

Name: \_\_\_\_\_

2016-2017 Chemistry Regents Review

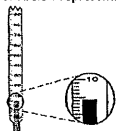
The diagram below shows a portion of a buret.



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 $\text{BaCl}_2$	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  $\text{cm}^3$ . What is the density of the solid, expressed to the correct number of significant figures?

- 1) 12  $\text{g/cm}^3$                       2) 2.0  $\text{g/cm}^3$                       3) 0.5  $\text{g/cm}^3$                       4) 0.50  $\text{g/cm}^3$

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

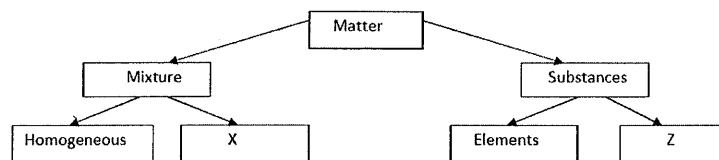
●● represents one molecule of nitrogen.

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

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

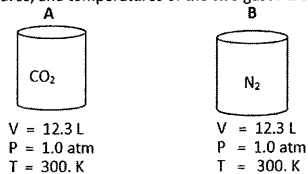
Describe, in terms of particle arrangement, the difference between nitrogen gas and liquid nitrogen.

10. Base your answers on the following chart.



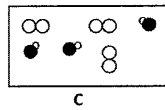
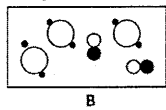
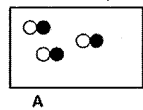
- What word is represented by the variable X?
- What word is represented by the variable Z?
- Identify one type of matter that cannot be broken down by either physical or chemical changes.
- Which type(s) of matter have a uniform composition?
- What type(s) of matter is/are physically combined?
- Define **compound**.
- What type of matter would the following be classified as?  
Air-  
Methane-  
Tin-  
A jar filled with various coins-
- How is distillation used to separate two liquids? Is this process physical or chemical? Explain.
- How is electrolysis used to separate a compound? Is this process physical or chemical? Explain.

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.



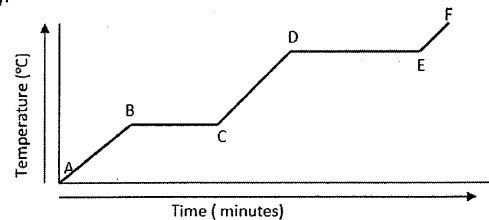
- a. How does the number of molecules of  $\text{CO}_2(g)$  in cylinder A compare to the number of molecules of  $\text{N}_2(g)$  in container B? Your answer must include both  $\text{CO}_2(g)$  and  $\text{N}_2(g)$ .
- b. The temperature of  $\text{CO}_2(g)$  is increased to 450. K and the volume of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

12. Base your answers to questions a-d on the pictures below.



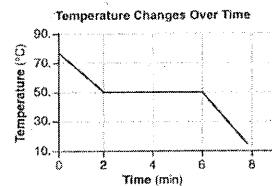
- a. Contrast sample A and sample B in terms of compounds and mixtures. Include both sample A and B in your answer.
- b. Explain why sample C could represent a mixture of fluorine and hydrogen chloride.
- c. Explain, in terms of composition, why sample A represents a pure substance.
- d. Explain how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

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 (•) 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.

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.



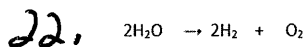
20. Sodium is an essential ingredient in the human diet. The Federal Food and Drug Administration recommends that the average adult daily requirement for sodium is 2.4 grams. Sodium is ingested through consuming plants and animal tissues, but another good source is table salt, sodium chloride.

- What is the chemical formula for sodium chloride?
- What is the gram formula mass of a mole of sodium chloride?
- Based on your answer to previous question (#14), how many moles of table salt, sodium chloride would need to be consumed in order to ingest the 2.4 grams? [Show work]

21. Scientists discovered, and have confirmed, that sulfur dioxide ( $\text{SO}_2$ ) and nitrogen oxides ( $\text{NO}_x$ ) are the primary causes of acid rain. In the US, about 2/3 of all  $\text{SO}_2$  comes from electric power generator that relies on burning fossil fuels like coal.

