

EASY PACKET 1

Team ID Number: _____

Physical Properties

Rank the following from smallest to largest atomic radius:

- 1) He, Ar, Ne
- 2) Li, H, He
- 3) O^{2-} , Ne, F^{-}
- 4) Ar, K^{+} , Ca^{2+}

EASY PACKET 1

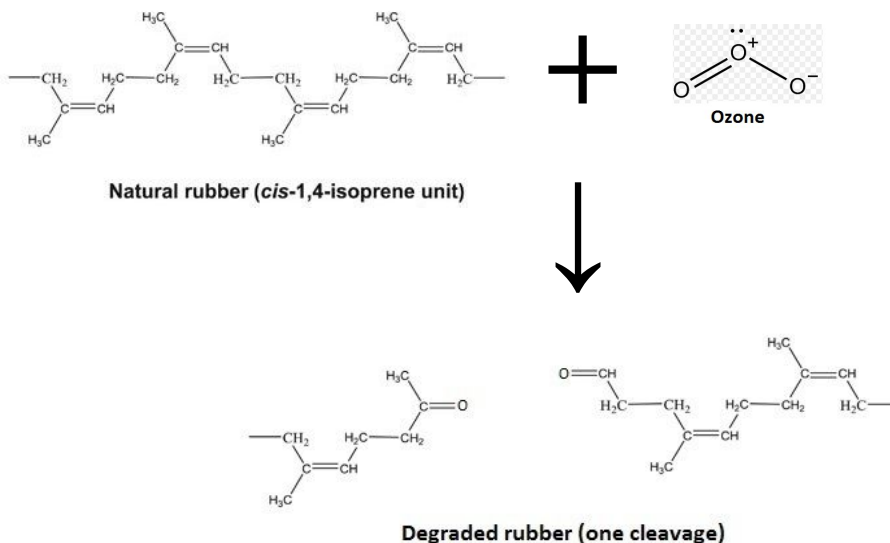
Team ID Number: _____

Thermodynamics

Assume a reaction in the forward direction where the change in enthalpy of the reaction is -73.0 kJ/mol , and the change in entropy of the reaction is 314.0 J/K . *What is the Gibbs's Free Energy (in kJ/mol) for this reaction at $25 \text{ }^\circ\text{C}$? Is the reaction spontaneous in the forward direction?*

Electrochemistry

Natural rubber is used in the creation of tires and windshield wipers. It is composed of alkenes containing many carbon-carbon double bonds. Ozone can react with alkenes which results to the degradation of rubber though a reaction called ozonolysis. One example of an ozonolysis reaction is shown below.



Use your knowledge of oxidation-reduction reactions, determine the oxidizing agent and reducing agent for this reaction.

EASY PACKET 2

Team ID Number: _____

Physical Properties

For each of the following questions, *first determine if the bond could be formed between the two atoms*. If a bond could be formed, *determine if the bond is ionic, polar covalent, or nonpolar covalent*. Then *determine the correct reasoning for bond formation*. (If no bond is formed, do not circle anything following that question)

1) Na - Cl

a) Does a bond occur? *(yes/no)*

b) If a bond could be formed this bond would be *(polar/nonpolar/ionic)* because there is *(a large difference/a small difference/no difference)* in electronegativity between the two atoms

2) C - O

a) Does a bond occur? *(yes/no)*

b) If a bond could be formed this bond would be *(polar/nonpolar/ionic)* because there is *(a large difference/a small difference/no difference)* in electronegativity between the two atoms

3) Cl - Cl

a) Does a bond occur? *(yes/no)*

b) If a bond could be formed this bond would be *(polar/nonpolar/ionic)* because there is *(a large difference/a small difference/no difference)* in electronegativity between the two atoms

4) Li - Ne

a) Does a bond occur? *(yes/no)*

b) If a bond could be formed this bond would be *(polar/nonpolar/ionic)* because there is *(a large difference/a small difference/no difference)* in electronegativity between the two atoms

5) Mg - I

a) Does a bond occur? *(yes/no)*

b) If a bond could be formed this bond would be *(polar/nonpolar/ionic)* because there is *(a large difference/a small difference/no difference)* in electronegativity between the two atoms

EASY PACKET 2

Team ID Number: _____

Acid/Base

Each of the following is dissolved in water. *Identify if the resulting solution will be acidic, basic, or neutral. Identify the conjugate acid or base or write N/A if there is none.*

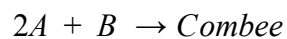
- 1) CH_3COONa
- 2) $(\text{NH}_4)_2\text{SO}_4$
- 3) NaClO

EASY PACKET 2

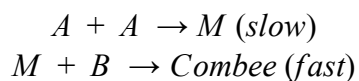
Team ID Number: _____

Kinetics

The formation of the creature Combee can be modeled as a molecular reaction. It requires two “A” parts which have a wing and an antenna and one “B(ee)” part which has nothing but a face and body. The full reaction is:



If the elementary steps are as show below:



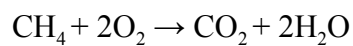
What is the rate equation?

EASY PACKET 3

Team ID Number: _____

Thermodynamics

Using the information given below, *determine the change in enthalpy, ΔH , for the following reaction:*



<u>Reaction</u>	<u>Change in Enthalpy</u>
$\text{C} + 2\text{H}_2 \rightarrow \text{CH}_4$	$\Delta H = -74.80 \text{ kJ/mol}$
$\text{C} + \text{O}_2 \rightarrow \text{CO}_2$	$\Delta H = -393.50 \text{ kJ/mol}$
$\text{H}_2 + \frac{1}{2} \text{O}_2 \rightarrow \text{H}_2\text{O}$	$\Delta H = -285.83 \text{ kJ/mol}$

EASY PACKET 3

Team ID Number: _____

Electrochemistry

Zinc metal reacts with copper (II) sulfate to form zinc sulfate and copper metal. *Write the oxidation half-reaction, the reduction half-reaction, and the total net ionic equation of this reaction.*

EASY PACKET 3

Team ID Number: _____

Acid/Base

Goomy, a fictional creature, secretes an acidic slime composed of HCl. The pH of the slime solution in water is 0.86. *How much solid HCl (in grams) would Goomy need to make 2.0L of slime?*

EASY PACKET 4

Team ID Number: _____

Physical Properties

The eco-friendly club at a certain high school want to know more about car pollution. In one of their calculations they find that the average mass of nitrogen monoxide (NO) emitted as smog from a single car is 8.0g per day. *What is the volume of this amount of gas under standard conditions for temperature and pressure (STP)?* Assume the gas behaves ideally.

