

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

### Practice NCFE Questions

#### Unit 1 & Unit 2 – Introduction, Atomic Theory, Light, Radioactive Decay, Electron Configuration, Bohr Model

- Which occurs if an electron transitions from  $n = 5$  to  $n = 2$  in a hydrogen atom?
  - Energy is absorbed, and visible light is emitted.
  - Energy is released, and visible light is emitted.
  - Energy is released, and visible light is not emitted.
  - Energy is absorbed, and visible light is not emitted.
- How do the three isotopes Sn-116, Sn-118, and Sn-119 differ?
  - Sn-116 has 166 neutrons, Sn-118 has 168 neutrons, and Sn-119 has 169 neutrons.
  - Sn-116 has 116 neutrons, Sn-118 has 118 neutrons, and Sn-119 has 119 neutrons.
  - Sn-116 has 66 neutrons, Sn-118 has 68 neutrons, and Sn-119 has 69 neutrons.
  - Sn-116 has 50 neutrons, Sn-118 has 52 neutrons, and Sn-119 has 53 neutrons.
- Which statement correctly compares an atom of boron-11 and an atom of carbon-14?
  - An atom of boron-11 has one fewer proton and two fewer neutrons than an atom of carbon-14.
  - An atom of boron-11 has one fewer neutron and two fewer protons than an atom of carbon-14.
  - An atom of boron-11 has one fewer proton and three fewer neutrons than an atom of carbon-14.
  - An atom of boron-11 has one fewer neutron and three fewer protons than an atom of carbon-14.
- Which atomic symbol represents an isotope of sulfur with 17 neutrons?
  - ${}_{16}^{17}\text{X}$
  - ${}_{16}^{33}\text{X}$
  - ${}_{32}^{17}\text{X}$
  - ${}_{32}^{49}\text{X}$
- A neutral atom has a ground state electron configuration  $1s^22s^22p^63s^2$ . The neutral atom becomes an ion during a chemical reaction. Which is the most likely charge of the ion?
  - 2+
  - 1+
  - 2-
  - 6-
- What color of light does a hydrogen atom emit when an electron transitions from the  $n=6$  energy level to the  $n=2$  energy level?
  - Orange
  - Yellow
  - Blue
  - Violet
- The equation below represents the radioactive decay of a gold isotope. What choice correctly completes this equation?
$${}_{79}^{174}\text{Au} \rightarrow {}_{77}^{170}\text{Ir} + ?$$
  - Alpha particle
  - Beta particle
  - Photon
  - Neutron
- A neutral atom of a certain element has the electron configuration  $1s^22s^22p^63s^23p^4$ . How many valence electrons does the atom have?
  - 4
  - 6
  - 11
  - 16

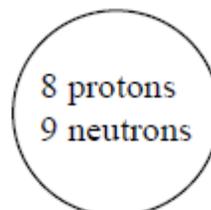
### Unit 3 – Periodic Table & Trends

- Which of these elements has the greatest atomic radius?
  - H
  - N
  - Cl
  - Cs
- Which group includes elements with the most similar properties?
  - N, O, and F
  - O, S, and Se
  - Cr, Pb, and Xe
  - Br, Ga, and Hg
- An atom of which element has the strongest attraction for electrons?
  - Ba
  - Cs
  - O
  - F
- Which pair of elements is both malleable and able to conduct heat?
  - bromine and silver
  - iodine and neon
  - iron and bromine
  - silver and iron
- Arrange the following elements in order of increasing electronegativity, from lowest to highest: F, K, Si, and S.
  - F < K < S < Si
  - K < Si < S < F
  - Si < F < K < S
  - S < Si < F < K
- How is copper (Cu) classified based on its location on the periodic table?
  - a nonmetal
  - an alkaline earth metal
  - a transition metal
  - an alkali metal
- The table below shows the electron configurations of three elements.