When sulfur dioxide reaches the atmosphere, it oxidizes to first form sulfur trioxide  $\text{SO}_3$ . 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.

- Write a balanced chemical equation for the reaction between  $\text{SO}_2$  and  $\text{O}_2$  to form sulfur trioxide.
- Write a balanced chemical equation for the reaction between water and sulfur trioxide to form sulfuric acid.
- Buildings and statues are often made of limestone which is composed of calcium carbonate. Write the formula for calcium carbonate.



- What is the total number of moles of  $\text{O}_2$  produced when 8 moles of  $\text{H}_2\text{O}$  is completely consumed?
- How does the balanced chemical equation show the Law of Conservation of Mass?
- What type of reaction does this equation represent?

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

On the set of axes to the right.

- Label one of them "Solubility" and the other "Temperature."
- Draw a line to indicate the solubility of  $\text{CO}_2(g)$  versus temperature.
- A capped bottle of soda contains  $\text{CO}_2(g)$  under high pressure. When the cap is removed, how does pressure affect the solubility of the dissolved  $\text{CO}_2(g)$ ?

24. A student uses 200 grams of water at  $60^\circ\text{C}$  to prepare a saturated solution of potassium chloride, KCl.

- According to reference Table G, how many grams of KCl must be used to create this saturated solution?
- This solution is cooled to  $10^\circ\text{C}$  and the excess precipitate (settle) out. The resulting solution is saturated at  $10^\circ\text{C}$ . How many grams of KCl precipitated out of the original solution?
- Identify the solute in this solution.

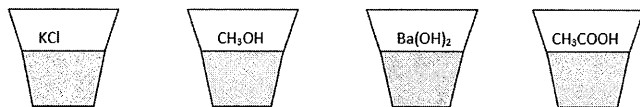
25. A truck carrying concentrated nitric acid overturns and spills its contents. The acid drains into a nearby pond. The pH of the pond water was 8.0 before the spill. After the spill, the pond water is 1,000 times more acidic.

- What is the new pH of the pond water after the spill?
- What color would bromthymol blue be at this new pH?
- Name an ion in the pond water that has increased in concentration due to the spill.

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

- What color change does phenolphthalein undergo during this titration?
- What is the concentration of the  $\text{HNO}_3$  that was titrated?

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

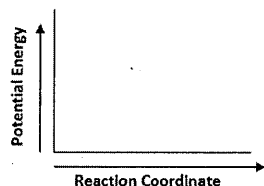


- Which solutions contain electrolytes?
- Which solution has the lowest pH?
- Which solution is most likely to react with Arrhenius acid to form a salt and water?
- Which solution has the lowest freezing point?
- What causes some aqueous solution to have a low pH?

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

- The equation indicates that KNO<sub>3</sub> has formed a saturated solution. Explain, in terms of equilibrium, why the solution is saturated.
- Describe, in terms of Le Chatelier's principle, why an increase in temperature increases the solubility of KNO<sub>3</sub>.

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.



- Label the heat of reaction on your PE diagram.
- Below, write one reaction from Table I that would have a PE diagram similar to the one drawn above.

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:

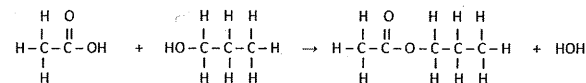


At standard atmosphere pressure, the boiling point of ethylene glycol is 198°C, compared to ethene that boils at -104°C.

- What is the IUPAC name of ethylene glycol?
- Why does ethylene glycol have a higher B.P. than ethene?
- Identify the type of organic reaction by which ethene is made into polyethylene.

31.

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



Reactant 1                  Reactant 2

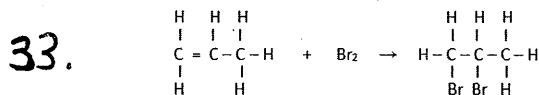
- What type of reaction is shown?
- To what class of organic compounds does Reactant 1 belong? Name Reactant 1:
- To what class of organic compound does Reactant 2 belong? Name Reactant 2:
- What is the name of organic product formed in this reaction?

32.

