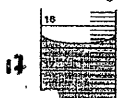


Name: KEY

2016-2017 Chemistry Regents Review

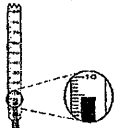
The diagram below shows a portion of a buret.



What is the meniscus reading in milliliters?

- 1) 16.00 3) 16.40
2) 17.00 4) 17.60

The diagram below represents a Celsius thermometer recording a certain temperature.



What is the correct reading of the thermometer?

- 1) 5°C 3) 4.3°C
2) 0.3°C 4) 4°C

A student determined the percentage of water of hydration in $\text{BaCl}_2 \cdot 2\text{H}_2\text{O}$ by using the data in the table below.

Quantity Measured	Value Obtained
Mass of $\text{BaCl}_2 \cdot 2\text{H}_2\text{O}$	3.80 grams
Mass of BaCl_2	3.20 grams
% of water calculated	15.79 %

The accepted percent of water of hydration is 14.75 %. What is the student's percent error?

- 1) 1.04 % 2) 6.00 % 3) 6.59 % 4) 7.05 %

Which volume measurement is expressed in two significant figures?

- 1) 20 ml 2) 202 ml 3) 220 ml 4) 0.2 ml

Which measurement has the greatest number of significant figures?

- 1) 44000 g 2) 404 g 3) 40.44 g 4) 0.40004 g

The mass of a solid is 3.60 g and its volume is 1.8 cm^3 . What is the density of the solid, expressed to the correct number of significant figures?

- 1) 12 g/cm^3 2) 2.0 g/cm^3 3) 0.5 g/cm^3 4) 0.50 g/cm^3

Which quantity expresses the sum of 22.1 g + 375.66 g + 5400.132 g to the correct number of significant figures?

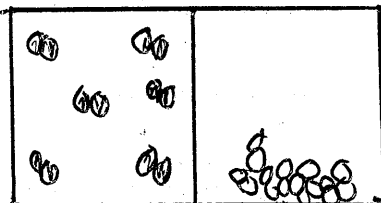
- 1) 5800 g 2) 5798 g 3) 5797.9 g 4) 5797.892 g

●● represents one molecule of nitrogen.

a. Draw a particle model that shows at least six molecules of nitrogen gas.

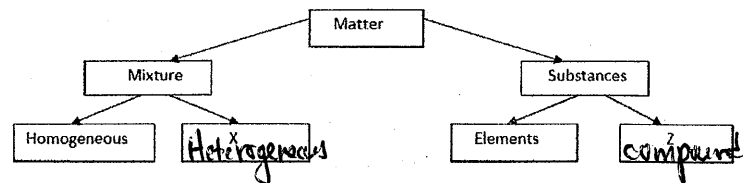
b. Draw a particle model that shows at least six molecules of liquid nitrogen.

c. Describe, in terms of particle arrangement, the difference between nitrogen gas and liquid nitrogen.



gas has greater distance btwn particles. (less dense)

10. Base your answers on the following chart.



a. What word is represented by the variable X? Heterogeneous

b. What word is represented by the variable Z? Compounds

c. Identify one type of matter that cannot be broken down by either physical or chemical changes. Elements

d. Which type(s) of matter have a uniform composition? Elements, Compounds, Homogeneous Mixtures

e. What type(s) of matter is/are physically combined? Mixtures

f. Define compound. A substance that contains 2 or more elements chemically combined in a fixed proportion.

g. What type of matter would the following be classified as?
Air- Homogeneous Mixture

(CH_4) Methane- Compound

(Sn) Tin- Element

A jar filled with various coins- Heterogeneous Mixture

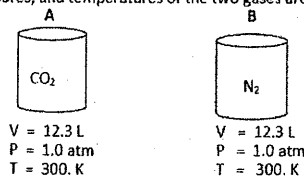
h. How is distillation used to separate two liquids? Is this process physical or chemical? Explain.

Boiling pt. It is a physical change b/c the identity of the substances doesn't change.

i. How is electrolysis used to separate a compound? Is this process physical or chemical? Explain.