Element 1	$1s^2 2s^2 2p^2$
Element 2	$1s^2 2s^2 2p^5$
Element 3	$1s^2 2s^2 2p^4$

What is the order of the elements from **smallest** to **largest** atomic radius?

- Element 1, Element 2, Element 3
  - Element 1, Element 3, Element 2
  - Element 2, Element 1, Element 3
  - Element 2, Element 3, Element 1
- The nucleus of an atom is shown. Which statement describes the element?
    - It is a nonmetal in group 2.
    - It is a nonmetal in group 16.
    - It is a metal in group 2.
    - It is a nonmetal in group 17.



#### Unit 4 – Nomenclature, Polarity, Bonding, Lewis Dot Structures, VSEPR Theory

- 1) What is the chemical formula for magnesium bromate?
  - a. MgBr
  - b. MgBr<sub>2</sub>
  - c. MgBrO<sub>3</sub>
  - d. Mg(BrO<sub>3</sub>)<sub>2</sub>
  
- 2) What *best* compares the properties of ionic and metallic substances?
  - a. The bonds of metallic substances are composed of delocalized electrons, and the bonds of ionic substances are composed of transferred electrons.
  - b. The bonds of metallic substances are composed of isolated electrons, and the bonds of ionic substances are composed of shared electrons.
  - c. A metallic substance insulates heat and electricity, and solid ionic substances conduct heat and electricity.
  - d. A metallic substance has a low melting point, and an ionic substance has a low melting point.
  
- 3) Which molecule contains a triple bond?
  - a. F<sub>2</sub>
  - b. O<sub>2</sub>
  - c. Cl<sub>2</sub>
  - d. N<sub>2</sub>
  
- 4) Which combination of elements would most likely form an ionic compound?
  - a. hydrogen and oxygen
  - b. carbon and chlorine
  - c. sodium and fluorine
  - d. silicon and sulfur
  
- 5) Which is an accurate comparison of the bonds that can occur between carbon atoms in terms of bond length and strength?
  - a. Double bonds are shorter than single bonds, but single bonds are stronger than triple bonds.
  - b. Triple bonds are shorter than double bonds, and double bonds are stronger than single bonds.
  - c. Double bonds are both shorter and stronger than triple bonds.
  - d. Triple bonds are the longest and strongest.
  
- 6) What is the IUPAC name for the chemical formula PbO<sub>2</sub>?
  - a. lead oxide
  - b. lead(II) oxide
  - c. lead(IV) oxide
  - d. lead dioxide
  
- 7) Which element will form covalent bonds with chlorine?
  - a. Carbon
  - b. Aluminum
  - c. Magnesium
  - d. Potassium
  
- 8) How are the bonds formed in a polar covalent compound?
  - a. Electrons are shared unequally.
  - b. Electrons are shared equally.
  - c. Electrons are gained.
  - d. Electrons are lost.
  
- 9) What is the chemical formula for chromium (III) oxide?
  - a. CrO
  - b. CrO<sub>2</sub>
  - c. Cr<sub>2</sub>O<sub>3</sub>
  - d. Cr<sub>3</sub>O<sub>2</sub>
  
- 10) An unknown substance is tested in the laboratory. The physical test results are listed – nonconductor of electricity, insoluble in water, soluble in oil, low melting point. Based on these results, what is the unknown substance?
  - a. Ionic and polar.
  - b. Ionic and nonpolar.
  - c. Covalent and polar.
  - d. Covalent and nonpolar.

