AP CHEMISTRY – REVIEW SHEET #4 Name _____

Period _____ Date _____

____ 1. _____ Mg + _____ NO_3^- + _____ $H^+ \rightarrow$ _____ Mg^{2+} + _____ NH_4^+ + _____ H_2O

When the equation above is balanced in acidic solution and all coefficients are reduced to their lowest terms, what is the coefficient for H^+?

A) 4 B) 6 C) 8 D) 9 E) 10

____ 2. **Ionization Energies for Element X**

	1st	2nd	3rd	4th	5th	6th	7th
Ionization Energy (kJ/mol)	787	1580	3200	4400	16000	20000	24000

The first seven ionization energies of element X are shown in the table above. On the basis of these data, element X is most likely a member of which of the following groups (families) of elements?

A) alkaline earth metals B) boron group C) carbon group
D) nitrogen group E) halogens

____ 3. A saturated solution of magnesium hydroxide has added to it dropwise a solution with a pH of 4. This results in:

A) a precipitate forming. B) production of a gas (bubbling)
C) magnesium metal precipitating. D) the solution becoming more basic.
E) water forming.

Use the following electron configurations as choices for the next four questions.

A) $1s^2 2s^2 2p^6 3s^2 3p^5$
B) $1s^2 2s^2 2p^6 3s^2 3p^6$
C) $1s^2 2s^2 2p^6 2d^{10} 3s^2 3p^6$
D) $1s^2 2s^2 2p^6 3s^2 3p^6 3d^5$
E) $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^3$

____ 4. An impossible electron configuration

____ 5. The ground state electron configuration for a transition metal

____ 6. The ground state electron configuration of the anion of a halogen

____ 7. The ground state electron configuration of a common ion of an alkaline earth metal

____ 8. $H_{2\,(g)} + \frac{1}{2}\, O_{2\,(g)} \rightarrow H_2O_{\,(l)}$ $\Delta H° = X$

$2\ Na_{(s)} + \frac{1}{2}\ O_{2\,(g)} \rightarrow Na_2O_{(s)}$ $\Delta H° = Y$

$Na_{(s)} + \frac{1}{2}\ O_{2\,(g)} + \frac{1}{2}\ H_2 \rightarrow NaOH_{(s)}$ $\Delta H° = Z$

Based on the information above, what is the standard enthalpy change for the following reaction: $\mathbf{Na_2O_{(s)} + H_2O_{(l)} \rightarrow 2\ NaOH_{(s)}}$?

A) X + Y + Z B) X + Y – Z C) X + Y – 2 Z

D) 2 Z – X – Y E) Z – X – Y

____ 9. $2\ Al + 6\ HCl \rightarrow 3\ H_2 + 2\ AlCl_3$

Aluminum reacts with hydrochloric acid, as indicated in the equation above, to produce hydrogen gas. The H_2 produced was then collected by water displacement at 27°C (where the vapor pressure of water is 21 torr) and a barometric pressure of 757 torr. If 0.555 L of gas is collected, the partial pressure of hydrogen gas is:

A) 0.555 x (273+27) B) 0.555 x 757 C) 757 – 27

D) 757 – 21 E) 0.555 x 300 / 273

____ 10. In the periodic table, as the atomic number increases from 11 to 17, what happens to the atomic radius?

A) It remains constant. B) It increases only.

C) It increases, then decreases. D) It decreases only.

E) It decreases, then increases.

____ 11. When 70.0 mL of 3.00 M Na_2CO_3 is added to 30.0 mL of 1.00 M $NaHCO_3$, the resulting concentration of Na^+ is:

A) 2.00 M B) 2.40 M C) 4.00 M D) 4.50 M E) 7.00 M

____ 12. In a molecule in which the central atom exhibits sp^3d^2 hybrid orbitals, the electron pairs are directed toward the corners of:

A) a tetrahedron B) a square-based pyramid

C) a trigonal bipyramid D) a square E) an octahedron

____ 13. Appropriate uses of a visible-light spectrophotometer include which of the following?

I. Determining the concentration of a solution of $Ni(NO_3)_2$

II. Measuring the conductivity of a solution of $K_2Cr_2O_7$

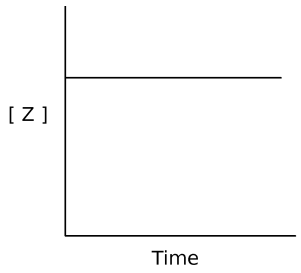
III. Determining which ions are present in a solution with Li^+, Zn^{2+}, Al^{3+}

A) I only B) II only C) III only D) I and II only E) I and III only

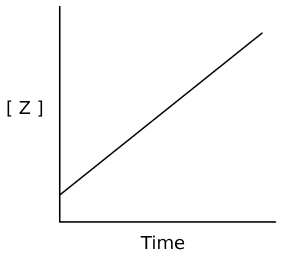
____ 14. A pure substance Z decomposes into two products, X and Y, as shown by the

equation Z → X + Y. Which of the following graphs of the concentration of Z versus time is consistent with the rate of the reaction being first order with respect to Z?