An electric current is shot through the compound to split it. It is a chemical change → the compound is changed into elements.

11. Cylinder A contains 22.0 grams of $\text{CO}_2(g)$ and Cylinder B contains $\text{N}_2(g)$. The volumes, pressures, and temperatures of the two gases are indicated under each cylinder.

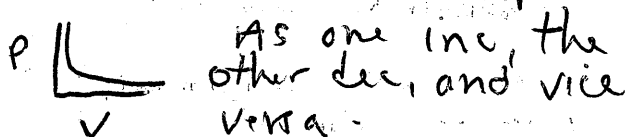


- a. How does the number of molecules of $\text{CO}_2(g)$ in cylinder A compare to the number of molecules of $\text{N}_2(g)$ in container B? Your answer must include both $\text{CO}_2(g)$ and $\text{N}_2(g)$.
- b. The temperature of $\text{CO}_2(g)$ is increased to 450. K and the volume of cylinder A remains constant. Show a correct numerical setup for calculating the new pressure of $\text{CO}_2(g)$ in cylinder A.

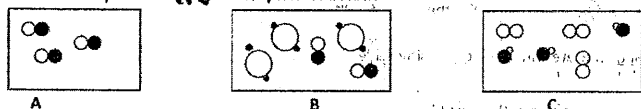
$$\frac{P_1}{T_1} = \frac{P_2}{T_2} \quad \frac{1 \text{ atm}}{300 \text{ K}} = \frac{X \text{ atm}}{450 \text{ K}}$$

- c. State the relationship between pressure and volume and draw what the relationship would look like on a graph below.

They have an inverse relationship.



12. Base your answers to questions and on the pictures below.



- a. Contrast sample A and sample B in terms of compounds and mixtures. Include both sample A and B in your answer.
- b. Explain why sample C could represent a mixture of fluorine and hydrogen chloride.
- c. Explain, in terms of composition, why sample A represents a pure substance.
- d. Explain how the average kinetic energy of sample B can be equal to the average kinetic energy of sample C.

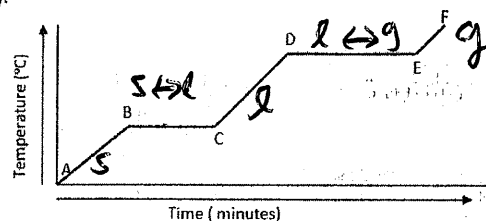
A is a compound
B is a mixture

F_2 is diatomic and HCl is a binary molecule (compound)

Only one type of particle

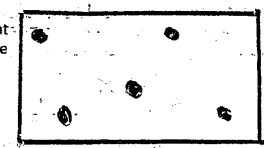
IF they are at the same temp

13. Given the heating curve where substance X starts as a solid below its melting point and is heated uniformly.



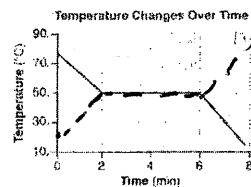
- a. Describe, in terms of particle behavior or energy, what is happening to substance X during line segment BC.
- b. Using \bullet to represent particles of substance X, draw at least five particles as they would appear in the substance at points F.
- c. Identify a line segment in which the average kinetic energy is increasing.

PE inc from S to L and KE remains constant.



gas.

14. The graph below shows a compound being cooled at a constant rate starting in the liquid phase at 75°C and ending at 15°C .



- a. What is the freezing point of the compound, in degree Celsius?
- b. State what is happening to the average kinetic energy of the particles of the sample between minute 2 and minute 6.
- c. What Kelvin temperature is equal to 15°C ?
- d. A different experiment was conducted with another sample of the same compound starting in the solid phase. The sample was heated at a constant rate from 15°C to 75°C . On the graph above, draw the resulting heating curve.

50°C

It remains constant.

$273 + 15 = 288 \text{ K}$

(dotted line)

15.

In the 19th century, Dmitri Mendeleev predicted the existence of a then unknown element X with a mass of 68. He also predicted that an oxide of X would have the formula X₂O. On the modern Periodic Table, what is the Group number and Period number of element X?