## Unit 5 – Chemical Reactions

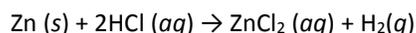
- 1) Solid chromium(II) reacts with oxygen gas to form solid CrO. What is this type of reaction?
  - a. decomposition
  - b. synthesis
  - c. single replacement
  - d. double replacement
- 2) When aluminum and sulfur react, which compound is produced?
  - a.  $\text{Al}_2\text{S}_3$
  - b.  $\text{Al}_3\text{S}_2$
  - c.  $\text{AlS}_2$
  - d.  $\text{AlS}$
- 3) Which of these compounds will form a precipitate when mixed with an aqueous solution of sodium sulfate,  $\text{Na}_2\text{SO}_4$ ?
  - a.  $\text{LiNO}_3$
  - b.  $\text{KNO}_3$
  - c.  $\text{Mg}(\text{NO}_3)_2$
  - d.  $\text{Ba}(\text{NO}_3)_2$
- 4) The chemical equation below represents an unbalanced chemical reaction:  $\text{Fe} + \text{O}_2 \rightarrow \text{Fe}_2\text{O}_3$   
When the equation is balanced, what coefficient is needed for  $\text{Fe}_2\text{O}_3$ ?
  - a. 1
  - b. 2
  - c. 3
  - d. 4
- 5) A student mixes two chemicals in a test tube. The test tube turns hot and bubbles appear. What indicators of chemical reaction is the student observing?
  - a. Change in color and formation of precipitate.
  - b. Change in color and formation of gas.
  - c. Change in temperature and formation of precipitate.
  - d. Change in temperature and formation of gas.
- 6) A student conducts the following demonstration:
  - A 15-g sample of  $\text{NaHCO}_3$  is placed in a test tube.
  - The bottom of the test tube is heated with an open flame.
  - Condensation forms on the inside walls of the test tube.
  - A burning splint is extinguished when placed at the mouth of the test tube.

What can the student conclude after conducting this demonstration?

- a. The burning splint was extinguished because of a lack of  $\text{CO}_2$  in the test tube.
  - b. The burning splint was extinguished because of a lack of  $\text{H}_2\text{O}$  vapor.
  - c. Decomposition produced  $\text{CO}_2$  and  $\text{H}_2\text{O}$ .
  - d. Combustion produced  $\text{O}_2$  and  $\text{H}_2\text{O}$ .
- 7) When a set amount of marble chips ( $\text{CaCO}_3$ ) is added to a small amount of dilute hydrochloric acid, a reaction occurs. What should be done to decrease the rate of reaction the next time an experiment is performed?
    - a. Use more acid.
    - b. Stir.
    - c. Use larger marble chips.
    - d. Add heat.
  - 8) When  $\text{AgNO}_3$  (*aq*) is mixed with  $\text{NaCl}$  (*aq*), which type of reaction will occur?
    - a. single replacement
    - b. synthesis
    - c. decomposition
    - d. double replacement
  - 9) Consider this combustion reaction equation:  $\text{C}_4\text{H}_{10} + \text{O}_2 \rightarrow \text{CO}_2 + \text{H}_2\text{O}$   
When the equation is balanced, what will be the coefficient of  $\text{O}_2$ ?
    - a. 1
    - b. 7
    - c. 10
    - d. 13
  - 10) How does increasing temperature affect the collisions of reactant molecules in a chemical reaction?
    - a. The reactant molecules collide more frequently with greater energy per collision.
    - b. The reactant molecules collide more frequently with less energy per collision.
    - c. The reactant molecules collide less frequently with less energy per collision.
    - d. The reactant molecules collide less frequently with greater energy per collision.