EASY PACKET 4

Team ID Number: _____

Thermodynamics

Gibbsite ($\text{Al}(\text{OH})_3$) is used in industrial applications to generate metal aluminum. An intermediate step in this process is heating gibbsite from 25°C to 960°C . Given that the heat capacity (C_p) of aluminum hydroxide is $31.91 \text{ J} \cdot \text{g}^{-1} \cdot \text{K}^{-1}$ at 25°C , *how much energy is required to heat 1.0 kg of gibbsite from 25°C to 960°C ?* Assume heat capacity is independent of temperature.

EASY PACKET 4

Team ID Number: _____

Kinetics

Consider the gas phase reaction below:



Assuming that the rate of the reaction was experimentally determined to be first order with respect to H_2 and first order with respect to I_2 , *which of the following proposed reaction mechanisms are consistent with the experimentally determined rate law?* Circle all that apply.

Reaction	Mechanism
A) $\text{H}_2(\text{g}) + \text{I}_2(\text{g}) \rightleftharpoons 2\text{HI}(\text{g})$	One-step mechanism
B) $\text{I}_2(\text{g}) \rightleftharpoons 2\text{I}(\text{g})$ $\text{H}_2(\text{g}) + 2\text{I}(\text{g}) \rightarrow 2\text{HI}(\text{g})$	Fast equilibrium Slow
C) $\text{I}_2(\text{g}) \rightleftharpoons 2\text{I}(\text{g})$ $\text{I}(\text{g}) + \text{H}_2(\text{g}) \rightarrow \text{HI}(\text{g}) + \text{H}(\text{g})$ $\text{H}(\text{g}) + \text{I}(\text{g}) \rightarrow \text{HI}(\text{g})$	Fast equilibrium Slow Fast
D) $\text{I}_2(\text{g}) \rightarrow 2\text{I}(\text{g})$ $\text{H}_2(\text{g}) + 2\text{I}(\text{g}) \rightleftharpoons 2\text{HI}(\text{g})$	Slow Fast equilibrium

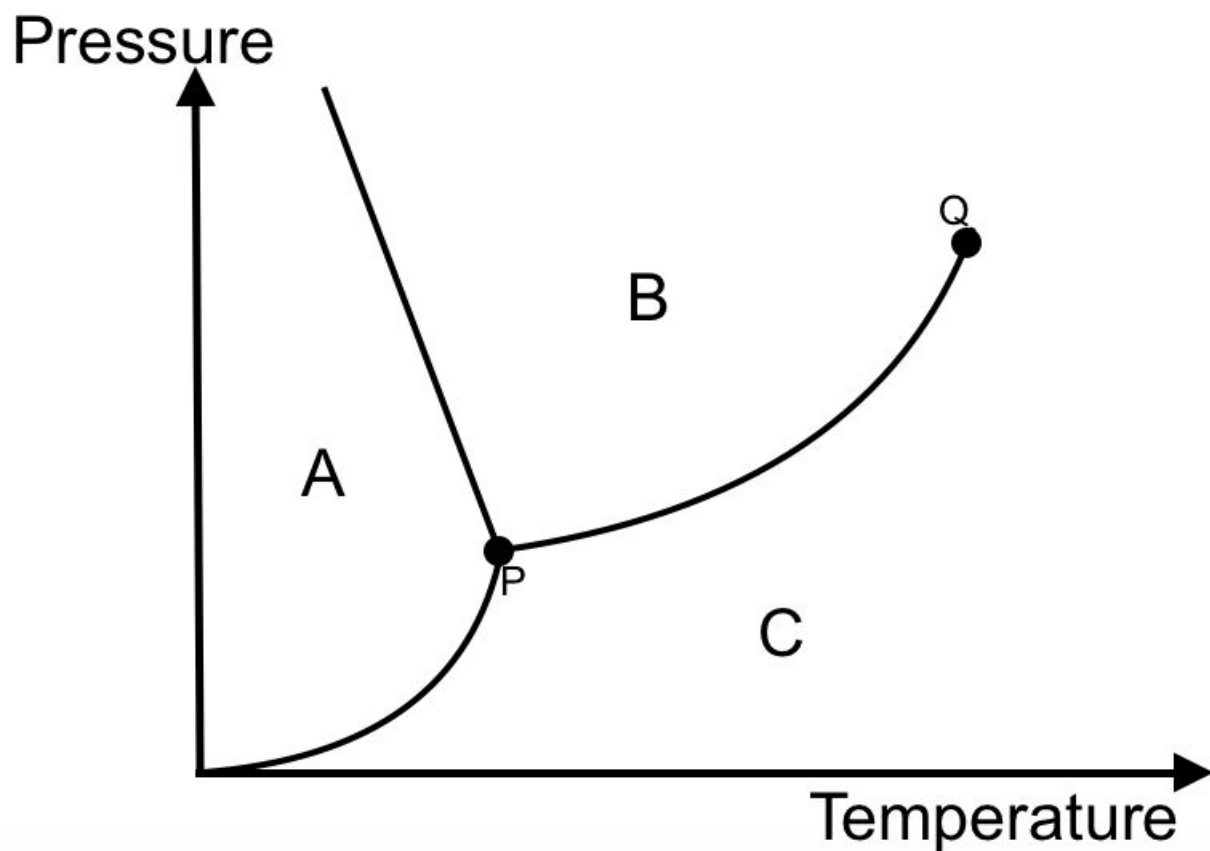
EASY PACKET 5

Team ID Number: _____

Physical Properties

Using the information from the phase diagram given below answer the following questions on the answer sheet:

- Label the correct phases (solid, liquid, or gas) for regions A, B, and C
- Circle the letter of the phase that is most dense
- What is the term for point Q, where phases in regions B and C become indistinguishable?
- What is the term for point P?

