. Using the formula above, calculate the number of joules (heat energy) that your candle released. Please show your work for each calculation.

4. In order to be able to compare the amount of heat energy between different materials, we must calculate the number of Joules in each gram of material. The formula is:

$$\textbf{Joules per gram} = \frac{\textbf{Joules produced in sample}}{\textbf{grams of sample burned}}$$

4. a. From your calculations and data so far, calculate the number of Joules per gram for the candle. The units are "Joules/g". Please show your calculations.

====================

Review Questions

R-1. If you were instructed to heat a beaker of water slowly, where would you place it in your burner flame ?

____

R-2. What could you physically do to most solid materials to make them burn faster? ____________________

____

R-3. If you were working in a lab and you were given 2 solutions, one of which is sodium chloride ($NaCl$), and one of which is calcium chloride ($CaCl_2$), explainhow would you tell them apart using flame tests ?

____

____

R-4. When you made your fire-fighting foam, what was the purpose of the laundry detergent ? ________________

____

R-5. Name 2 materials which conduct heat well. ____

R-6. Materials which do not conduct heat well are called ? ________________________________

R-7. Name 2 materials which do not conduct heat well. ____

R-8. Acetylene (C_2H_2) does not burn well on its own. How can you make acetylene burn much hotter ? __________

____

R-9. Write the **word equation** for the burning of acetylene in air ?

____

Name:_______________

Exercise "Fire-C": Chapter Review

1. "All fire is alike". Explain what is wrong with this statement ? ____________________

____

____

2. When you burn wood in a fireplace, the mass you begin with is much more than the mass you end up with.

   What happens to this mass ? ______________________________

3. What is another word for burning ? ____________________

4. What is the coolest type of flame: welding, candle, lab burner ? ____________________

5. What is the hottest part of a lab burner flame ? ______________________________

6. Write the **word equation** for the combustion of a candle (paraffin, $C_{25}H_{52}$).

____

7. Write the **formula equation** for the combustion of methane (CH_4).

____

8. What 2 gases (names and formulas) make up the welding flame used in the lab ? ____________

____

9. Define **surface area**. ______________________________

____

10. What is the relationship between surface area and burning ? ____________________

____

11. Pieces of coal do not explode, but coal dust explosions are dangerous. Explain why coal dust

    explodes, but pieces coal will not. ______________________________

____

____

12. Explain why fireworks are colorful. ______________________________

____

13. What is "Sterno" ? ______________________________

14. What is a foam ? ______________________________

15. In a foam, what holds the gas in the liquid ? ______________________

16. Give 2 examples of a foam. ______________________________

17. What is an insulator ? ______________________________

18. What types of insulators are used on the handles of cooking pots and pans ? ____________

____

19. Explain why the flame burned above the wire gauze in the "Fire-5" lab. ______________

____

____

20. Why did some of the test tubes with acetylene and air burn better than some of the others ?

____

____

21. If you want to determine how much heat a material gives off when burned,

what do you heat up ? ______________________

22. Calculate the mass of burned up candle. Show your work and include units:

Mass of candle at start: 42.5 g
Mass of candle at end: 39.9 g

23. Heat energy is expressed in ______________________.

24. Name 2 items, beside the water in the flask, which were heated with the candle flame.

____

25. Using the following formulas:

Heat Energy (Joules) = (mass of water (g)) (temperature change of water (oC))(4.18)
Remember: 1.0 mL of water = 1.0 grams of water

Joules per gram = $\frac{\text{Joules produced in sample}}{\text{grams of sample burned}}$

Calculate: a) the amount of heat energy given off; b) the amount of heat energy per gram. Show your calculations and include units:

Mass of candle burned off: 2.0 g   Volume of water: 100 mL

Temperature change of water: 22 ^{o}C

a)

b)

26. Using the Cation / Anion Sheet, write the formulas from the following names:

a) sodium hydroxide: ______________________

b) potassium nitrate: ______________________

c) hydrogen chloride: ______________________

d) aluminum phosphate: ______________________

27. Using the Cation / Anion Sheet, write the names from the following formulas:

a) SiC: ______________________

b) $NaNO_3$: ______________________

c) LiCl: ______________________

d) $MgSO_4$: ______________________