## Section | Part A and B Practice 25 Multiple Choice questions

Start: Answer all questions on this day before stopping.

Note: NO CALCULATORS may be used for questions on this day. You may use ONLY the Periodic Table provided on page 337

Note: For all questions, assume that the temperature is 298 K, unless otherwise noted. the pressure is 1.00 atmosphere and solutions are aqueous

## Questions 1 through 3

γ -----> Ζ

The followings are possible rate laws for the hypothetical reaction given

- ) Rate = k[X]) Rate =  $k[X]^2$
- Rate = k[X][Y]
- (D) Rate =  $k[X]^{2}[Y]$ (E) Rate =  $k[X]^{2}[Y]^{2}$
- 1. This is the rate law for the first order reaction.
- 2. This is the rate law for a reaction that is second order with respect to Y.
- 3. This is the rate law for a third order reaction.

Questions 4 through 7 refer to the following particles:

- (A) alpha
- (B) beta
- (C) gamma
- (D) X-ray
- (E) ultraviolet
- Radiation having the highest energy.
- 5. Radiation used in determining the crystal structure of a solid
- 6. Radiation that catalyzes the breakdown of the ozone layer.
- 7. Radiation that exists as a stream of particles that are equivalent to helium nuclei.

- 8. Which of the following is correctly named?
- Ð S S cesium (I) chloride
- (B) Fe<sub>2</sub>O<sub>3</sub> (C) CBr<sub>4</sub> iron (II) oxide
- carbon quatrobromide
- 0 N<sub>0</sub>2 dioxygen mononitride
- (E) MnO<sub>2</sub> manganese (IV) oxide
- 9. Which one of the following electron configurations for the atoms in their ground state is NOT correct?
- (A) Ca 1s<sup>2</sup> 2s<sup>2</sup> 2p<sup>6</sup> 3s<sup>2</sup> 3p<sup>6</sup> 4s<sup>2</sup>
- (B) Bi [Xe] 6s<sup>2</sup> 4f<sup>14</sup> 5d<sup>10</sup> 6p<sup>3</sup>
- (C) As [Ar] 4s<sup>2</sup>3d<sup>10</sup>4p<sup>3</sup>
- (D) Br [Ar] 4s<sup>2</sup>3d<sup>10</sup>4p<sup>5</sup>
- 1s² 2s² 2p6 3p5

10. At constant temperature and pressure, the heats of formation of  $H_2O(g)$ ,  $CO_2(g)$ , and  $C_2H_6(g)$  (in kilojoules per mole) are as follows:

Ì			$\neg$
C <sub>2</sub> H <sub>6</sub> (g)	CO <sub>2</sub> (g)	H <sub>2</sub> O(g)	Species
· -84	-393	-251	ΔHf (KJ/mol)

of C<sub>2</sub>H<sub>6</sub> gas to oxidize to carbon dioxide gas and water vapor If  $\Delta H$  values are negative for exothermic reactions, what is  $\Delta H$  for 1 mole

- O
- 0 1455 kJ/mole

- ₿ -2910 kJ/mole
- 2910 kJ/mole
- (Temperature and pressure are held constant)?
- -8730 kJ/mole
- -1455 kJ/mole

Day 7's Continue

# 11. In the periodic table, as the atomic number increases from 3 to 10, what happens to the atomic radius?

- (A) It decreases only
- (B) It decreases, then increases.
- (C) It remains constant.
- (D) It increases only.
- It increases, and then decreases.
- 12. When dilute acid was added to a solution of one of the following chemicals, a gas was evolved. This gas is more dense than air and can be poured over a flaming candle to extinguish the flame. The chemical was
- (A) household ammonia, NH<sub>3</sub>
- baking soda, NaHCO<sub>3</sub>
- table salt, NaCl
- isopropyl alcohol, C<sub>2</sub>H<sub>5</sub>OH
- (E) vinegar, 5% HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub>
- Acetaldehyde, CH<sub>3</sub>CHO, decomposes into methane gas and carbon is 0.10 mole / (L . sec) when the concentration of acetaldehyde is 0.010  $\,$ mole /L. What is the rate of the reaction when the concentration of monoxide gas. This is a second-order reaction (rate is proportional to acetaldehyde is 0.050 mole/L? the concentration of the reactant). The rate of decomposition at 140°C
- (A) 0.50 mole / (L . sec)
- (B) 1.00 mole / (L . sec)
- (C) 1.50 mole / (L . sec)
- (D) 2.00 mole / (L . sec)
- (E) 2.50 mole / (L . sec)
- 14. Which of the following molecules listed below has the largest dipole moment?
- (A) Cl<sub>2</sub>
- (B) HCI
- 0 SOS
- S
- 田豆

