

Thermodynamics Review

You should look at all the labs and worksheets completed during the unit. The labs include: Heat Transfers, Heat of Reaction for Mg and HCl, Combustion, Canned Heat. You should be able to:

Define Temperature, Heat, and Specific Heat and Discuss Heat Transfers.

Temp = hot or cold

Specific Heat = energy to raise 1g by 1°C

Heat = energy

Make Calculations using $q = mC\Delta t$

If 200.0 grams of water is heated from 27°C to 51°C, how much energy was absorbed

$$q = 200.0g \cdot 4.18 \frac{j}{g \cdot ^\circ C} \cdot 24^\circ C = \boxed{20064 j}$$


What is the mass of a sample of aluminum if 5234j of heat are required to raise its temperature from 15°C to 36°C?

$$5234 = m \cdot 90 \frac{j}{g \cdot ^\circ C} \cdot 21^\circ C = \boxed{277g}$$

from periodic table

Describe the two types of thermochemical reactions:


Endo
absorbed
increases
goes down



ΔH is pos.
heat = reactant

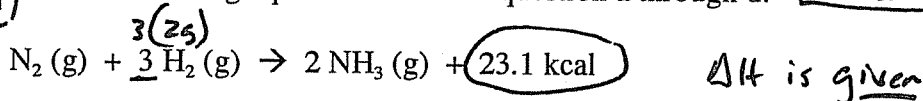
Is energy released or absorbed
Does the stored energy increase or decrease
What happens to the temperature
What would the graph of energy look like?
The ΔH would be (-) or (+)
Is energy written as a reactant or a product?

Exo
released
decreases
goes up



ΔH is neg
heat = product

Use the following equation to answer question a through d:



a. What is the ΔH (change in heat) for the reaction?

$\Delta H = -23.1$ * Is negative because energy is product
So reaction is exothermic

b. Is the reaction exothermic or endothermic?

exothermic

c. What does the graph of energy vs. time look like? Which has more energy, the reactants or the products?



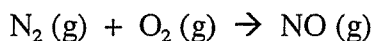
Reactants have more stored energy

d. How much energy is produced when 31.5 g of H_2 reacts?

molar mass from periodic table $\times 3$ moles $\rightarrow \frac{3(2g H_2)}{31.5g} = \frac{23.1 \text{ kcal}}{x}$

$$x = 121 \text{ kcal}$$

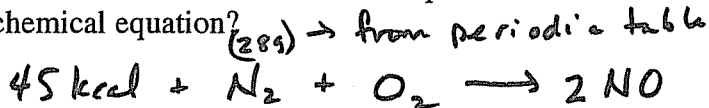
Use the following equation to answer question a through d:



change in enthalpy = +45 kcal

+ ΔH
means
endothermic

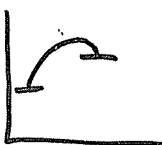
- a. Write and balance the thermochemical equation? What is included in a thermochemical equation?



- b. Is the reaction exothermic or endothermic?

endothermic

- c. What does the graph of energy vs. time look like? Which has more energy, the reactants or the products?



- d. How much energy is required when 14.2 g of N₂ reacts?

from periodic table
= molar mass

$$\frac{45 \text{ kcal}}{x} = \frac{28 \text{ g N}_2}{14.2 \text{ g N}_2}$$

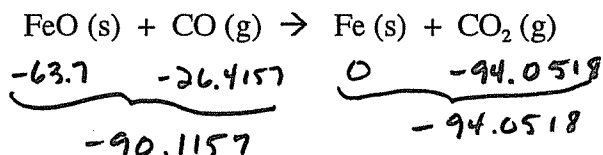
$$x = 22.8 \text{ kcal}$$

Use a ΔH_f^o chart to calculate the ΔH of a reaction:

Calculate the heat of reaction for the following. (The reactions may not be balanced.)