**Unit 6 & Unit 7 – The Mole, Empirical Formulas, Molecular Formulas, Percent Composition, Stoichiometry**

- 1) A compound consisting of 56.38% phosphorus and 43.62% oxygen has a molecular mass of 220 g/mol. What is the molecular formula of this compound?
- PO
  - PO<sub>2</sub>
  - P<sub>2</sub>O<sub>3</sub>
  - P<sub>4</sub>O<sub>6</sub>
- 2) How much mass is in a 3.25-mole sample of NH<sub>4</sub>OH?
- 10.8 g
  - 34.0 g
  - 35.1 g
  - 114 g
- 3) The equation below represents a balanced chemical reaction:  
 $2\text{Mg} (s) + \text{O}_2 (g) \rightarrow 2\text{MgO} (s)$   
How many moles of MgO are produced when 7.2 moles of O<sub>2</sub> react with excess Mg?
- 3.6 moles
  - 14 moles
  - 22 moles
  - 29 moles
- 4) Given the balanced chemical equation for the reaction,  $\text{P}_4 + 5\text{O}_2 \rightarrow \text{P}_4\text{O}_{10}$   
What mass of oxygen is needed to completely react with 7.75g P<sub>4</sub>?
- 2.00 grams
  - 5.00 grams
  - 10.00 grams
  - 40.00 grams
- 5) How many O<sub>2</sub> particles are in 2.50 moles of O<sub>2</sub> at Standard Temperature and Pressure (STP)?
- $4.15 \times 10^{22}$  particles
  - $2.41 \times 10^{23}$  particles
  - $5.02 \times 10^{23}$  particles
  - $1.51 \times 10^{24}$  particles
- 6) How many moles of nitrogen gas are in 135 L of nitrogen gas at Standard Temperature and Pressure (STP)?
- 4.82 moles of N<sub>2</sub>
  - 5.53 moles of N<sub>2</sub>
  - 6.02 moles of N<sub>2</sub>
  - 9.64 moles of N<sub>2</sub>
- 7) What is the molecular formula of a compound with the empirical formula CH<sub>2</sub>O and a molecular mass of 60 g/mol?
- CH<sub>2</sub>O
  - C<sub>2</sub>H<sub>4</sub>O<sub>2</sub>
  - C<sub>2</sub>H<sub>4</sub>O<sub>4</sub>
  - C<sub>2</sub>H<sub>2</sub>O<sub>2</sub>
- 8) The equation below represents a chemical reaction.

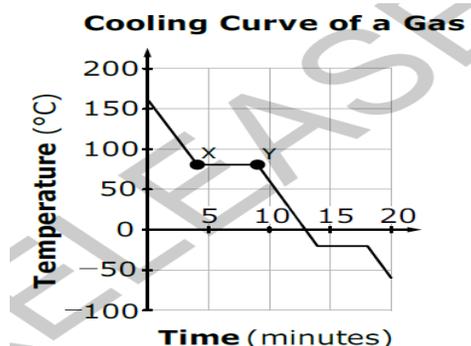


5.00-g sample of zinc is added to hydrochloric acid. The amount of hydrochloric acid is sufficient to allow the zinc to react completely. What mass of hydrogen gas does this reaction produce?

- 0.0308g
- 0.0771g
- 0.121g
- 0.154g

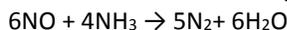
**Unit 8 – Kinetic Molecular Theory, Phase Diagrams, Heating and Cooling Curves, Gas Laws, IMFs**

1) This graph represents data collected when a sample of a gas is uniformly cooled from 155°C. Why does the temperature of the sample remain constant between point X and point Y?



- a. because the sample is transitioning from a gaseous state to a solid state
- b. because the sample is transitioning from a gaseous state to a liquid state
- c. because the sample is transitioning from a solid state to a gaseous state
- d. because the sample is transitioning from a liquid state to a solid state

2) This balanced chemical equation represents a chemical reaction:



What volume of  $\text{NH}_3$  gas, at Standard Temperature and Pressure (STP), is required to react with 15.0 g of NO?

- a. 5.68 L
- b. 7.47 L
- c. 10.0 L
- d. 11.2 L

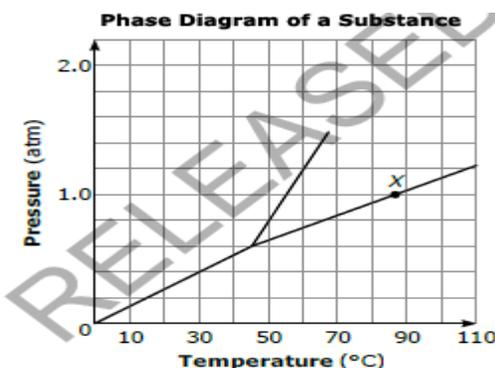
3) What causes an inflated balloon to shrink when it is cooled?