A)



B)



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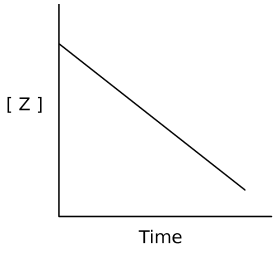
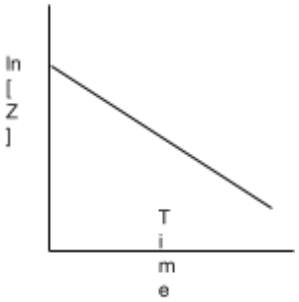
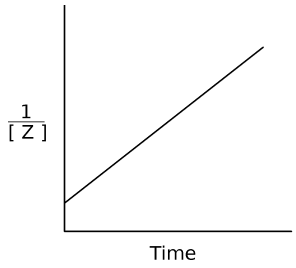


D)



E)



FREE RESPONSE

1.

$$C_6H_5OH_{(s)} + 7\ O_{2(g)} \rightarrow 6\ CO_{2(g)} + 3\ H_2O_{(l)}$$

When a 2.000-gram sample of pure phenol, $C_6H_5OH_{(s)}$, is completely burned according to the equation above, 64.98 kilojoules of heat is released. Use the information in the table below to answer the questions that follow.

Substance	Standard Heat of Formation, $\Delta H°_f$; at 25°C (kJ/mol)
$C_{(graphite)}$	0.00
$CO_{2(g)}$	-393.5
$H_{2(g)}$	0.00
$H_2O_{(l)}$	-285.85
$O_{2(g)}$	0.00
$C_6H_5OH_{(s)}$	?

(a) Calculate the molar heat of combustion of phenol in kilojoules per mole at 25°C.

(b) Write an equation for the formation of phenol from its elements at 25°C.

(c) Calculate the standard heat of formation, $\Delta H°_f$, of phenol in kilojoules per mole at 25°C.

(d) If the volume of the combustion container is 10.0 liters, calculate the final pressure in the container when the temperature is changed to 110.°C. (Assume no oxygen remains unreacted and that all products are gaseous.)

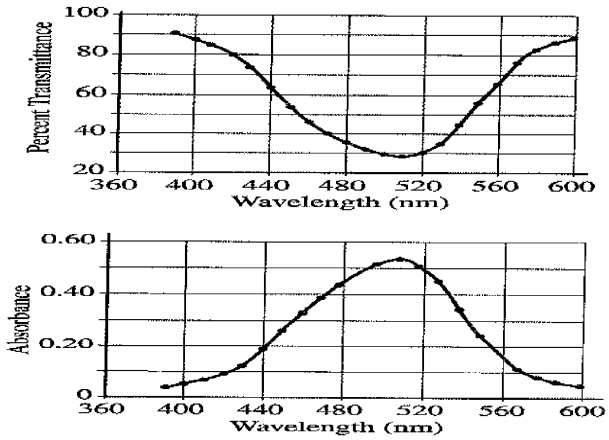
2.

A student is instructed to determine the concentration of a solution of $CoCl_2$ based on absorption of

light (spectrometric/colorimetric method). The student is provided with a 0.10 *M* solution of $CoCl_2$ with which to prepare standard solutions with concentrations of 0.020 *M*, 0.040 *M*, 0.060 *M* and 0.080 *M*.

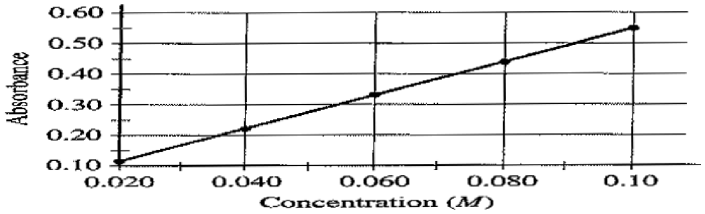
(a) Describe the procedure for diluting the 0.10 *M* solutions to a concentration of 0.020 *M* using distilled water, a 100 mL volumetric flask, and a pipet or buret. Include specific amounts where appropriate.