Use chart
w/ compounds

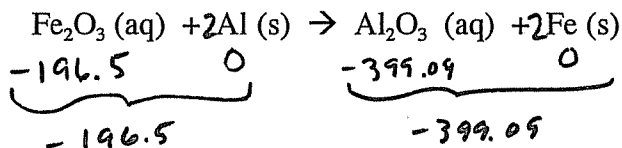
* Elements
are 0



$$P - R$$

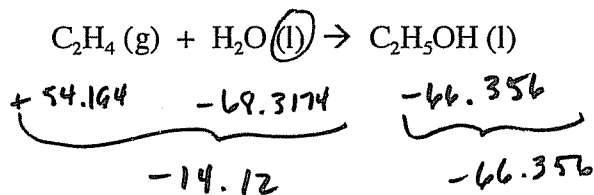
$$-94.0518 - (-90.1157)$$

$$= -3.9 \text{ kcal}$$



$$-399.05 - (-196.5)$$

$$= -202.55 \text{ kcal}$$



$$-66.356 - (-14.12)$$

$$= -52.236$$

* none of these had more than 1 mole. If you had 2 moles, you multiply the ΔH_f^o by 2 ...

Use a lab data to calculate the ΔH of a reaction:

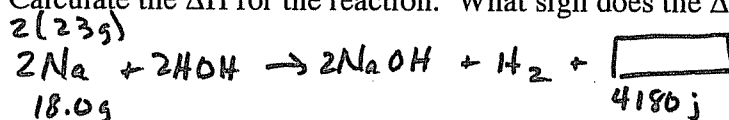
18.0 grams of sodium was placed in 200.0 grams of water. Sodium hydroxide (NaOH) and hydrogen gas were produced. The temperature increased from 20.0°C to 25.0°C. (Exothermic or endothermic?)

Calculate the heat released by the reaction. $q = mc\Delta t$

$$q = 200.0g \cdot 4.18 \frac{j}{g^{\circ}C} \cdot 5^{\circ}C = 4180 j$$

* temp change was water, so use mass of water

Calculate the ΔH for the reaction. What sign does the ΔH have?



$$\frac{2(23g)}{18.0g} = \frac{x}{4180}$$

Write the thermochemical equation for the reaction.

$$x = 10682 j$$



$$\boxed{\Delta H = -10.68 kJ}$$

Describe how fuels are used to produce energy.

What type of reaction is usually used to get the energy from the fuel? (for example, how do we use octane?)

we burn them = combustion reaction

Combustion is burning in presence of O_2

* I made it negative because temp went up

Write the equation for butane (C_4H_{10}) undergoing this type of reaction. What are always the products? The ΔH is



underlined are always the same for

What are some considerations that make a fuel good for specific application. (Sterno was good for using in a buffet, why?)

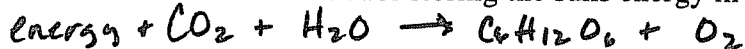
amount of energy released / physical state / stability etc

Sterno good because low heat, even heat, solid so won't spill.

combustion

How can the argument be made that all energy that we use (in foods and fuels) comes from the sun?

What is the reaction for storing the sun's energy in biomolecules?



How is petroleum "buried sunshine"?

How does our body run on energy from the sun?

Plants ~~use~~ make food using sun's energy and we eat the plant

Compare natural gas, coal, and petroleum as fuels. List advantages and disadvantages for each.

	good	bad
Coal-	we have lots	solid so harder to move, hard to mine lots of greenhouse gases
Gas	clean, easy to transport	limited supply
Petroleum	cleaner than coal liquid = pipeline	Has to be separated before use limited supply

How do we alter petroleum before use?

What is fractional distillation?

Petroleum is heated and separated into "fractions" Based on boiling point. They separate into groups by size. Small molecules on top. Big on bottom

↳ Breaking long molecules of petroleum into smaller ones.

Describe octane ratings:

What does it tell you?

Tells you how badly the gas will cause knocking in the engine

How is it determined?

Branched = better fuel, straight chains = worse fuel
isooctane = 100 ——— n-heptane = 0
others ranked between

How can it be improved?

→ heating straight chains makes them branch
→ adding tetramethyl lead (we don't do anymore)
= unleaded

Discuss food and energy;

How do food Calories compare to calories?

Calorie = kcalorie or 1000 calories

What is a bomb calorimeter and how are Calories determined?

Food is burned in interior chamber
Water in outer chamber absorbs the heat
and calories are calculated as $q = mC\Delta T$

(just like we did, but w/ better apparatus)