78

16. 
$$2NO_2Cl(g) < =====> 2NO_2(g) + Cl_2(g)$$

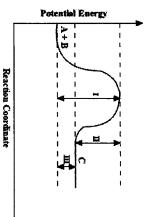
If the  $K_c$  of the reaction is 8.90 at 350°C, what is its  $K_p$ ?

- (A) 0.174
- (B) 0.310 (C) 256 (D) 350.
- (E) 455

17. The simplest formula for a hydrocarbon that is 20.0 percent hydrogen by mass is

- (A) CH (B) CH<sub>2</sub> (C) CH<sub>3</sub> (D) C<sub>2</sub>H<sub>2</sub> (E) C<sub>2</sub>H<sub>3</sub>

18. The potential energy diagram for the reaction A+B -----> C is shown above.



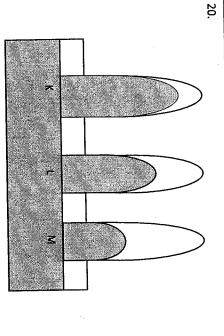
of the indicated energy differences? The addition of a catalyst to this reaction would cause a change in which

- (A) I only
- (B) II only
- (C) III only
- (D) I and II only
- (E) I, II, and III

19. A gaseous mixture containing 1.5 mol Ne and 4.5 mol  $NO_2$  has a total pressure of 8.0 atm. What is the partial pressure of NO<sub>2</sub>?

- (A) 1.5 atm
- (B) 2.7 atm
- (C) 4.5 atm
- 6.0 atm

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and another had 5 mL of a 2 m NaCl solution placed on top of the another had 5 mL of a 2 m glucose solution placed on top of the mercury, manometers had 5 mL of distilled water placed on top of the mercury, Three manometers are shown in the picture above. One of the

- (A) Manometer K contained the water, manometer L contained the glucose solution, and manometer M contained the NaCl solution.
- **B** 0 Manometer K contained the glucose solution, manometer L Manometer K contained the water, manometer L contained the NaCl solution, and manometer M contained the glucose solution. contained the water, and manometer M contained the NaCl solution
- 9 Manometer K contained the NaCl solution, manometer L contained the glucose solution, and manometer M contained the water.

contained the NaCl solution, and manometer M contained the water. aranometer K contained the glucose solution, manometer I

21. Given  $[Cr(NH_3)_6](NO_3)_3$ , what is the oxidation number of the Cr?

- (E) +3 (E) +5

22.  $CaCO_3(s) + 2H^+(aq) ----- > Ca^{2+}(aq) + H_2O(l) + CO_2(g)$ 

CO<sub>2</sub>(g) at STP? If 150 grams of CaCO<sub>3</sub> (g) were consumed, what was the volume of

- (A) 11-liter

- (B) 22-liter(C) 34-liter(D) 45-liter
- Œ 56-lite

23.  $Zn(s) + Cu^{2+} ---- > Zn^{2+} + Cu(s)$ 

of the following could correctly account for this observation? A galvanic cell based on the reaction represented above was constructed 1.20 volts instead of the standard cell potential, E°, of 1.10 volts. Which from zinc and copper half-cells. The observed voltage was found to be

- (A) The zinc electrode contained more mass than the copper electrode.
- (B) The  $Zn^{2+}$  electrolyte was 0.5M  $Zn(NO_3)_2$ , while the  $Cu^{2+}$  electrolyte was 1.0M Cu(NO<sub>3</sub>)<sub>2</sub>.
- 0 The Zn<sup>2+</sup> solution was colorless while the Cu<sup>2+</sup> solution was blue.
- The solutions in the half-cells began at different temperatures
- (E) The salt bridge contained NaBr as the electrolyte.

