Released Form

Student Name: _____

Spring 2013 North Carolina Measures of Student Learning: NC's Common Exams **Chemistry**

Student Booklet

Public Schools of North Carolina
State Board of Education
Department of Public Instruction
Raleigh, North Carolina 27699-6314

1 Three isotopes of carbon are indicated below:

$^{12}_{6}C$, $^{13}_{6}C$, and $^{14}_{6}C$

How are these isotopes alike?

A They have the same number of protons and the same atomic mass.

B They have the same number of neutrons and the same atomic mass.

C They have the same number of protons and the same atomic number.

D They have the same number of neutrons and the same atomic number.

2 Which statement correctly compares an atom of boron-11 and an atom of carbon-14?

A An atom of boron-11 has one fewer proton and two fewer neutrons than an atom of carbon-14.

B An atom of boron-11 has one fewer neutron and two fewer protons than an atom of carbon-14.

C An atom of boron-11 has one fewer proton and three fewer neutrons than an atom of carbon-14.

D An atom of boron-11 has one fewer neutron and three fewer protons than an atom of carbon-14.

3 Which ***best*** represents the electron configuration for an atom of iron?

A $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^6$

B $1s^2 1p^6 2s^2 2p^6 3s^2 3p^6 4s^2$

C $1s^2 2s^2 2p^6 3s^2 3p^6 3d^8$

D $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 4d^6$

Go to the next page.

4 How many electrons are in the outermost energy level of an electrically neutral atom of aluminum?

A 13

B 8

C 3

D 2

5 Which transition occurs when light with a wavelength of 434 nm is emitted by a hydrogen atom?

A The electron jumps from $n = 2$ to $n = 4$.

B The electron jumps from $n = 2$ to $n = 5$.

C The electron falls from $n = 4$ to $n = 2$.

D The electron falls from $n = 5$ to $n = 2$.

6 The nuclear equation below represents the alpha decay of $^{222}_{86}Rn$:

$$^{222}_{86}Rn \rightarrow {}^{4}_{2}He + X$$

What is the mass number of the element represented by X?

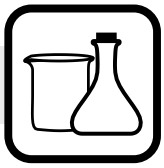
A It is 88, because element X gains 2 protons.

B It is 218, because element X loses 2 protons and 2 neutrons.

C It is 220, because element X loses 2 neutrons.

D It is 226, because element X gains 2 protons and 2 neutrons.

Go to the next page.



7 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.

8 When aluminum and sulfur react, which compound is produced?

A Al_2S_3

B Al_3S_2

C AlS_2

D AlS

9 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

Go to the next page.

10 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.

11 Which represents the formula for iron(III) chromate?

A $Fe_2(CrO_4)_3$

B $Fe_2(CrO_4)_2$

C $Fe_3(CrO_4)_2$

D $Fe_3(CrO_4)_3$

12 What is the IUPAC name for the chemical formula PbO_2?

A lead oxide

B lead(II) oxide

C lead(IV) oxide

D lead dioxide

13 Which is true about the melting points of ionic and molecular compounds?

A The melting points of ionic and molecular compounds are similar.

B The melting points of ionic compounds are lower than the melting points of molecular compounds.

C The melting points of ionic and molecular compounds increase with the number of atoms present in the compound.

D The melting points of ionic compounds are higher than the melting points of molecular compounds.

14 Which pair of elements is both malleable and able to conduct heat?

A bromine and silver

B iodine and neon

C iron and bromine

D silver and iron

15 Which group includes elements with the most similar properties?

A N, O, and F

B O, S, and Se

C Cr, Pb, and Xe

D Br, Ga, and Hg

16 An atom of which element has the strongest attraction for electrons?

A Ba

B Cs

C O

D F

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

A The amount of liquid increases.

B The amount of vapor increases.

C The amounts of liquid and vapor increase equally.

D The amounts of liquid and vapor decrease equally.

18 Which ***best*** explains the relationship between heat energy and temperature?

A As heat energy increases and temperature increases, freezing occurs.

B As heat energy decreases and temperature remains constant, condensation occurs.

C As heat energy decreases and temperature remains constant, evaporation occurs.

D As heat energy increases and temperature decreases, melting occurs.

Go to the next page.

19 Why does it require 5,511 J of heat energy to melt 16.5 g of ice?

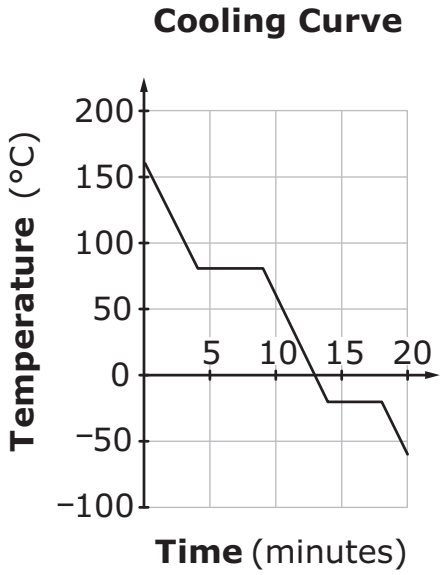
A 2,260 J/g of heat energy is absorbed by the ice as it is converted from a solid to a liquid.

B 334 J/g of heat energy is absorbed by the ice as it is converted from a solid to a liquid.

C 4.18 J/g°C of heat energy is required as ice is converted from a solid to a liquid.

D 2.05 J/g°C of heat energy is required as ice is converted from a solid to a liquid.

20 The graph below shows a cooling curve for a sample of gas that is uniformly cooled from 155°C.



Why does the freezing point of the substance occur at –20°C?