- a. Because cooling the balloon causes gas to escape from the balloon.
- b. Because cooling the balloon causes the gas molecules to collide more quickly.
- c. Because cooling the balloon causes gas molecules to become smaller.
- d. Because cooling the balloon causes the average kinetic energy of the gas to decrease.

4) Which type of bonding or intermolecular forces is/are weakest?

- a. London dispersion forces
- b. Hydrogen bonding
- c. Dipole-dipole forces
- d. Covalent bonding

5) A phase diagram is shown on the right. Which choice describes the state of the substance at X?



- a. A boiling liquid is in equilibrium with its vapor.
- b. A subliming solid is in equilibrium with its vapor.
- c. A freezing liquid is in equilibrium with its solid.
- d. A melting solid is in equilibrium with its liquid.

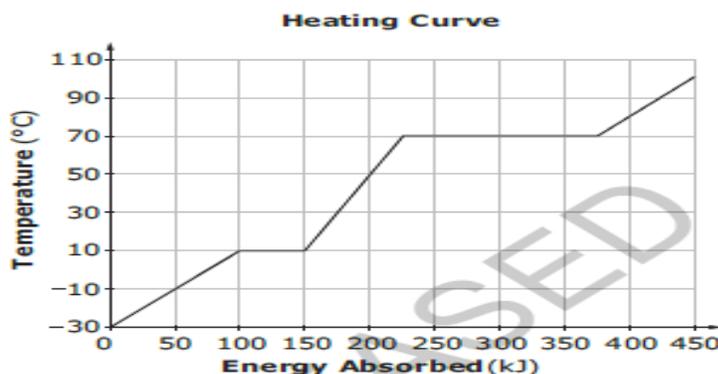
6) What is the **approximate** temperature of 1.4 moles of a gas with a pressure of 3.25 atmospheres in a 4.738-liter container?

- a. 180 K
- b. 170 K
- c. 150 K
- d. 130 K

7) Which statement best compares how bond strengths affect the physical properties of iron and lead?

- a. Iron has a higher melting point because the bonds in iron are stronger.
- b. Iron has a higher melting point because the bonds in iron are weaker.
- c. Lead has a higher density because the bonds in lead are stronger.
- d. Lead has a higher density because the bonds in the lead are weaker.

8) The graph on the right represents a substance being heated from  $-30^\circ\text{C}$  to  $110^\circ\text{C}$ . If 50 kJ of heat are removed from the substance when it is at  $50^\circ\text{C}$ , what will be the state and temperature of the substance?



- a. gas at  $70^\circ\text{C}$
- b. gas at  $100^\circ\text{C}$
- c. liquid at  $0^\circ\text{C}$
- d. liquid at  $10^\circ\text{C}$

## Unit 9 – Solutions, Equilibrium, Solubility, Solubility Curves, Le Chat

- 1) The equation represents a chemical reaction at equilibrium.  $\text{HCl (aq)} + \text{Mg (s)} \rightarrow \text{MgCl}_2 \text{ (aq)} + \text{H}_2 \text{ (g)} + \text{heat}$   
What happens to the system when the temperature is decreased?
- The reaction shifts toward the right, and the amount of hydrogen gas increases.
  - The reaction shifts toward the right, and the amount of hydrogen gas decreases.
  - The reaction shifts toward the left, and the amount of hydrogen gas increases.
  - The reaction shifts toward the left, and the amount of hydrogen gas decreases.

