

CHEMISTRY REGENTS REVIEW

Hi ChemStud! You are being provided this review packet ahead of time so you can have a study tool for your upcoming Regents. Topics with less detail will be explained/focused on more in the review class - you will take your own notes for them. We will not have time to review every part of this packet in detail, so I will provide an “answer key/annotated copy” at the review incase we don’t cover something you ended up having a question about. It would be very beneficial for you to complete as many of the questions as you can before the review. If you have a specific question you want reviewed please e-mail me (chemteachgibbons@gmail.com). I’ll let you know if it will be addressed and if it won’t I’ll be happy to answer it for you via e-mail. Please bring a Reference Table you are OK with writing on to the review. –Mrs. Gibbons

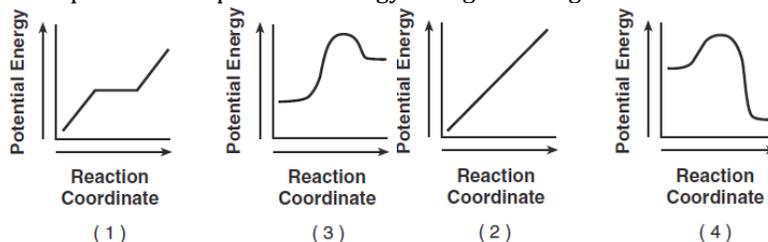
Review Agenda

1. Test taking strategies (5 mins)
2. Reference tables, key phrases, tricky topics (45 mins)
3. Address your questions (10 mins)

I. Test Taking Strategies

1. Always mark up your test. Cross out info that doesn’t pertain to question. Circle key vocab.
2. Process of Elimination – get rid of all answers that don’t work or make sense.
3. DON’T RUSH. You have 3 hours, use that time to your advantage; double check responses.
4. One of these answers is NOT like the others, which makes it probably the answer!
 Ex: Which substance is most soluble in water? a) $(\text{NH}_4)_3\text{PO}_4$ b) $\text{Cu}(\text{OH})_2$ c) Ag_2SO_4 d) CaCO_3
Only one option is soluble in water according to Table F

Ex: Which diagram represents the potential energy changes during an exothermic reaction?



Only one graph illustrates PE decreasing over the reaction coordinate = exothermic rxn

5. If you think you know from memory double check a Reference Table if you can!
 Ex. What is the chemical name for $\text{H}_2\text{SO}_3(\text{aq})$? *double check with Ref Tab K: Common Acids!*
 a) sulfuric acid b) sulfurous acid c) hydrosulfuric acid d) hydrosulfurous acid
6. Be brief in the short answer; usually don’t need a full sentence. Less is more.
 Ex: Explain why the equation ${}^3_1\text{H} \rightarrow {}^3_2\text{He} + {}^0_{-1}\text{e}$ represents a transmutation.
One element changes to another element or atomic number/# of protons in nucleus changes
7. When a short answer asks you to “explain, in terms of _____” USE those TERMS in answer!
 Ex: Explain, in terms of intermolecular forces, why iodine is a solid at STP but chlorine is a gas at STP.
Intermolecular forces of iodine are stronger/weaker than the intermolecular forces of chlorine.
8. Look for answers in the short answer introduction paragraph! Don’t SKIP reading those!

9. Helpful Ways to Solve Math Problems: **GUESS** (*without actually guessing!*)
- Identify what information is **GIVEN** in a problem.
 - Identify the **UNKNOWN** variable the problem is ASKING you to solve for.
 - Choose an **EQUATION** that utilizes GIVEN information & has UNKNOWN variable.
 - SUBSTITUTE** (plug in) information. Do any possible math to simplify number and units.
 - SOLVE**: by REARRANGING (if necessary) equation to get VARIABLE you are SOLVING for ALONE on one side of the = sign.