Group 1

- Explain, in terms of atomic structure, why the atomic radius of iodine is greater than the atomic radius of fluorine.
- Explain, in terms of electron configuration, why selenium and sulfur have similar chemical properties?
- How are the elements arranged on the modern periodic table?

Iodine has more electron shells

Same # of valence e-

16.

Li																		
H																		
He																		
Na																		
Unknown																		

- Explain, in terms of excited state, energy transition, and ground state, how a bright-line spectrum is produced.
- Identify the two elements in the unknown spectrum.

When an excited state electron transitions from a higher state to the ground state, energy is released.

Hydrogen + Helium

- How/why can the spectrum of an element be used to determine its identity?
- All atoms of the same element have an identical bright light spectrum. It is the "fingerprint" of an element.*

17.

An atom has an atomic number of 9, a mass number of 19, and electron configuration of 2-6-1.

- Explain why the number of electrons in the second and the third shells show that this atom is in an excited state.
- What is the total number of neutrons in this atom?
- What is the ground state electron configuration of this element?
- Would this element have an ion that has a radius that is bigger or smaller than its neutral atom? Explain.

2nd shell max is 8. It should be full before moving to 3rd.

Bigger. Fluorine (nonmetal) gains one electron to form a fluoride ion. Anions (Negative ions) are larger than their neutral atoms.

18.

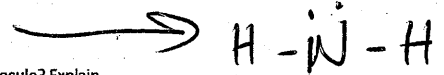
Each molecule listed below is formed by the sharing of electrons between atoms when atoms within the molecule are bonded together.

- Molecule A: Cl₂
- Molecule B: CCl₄
- Molecule C: NH₃

- Explain how the bonding in KCl is different from the bonding in molecules A, B, and C.
- Explain why NH₃ has stronger forces of attraction than Cl₂.
- Explain why CCl₄ is classified as a nonpolar molecule.
- Draw the Lewis electron-dot structures for the NH₃ molecule.

It is ionic. (Electrons were transferred)
NH₃ has hydrogen bonding.

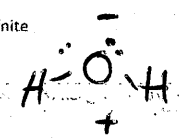
Symmetric distribution of charge



- Is hydrogen bromide a polar or nonpolar molecule? Explain.

Polar H-Br. Asymmetric Dist. of charge.

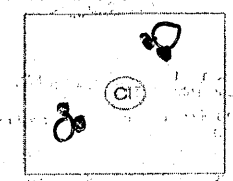
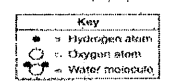
- Water is a polar molecule because it is bent and has a definite positive and negative side to it.



- Draw the structure for a molecule of water, H₂O.
- On your drawing, indicate with a "+" the positive side, and with "-" the negative side.
- Describe one property of water that would change if water molecule were a straight molecule and nonpolar.

Its boiling point.

Using the key to the right, draw at least two water molecules in the box showing the correct orientation of each water when it is near the Cl⁻ ion in the aqueous solution



20. Sodium is essential ingredient in the human diet. The Federal Food and Drug Administration recommends that the average adult daily requirement for sodium is 2.4 grams. Sodium is ingested through consuming plants and animal tissues, but another good source is table salt, sodium chloride.

a. What is the chemical formula for sodium chloride? NaCl

b. What is the gram formula mass of a mole of sodium chloride?

$$23 + 35 = 58 \text{ g/mole}$$

c. Based on your answer to previous question, how many moles of table salt, sodium chloride would need to be consumed in order to ingest the 2.4 grams? [Show work]

$$\# \text{ moles} = \frac{2.4 \text{ g}}{58 \text{ g/mole}} = .04 \text{ moles}$$

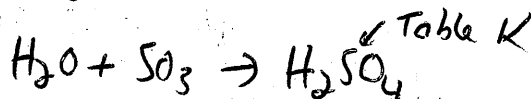
21. Scientists discovered, and have confirmed, that sulfur dioxide (SO_2) and nitrogen oxides (NO_x) are the primarily causes of acid rain. In the US, about 2/3 of all SO_2 comes from electric power generator that relies on burning fossil fuels like coal.