- 2) Which *best* describes electrolytic and nonelectrolyte solutions?
- Electrolytic solutions produce ions in solution, while nonelectrolytes do not produce ions in solution.
  - Electrolytic solutions include alcohols and sugars, while nonelectrolytes include acids and bases.
  - Electrolytic solutions are not able to conduct electricity, while nonelectrolytes are able to conduct electricity.
  - Electrolytic solutions are composed of polar covalent substances, while nonelectrolytes are composed of ionic compounds.

- 3) The graph to the right shows the solubility of various compounds. At what temperature will 50 g of  $\text{NH}_4\text{Br}$  produce a saturated solution when dissolved in 100 g of water?

- 48°C
- 54°C
- 60°C
- 66°C

- 4) When salt ( $\text{NaCl}$ ) is dissolving in water ( $\text{H}_2\text{O}$ ), what happens to the attraction between the salt ions and the oxygen atoms of the water?

- The chlorine ion is attracted to the partial negative charge of the oxygen atoms.
- The chlorine ion is attracted to the partial positive charge of the oxygen atoms.
- The sodium ion is attracted to the partial negative charge of the oxygen atoms.
- The sodium ion is attracted to the partial positive charge of the oxygen atoms.

- 5) The chemical equation below represents a reaction at equilibrium in a closed flask. Which action will cause the equilibrium to shift to the left?  $\text{CO (g)} + 3\text{H}_2 \text{ (g)} \leftrightarrow \text{CH}_4 \text{ (g)} + \text{H}_2\text{O (g)} + \text{heat}$

- heating the flask with a hot plate
- placing the flask in an ice bath
- removing  $\text{H}_2\text{O}$  from the flask
- adding  $\text{CO}$  to the flask

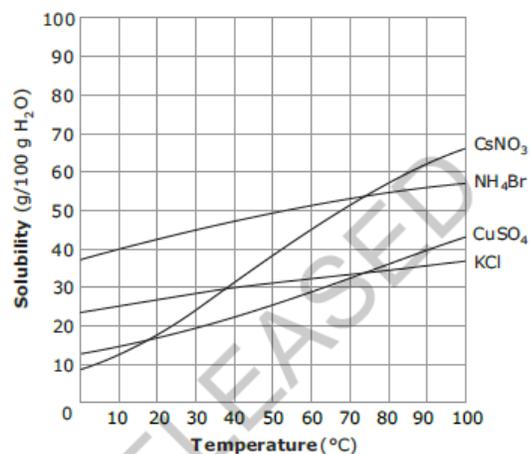
- 6) The diagram on the right shows the solubility of sugar in water. A student dissolves 300 g of sugar in 100 g of water at 80°C. The solution is then allowed to cool to 40°C. The appearance of the solution does not change during the cooling. Which term accurately describes the solution at 40°C?

- Suspension
- Colloid
- Supersaturated
- Unsaturated

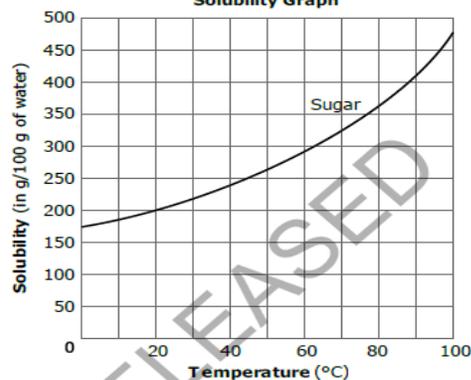
- 7) Heat is added to a solution to
- Increase the solubility of a solid solute.
  - Increase the solubility of a gas solute.
  - Increase the miscibility of the solution.
  - Increase the degree of saturation of the solution.

- 8) A scientist observes a chemical reaction as it takes place. How can the scientist tell if the reaction has achieved equilibrium?
- Measure concentration of products and reactants over time.
  - Monitor the temperature of the reaction over time.
  - Measure the pH of the solution over time.
  - Wait for the formation of a precipitate.