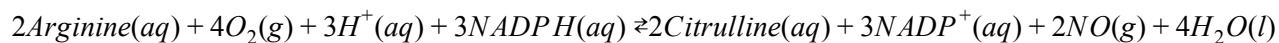


EASY PACKET 5

Team ID Number: _____

Equilibrium

You are in a lab that is trying to optimize the synthesis of nitric oxide. You suggest that instead of using the most common commercial synthesis, you use the enzyme nitric oxide synthase in a rigid container with constant volume, whose reaction can be modeled as:



Assume that the particular isoform of nitric oxide synthase you found has a reaction that can be treated as an endothermic equilibrium reaction. Using your knowledge of Le Chatelier's Principle, *determine whether each condition will increase, decrease or have no effect on the final concentration of nitric oxide.*

- 1) Increase temperature
- 2) Increase partial pressure of oxygen
- 3) Increase partial pressure of argon
- 4) Increase concentration of arginine
- 5) Increase concentration of citrulline
- 6) Increase concentration of nitric oxide synthase

EASY PACKET 5

Team ID Number: _____

Electrochemistry

Peeti is trying to put together a galvanic cell with 1.0 M of Ag^+ with a silver electrode in one beaker and 1.0 M Cu^{2+} with a copper electrode in another beaker. The electrodes are connected with a platinum wire and the ions are balanced with a salt bridge. *What is the standard reduction cell potential for this galvanic cell?* (Assume the temperature is 25 °C.)

EASY PACKET 6

Team ID Number: _____

Physical Properties

Cotton candy is a sweet, fluffy treat. On average, the St. Louis Cardinals sell 200 bags of cotton candy for each game. The volume of the bag is 1.0 L and the density of cotton candy is 2.7 kg/m^3 . Assuming that cotton candy is made up entirely of glucose ($\text{C}_6\text{H}_{12}\text{O}_6$), *how many moles of glucose are sold during one Cardinals game?* (Note: $1.0 \text{ L} = 0.0010 \text{ m}^3$)

EASY PACKET 6

Team ID Number: _____

Thermodynamics

Peeti would like to know the heat evolved from a certain neutralization reaction. From List 1, *circle all the experiment(s) that would be most useful for determining the heat evolved*. From List 2, *circle the material(s) that would be useful for this experiment*

List 1:

- A) Column Chromatography
- B) Redox Titration
- C) Distillation
- D) Bomb Calorimetry

List 2:

- A) Thermometer
- B) Bunsen burner
- C) UV light
- D) Nonpolar solvent such as hexane
- E) pH meter
- F) Bomb calorimeter
- G) Spectrometer
- H) Litmus strips
- I) Condenser
- J) Inert gas such as neon

EASY PACKET 6

Team ID Number: _____

Equilibrium

The Van't Hoff Equation allows for predicting the equilibrium constant K of a reaction at different temperatures. For the reaction $\text{O}_2(\text{g}) + 2\text{H}_2(\text{g}) \rightarrow 2\text{H}_2\text{O}(\text{g})$ has a $\Delta H = -483.64 \text{ kJ}$ and a $K_{\text{eq}} = 1.256 \times 10^{80}$ at 298 K. *What is the ΔG of this reaction at 900 K?*

EASY PACKET 7

Team ID Number: _____

Acid/Base

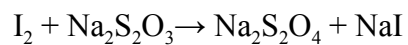
A titration is carried out on 10.0 mL of an unknown, monoprotic acid using 3.0 M NaOH. It is determined that the equivalence point is reached when 15.0 mL of NaOH was added. When 7.5 mL of NaOH was added, the pH was 6.0. *What is the pK_a for the unknown acid?*

EASY PACKET 7

Team ID Number: _____

Chemical Reactions

Peeti performs a redox reaction with iodine and sodium thiosulfate ($\text{Na}_2\text{S}_2\text{O}_3$) to form sodium dithionite ($\text{Na}_2\text{S}_2\text{O}_4$) in a basic solution. *Write the balanced net ionic equation of this reaction.* Below is the unbalanced molecular equation:



EASY PACKET 7

Team ID Number: _____

Equilibrium

Peeti McPeetz wants to poison a well with lead (II) chloride ($K_{sp} = 1.70 \times 10^{-5}$). EPA action levels of lead in drinking water is 15.0 ppm. (Note: 1.0 ppm is equivalent to 1.0 mg/L). If the well has 2000.0 L of water, *how many moles of lead would Monsieur McPeetz require?*

EASY PACKET 8

Team ID Number: _____

Physical Properties

A 2.0 L soda bottle can have a pressure of up to 10.2atm before bursting. There is a sealed 2.0 L soda bottle sitting in your oven at room temperature with 10.5 mL of water inside. *What temperature would the oven have to reach before the bottle explodes?* Assume the bottle can withstand high temperatures.

EASY PACKET 8

Team ID Number: _____

Acid/Base

Peeti would like to know the pH of a solution of NaOH. From List 1, *circle all the experiment(s) that would be most useful for determining this information*. From List 2, *circle the material(s) that would be useful for this experiment*.