When sulfur dioxides reaches the atmosphere, it oxidizes to first form sulfur trioxide SO_3 . It then becomes sulfuric acid as it joins with water in the air and falls back down to earth. Acid rain causes acidification of lakes and streams. In addition, acid rain accelerates the decay of building materials and paints, including irreplaceable buildings, statues, and sculptures that are part of our nation's cultural heritage.

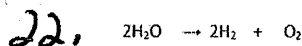
a. Write a balance chemical equation for the reaction between SO_2 and O_2 to form sulfur trioxide.



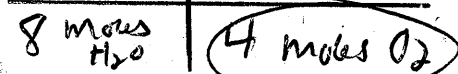
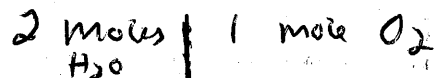
b. Write a balance chemical equation for the reaction between water and sulfur trioxide to form sulfuric acid.



c. Buildings and statues are often made of limestone which is composed of calcium carbonate. Write the formula for calcium carbonate.



a. What is the total number of moles of O_2 produced when 8 moles of H_2O is completely consumed?



b. How does the balanced chemical equation show the Law of Conservation of Mass?

and types of atoms on reactant side equal to the product side.

c. What type of reaction does this equation represent?

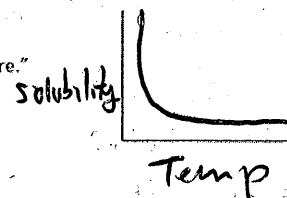
Decomposition

23. When cola, a type of soda pop, is manufactured, $\text{CO}_2(\text{g})$ is dissolved in it.

On the set of axes to the right.

a. Label one of them "Solubility" and the other "Temperature."

b. Draw a line to indicate the solubility of $\text{CO}_2(\text{g})$ versus temperature.



c. A capped bottle of soda contains $\text{CO}_2(\text{g})$ under high pressure. When the cap is removed, how does pressure affect the solubility of the dissolved $\text{CO}_2(\text{g})$?

Lower external pressure decreases gas solubility.

24. A student uses 200 grams of water at 60°C to prepare a saturated solution of potassium chloride, KCl.

a. According to reference Table G, how many grams of KCl must be used to create this saturated solution.

$$\frac{45 \text{ g KCl}}{100 \text{ g H}_2\text{O}} = \frac{90 \text{ g KCl}}{200 \text{ g H}_2\text{O}}$$

b. This solution is cooled to 10°C and the excess precipitate (settle) out. The resulting solution is saturated at 10°C . How many grams of KCl precipitated out of the original solution?

$$\frac{60 \text{ g KCl}}{200 \text{ g H}_2\text{O}} @ 10^\circ\text{C} \quad 90 - 60 = 30 \text{ g}$$

c. Identify the solute in this solution: KCl

25. A truck carrying concentrated nitric acid overturns and spills its contents. The acid drains into a nearby pond. The pH of the pond water was 8.0 before the spill. After the spill, the pond water is 1,000 times more acidic.

a. What is the new pH of the pond water after the spill?

5

b. What color would bromthymol blue be at this new pH?

yellow

c. Name an ion in the pond water that has increased in concentration due to the spill.

H^+

26. A student titrates 60.0 mL of $\text{HNO}_3(\text{aq})$ with 0.30 M $\text{NaOH}(\text{aq})$. Phenolphthalein is used as the indicator. After adding 42.2 mL of $\text{NaOH}(\text{aq})$, a color change remains for 25 seconds, and the student stops the titration.