Solubility of Various Compounds



Solubility Graph



## Unit 10 – Acids and Bases, Indicators

- 1) Why is KOH considered to be an Arrhenius base?
- It produces OH<sup>+</sup> ions in solution.
  - It produces H<sup>+</sup> ions in solution.
  - It produces H<sup>-</sup> ions in solution.
  - It produces OH<sup>-</sup> ions in solution.
- 2) Based on the hydroxide ion concentration, which unknown substance would be an acid?
- Substance A, [OH<sup>-</sup>] = 1.0 x 10<sup>-2</sup>M
  - Substance B, [OH<sup>-</sup>] = 1.0 x 10<sup>-4</sup>M
  - Substance C, [OH<sup>-</sup>] = 1.0 x 10<sup>-6</sup>M
  - Substance D, [OH<sup>-</sup>] = 1.0 x 10<sup>-8</sup>M
- 3) A student describes a liquid as feeling slippery. The student places red litmus paper into the liquid, and the paper turns blue. What can the student conclude from these observations?
- The substance is likely a nonmetal.
  - The substance is likely a metal.
  - The substance is likely a base.
  - The substance is likely an acid.

- 4) The chart to the right shows the characteristics of several common acid-base indicators. Which indicator would appear to be yellow in a solution with a hydrogen ion concentration of 1.0 x 10<sup>-7</sup>?
- Bromocresol Green
  - Congo Red
  - Phenol Red
  - Indigo Carmine

Indicator	pH Range	Color Range
Bromocresol Green	3.8–5.4	Yellow to Blue
Congo Red	3.0–5.0	Blue to Red
Phenol Red	6.8–8.2	Yellow to Red
Indigo Carmine	11.6–13.0	Blue to Yellow

- 5) What volume of 0.200M HCl will neutralize 10mL of 0.400M KOH?
- 40.0mL
  - 20.0mL
  - 8.00mL
  - 5.00mL
- 6) A solution has a pOH of 12. Which **best** describes the solution?
- It has a pH of 2 and is a base.
  - It has a pH of 12 and is a base.
  - It has a pH of 2 and is an acid.
  - It has a pH of 12 and is an acid.
- 7) An acid-base titration is represented by the following chemical equation. CsOH (aq) + HBr (aq) → CsBr (aq) + H<sub>2</sub>O (l)  
In the titration, 15.0 mL of CsOH solution is neutralized by 38.2 mL of 0.250 M HBr solution. What is the molarity of the CsOH solution?
- 0.0982 M
  - 0.637 M
  - 1.36 M
  - 10.2 M

- 8) A student conducts an experiment to identify the pH of some common household substances. The data is recorded in this table. Which substance would be classified as containing the highest concentration of hydroxide ions?
- Ammonia
  - Drain Cleaner
  - Lemon Juice
  - Vinegar

Substance	pH
Ammonia	11.9
Drain Cleaner	13.5
Hand Soap	10.1
Lemon Juice	2.3
Vinegar	3.0
Water	6.8

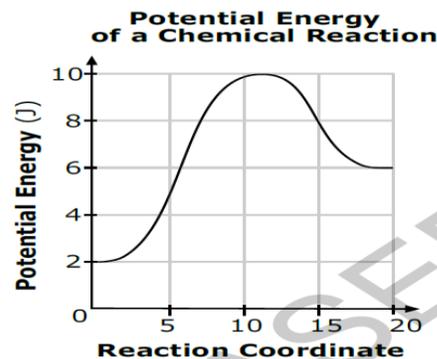
## Unit 11 – Thermodynamics

- 1) How does the amount of heat energy change as a 250-g sample of water is heated from 5.0°C to 30.0°C?
- The amount of heat energy increases, causing the water to sublime.
  - The amount of heat energy increases, causing the water to evaporate.
  - As the temperature increases, the amount of heat energy decreases.
  - As the temperature increases, the amount of heat energy increases.