List 1:

- A) Mass spectrometry
- B) Titration
- C) Spectrophotometry
- D) Bomb Calorimetry

List 2:

- A) 1.0M NH₃
- B) 1.0M potassium hydrogen phthalate (KHP)
- C) 1.0M KCl
- D) Galvanic Cell
- E) Phenolphthalein
- F) Ammeter
- G) Bunsen Burner
- H) Buret
- I) Safety Goggles
- J) Timer

EASY PACKET 8

Team ID Number: _____

Kinetics

The half life of carbon-14 (^{14}C) is 5730 years. Carbon-14 decays into nitrogen-14. *How many years will it take for 512.0 g of pure carbon-14 to decay into 100.0 g of nitrogen-14 (^{14}N)?*

EASY PACKET 9

Team ID Number: _____

Physical Properties

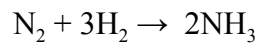
Pretend there is an animal called Magneticus Mageton that is able to float by generating a force from charging the ground below its body. If a 6.0 kg Magneticus Mageton can safely charge its body to $5.0 \times 10^{-8} \text{ C}$, *how much does the Magneticus Mageton need to charge the ground to float 2.0 m above the ground?* (Note: Remember, in order for something to float, upward acceleration must have the same magnitude as the acceleration of gravity, which is 9.81 m/s^2 .)

EASY PACKET 9

Team ID Number: _____

Thermodynamics

For a simple chemical reaction below:



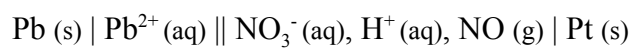
the ΔG for the reaction is 43.96 kJ. Assuming ΔG is temperature independent, *what is the equilibrium constant for this reaction at 100.0 K and 1000.0 K?*

EASY PACKET 9

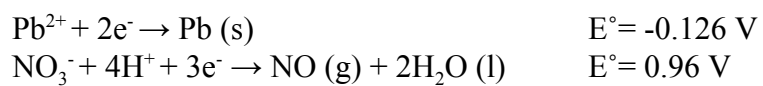
Team ID Number: _____

Electrochemistry

Find E° of the following cell



given these standard reduction potentials:



EASY PACKET 10

Team ID Number: _____

Equilibrium

Peeti dissolves 8.69g of cadmium iodate ($\text{Cd}(\text{IO}_3)_2$). He dissolves it in 68.7 mL of water. At $25\text{ }^\circ\text{C}$, $K_{sp} = 1.5 \times 10^{-8}$ for cadmium iodate. *How many grams of cadmium iodate remain undissolved?*

EASY PACKET 10

Team ID Number: _____

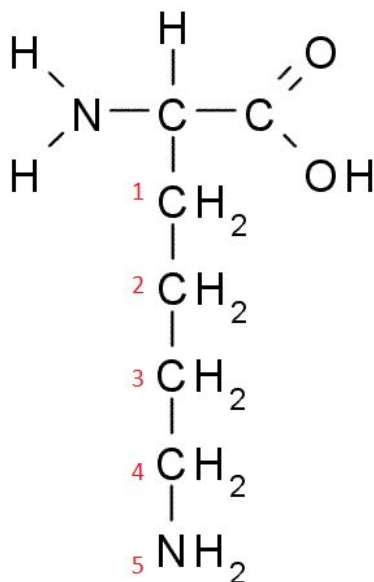
Chemical Reactions

Zinc metal reacts with copper sulfate to form zinc sulfate and copper metal. *Write the oxidation half-reaction, the reduction half-reaction, and the total net ionic equation of this reaction.*

Acid/Base

In eukaryotic cells, DNA is wrapped around positively charged proteins called histones. Because DNA is negatively charged, it is able to tightly bind to histones because of the favorable interactions between charges.

The charge on histones is a result of the amino acid, lysine. Lysine is depicted below:



The carbon chain labelled 1-4 and ending with a nitrogen group labelled 5 is called the R group. Most reactions and interactions of amino acids occur on the R group.

Now consider your knowledge of ammonia, and other similar nitrogen based compounds. Also consider your knowledge of simple carbon compounds such as methane. Consider whether a parallel can be drawn between these compounds and lysine, and *determine the formal charge on each of the numbered atoms in a solution at pH 2.0.*

EASY PACKET 11

Team ID Number: _____

Physical Properties

Planet Laberstros has a unique element simply labeled as 'Y'. This element has three separate isotopes. Astronauts on Earth manage to retrieve a 7.3 mole sample of 'Y' from Planet Laberstros. Using the table below, *how heavy is this sample?* Report your answer in grams.

<u>Atomic Mass</u>	<u>Percent Abundance</u>
120	70.1%
123	10.3%
125	19.6%

EASY PACKET 11

Team ID Number: _____

Chemical Reactions

Toluene is a commonly used organic solvent that slowly chews through plastic. Peeti stores 300.0 mL of toluene in a bottle made from 600.0 g of polystyrene (a type of plastic) and leaves for winter break. The density of polystyrene is 1.04 g/cm^3 , and the density of toluene is 0.867 g/cm^3 . When he arrives, Peeti notices a puddle of toluene and no polystyrene bottle. Assuming no toluene has evaporated, *what is the weight percent of polystyrene in the solution?*