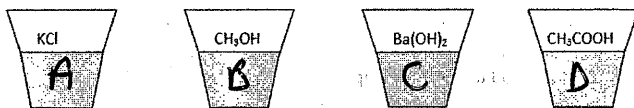
a. What color change does phenolphthalein undergo during this titration?

colorless to pink

b. What is concentration of the HNO_3 that was titrated?

$$\begin{aligned} M_A V_A &= M_B V_B \\ (X)(60) &= (.30)(42.2) \\ X &= .21 \text{ M HNO}_3 \end{aligned}$$

27. Four beakers each containing 100 milliliters of aqueous solution of equal concentration at 25°C.



- a. Which solutions contain electrolytes? **A, C, and D**
 b. Which solution has the lowest pH? **D**
 c. Which solution is most likely to react with Arrhenius acid to form a salt and water? **C**
 d. Which solution has the lowest freezing point? **C**
 e. What causes some aqueous solution to have a low pH? **D**

28. Given the equilibrium equation at 298 K
- $$\text{KNO}_3(s) + 34.89 \text{ kJ} \leftrightarrow \text{K}^+(aq) + \text{NO}_3^-(aq)$$

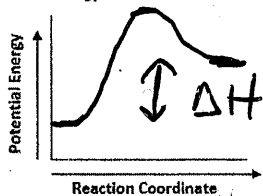
- a. The equation indicates that KNO_3 has formed a saturated solution. Explain, in terms of equilibrium, why the solution is saturated.

The double arrow indicates the solution is at equilibrium. Only sat solutions are @ equilibrium.

- b. Describe, in terms of Le Chatelier's principle, why an increase in temperature increases the solubility of KNO_3 .

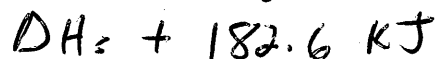
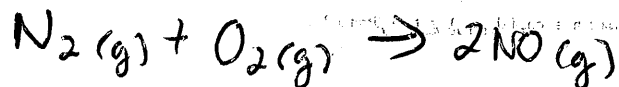
IF temp is \uparrow , the eq shifts to the right, and more (s) becomes (aq).

29. On the set of axes provided: Sketch the potential energy diagram for an endothermic chemical reaction that shows the activation energy and the potential energy of the reactants and the potential energy of the products.



- a. Label the heat of reaction on your PE diagram.

- b. Below, write one reaction from Table I that would have a PE diagram similar to the one drawn above.



*Any rxn with a + ΔH .

30.

Ethene (common name ethylene) is a commercially important organic compound. Millions of tons of ethene are produced by the chemical industry each year. Ethene is used in the manufacture of synthetic fibers for carpeting and clothing, and it is widely used in the making of polyethylene. Low-density polyethylene can be stretched into a clear, thin film that is used for wrapping food products and consumer goods. High-density polyethylene is molded into bottles for milk and other liquids. Ethene can also be oxidized to produce ethylene glycol, which is widely used in antifreeze for automobiles. The structural formula for ethylene glycol is:



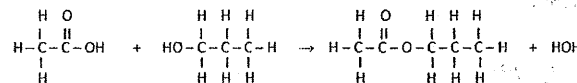
1,2-ethanediol

At standard atmosphere pressure, the boiling point of ethylene glycol is 198°C, compared to ethene that boils at -104°C.

- a. What is the IUPAC name of ethylene glycol? **1,2-ethanediol**
 b. Why does ethylene glycol have a higher B.P. than ethene? **has hydrogen bonding, while ethene is nonpolar and does not.**
 c. Identify the type of organic reaction by which ethene is made into polyethylene. **polymerization**

Many artificial flavorings are prepared using the type of organic reaction shown below.

31.



Reactant 1

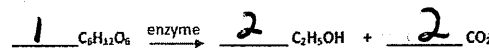
Reactant 2

- a. What type of reaction is shown? **esterification**
 b. To what class of organic compounds does Reactant 1 belong? **organic acid**
 c. To what class of organic compound does Reactant 2 belong? **alcohol**
 d. What is the name of organic product formed in this reaction?

Name Reactant 1: **ethanoic acid**
 Name Reactant 2: **propanol**

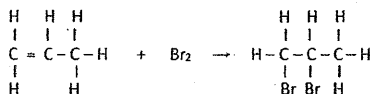
32.