- 2) The potential energy diagram of a chemical reaction is shown to the right.

Which **best** describes the energy in the chemical reaction?

- Heat energy was released.
- Energy was lowered by a catalyst.
- 8 J of energy were required to start the reaction.
- 10 J of energy were required to start the reaction.

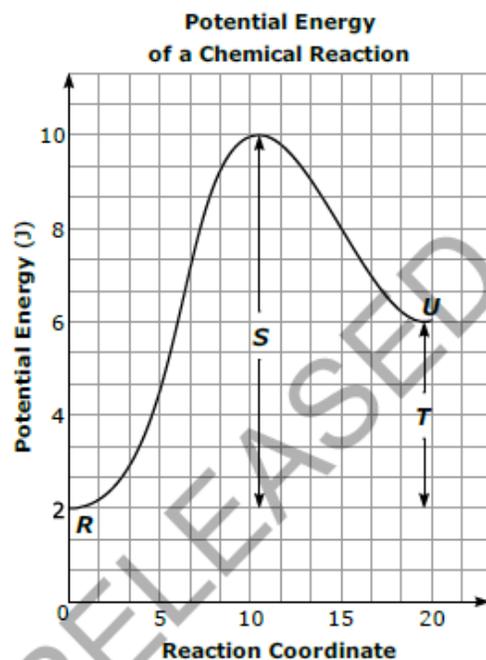


- 3) 100J of heat is added to 2g of the following substances. Which one will experience the biggest change in temperature?

- aluminum
- copper
- iron
- lead

- 4) The potential energy diagram of a chemical reaction is shown to the right. Which choice would be changed by the addition of a catalyst to the reaction?

- R
- S
- T
- U



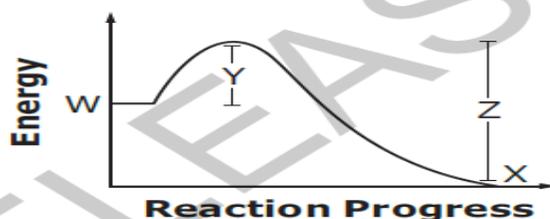
- 5) A sample of metal has a mass of 5.2 g and absorbs 20.0 J of energy as it is heated from 30.0°C to 40.0°C. What is the identity of the metal?

- Iron
- Gold
- Copper
- Magnesium

- 6) This is a potential energy diagram on the right. What can be concluded from the potential energy diagram?

- The reaction produced a covalent compound.
- The reaction produced an ionic compound.
- The reaction was exothermic.
- The reaction was endothermic.

**Potential Energy Diagram**



- 7) What occurs when energy is removed from a liquid-vapor system in equilibrium?

- The amount of liquid increases.
- The amount of vapor increases.
- The amounts of liquid and vapor increase equally.
- The amounts of liquid and vapor decrease equally.

- 8) In a chemical reaction, how does increasing the temperature of the reactants affect the reaction process?

- The reactants absorb more heat, which turns them into products faster.
- The activation energy is decreased, which makes the reaction proceed faster.
- The kinetic energy of the reactants increases, causing more effective collisions.
- The particles break down faster, increasing the surface area and the reaction rate.

**Answers**

	Q 1	Q 2	Q 3	Q 4	Q 5	Q 6	Q 7	Q 8	Q 9	Q 10
Unit 1+2	B	C	A	B	A	D	A	B	-	-
Unit 3	D	B	D	D	B	C	D	B	-	-
Unit 4	D	A	D	C	B	C	A	A	C	D
Unit 5	B	A	D	B	D	C	C	D	D	A
Unit 6+7	D	D	B	C	D	C	B	D	-	-
Unit 8	B	B	D	A	A	D	A	D	-	-
Unit 9	A	A	B	C	A	C	A	A	-	-
Unit 10	D	D	C	C	B	C	B	B	-	-
Unit 11	D	C	A	B	C	C	A	C	-	-