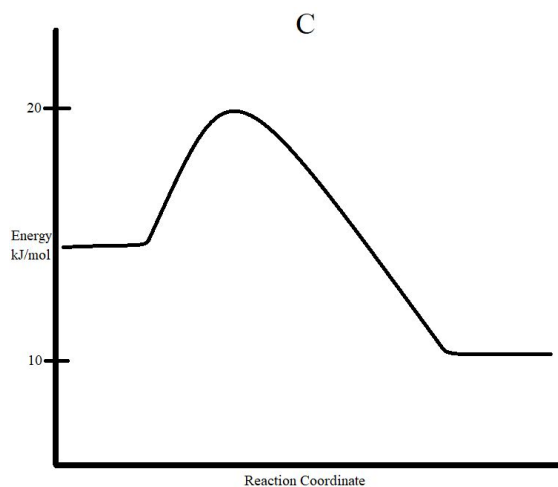
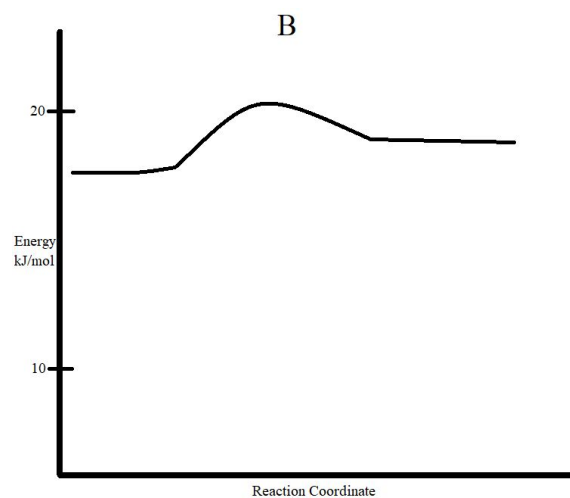
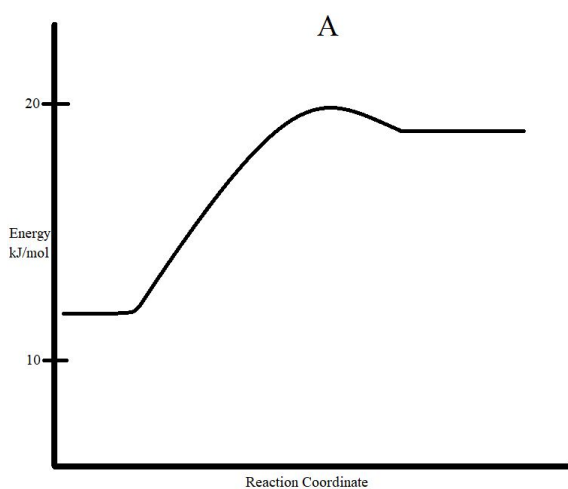
Kinetics

The Arrhenius equation describes the relationship between activation energy and the rate constant:

$$k = Ae^{-E_a/RT}$$

where A is a constant and R is the gas constant

Consider the following reaction coordinate diagrams. Rank the following reaction coordinate diagrams (A, B, and C) in order of increasing rate. (Note: The rate constant is not the same for any of the reactions.)



EASY PACKET 12

Team ID Number: _____

Physical Properties

Sterling silver has a molar ratio of 85:10:5 of silver, copper, and steel respectively. Suppose we have 47.7g silver, *what is the minimum amount of copper and steel required to create the maximum amount of sterling silver?*

EASY PACKET 12

Team ID Number: _____

Thermodynamics

Timid Timmy, a fictitious character, has 2 beakers at 25.0 °C and 1.0 atm, one with 150.0 g of pure water and one with 150.0 g of a 1.10 molal calcium nitrate aqueous solution. *Calculate the difference in energy that must be added to bring each beaker to its boiling point.* Assume that the specific heat of both solutions is $4.184 \frac{\text{J}}{\text{g} \cdot ^\circ\text{C}}$. $\Delta T = K_b \cdot \text{molality}$, where $K_b = 0.512 \frac{^\circ\text{C}}{\text{molal}}$ and the boiling point of water at 1.0 atm is 100.0 °C.

EASY PACKET 12

Team ID Number: _____

Equilibrium

While preparing a solution for an experiment, Peeti accidentally adds 0.5g of zinc fluoride (ZnF_2) into a beaker filled with 100mL of water. Afraid to let anyone know about his mistake, *how much extra water must Peeti add to the beaker such that all the zinc fluoride is dissolved?* (K_{sp} of $\text{ZnF}_2 = 3.04 \times 10^{-2}$)

EASY PACKET 13

Team ID Number: _____

Physical Properties

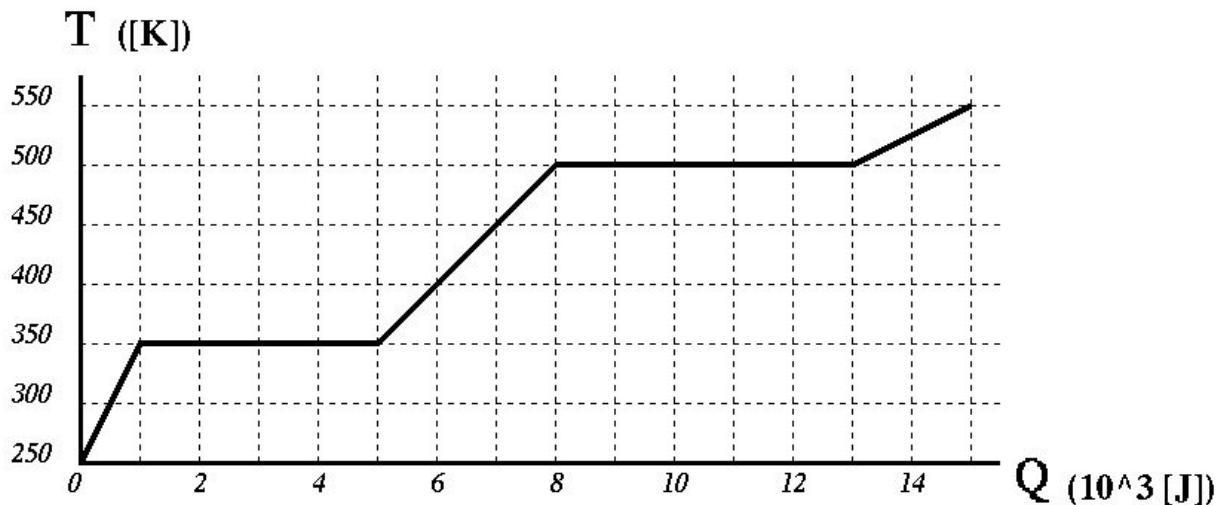
Referring to the table below, determine *which liquid has the lowest equilibrium vapor pressure* and *which has the weaker intermolecular force*.