Ex: Using data from the table, what is the percent composition by mass of the water in the hydrated salt

Mass of empty crucible (container) + cover	11.70 g
Mass of crucible + cover + hydrated salt before heating	14.90 g
Mass of crucible + cover + anhydrous salt (salt w/ no crystals) after heating	14.53 g

(space left for work)

II: Topic Review w/ Reference Tables and Key Phrases

1. ATOMIC CONCEPTS

- Ref Tables O (helps with mass and charge of subatomic particles (p, n, e))
- In the wave-mechanical model, an orbital is a region of space in an atom where there is
 - a high probability of finding an electron
 - a high probability of finding a neutron
 - a circular path in which electrons are found
 - a circular path in which neutrons are found
- What is the charge of the nucleus in an atom of Oxygen-17? *Commonly answered wrong.*
- Write numerical setup to solve for atomic mass of an element, given isotope % abundance.
Ga-69: mass = 68.926u, % abund = 60.11 Ga-71: mass = 70.925, % abund = 39.89
- Exam commonly uses the term “dense” to describe atom’s nucleus – why?
- Bright-line spectra help classify metals by identifying which colors are emitted from atom after excited electrons return to their ground state (photons emitted b/c energy released from “**electron moving from higher to lower energy level/orbital**”).

2. PERIODIC TABLE

- Ref Table S: use Table S if you don’t memorize periodic trends
- Elements arranged by é ATOMIC NUMBER (#of protons), NOT by MASS
- At STP, the element oxygen can exist as either O₂ or O₃ gas molecules. These two forms of the element have
 - same chem and phys properties
 - same chem properties & different phys properties
 - different chem. properties & same phys properties
 - different chem & phys properties
- For Trends remember:
 - Fluorine is MOST Electronegative atom b/c strongest nucleus w/ only 2 orbitals
 - Positive ions are SMALLER than atom; nucleus can pull less electrons in tighter
 - Negative ions are LARGER than atom; nucleus pull decreases per electron b/c there’s more electrons now
 - Number of Valence electrons help remind about first ionization energies & bonding

- v. → Period, Atomic Radius ↓ b/c nuclear charge ↑, pulling e⁻ in same orbital closer
- vi. ↓ Group, Atomic Radius ↑ b/c more energy levels making atom wider
- e. Questions:
 - i. How many electrons are contained in an Au³⁺ ion? a) 76 b) 79 c) 82 d) 197
 - ii. Conductivity in a metal results from the metal atoms having
 - (1) highly mobile protons in the nucleus
 - (2) high electronegativity
 - (3) high ionization energy
 - (4) highly mobile electrons in the valence shell
 - iii. Which changes occur as a chlorine atom, Cl, becomes a chloride ion, Cl⁻¹?
 - (1) Cl atom gains one electron & radius decreases
 - (2) Cl atom gains one electron & radius increases.
 - (3) Cl atom loses one electron & radius decreases.
 - (4) Cl atom loses one electron & radius increases.

3. MOLES/STOICHIOMETRY

- a. Ref Table T: % comp by mass, mole calculation, mole ratio*

- b. Empirical, Molecular and Structural Formulas

- c. **CONSERVATION of MASS, ENERGY, and CHARGE:** *This is why we have balanced chemical equations; matter/energy not created or destroyed*
- d. Compounds = FIXED ratio of atoms; properties change based on arrangement of atoms
- e. **COEFFICIENTS** = # moles of substance. Used in MOLE RATIOS.
$$\underline{\hspace{1cm}} \text{KI} + \underline{\hspace{1cm}} \text{F}_2 \rightarrow \underline{\hspace{1cm}} \text{KF} + \underline{\hspace{1cm}} \text{I}_2$$

- f. Recognize SYNTHESIS, DECOMPOSITION, SINGLE & DOUBLE REPLACEMENT Rxns

4. CHEMICAL BONDING

- a. Ref Tables D, E, F, G, H, I, J, Q, R
- b. 2 Types of Compounds:
 - i. IONIC: metal + nonmetal or metal + polyatomic ions)
 - ii. COVALENT/MOLECULAR (non-metals, *sharing electrons*)
 - iii. What type of bonding is in K₃PO₄? _____
 - iv. Which formula represents a non-polar molecule containing polar covalent bonds
(1) H₂ (2) CO₂ (3) NH₃ (4) H₂O draw electron dot/line diagrams

- c. Polarity of bonds determined by Electronegativity differences of atoms (Table S)
- d. Conductivity, Malleability, Solubility, Hardness, Melting point, and Boiling point
- e. *Stronger IMFs require more energy to change phase of matter*
 - i. Which statement concerning propanone and water at 50°C is true? (Table H)
 - (1) Propanone has a higher vapor pressure and stronger intermolecular forces than water
 - (2) Propanone has a higher vapor pressure and weaker intermolecular forces than water.
 - (3) Propanone has a lower vapor pressure and stronger intermolecular forces than water.
 - (4) Propanone has a lower vapor pressure and weaker intermolecular forces than water.