A because the latent heat energy is absorbed by the substance as it is converted from a liquid to a solid

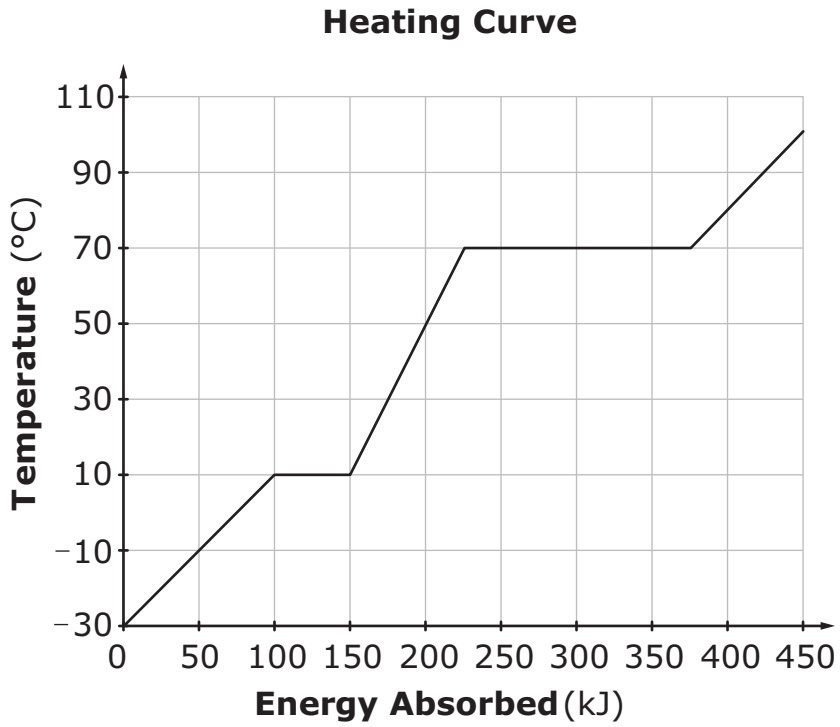
B because the latent heat energy is released into the air as the substance is converted from a liquid to a solid

C because the average kinetic energy is increasing for the substance as it is converted from a solid to a liquid

D because the average kinetic energy is decreasing for the substance as it is converted from a solid to a liquid

Go to the next page.

21 The graph below represents a substance being heated from –30°C to 110°C.



If 50 kJ of heat are removed from the substance when it is at 50°C, what will be the state and temperature of the substance?

A gas at 70°C

B gas at 100°C

C liquid at 0°C

D liquid at 10°C

22 How many moles of nitrogen gas are in 135 L of nitrogen gas at Standard Temperature and Pressure (STP)?

A 4.82 moles of N_2

B 5.53 moles of N_2

C 6.02 moles of N_2

D 9.64 moles of N_2

Go to the next page.

23 A mixture of gases (NO_2, CO_2, SO_2) is collected in a bottle. The partial pressure of NO_2 is 1.25 atm, and the partial pressure of CO_2 is 2.63 atm. If the total pressure of the gases is 11.20 atm, what is the partial pressure of SO_2?

A 2.89 atm

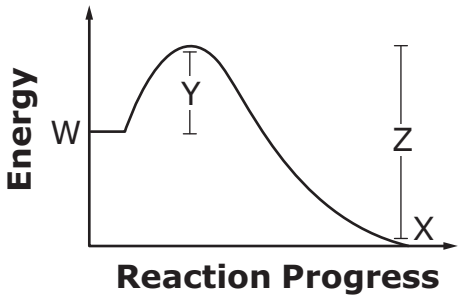
B 7.32 atm

C 9.23 atm

D 11.20 atm

24 This is a potential energy diagram.

Potential Energy Diagram



What can be concluded from the potential energy diagram?

A The reaction produced a covalent compound.

B The reaction produced an ionic compound.

C The reaction was exothermic.

D The reaction was endothermic.

Go to the next page.

25 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.

26 Which reaction produces gas that turns lime water milky?

A $Zn + 2HCl \rightarrow ZnCl_2 + H_2$

B $2KClO_3 \rightarrow 2KCl + 3O_2$

C $CaCO_3 \rightarrow CaO + CO_2$

D $2NaCl \rightarrow 2Na + Cl_2$

27 The chemical equation below represents an unbalanced chemical reaction:

$$Fe + O_2 \rightarrow Fe_2O_3$$

When the equation is balanced, what coefficient is needed for Fe_2O_3?

A 1

B 2

C 3

D 4

Go to the next page.

28 When $AgNO_3$ (*aq*) is mixed with NaCl (*aq*), which type of reaction will occur?

A single replacement

B synthesis

C decomposition

D double replacement

29 How much mass is in a 3.25-mole sample of NH_4OH?

A 10.8 g

B 34.0 g

C 35.1 g

D 114 g

30 The equation below represents a balanced chemical reaction:

$$2Mg\ (s) + O_2\ (g) \rightarrow 2MgO\ (s)$$

How many moles of MgO are produced when 7.2 moles of O_2 react with excess Mg?

A 3.6 moles

B 14 moles

C 22 moles

D 29 moles

Go to the next page.

31 Why does the rate of a chemical reaction increase when the surface area of a reactant is increased?

A When the surface area increases, the reaction temperature increases.

B When the surface area increases, the number of particle collisions increases.

C When the surface area increases, the concentration of the substance increases.

D When the surface area increases, the density of the substance increases.

32 Which ***best*** describes the role of enzymes in a chemical reaction?

A They lower the activation energy in the reaction.