	Molar Mass (g/mol)	Boiling Point (°C)
C₆H₆	78	80.1
CCl₄	154	76.7

Thermodynamics

Scientists have synthesized a new chemical called Chemical Z. They have gathered some important thermodynamic data, displayed in the chart below. In an isolated system, 120.0 g of Chemical Z at 250.0 K are combined with 320.0 g of Chemical Z at 450.0 K. *What is the final temperature (T_F) of the system?*

Heat v. Temperature per gram of Chemical Z



EASY PACKET 13

Team ID Number: _____

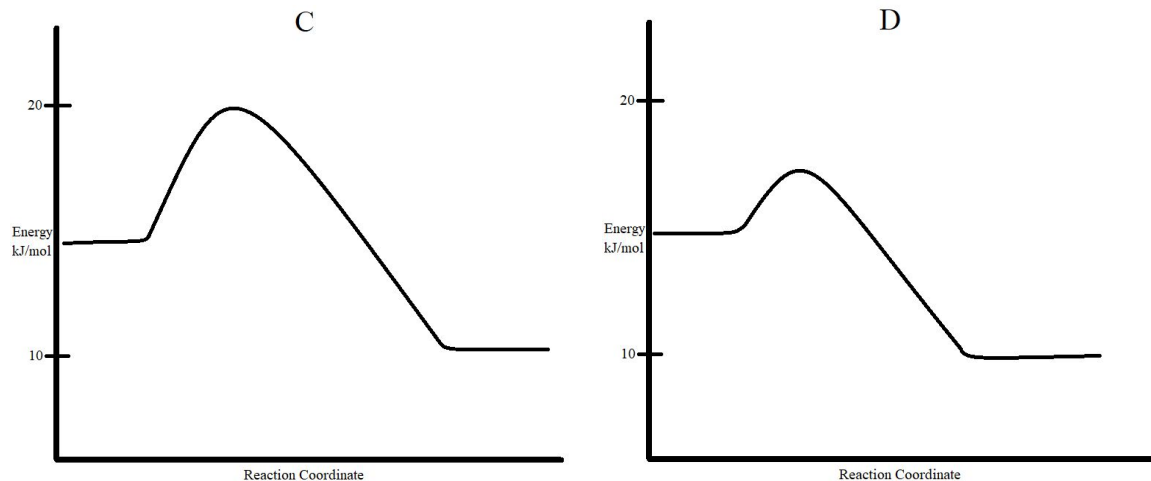
Kinetics

In chemistry, we are interested in both thermodynamic and kinetic processes. Thermodynamic processes favors the product that is more stable while kinetic processes favor the product that forms faster. Considering a reaction in which two different products can be formed from the same starting reactant, as shown below, *determine which product is favored thermodynamically and which product is favored through kinetics.*

<u>Reaction</u>	<u>E_a</u>	<u>ΔH</u>
Reactants → Product A	+ 55 kcal/mol	- 25 kcal/mol
Reactants → Product B	+ 75 kcal/mol	- 15 kcal/mol

Kinetics

The following reaction coordinate diagrams represent the same reaction, but under different conditions:



Complete the following statements:

Reason 1: Reaction D has _____ (less/more/equal) initial energy than Reaction C.

Reason 2: Reaction D is the _____ (catalyzed/uncatalyzed) version of Reaction C.

Reason 3: Reaction D requires _____ (less/more/equal) activation energy than Reaction C.

Reason 4: Reaction D has _____ (less/more/equal) final energy than Reaction C.

Therefore, Reaction D will proceed _____ (faster than/slower than/at the same rate as) Reaction C because of _____ (circle all reasons that apply).

EASY PACKET 14

Team ID Number: _____

Physical Properties

Mercury is one of the few elements on the periodic table that are liquid at room temperature. As a liquid, much of the ambient air can dissolve into the mercury. On Earth, the density of mercury is 13.69g/cm^3 and the molar mixing ratio of air (the ratio of moles of air to moles of mercury) is 0.10. *Find the concentration of air in a solution of mercury.*

EASY PACKET 14

Team ID Number: _____

Acid/Base

Assume HX is a strong acid, and HY and HZ are acids of unknown strength. Using the reactions given below, *rank each conjugate base by its basicity*.

<u>Reaction Name</u>	<u>Reaction</u>
X	$\text{HX} + \text{NH}_3 \rightarrow \text{X}^- + \text{NH}_4^+$
Y	$\text{HY} + \text{X}^- \rightarrow \text{HX} + \text{Y}^-$
Z	$\text{HX} + \text{Z}^- \rightarrow \text{HZ} + \text{X}^-$

EASY PACKET 15

Team ID Number: _____

Physical Properties

Peeti is using a UV-Vis spectrophotometer to determine the concentration of cerium oxide in a solution. Cerium oxide has a peak absorbance at around 420nm. Initially, Peeti measures a 0.25M of cerium oxide to have an absorbance of 0.72. Next, Peeti takes his sample with unknown amount of cerium oxide and measures an absorbance of 0.53. *What is the molarity of cerium oxide in the unknown sample?* Assume the solvent has no absorbance and the cuvette length does not change between trials.