 - ii. *Why is Heat of Fusion (H_f) less than Heat of Vaporization (H_v) for water?*

- f. **LIKE DISSOLVES LIKE:** nonpolar solute will dissolve in nonpolar solvent; polar solute will dissolve in polar solvent. Check Table F for solubility of ionic compounds.
Which pair of formulas represents two compounds that are **electrolytes**?
(1) HCl and CH₃OH (2) C₅H₁₂ and CH₃OH (2) HCl and NaOH (4) C₅H₁₂ and NaOH
- g. Commonly seen TRIPLE Bonded diatomic element: N₂
- h. Activity Series Table J identifies elements with “**higher desire to bond/react**”.
- i. When a “**bond is broken, energy is absorbed**”. When a “**bond is formed, energy is released**”. *ENDOthermic vs EXOthermic*
i. Electrolysis (chemical change): $2 \text{H}_2\text{O} + \text{energy} \rightarrow 2\text{H}_2 + \text{O}_2$

5. PHYSICAL BEHAVIOR OF MATTER

- a. Ref Tables B, E, F, G, H, I, S
- b. Solids, liquids, gases, pure substance (element or compound) vs. mixture (homogeneous or heterogeneous can have different proportions of substances)
i. *Separate mixtures with physical properties (boiling points = distillation)*
- c. **Boiling Point Elevation / Freezing Point Depression**
Compared to a 0.1 M aqueous solution of NaCl, an 0.8 M aqueous solution of NaCl has a
(1) higher boiling point and a higher freezing point (2) higher boiling point and a lower freezing point
(3) lower boiling point and a higher freezing point (4) lower boiling point and a lower freezing point
- d. **Ideal Gases:** when particles have freedom to roam as far and as fast as possible:
HIGH temp, LOW pressure
*read question carefully b/c it will ask for “least like” or “most like” an ideal gas
Kinetic Molecular Theory “random, constant, straight-line motion” “no attractive forces between gases” “collisions can transfer energy but system total energy remains constant”
- e. **Entropy = DISORDER** in a system
Systems in nature tend to undergo changes toward
(1) lower energy and lower entropy (2) lower energy and higher entropy
(3) higher energy and lower entropy (4) higher energy and higher entropy
- f. ENERGY: *chemical* (bonds), electrical (electron flow), *thermal* (random motion/heat), mechanical, *nuclear*
- g. Avogadro’s Principle: “**different gases, same VOLUME, means SAME # of molecules**”
At STP, which gaseous sample has the same number of molecules as 3.0 liters of N₂(g)?
(1) 6.0 L of F₂(g) (2) 3.0 L of H₂(g) (3) 4.5 L of N₂(g) (4) 1.5 L of Cl₂(g)
- h. **TEMPERATURE = AVERAGE KINETIC ENERGY**
The average kinetic energy of water molecules decreases when
(1) H₂O(l) at 337K changes to H₂O(l) at 300K (2) H₂O(l) at 373K changes to H₂O(g) at 373K
(3) H₂O(s) at 200K changes to H₂O(s) at 237K (4) H₂O(s) at 273K changes to H₂O(l) at 273K
- i. HEAT TRANSFERS from “**HIGH systems to LOW systems**”.
- j. **Table G** data based on 100g of Water... make sure to determine amount of water in ?
i. How many grams of KNO₃ create a saturated potassium nitrate solution in 200g of H₂O at 50°C?
(1) 32g KNO₃ (2) 70g KNO₃ (3) 83g KNO₃ (4) 90g KNO₃
ii. According to Reference Table G, which substance forms an unsaturated solution when 80 grams of the substance is dissolved in 100 grams of H₂O at 10°C?
(1) KI (2) KNO₃ (3) NaNO₃ (4) NaCl
iii. A saturated solution of NaNO₃ is prepared at 60.°C using 100. Grams of water. As this solution is cooled to 10.°C, NaNO₃ precipitates (settles) out of the solution. The resulting solution is saturated. Approximately how many grams of NaNO₃ settled out of the original solution?
(1) 46 g (2) 61 g (3) 85 g (4) 126g