B They prevent the reaction from occurring.

C They are produced by the reaction.

D They are consumed by the reaction.

Go to the next page.

33 The equation below represents the reaction between nitrogen gas and hydrogen gas to form ammonia. The reaction occurs within a closed container and comes to equilibrium:

$$N_2 + 3H_2 \rightleftarrows 2NH_3$$

What expression represents the equilibrium expression for this reaction?

A $K_{eq} = \dfrac{[NH_3]^2}{[N_2][H_2]^3}$

B $K_{eq} = \dfrac{[N_2][H_2]^3}{[NH_3]^2}$

C $K_{eq} = \dfrac{[N_2][H_2]}{[NH_3]}$

D $K_{eq} = \dfrac{[N_2]^2[H_2]^2}{[NH_3]^3}$

34 A sample of ammonia gas and hydrogen chloride gas is placed in a sealed container at 25°C and allowed to come to equilibrium according to this equation:

$$NH_3\ (g) + HCl\ (g) \rightleftarrows NH_4Cl\ (s)$$

After equilibrium is established, the container is opened to allow the NH_3 (g) and HCl (g) to escape. How would this affect the equilibrium?

A The reaction would produce less NH_3 (g) and HCl (g).

B The reaction would shift to the right to produce more NH_4Cl (s).

C The reaction would shift to the left to produce more NH_3 (g) and HCl (g).

D The reaction would produce more NH_3 (g), HCl (g), and NH_4Cl (s) until the original equilibrium is reestablished.

Go to the next page.

35 Why is KOH considered to be an Arrhenius base?

A It produces OH^+ ions in solution.

B It produces H^+ ions in solution.

C It produces H^- ions in solution.

D It produces OH^- ions in solution.

36 The chart below shows the characteristics of several common acid-base indicators.

Characteristics of Common Acid-Base Indicators

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

Which indicator would appear to be yellow in a solution with a hydrogen ion concentration of 1.0×10^{-7}?

A Bromocresol Green

B Congo Red

C Phenol Red

D Indigo Carmine

Go to the next page.

37 Which ***best*** describes electrolytic and nonelectrolyte solutions?

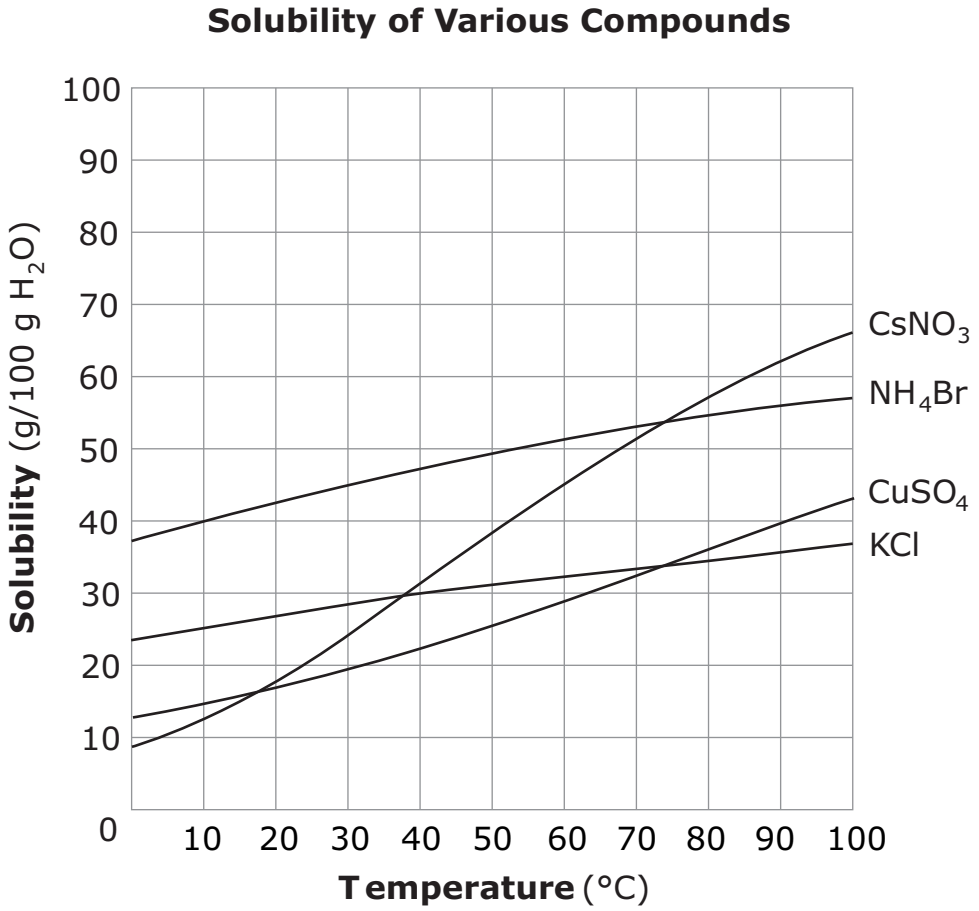
A Electrolytic solutions produce ions in solution, while nonelectrolytes do not produce ions in solution.

B Electrolytic solutions include alcohols and sugars, while nonelectrolytes include acids and bases.

C Electrolytic solutions are not able to conduct electricity, while nonelectrolytes are able to conduct electricity.

D Electrolytic solutions are composed of polar covalent substances, while nonelectrolytes are composed of ionic compounds.

38 The graph below shows the solubility of various compounds.



At what temperature will 50 g of NH_4Br produce a saturated solution when dissolved in 100 g of water?