Given the unbalanced equation:



- a. Identify the type of reaction represented. **Fermentation**
 b. What is the IUPAC name of the organic product? **ethanol**
 c. Balance the equation provided, using the smallest whole-number coefficients.

33.



- a. What is the gram-formula mass of the product in this reaction?

202 g/mole

- b. What type of organic reaction is represented by this equation?

Addition

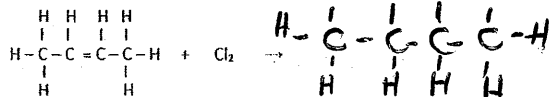
- c. What is the IUPAC name for the organic compound that reacts with Br₂?

propene

- d. What is the IUPAC name of the organic product that is formed in this reaction?

1,2-dibromopropane

34.



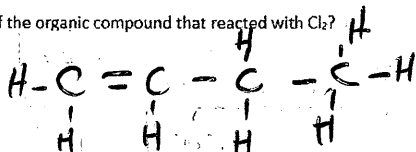
2,3-dichlorobutane

- a. To the right of the reactants and the arrow, draw the structural formula for the product of the reaction shown.

- b. What is the IUPAC name of the hydrocarbon reactant?

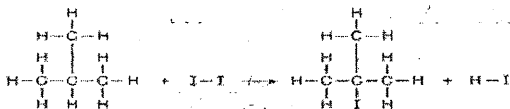
2-butene

- c. Draw an isomer of the organic compound that reacted with Cl₂?



35.

The hydrocarbon 2-methylpropane reacts with iodine as represented by the balanced equation below. At standard pressure, the boiling point of 2-methylpropane is lower than the boiling point of 2-iodo-2-methylpropane.



2-methylpropane

2-iodo-2-methylpropane

- a. What type of organic reaction is this?

Substitution

- b. Give the molecular formula of one hydrocarbon that could also serve as a reactant in this type of reaction.

* Any Alkane

C₂H₆

36.

Aluminum is one of the most abundant metals in Earth's crust. The aluminum compound found in bauxite ore is Al₂O₃. Over one hundred years ago, it was difficult and expensive to isolate aluminum from bauxite ore. In 1886, a brother and sister team, Charles and Julia Hall, found that molten (melted) cryolite, Na₃AlF₆, would dissolve bauxite ore. Electrolysis of the resulting mixture caused the aluminum ions in the Al₂O₃ to be reduced to molten aluminum metal. This less expensive process is known as the Hall process.

- a. Explain, in terms of electrical energy, how the operation of a voltaic cell differs from the operation of an electrolytic cell used in the Hall process. Include both voltaic cell and electrolytic cell in your answer.

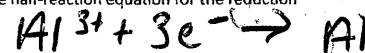
Voltaic - chemical to electrical
Electrolytic - electrical to chemical

- b. Explain, in terms of ions, why molten cryolite conducts electricity.

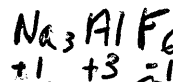
(2)

The ions are free to carry a charge

- c. Write a balance half-reaction equation for the reduction of Al³⁺ to Al



- d. Write the oxidation state for each of the elements in cryolite.



+1 +3 -1

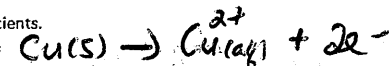
① Cu(s) ② AgNO₃(aq)① Cu(NO₃)₂(aq) ② Ag(s)

37.

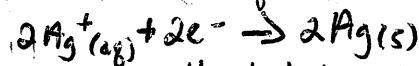
- a. Balance the redox equation using the smallest whole number coefficients.

- b. Write half-reaction equations for oxidation and reduction that occur in the above reaction.

Oxidation half:



Reduction half:



* Make sure they're balanced

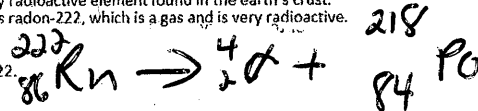
- c. Would this reaction be spontaneous? Why or why not?

Yes - Copper is above silver in Table J

38.