6. KINETICS/EQUILIBRIUM

- a. **Collision Theory:** rxn happens if particles collide w/ “**proper energy & orientation**”
 b. **Rate of Reaction:** affected by temperature, concentration, *nature of reactants*, surface area, presence of a catalyst

i. A 5.0-gram sample of Fe(s) is to be placed in 100. milliliters of HCl(aq). Which changes will result in the fastest rate of reaction?

- (1) increasing the surface area of Fe(s) and increasing the concentration of HCl(aq)
 (2) increasing the surface area of Fe(s) and decreasing the concentration of HCl(aq)
 (3) decreasing the surface area of Fe(s) and increasing the concentration of HCl(aq)
 (4) decreasing the surface area of Fe(s) and decreasing the concentration of HCl(aq)

ii. A 1.0-gram piece of zinc reacts with 5 milliliters of HCl(aq). Which of these conditions of concentration and temperature would produce the greatest rate of reaction

- (1) 1.0 M HCl(aq) at 20.°C (2) 1.0 M HCl(aq) at 40.°C
 (3) 2.0 M HCl(aq) at 20.°C (4) 2.0 M HCl(aq) at 40.°C

c. **CATALYST:** “*lowers activation energy, creates alternate reaction pathway*”

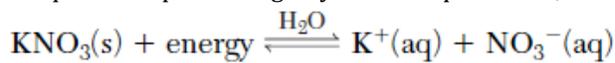
d. **EQUILIBRIUM:** “concentration of reactants and products are CONSTANT NOT EQUAL”
 “RATES of forward and reverse reactions are EQUAL”

e. **Shifts on Equilibrium:** *Think about if you are affecting reactants or products: are you taking it away or adding more? Will the reaction shift forward or reverse to rebalance?*

i. Analyze shifts on Eqn from Table I $\text{N}_2(\text{g}) + 2\text{O}_2(\text{g}) \rightarrow 2\text{NO}_2(\text{g}) \quad \Delta H = +66.4\text{kJ}$

- increase temp _____
- decrease $\text{NO}_2(\text{g})$ _____
- increase pressure _____

Given the equation representing a system at equilibrium, which change causes the equilibrium to shift?



(1) increasing pressure (2) increasing temperature (3) adding a noble gas (4) adding a catalyst

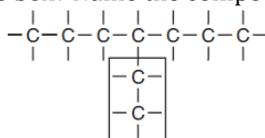
7. ORGANIC CHEM

- a. Ref Tables P, Q, and R (*use patterns in Table R to help name compounds for exam*)
 b. Compounds with **Carbon** – bonds to itself to form “**rings, chains, network structures**”
 c. Saturated vs Unsaturated Hydrocarbons

i. Which hydrocarbon is saturated? (1) C_2H_2 (2) C_4H_6 (3) C_3H_4 (4) C_4H_{10}

ii. Explain, in terms of bonding, why the hydrocarbon ethene is classified as unsaturated.

iii. What is the group in the box? Name the compound.



d. Functional Groups (Table R) cause organic compounds to have DIFFERENT properties

e. **ISOMER:** “same molecular formula, *DIFFERENT* structure and therefore properties”