A 48°C

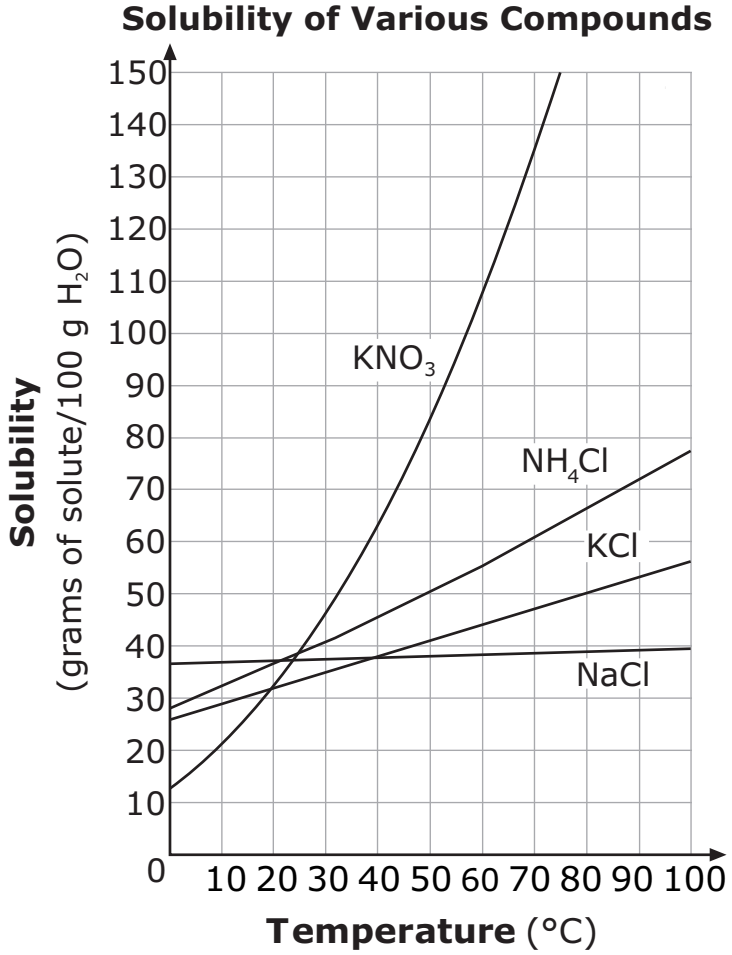
B 54°C

C 60°C

D 66°C

Go to the next page.

39 The graph below shows the solubility of various compounds.



Which salt solution could contain ***approximately*** 50 g of solute per 100 g of H_2O at 80°C?

A a saturated solution of KCl

B a saturated solution of KNO_3

C an unsaturated solution of NaCl

D a supersaturated solution of NH_4Cl

40 When salt (NaCl) is dissolving in water (H_2O), what happens to the attraction between the salt ions and the oxygen atoms of the water?

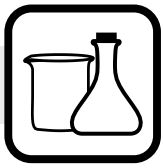
A The chlorine ion is attracted to the partial negative charge of the oxygen atoms.

B The chlorine ion is attracted to the partial positive charge of the oxygen atoms.

C The sodium ion is attracted to the partial negative charge of the oxygen atoms.

D The sodium ion is attracted to the partial positive charge of the oxygen atoms.

This is the end of the multiple-choice portion of the test.



The questions you read next will require you to answer in writing.

1. **Write your answers on separate paper.**
2. **Be sure to write your name on each page.**

1 Ionization energy of an element is one of many trends found on the periodic table.

- Describe ionization energy trends of the elements in the periodic table.
- List the elements beryllium, boron, carbon, fluorine, nitrogen, and oxygen based on ***increasing*** ionization energy.

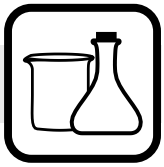
2 A compound with a molecular mass of 78 g/mol contains the elements carbon and hydrogen in a ratio of 1 carbon : 1 hydrogen. Answer the questions using the data provided. Show your work.

- What is the empirical formula for this compound?
- What is the molecular formula for this compound?
- What is the percent composition of carbon in this compound?

3 Acids and bases are substances classified as electrolytes.

- Why are acids and bases considered electrolytes?
- Compare the electrical conductivity of strong acids and bases to the electrical conductivity of weak acids and bases.

Go to the next page.



This is the end of the Chemistry test.

1. **Look back over your answers.**
2. **Put all of your papers inside your test book and close the test book.**
3. **Place your calculator on top of the test book.**
4. **Stay quietly in your seat until your teacher tells you that testing is finished.**

Chemistry
RELEASED Form
Spring 2013
Answer Key

Item number	Type	Key	Unifying Concept
1	MC	C	Matter: Properties and Change
2	MC	A	Matter: Properties and Change
3	MC	A	Matter: Properties and Change
4	MC	C	Matter: Properties and Change
5	MC	D	Matter: Properties and Change
6	MC	B	Matter: Properties and Change
7	MC	A	Matter: Properties and Change
8	MC	A	Matter: Properties and Change
9	MC	C	Matter: Properties and Change
10	MC	B	Matter: Properties and Change
11	MC	A	Matter: Properties and Change
12	MC	C	Matter: Properties and Change
13	MC	D	Matter: Properties and Change
14	MC	D	Matter: Properties and Change
15	MC	B	Matter: Properties and Change
16	MC	D	Matter: Properties and Change
17	MC	A	Energy: Conservation and Transfer
18	MC	B	Energy: Conservation and Transfer
19	MC	B	Energy: Conservation and Transfer
20	MC	B	Energy: Conservation and Transfer
21	MC	D	Energy: Conservation and Transfer
22	MC	C	Energy: Conservation and Transfer
23	MC	B	Energy: Conservation and Transfer