Uranium-238, a solid, is a naturally radioactive element found in the earth's crust. As it decays one of the products is radon-222, which is a gas and is very radioactive.

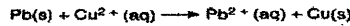
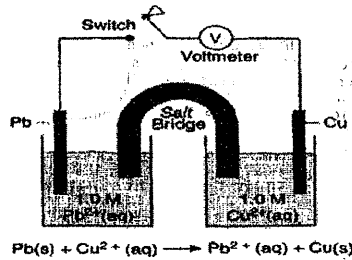
- a. Write a nuclear equation for the decay of Rn-222.



- b. The half-life of Radon-222 is 3.82 days. How many grams of a 1.0 gram sample of radon-222 would remain after 7.64 days?

$$\frac{7.64}{3.82} = 2 \text{ Half Lives} \quad 1g \xrightarrow{1} .5g \xrightarrow{2} .25g$$

39.



a. Explain the function of the salt bridge in the voltaic cell.

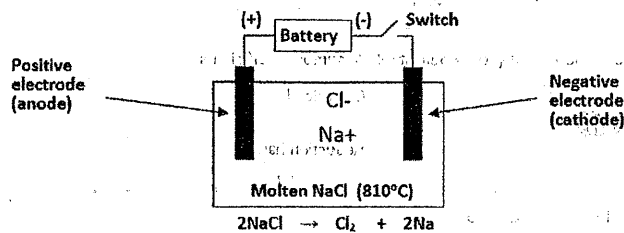
To allow the flow of ions / neutralize charge

b. Write the oxidation $1/2$ rxn.



c. Identify the anode in the voltaic cell.

40.



a. Write the balanced half-reaction for the reduction that occurs in this electrolytic cell.



b. What is the purpose of the battery in this electrolytic cell?

To supply the needed energy for the nonspontaneous process.

c. When the switch is closed, which electrode will attract the sodium ions?

The (-) cathode

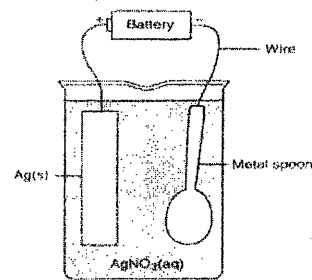
d. What is this lab technique/application called? electrolysis.

41.

Electroplating is an electrolytic process used to coat metal objects with a more expensive and less reactive metal. The diagram below shows an electroplating cell that includes a battery connected to a silver bar and a metal spoon. The bar and spoon are submerged in $\text{AgNO}_3(aq)$.

AgNO_3 is soluble and AgCl is not.

An Electroplating Cell



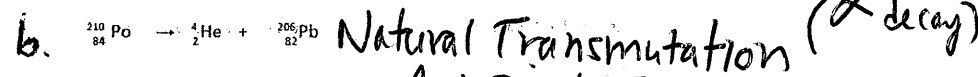
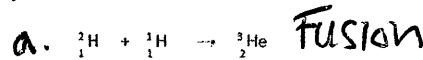
a. According to Reference Table F, explain why AgNO_3 is a better choice than AgCl for use in this electrolytic process.

b. What is the anode? $\text{Ag}(s)$

c. What is the cathode? Spoon.

42.

Identify the type of nuclear reaction represented by each equation below.



43.

The table below shows some properties of three solids: X, Y, and Z

Properties	X	Y	Z	N
Melting Point ($^{\circ}\text{C}$)	800	80	1200	2000
Soluble in water	yes	no	no	no
Solid state conducts electricity	no	no	Yes	no
Liquid state conduct electricity	yes	no	yes	no

a. Classify solid X, Y, and Z as the followings: Metallic, ionic, or molecular

Solid X: ionic
Solid Y: molecular
Solid Z: metallic

b. Explain, in terms of ions, why solid X would be able to conduct electricity when it dissolves in water, but not as a solid.

As a solid, ions are bound and not available to conduct electricity.

c. Make a 5th column containing the variable N (for network solid) and fill in the information. Make up a value for the melting point. Just make sure it is correct with respect to its relativity to the other types of substances.