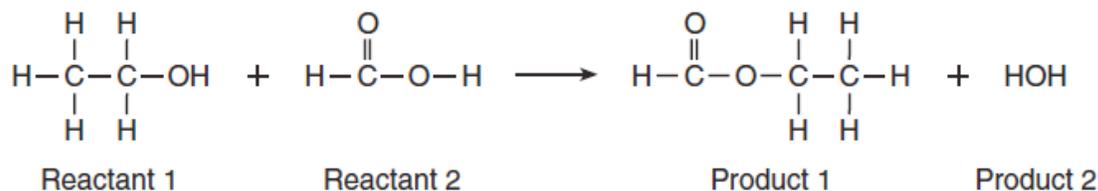
- i. Which compound is an isomer of $C_2H_5OC_2H_5$?
 (1) CH_3COOH (2) $C_3H_7COCH_3$ (3) $C_2H_5COOCH_3$ (4) C_4H_9OH

f. Organic Reactions: addition, substitution, polymerization,

- i. **Esterification:** alcohol + acid \rightarrow ester + water
 ii. **Fermentation:** glucose/sugar decomposes into ethanol + carbon dioxide
 iii. **Saponification:** product is SOAP
 iv. **Combustion:** organic compound + oxygen \rightarrow carbon dioxide and water

Base your answers to questions 75 through 77 on the information below and on your knowledge of chemistry.

The unique odors and flavors of many fruits are primarily due to small quantities of a certain class of organic compounds. The equation below represents the production of one of these compounds.



75 Show a numerical setup for calculating the gram-formula mass for reactant 1. [1]

76 Explain, in terms of molecular polarity, why reactant 2 is soluble in water. [1]

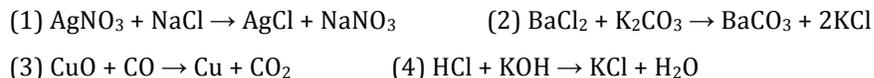
77 State the class of organic compounds to which product 1 belongs. [1]

8. OXIDATION-REDUCTION

a. Ref Table J: More **ACTIVE** atoms **WANT** to react and **GIVE AWAY** electrons.

b. Reaction where there is a “**TRANSFER OF ELECTRONS**”

- i. Which balanced equation represents a redox reaction?



c. **OIL RIG: oxidation is LOSS of electrons, reduction is GAIN of electrons**

d. **RED CAT AN OX: reduction occurs at cathode, oxidation at anode**

What occurs at one of the electrodes in both an electrolytic cell and a voltaic cell?

- (1) Oxidation occurs as electrons are gained at the cathode.
 (2) Oxidation occurs as electrons are lost at the anode.
 (3) Reduction occurs as electrons are gained at the anode.
 (4) Reduction occurs as electrons are lost at the cathode.

e. **Electrolytic Cell:** requires battery (energy), NOT spontaneous; **ELECTROLYSIS**

Which energy conversion must occur in an operating electrolytic cell?

- (1) electrical energy to chemical energy (2) electrical energy to nuclear energy
 (3) chemical energy to electrical energy (4) chemical energy to nuclear energy

f. **Voltaic Cell:** *spontaneous*, based on activity of metals

Which energy conversion occurs during the operation of a voltaic cell?

- (1) Chemical energy is spontaneously converted to electrical energy.
- (2) Chemical energy is converted to electrical energy only when an external power source is provided.
- (3) Electrical energy is spontaneously converted to chemical energy
- (4) Electrical energy is converted to chemical energy only when an external power source is provided.

A student develops the list shown below that includes laboratory equipment and materials for constructing a voltaic cell.

- a strip of zinc
- a strip of copper
- a 250-mL beaker containing 150 mL of 0.1 M zinc nitrate
- a 250-mL beaker containing 150 mL of 0.1 M copper(II) nitrate
- wires
- a voltmeter
- a switch
- a salt bridge

1. Draw the student's set-up and state the purpose of the salt bridge in the voltaic cell.

2. Write and balance the half-reaction equation in your answer booklet for the oxidation of the Zn(s) that occurs in the voltaic cell.