Item number	Type	Key	Unifying Concept
24	MC	C	Energy: Conservation and Transfer
25	MC	A	Energy: Conservation and Transfer
26	MC	C	Energy: Conservation and Transfer
27	MC	B	Energy: Conservation and Transfer
28	MC	D	Energy: Conservation and Transfer
29	MC	D	Energy: Conservation and Transfer
30	MC	B	Energy: Conservation and Transfer
31	MC	B	Interaction of Energy and Matter
32	MC	A	Interaction of Energy and Matter
33	MC	A	Interaction of Energy and Matter
34	MC	C	Interaction of Energy and Matter
35	MC	D	Interaction of Energy and Matter
36	MC	C	Interaction of Energy and Matter
37	MC	A	Interaction of Energy and Matter
38	MC	B	Interaction of Energy and Matter
39	MC	A	Interaction of Energy and Matter
40	MC	C	Interaction of Energy and Matter
41	CR	Rubric	Matter: Properties and Change
42	CR	Rubric	Energy: Conservation and Transfer
43	CR	Rubric	Interaction of Energy and Matter

Item Types:
MC = multiple choice
CR = constructed response

Answers to Released Chemistry Exam

1) Like any isotopes, these isotopes have the same atomic number and the same number of protons.

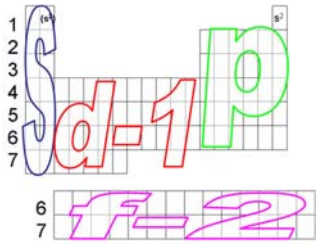
	C-12	C-13	C-14
Alternative symbol	$^{12}_{6}C$	$^{13}_{6}C$	$^{14}_{6}C$
# of p^+	6	6	6
# of n^0	6	7	8
# of e^-	6	6	6
Atomic #	6	6	6
Mass #	12	13	14

2) See below

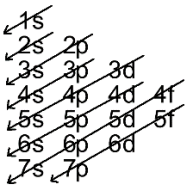
	B-11	C-14
	$^{11}_{5}B$	$^{14}_{6}C$
# of p^+	5	6
# of n^0	6	8
# of e^-	5	6

3) $[Ar]4s^23d^6$

Either use this chart:



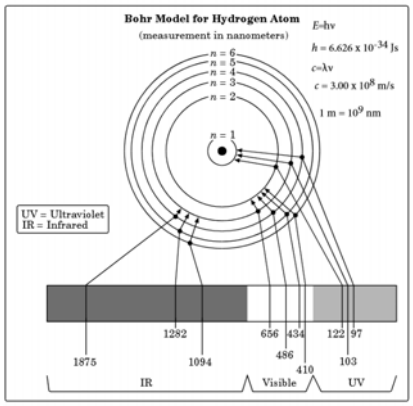
Or use this one (which I do not teach in my course):



4) $1s^22s^22p^6$**$3s^23p^1$**

Valence energy level = outermost energy level = 3rd energy level. There are 3 electrons in the 3rd energy level. Also, count the number of "tall columns" from left to right until you get to Al; aluminum is in the 3rd tall column.

5) Use this diagram from page 8 of the reference tables:



434 nm is the wavelength of light emitted when the n=5 → n=2 transition occurs.

Remember:

Light is **emitted** when **relaxation** occurs. Relaxation is when an electron goes from a high energy level to a lower energy level.

Energy is **absorbed** when **excitation** occurs. Excitation is when an electron goes from a low energy level to a higher energy level.

Answers to Released Chemistry Exam

(6) Add across the top,
(B) add across the bottom,

$222 = 4 + X$ $\quad X = 218$

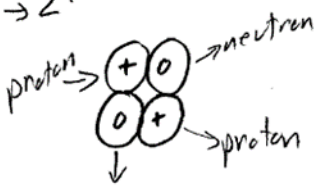
$86 = 2 + Y$ $\quad Y = 84$

mass # → 218 ~~84~~

atomic # → 84

mass # → 4 ^4He is an alpha particle

atomic # → 2



alpha particle ("α particle")

(7) (A)

(8) $Al^{+3}S^{2-}$ Al_2S_3

-or-

(9) "ionic" = made of ions, one cation and one anion.

In this case, pick the metal + nonmetal

Na → metal, low electronegativity, "giver", cation

F → nonmetal, high electronegativity, "taker", anion

(10) All things being equal,
strong = short
weak = long (B)

C≡C shorter, stronger
C=C ↓ ↓
C–C longer, weaker

(11) iron III = Fe^{3+} (A)
chromate = CrO_4^{2-} → this is on page 7 of the ref tables.

$Fe^{3+}_{2}Cr O_4^{2-}{}_3$

$Fe_2(CrO_4)_3$

(12) "IUPAC name" means "name"

PbO_2 charges must add up to zero

Pb	O^{2-} ← from periodic table position	this has to be +4 to even out the oxide ions.
	O^{2-}	
?	−4	

Check: $Pb^{+4}O^{2-} \Rightarrow Pb_2O_4 \Rightarrow PbO_2$ ✓

lead (IV) oxide

Transition metals often must be named by charge because there is more than one charge (oxidation state) possible. This is also true of most metals outside group I & group II.