EASY PACKET 15

Team ID Number: _____

Electrochemistry

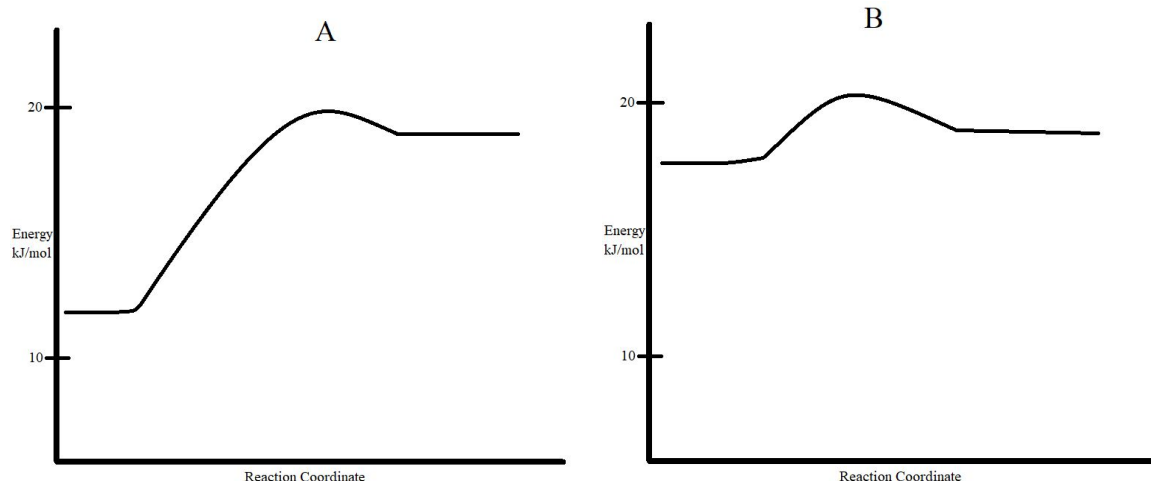
Water can be split into hydrogen gas and oxygen gas through a process called electrolysis. Electrolysis is an oxidation-reduction reaction that takes place as follows:

<u>Anode</u>	$4\text{OH}^-(\text{aq}) \rightarrow \text{O}_2(\text{g}) + 2\text{H}_2\text{O}(\text{l}) + 4\text{e}^-$	$E_{\text{red}} = -1.23\text{V}$
<u>Cathode</u>	$2\text{H}_2\text{O}(\text{l}) + 2\text{e}^- \rightarrow \text{H}_2(\text{g}) + 2\text{OH}^-(\text{aq})$	$E_{\text{ox}} = 0.0\text{V}$

What is the cell potential for electrolysis of water?

Kinetics

The following reaction coordinate diagrams represent the same reaction, but under different conditions:

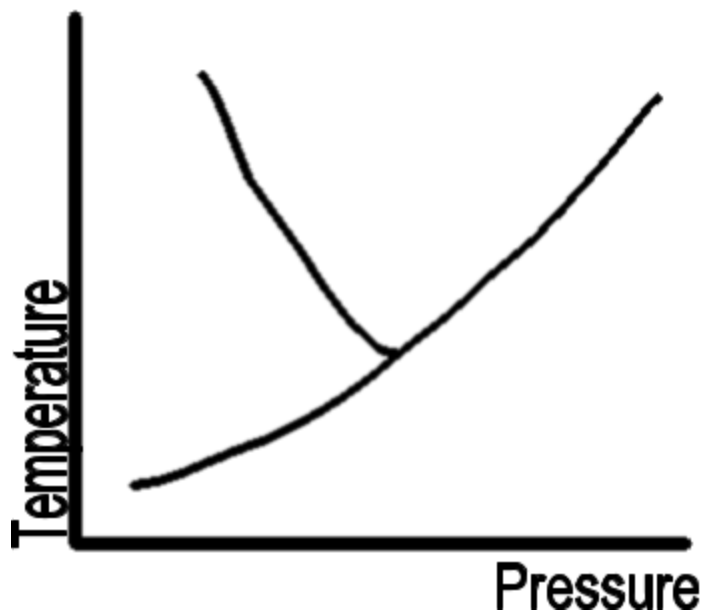


Complete the following statements:

- Reason 1: Reaction B has _____ (less/more/equal) initial energy than Reaction A.
 Reason 2: Reaction B is the _____ (catalyzed/uncatalyzed) version of Reaction A.
 Reason 3: Reaction B has _____ (less/more/equal) activation energy than Reaction A.
 Reason 4: Reaction B has _____ (less/more/equal) final energy than Reaction A.
 Therefore, Reaction B will proceed _____ (faster than/slower than/at the same rate as) Reaction A because of _____ (list all reasons that apply).

Physical Properties

How would the following phase diagram of a solvent change if NaCl was added? Indicate the change graphically or write N/A if no change occurs.

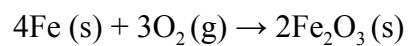


EASY PACKET 16

Team ID Number: _____

Chemical Reactions

Iron rusts in the presence of oxygen by the following reaction:



How many grams of rust (Fe_2O_3) will be produced if there are 10.0g of iron in excess oxygen?

EASY PACKET 16

Team ID Number: _____

Kinetics

A newly discovered element X reacts with H_2 with the following experimentally determined rates:

Rate	[X]	[H₂]
1.2×10^{-5}	0.2	0.2
2.4×10^{-5}	0.4	0.4
2.4×10^{-5}	0.4	0.2

What order is the reaction with respect to X? With respect to H₂?

EASY PACKET 17

Team ID Number: _____

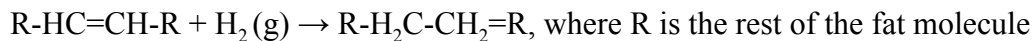
Physical Properties

For each of the following, *state the hybridization of the underlined atom.*

- 1) $\underline{\text{C}}\text{O}_2$
- 2) $\underline{\text{B}}\text{F}_3$
- 3) $\text{CH}_3\underline{\text{C}}\text{OOH}$
- 4) $\underline{\text{C}}\text{O}$
- 5) $\underline{\text{N}}\text{H}_3$

Chemical Reactions

Margarine, a common butter substitute in cooking, can be made by hydrogenating vegetable oil. Hydrogenation occurs by adding hydrogen gas to unsaturated fats (i.e. fats with at least one double bond between carbons) in the presence of a metal catalyst, such as nickel:



Suppose you want to make margarine from a vegetable oil made of 10.0 mol of monounsaturated fats. This means there is only one double bond per fat molecule, so the above reaction only needs to occur once. At 1.0 atm and 0 °C (STP), *how many liters of hydrogen are needed?*

EASY PACKET 17

Team ID Number: _____

Kinetics

A certain reaction has an activation energy of about $10.0 \frac{\text{kJ}}{\text{mol}}$. *How much faster would the forward rate of reaction be at 75 °C than at 25 °C?*

Hint: use the following equation: $k = Ae^{-\frac{E_A}{RT}}$

EASY PACKET 18

Team ID Number: _____

Physical Properties

For each of the following molecules, name the VSEPR geometry of the underlined atom

- 1) H₂O
- 2) PF₅
- 3) HCN
- 4) CH₄
- 5) CO₂
- 6) SO₂
- 7) NH₃

EASY PACKET 18

Team ID Number: _____

Chemical Reactions

How many moles are in 20.0 g of each of the following compounds?