3. Compare the activities of the two metals used by the student for constructing the voltaic cell.

9. ACIDS, BASES, and SALTS

a. Ref Tables K, L, M, F

b. Arrhenius acids and bases are electrolytes – compounds that **produce ions in solution**

- i. **Arrhenius Acids produce H^+ ions** (may also see referred to as H_3O^+ ions)
- ii. **Arrhenius Bases produce OH^- ions**

c. Alternate theory: Acid = H^+ donor (NH_4^+) Base = H^+ acceptor (NH_3)

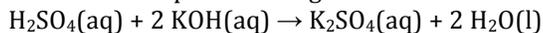
d. **NEUTRALIZATION rxn:** ACID + BASE \rightarrow SALT(aq) + WATER (pH 7, hence neutralization)

Which compound could serve as a reactant in neutralization reaction?

- (1) NaCl (2) KOH (3) CH_3OH (4) CH_3CHO

e. Titration: process of using known concentration and volume of a solution to determine concentration of another solution. Table T: **$M_1V_1 = M_2V_2$**

Information related to a titration experiment is given in the balanced equation and table below.



Titration Experiment Results

volume of $H_2SO_4(aq)$ used	12.9 mL
concentration of $H_2SO_4(aq)$?
volume of $KOH(aq)$ used	36.0 mL
concentration of $KOH(aq)$	0.16 M

Based on the equation and the titration results, what is the concentration of the $H_2SO_4(aq)$?

- (1) 0.12 M (2) 0.16 M (3) 0.24 M (4) 0.96 M

- f. **Acid-Base Indicators** (*Table M*) if pH of solution is below number on left, color of solution will be color on the left in “color change” column. If pH is higher than number on the right, color of solution will change to color on the right in “color change” column.

State the color of bromthymol blue indicator in a sample of the commercial vinegar (pH 2.4) _____

- g. **pH**: represents acidity or alkalinity of solution. **Scale**: 1-14 Most Acidic to Most Basic
pH indicates **concentration of hydronium/H⁺ ions** in solution.

Hydrogen Ion and pH Data for HCl(aq) Solutions

HCl(aq) Solution	Hydrogen Ion Concentration (M)	pH
A	1.0×10^{-2}	2.0
B	?	5.0

How do you determine unknown [H⁺]?

10. NUCLEAR CHEM

- a. Ref Tables N, O, Periodic Table (always check Atomic Numbers [protons] in rxns!)
- b. Isotope stability depends on NUCLEUS. Heavy nucleus causes spontaneous decay.
- c. **TRANSMUTATION: one atom changes into another b/c nucleus is changed**
- d. Table N has **DECAY MODES** – *what is emitted from unstable isotope*
 Write the decay reaction of Iodine-131:
- e. **Conservation of Mass and Charge**: always check when writing nuclear reactions
- f. Nuclear Reactions: **“Convert MATTER into ENERGY”** MUCH MORE energy released in nuclear reaction than a chemical reaction
- i. **Natural transmutation** = SPONTANEOUS b/c nucleus is unstable
- ii. **Artificial transmutation** = high energy particles used to bombard/breakup nucleus
- iii. **Fusion**: (fuse) the combining of two SMALLER nuclei to form one larger atom
 In a nuclear fusion reaction, the mass of the products is
- (1) less than the mass of the reactants because some of the mass has been converted to energy.
 - (2) less than the mass of the reactants because some of the energy has been converted to mass.
 - (3) more than the mass of the reactants because some of the mass has been converted to energy.
 - (4) more than the mass of the reactants because some of the energy has been converted to mass.
- iv. **Fission**: (fizzle apart) the break down of a larger atom into two smaller atoms
 When a uranium-235 nucleus absorbs a slow-moving neutron, different nuclear reactions may occur. One of these possible reactions is represented by the complete, balanced equation below.
- $$\text{Equation 1: } {}_{92}^{235}\text{U} + {}_0^1\text{n} \rightarrow {}_{36}^{92}\text{Kr} + {}_{56}^{142}\text{Ba} + 2{}_0^1\text{n} + \text{energy}$$
- For this reaction, the sum of the masses of the products is slightly less than the sum of the masses of the reactants. Another possible reaction of U-235 is represented by the incomplete, balanced equation below.
- $$\text{Equation 2: } {}_{92}^{235}\text{U} + {}_0^1\text{n} \rightarrow {}_{38}^{92}\text{Sr} + \text{_____} + 2{}_0^1\text{n} + \text{energy}$$
1. Identify the type of nuclear reaction represented by equation 1. _____
 2. Write a notation for the missing product in equation 2 in the space provided above.
 3. **Determine the half-life of krypton-92 if only 6.0 milligrams of an original 96.0-milligram sample remains unchanged after 7.36 seconds.**

- g. **HALF-LIFE** Tips/Hints

- h. Review Benefits and Risks of Nuclear Power

III. Short Answer Questions from Previous Regents Exams

Complete these before coming to the review so you can ask questions if necessary!