(C)

(13) ionic = generally stronger bonds
covalent = generally weaker
strong = hard to melt
weak = easy to melt
(D)

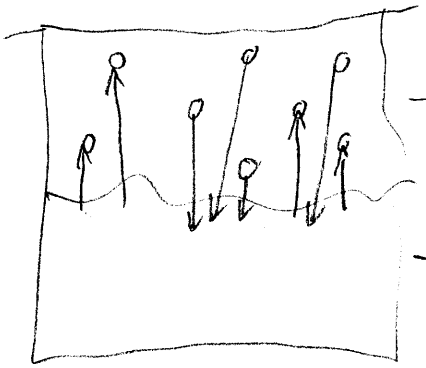
(14) metals are malleable & conduct heat well
(D) – Ag & Fe are both metals

(15) I guess (B) because all 3 are in the same group (group 16)

(16) (D) F is smaller
F has lowest shielding effect

Also, electroneg decr top to bottom
incr L → R
"electronegativity" means "tendency to attract electrons"

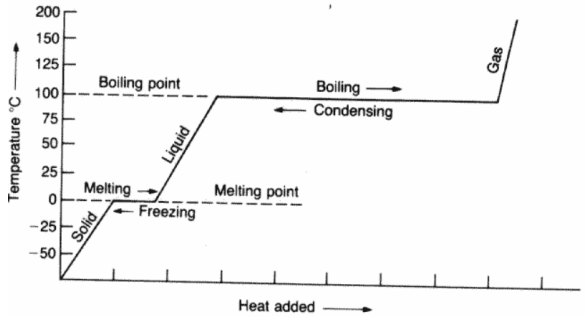
(17)



If you cool this system down, then more vapor (g) will turn into liquid (l). (A)

Alternatively, vapor pressure decreases when temp decreases. When vapor pressure decreases, vapor turns into liquid.

(18) Use this diagram to understand why the g → l phase change requires heat leaving the system. Note that temp doesn't change during phase changes.



(19) $q = mH_f$

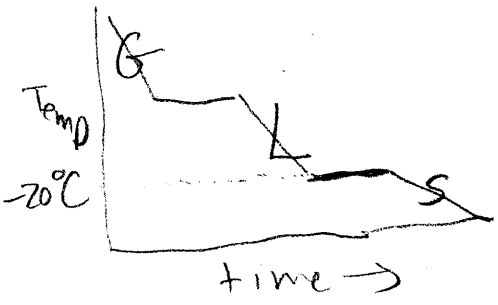
$5,511\,J = (16.5g)(H_f)$

$\frac{5511\,J}{16.5g} = H_f = 334\,J/g$

"Why" = because it takes 334 J of heat to melt 1 g of ice. Heat of Fusion of ice is listed on p. 1 of ref tables

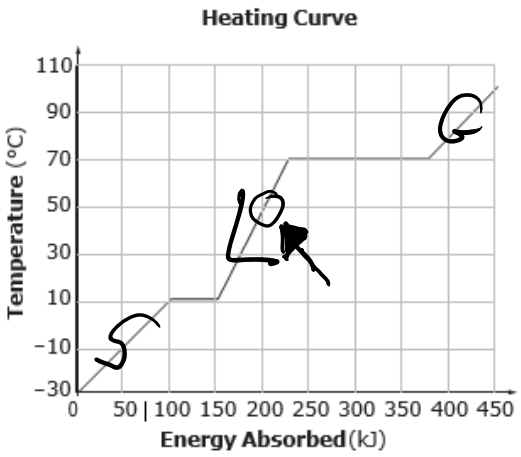
(20) Note that problem states that initial phase is gas.

(B)



At −20°C, heat is being removed from system but temp can't decrease until heat of fusion is lost. If temp (kinetic energy) isn't decreasing, then potential energy must be decreasing. Latent energy = potential energy in this case.

21.



There are two ways to solve this problem.

(a) Here is one way: Find the point on the curve which corresponds to "50°C". Now walk backwards by 50 kJ on the x-axis. You are left with a liquid at 10°C.

(b) Alternatively, realize that the substance in the diagram is a solid to begin with. This fact is not stated in the problem, but it should have been. Anyway, Once 100 kJ of heat is added, the substance is still a solid but is at its melting point (10°C). Once a total of 150 kJ has been added, the substance us still at 10°C but is now a liquid after absorbing the heat of fusion. Once a total of 200kJ has been added, the substance is a liquid at 50°C. At this point, realize that if you were to let the substance release 50 kJ of heat, it would cool to 10°C but would still be a liquid.

22. Because at STP, 22.4 L of gas = 1 mol of gas. (You could use PV=nRT to get the same result here, but it would require a little more work.)

$$135\ \text{L} \ \text{x}\ \frac{1\ \text{mol}}{22.4\ \text{L}} = 6.03\ \text{mol}$$

23. This is a Dalton's Law problem. When you see the phrases "total pressure," "partial pressure," or "mixture of gases" there is a pretty good chance that you need to use this equation:

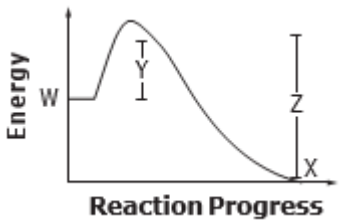
$$P_{tot} = P_1 + P_2 + P_3 + \ldots$$

$$P_{tot} = P_{NO_2} + P_{CO_2} + P_{SO_2}$$

$$11.20\ \text{atm} = 1.25\ \text{atm} + 2.63\ \text{atm} + P_{SO_2}$$

$$7.32\ \text{atm} = P_{SO_2}$$

24.



When the reaction goes "downhill," then it is releasing energy from the system to the surroundings. This problem seems to be treating potential energy and heat as the same thing. Therefore, because heat is given off by the system (i.e., given off by the chemical(s) which is/are reacting) the reaction is exothermic. A diagram that shows an "uphill" reaction would mean that the reaction would be "endothermic."