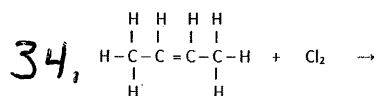
Given the unbalance equation:



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

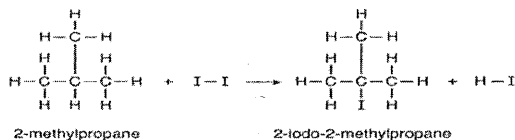


- What is the gram-formula mass of the product in this reaction?
- What type of organic reaction is represented by this equation?
- What is the IUPAC name for the organic compound that reacts with  $\text{Br}_2$ ?
- What is the IUPAC name of the organic product that is formed in this reaction?



- To the right of the reactants and the arrow, draw the structural formula for the product of the reaction shown.
- What is the IUPAC name of the hydrocarbon reactant?
- Draw an isomer of the organic compound that reacted with  $\text{Cl}_2$ ?

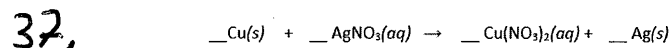
35. The hydrocarbon 2-methylpropane reacts with iodine as represented by the balanced equation below. At standard pressure, the boiling point of 2-methylpropane is lower than the boiling point of 2-iodo-2-methylpropane.



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

36. Aluminum is one of the most abundant metals in Earth's crust. The aluminum compound found in bauxite ore is  $\text{Al}_2\text{O}_3$ . 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,  $\text{Na}_3\text{AlF}_6$ , would dissolve bauxite ore. Electrolysis of the resulting mixture caused the aluminum ions in the  $\text{Al}_2\text{O}_3$  to be reduced to molten aluminum metal. This less expensive process is known as the Hall process.

- 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.
- Explain, in terms of ions, why molten cryolite conducts electricity.
- Write a balance half-reaction equation for the reduction of  $\text{Al}^{3+}$  to  $\text{Al}$ .
- Write the oxidation state for each of the elements in cryolite.



- Balance the redox equation using the smallest whole number coefficients.
- Write half-reaction equations for oxidation and reduction that occur in the above reaction.

Oxidation half:

Reduction half:

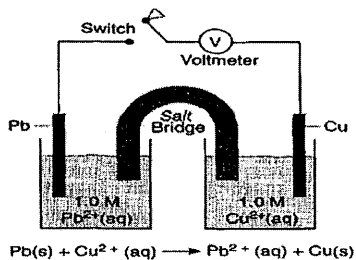
*\* Make sure they're balanced*

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

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.

- Write a nuclear equation for the decay of  $\text{Rn-222}$ .
- 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?

39.

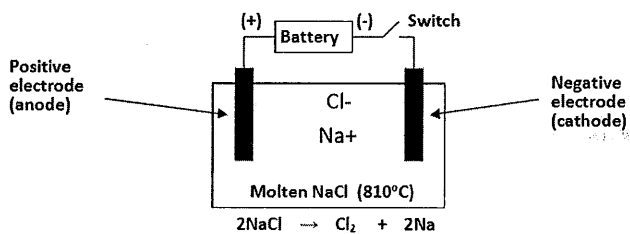


a. Explain the function of the salt bridge in the voltaic cell.

b. Write the oxidation  $\frac{1}{2}$  rxn.

c. Identify the anode in the voltaic cell.

40.



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

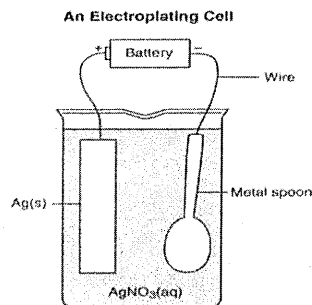
b. What is the purpose of the battery in this electrolytic cell?

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

d. What is this lab technique/application called?

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  $\text{AgNO}_3(\text{aq})$ .

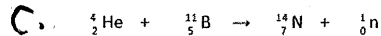
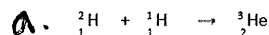


a. According to Reference Table F, explain why  $\text{AgNO}_3$  is a better choice than  $\text{AgCl}$  for use in this electrolytic process.

b. What is the anode?

c. What is the cathode?

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

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

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.

c. Make a 5<sup>th</sup> 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.