Base your answers to questions 55 through 57 on the information below and on your knowledge of chemistry.

The compounds KNO_3 and NaNO_3 are soluble in water.

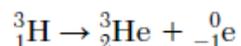
- 55 Compare the entropy of 30. grams of solid KNO_3 at $20.^\circ\text{C}$ with the entropy of 30. grams of KNO_3 dissolved in 100. grams of water at $20.^\circ\text{C}$. [1]
- 56 Explain why the total thermal energy of a sample containing 22.2 grams of NaNO_3 dissolved in 200. grams of water at $20.^\circ\text{C}$ is greater than the total thermal energy of a sample containing 11.1 grams of NaNO_3 dissolved in 100. grams of water at $20.^\circ\text{C}$. [1]
- 57 Compare the boiling point of a NaNO_3 solution at standard pressure to the boiling point of water at standard pressure. [1]

Base your answers to questions 61 through 63 on the information below and on your knowledge of chemistry.

- A test tube contains a sample of solid stearic acid, an organic acid.
 - Both the sample and the test tube have a temperature of 22.0°C .
 - The stearic acid melts after the test tube is placed in a beaker with 320. grams of water at 98.0°C .
 - The temperature of the liquid stearic acid and water in the beaker reaches 74.0°C .
- 61 Identify the element in stearic acid that makes it an organic compound. [1]
- 62 State the direction of heat transfer between the test tube and the water when the test tube was placed in the water. [1]
- 63 Show a numerical setup for calculating the amount of thermal energy change for the water in the beaker. [1]

Base your answers to questions 64 and 65 on the information below and on your knowledge of chemistry.

A nuclear reaction is represented by the equation below.



- 64 Identify the decay mode of hydrogen-3. [1]
- 65 Explain why the equation represents a transmutation. [1]

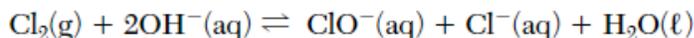
Base your answers to questions 71 through 75 on the information below and on your knowledge of chemistry.

Rubbing alcohol is a product available at most pharmacies and supermarkets. One rubbing alcohol solution contains 2-propanol and water. The boiling point of 2-propanol is 82.3°C at standard pressure.

- 71 Explain, in terms of electronegativity differences, why a C – O bond is more polar than a C – H bond. [1]
- 72 Identify a strong intermolecular force of attraction between an alcohol molecule and a water molecule in the solution. [1]
- 73 Determine the vapor pressure of water at a temperature equal to the boiling point of the 2-propanol. [1]
- 74 Explain, in terms of charge distribution, why a molecule of the 2-propanol is a polar molecule. [1]
- 75 In the space in *your answer booklet*, draw a structural formula for the 2-propanol. [1]

Base your answers to questions 78 through 81 on the information below and on your knowledge of chemistry.

Common household bleach is an aqueous solution containing hypochlorite ions. A closed container of bleach is an equilibrium system represented by the equation below.



- 78 Compare the rate of the forward reaction to the rate of the reverse reaction for this system. [1]
- 79 State the change in oxidation number for chlorine when the $\text{Cl}_2(\text{g})$ changes to $\text{Cl}^-(\text{aq})$ during the forward reaction. [1]
- 80 Explain why the container must be closed to maintain equilibrium. [1]
- 81 State the effect on the concentration of the ClO^- ion when there is a *decrease* in the concentration of the OH^- ion. [1]

Use the Potential Energy Diagram to the right to identify the following:

1. Heat of reaction _____
2. PE of products _____
3. PE of reactants _____
4. Activation Energy _____
5. Draw on the diagram what would happen to the reaction pathway if a catalyst was added.