25. Higher temp = faster particles. Faster particles have more kinetic energy than slower particles. (Imagine being bumped by someone walking vs. being hit by someone running.) Faster-moving particles bump into each other more frequently.

26. You need to look for the reaction which produces CO_2 (g). The test for CO_2 (g) is to bubble the carbon dioxide through a solution of "lime water." Lime water is a solution of calcium hydroxide

in water: $Ca(OH)_2$ (aq). When CO_2 (g) is bubbled through lime water, the solution will turn cloudy white. This cloudy white appearance is due to the presence of suspended particles of white $CaCO_3$. The insoluble calcium carbonate powder will eventually sink, but until it does the ppt makes the test tube's contents appear cloudy white. Here is the reaction for the CO_2 test:

CO_2 (g)	+	$Ca(OH)_2$ (aq)	→	$CaCO_3$ (s)	+	H_2O (l)
carbon dioxide gas		lime water		insoluble precipitate		water

27. $4Fe + 3O_2 \rightarrow 2Fe_2O_3$

28. $AgNO_3$ (aq) + NaCl (aq) → AgCl (s) + $NaNO_3$ (aq)

This is a double replacement reaction. It is also a precipitation reaction. The types of reactions are listed in your reference tables.

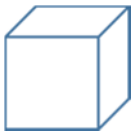
29. $$3.25 \text{ mol x } \frac{35.06\ g}{1\ mol} = 114 \text{ g}$$

30. Mg is unimportant because it is present in excess. Since it will not all react, the Mg cannot be used to predict the amount of product made.

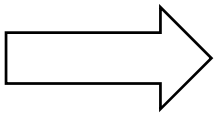
$$7.2 \text{ mol } O_2 \text{ x } \frac{2\ mol\ MgO}{1\ mol\ O_2} = 14 \text{ mol MgO (rounded to two sig figs)}$$

Note: The "2" for the MgO and the "1" for the O_2 in the conversion factor above came from the coefficients in the balanced equation. The balanced equation is given to you in the problem.

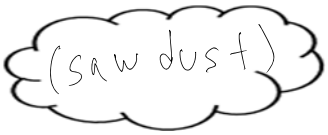
31. "Increased surface area" = "broken into smaller pieces."



Block of wood is a big chunk but has small surface area . . .



. . . but if you grind it up . . .



. . . then the sawdust it produces has very tiny pieces but a very large total surface area.

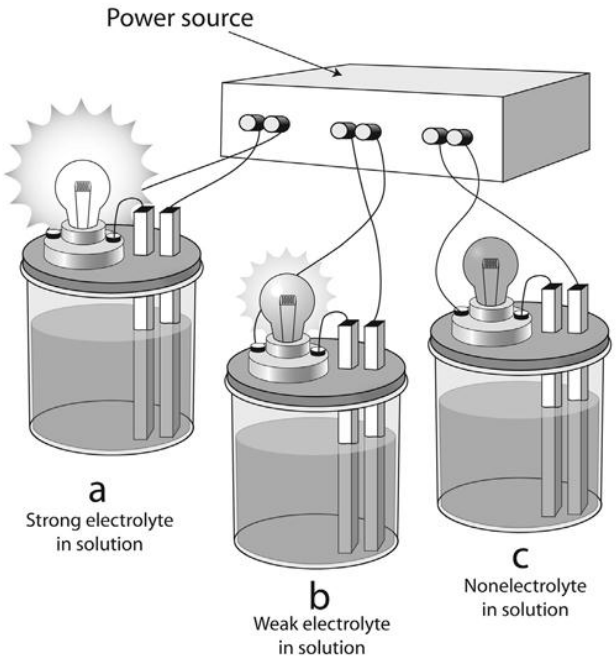
Powdered wood (sawdust) is potentially explosive because the flammable wood is now much more exposed to the oxygen in air. More surface area = more collisions of reactant molecules = faster reaction rate.

32. Enzymes are biological catalysts. Catalysts speed up reactions by lowering the activation energy (E_a).
33. Products over reactants. Multiply, don't add. Coefficients become exponents (superscripts).
34. When amounts of reactants decrease, then concentrations of reactants decrease. When [reactants] decreases, then reaction has to shift to the left in order to make more of the reactants. "Shift to the left" means that the reverse reaction (←) happens more often than the

forward reaction (→) until the reaction reaches equilibrium. (Once the reaction reaches equilibrium, the rates of the forward and reverse reactions are the same.)

35. Just ignore the word "Arrhenius."
36. When $[H^+] = 10^{-7}$ M, pH = 7. Phenol red has two colors: yellow when the pH is 6.8 and below, and red when the pH is 8.2 and above. If you were to put some phenol red into a solution that has a pH of 6.8 and then add enough base so that its pH increases to 8.2, you would see the phenol red indicator change from a color of yellow to red. At pH = 7, I would guess that the color of this indicator is closer to yellow than to red. We (hopefully, at the very least) used the indicators litmus (blue to red: acid) and phenolphthalein (colorless in acid, pink in basic solution above pH = 10) in class.
37. **Electrolyte:** will dissolve and also DISSOCIATE into ions. An electrolyte will conduct an electric current when dissolved. NaCl is table salt. It is a great electrolyte. It will conduct an electric current if dissolved or melted. It has ions which can carry an electric current, but the ions have to be free to move. The ions are Na^+ and Cl^- .The ions aren't free to move when NaCl is an undissolved solid. Solid NaCl won't conduct an electric current, but NaCl (aq) and NaCl (ℓ) will. If a substance contains ions or produces ions when it is dissolved, then it is an electrolyte.