- a) O_2
- b) CO_2
- c) $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$

EASY PACKET 18

Team ID Number: _____

Kinetics

Planet X has many unknown gaseous molecules floating around the atmosphere, forming and decomposing in ways unknown to scientists on Earth. A common reaction in the atmosphere is shown below:



This reaction is examined in controlled conditions to determine the rate law of the reaction. Using the table below, *determine the rate law of the reaction*:

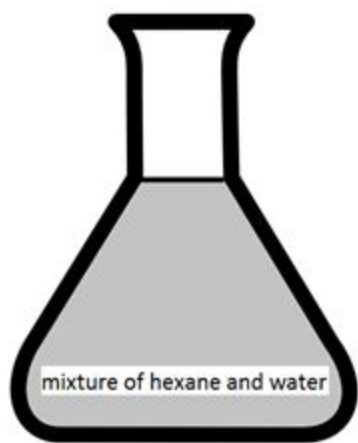
<u>Trail Number</u>	<u>[Y]</u>	<u>[Z]</u>	<u>Rate</u>
Trail 1	0.7	3.15	0.0833
Trail 2	0.7	6.3	0.3334
Trail 3	2.8	6.3	1.3336

EASY PACKET 19

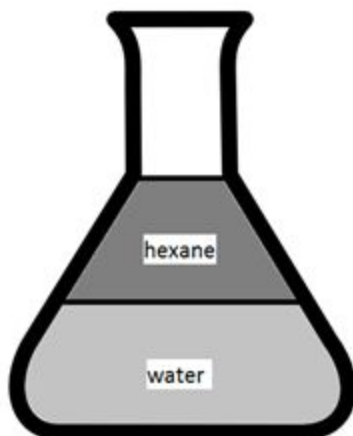
Team ID Number: _____

Physical Properties

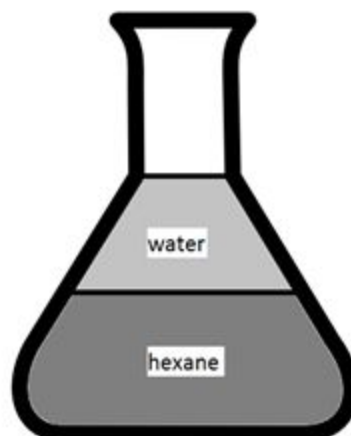
Hexane, C_6H_{14} , is an organic solvent with a density of 0.655 g/mL. *Which of the following images best describes water and hexane mixed together, after the system reaches equilibrium?* Recall that the density of water is 1.0 g/mL.



A



B



C

EASY PACKET 19

Team ID Number: _____

Chemical Reactions

WUCT's resident storyteller (Juan Zapata Thyme) has a 5.47 g piece of magnesium metal (MW = 24.305 g/mol). He would like to add 100 mL of HCl (aq) to completely react with the magnesium. *What is the minimum concentration of hydrochloric acid that Juan needs to add?*

EASY PACKET 19

Team ID Number: _____

Acid/Base

A chemist mixes 15.0 mL of 0.05 M HCl and 15.0 mL of 0.01 M HNO₃. *What is the pH of the resulting solution?*

Physical Properties

Peeti performed an experiment in his laboratory. Peeti presented his results to his instructor and was immediately reprimanded and put on work probation! His results were both wildly inaccurate and imprecise. *Circle which of the following could have caused Peeti's inaccuracy and imprecision.*

The inaccuracy in Peeti's results may have been caused by:

- a) Peeti made measurements with instruments that were miscalibrated
- b) Peeti's experimental conditions varied between each trial
- c) Peeti performed all of his temperature-sensitive experiments at 25 °F instead of 25 °C
- d) Peeti tried to measure 1.5 mL of liquid in a 1.0 L beaker with markings every 100 mL
- e) Peeti exactly followed the manufacturer's instructions for the spectrophotometer
- f) Peeti forgot to wear safety goggles

The imprecision in Peeti's results may have been caused by:

- a) Peeti made measurements with instruments that were miscalibrated
- b) Peeti's experimental conditions varied between each trial
- c) Peeti spilled his soda into his experiment
- d) Peeti tried to measure 1.5 mL of liquid in a 1.0 L beaker
- e) Peeti exactly followed the manufacturer's instructions for the spectrophotometer
- f) Peeti forgot to wear safety goggles

EASY PACKET 20

Team ID Number: _____

Chemical Reactions

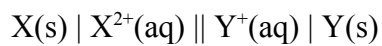
Selma Junkoff, the eBay specialist at WUCT, wanted to know how much CO_2 (MW = 44.01 g/mol) is released into the atmosphere by one gasoline-powered car. Gasoline is 90% octane (C_8H_{18} ; MW = 114.23 g/mol) by mass. If 2.812 kg of gas (~1.0 gallon) is combusted in oxygen by a car engine, *how many grams of CO_2 are produced?*

EASY PACKET 20

Team ID Number: _____

Electrochemistry

Potato Joe sets up a cell with the following reaction:



After five minutes, Potato Joe notices that the concentration of X^{2+} in the cell is 0.05M. The volume of solution in that cell is 100.0mL. *What is the average current over those five minutes?*

Recall that the charge of a single electron is 1.62×10^{-19} Coulombs (C). 1 Ampere (A) = 1 C/second