The student takes the 0.10 M solution and determines the percent transmittance and the absorbance at various wavelengths. The two graphs below represent the data.



(b) Identify the optimum wavelength for the analysis.

The student measures the absorbance of the 0.020 *M*, 0.040 *M*, 0.060 *M*, 0.080 M and 0.10 *M* solutions. The data are plotted below.



(c) The absorbance of the unknown solution is 0.275. What is the concentration of the solution?

(d) Beer's Law is an expression that includes three factors that determine the amount of light that passes through a solution. Identify two of these factors.

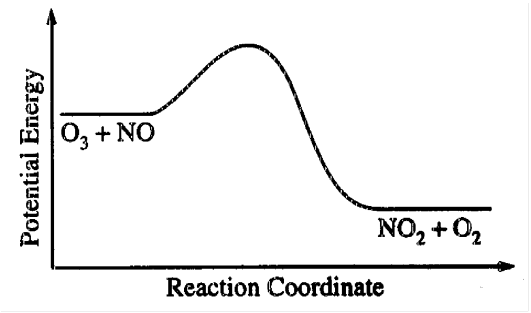
(e) The student handles the sample container (*e.g.*, test tube or cuvette) that holds the unknown solution and leaves fingerprints in the path of the light beam. How will this affect the calculated concentration of the unknown? Explain your answer.

(f) Why is this method of determining the concentration of $CoCl_2$ solution appropriate, whereas using the same method for measuring the concentration of NaCl solution would not be appropriate?

3.

Answer the following questions regarding the kinetics of chemical reactions.

(a) The diagram below at right shows the energy pathway for the reaction $O_3 + NO \rightarrow NO_2 + O_2$. Clearly label the following directly on the diagram.

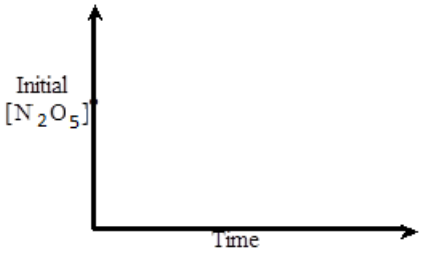


(i) The activation energy *(E_a)* for the forward reaction

(ii) The enthalpy change (ΔH) for the reaction

(b) The reaction $2\ N_2O_5 \rightarrow 4\ NO_2 + O_2$ is first order with respect to N_2O_5.

(i) Using the axes at right, complete the graph that represents the change in $[N_2O_5]$ over time as the reaction proceeds.

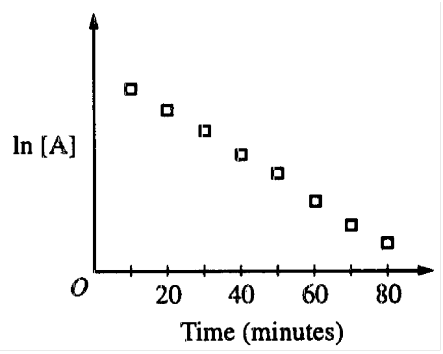


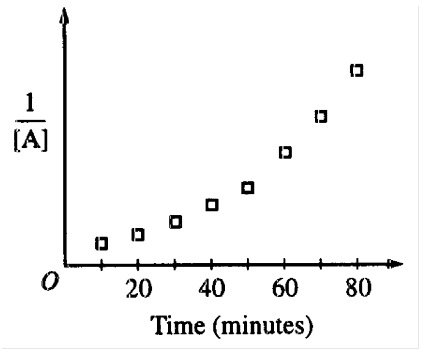
(ii) Describe how the graph in (i) could be used to find the reaction rate at a given time, *t*.

(iii) Considering the rate law and the graph in (i), describe how the value of the rate constant, *k,* could be determined.

(iv) If more N_2O_5 were added to the reaction mixture at constant temperature, what would be the effect on the rate constant, *k* ? Explain.

(c) Data for the chemical reaction $2A \rightarrow B + C$ were collected by measuring the concentration of A at 10-minute intervals for 80 minutes. The following graphs were generated from analysis of the data.





Use the information in the graphs above to answer the following.

(i) Write the rate-law expression for the reaction. Justify your answer.

(ii) Describe how to determine the value of the rate constant for the reaction.