    Nonelectrolyte: will dissolve but WILL NOT DISSOCIATE into ions. A nonelectrolyte will not conduct an electric current when dissolved, nor when a solid, nor when melted. $C_{12}H_{22}O_{11}$ is table sugar, also called sucrose. $C_6H_{12}O_6$ is another sugar; it called glucose. Both are examples of nonelectrolytes. Many molecular compounds are nonelectrolytes. Sugars dissolve into little, individual, neutral packages called molecules; these molecules do not go on to dissociate into ions, though.



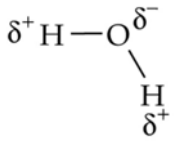
Notes on the diagram showing the "light bulb electrolyte test":

(a) Some type of ionic compound or strong acid or strong base.

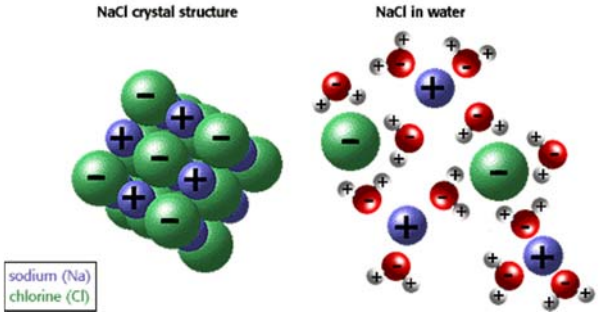
(b) Some type of weak acid or weak base

(c) Some type of soluble compound (such as a sugar) which does not make ions when dissolved.

38. Saturated solution = "on the line." Therefore, you can make a saturated solution of NH_4Br when 50 g of that substance is dissolved in 100 g of water at about 54°C.
39. 50 g of KCl (potassium chloride) will dissolve in 100g of water at 80°C.
40. Water is a V-shaped, polar molecule. It is a molecule with a partially-negative side and a partially-positive side. Because oxygen is more electronegative than hydrogen, the O side is δ– and the H side is δ +. When NaCl dissociates into Na^+ and Cl^- ions in aqueous solution, the positive sodium ions will be attractive to the partially-negative oxygen side of water molecules. The negative chloride ions will be attracted to the partially-positive hydrogen side of water.

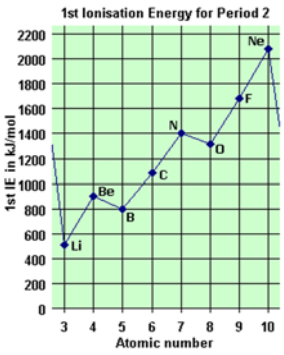


* Water is a V-shaped, polar molecule.



41.

a. ***In general***, I.E. increases L → R across a period and decreases T → B down a group.
b. Since these elements are in the same period, you should probably list them in order from left to right. Be, B, C, N, O, F. *At least that last answer was what the test scorers were looking for*. In case you care, reality is a little more complicated. The actual ionization energies of the period 2 elements are shown in the picture at right.



42. OK. They should have said that there was a *mole ratio* of 1 carbon: 1 hydrogen, or an atom ratio of 1:1. At any rate, that is what the question meant to say. If you assumed that there was a 1:1 mass ratio between these elements then I guess you got this wrong. Oops. Sorry.
    a. Since there is 1 mol C per 1 mol H, the empirical formula is **CH**. The empirical formula of a compound is the lowest whole-number ratio of atoms of each element in the compound. It is not necessarily the same as the molecular formula.
    b. The molecular formula is the actual number of each atoms of each element in a molecule of the compound.
    78 g/mol is the actual molar mass of the compound, but "CH" only adds up to

(12 + 1) = 13 g/mol. Therefore CH can't be the actual (molecular) formula of the compound.

$$\frac{\text{Actual molar mass of actual compound}}{\text{apparent molar mass of empirical formula}} = \frac{78}{13} = 6$$

The actual compound will have 6 times as many C atoms and 6 times as many H atoms, but it must have a 1:1 ratio of C atoms : H atoms. Therefore the molecular formula of the compound is C_6H_6. You can check that (12.01 X 6) + (1.01 X 6) = approximately 78 g/mol.

c. The % composition can be calculated from either the MF or the EF – it doesn't matter which you use. I calculated both the long way, but you could get the second element by simply showing that you subtracted the first element's percent composition from 100%:

$$\%\,C = \frac{\text{mass C}}{\text{total molar mass}} \times 100 = \frac{6 \times 12.01}{78.12} \times 100 = \frac{72.06}{78.12} \times 100 = 92.2\,\%$$ (I used 3 sig figs)

$$\%\,H = \frac{\text{mass H}}{\text{total molar mass}} \times 100 = \frac{6 \times 1.01}{78.12} \times 100 = \frac{6.06}{78.12} \times 100 = 7.76\%$$ (I used 3 sig figs)

43.

a. Acids and bases produce ions when dissolved in water, so they are considered electrolytes.

b. Strong acids (and strong bases) ionize completely in solution. Weak acids (and weak bases) only ionize partially in solution. A weak acid – all things being equal - produces relatively few ions in solution compared to a strong acid. That means a 1M solution of a strong acid like hydrochloric acid (HCl (aq)) will have a lot more ions floating around than a 1M solution of a weak acid such as acetic acid ($HC_2H_3O_2$ (aq)). More ions in solution will allow the solution to conduct electricity a lot better. Please see important diagram attached to the answer to question #37 in this study guide.