8

- 24. The first part of the decay of plutonium-240 involves three alpha emissions followed by two beta emissions. What nuclide has been formed at this intermediate stage of the decay series?
- (A) Radium-228
- (B) Radium-224
- (C) Actinium-228
- (E) Thorium-228 (D) Thorium-232
- 25. What ions would you find in solution if potassium perchlorate was dissolved in water?

- (A) KCl, O<sub>2</sub>
  (B) K+, Cl<sup>-</sup>, O<sub>2</sub><sup>-</sup>
  (C) KCl, O<sub>2</sub><sup>-</sup>
  (D) K<sup>+</sup>, ClO<sub>4</sub><sup>-</sup>
  (E) K<sup>+</sup>, Cl<sup>-</sup>, O<sub>2</sub><sup>-</sup>

Day 7

STOP. Correct your answers and note how many correct points

## y 8: 2 Free Response Questions wints Section II Part A Practice

**START:** Answer all questions on this day before stopping.

Note: You may use a calculator for questions on this day.

You may use any of the reference material provided on pg 337-340

CLEARLY SHOW THE METHOD USED AND THE STEPS INVOLVED IN ARRIVING ATYOUR ANSWERS. It is to your advantage to do this, since you may obtain partial credit if you do and you will receive little or no credit if you do not.

Attention should be paid to significant figures.

### (10 points)

The reaction  $2NO_2(g) + Cl_2(g) ---- > 2NO_2Cl(g)$ 

was studied at 20°C and the following data were obtained:

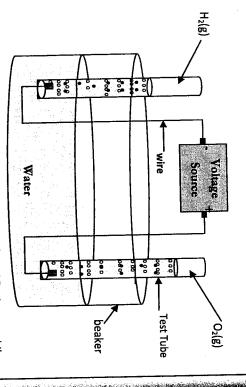
20 Carlotter   10 Car			
Experiment	Initial [NO <sub>2</sub> ]	Initial [Cl <sub>2</sub> ]	Initial Rate increase of NO <sub>2</sub> Cl
	(mole/L)	(mole/L)	(mole/(L.sec))
1	0.100	0.005	1.35 × 10 <sup>-7</sup>
2	0.100	0.010	2.70 x 10 <sup>-7</sup>
3	0.200	0.010	5.40 × 10 <sup>-7</sup>
State of the state			

- (a) Write the rate law for the reaction.
- (b) What is the overall order for the reaction? Explain.
- (c) Calculate the rate-specific constant, k, including the correct units.
- (d) In Experiment 3, what is the initial rate of decrease of [Cl<sub>2</sub>]?
- (e) Based on the equation given for this reaction:
- (i) Propose a mechanism for the reaction that is consistent with the rate law expression you found in part (a)
- (ii) Which is the rate determining step in the proposed mechanism?

### Day 8: Continue

### (10 points)

The setup below shows the electrolysis of water that is at 25°C and 1 atm.



the voltage source supplies a constant 1.213 amperes of current. The electrolysis process was allowed to proceed for 4.37 minutes while

- (a) Write a balance equation for the decomposition of water during the electrolysis process.
- (b) Write a balance half-reaction equation for the reaction at the cathode.
- (c) Calculate the amount of electrical charge, in coulombs, that passes through the solution during the time period mentioned.
- (d) The half-reaction that occurs at the anode is:  $2H_2O(l)$  ---- >  $O_2(g)$  +  $\,4H^{\star}(aq)$  +  $\,4e^-$  (i) Calculate the number of moles of  $O_2(g)$  produced at the anode.
- (ii) Calculate the volume, in liters, of  $O_2(g)$  produced during the electrolysis process.
- (iii) Explain why the volume of  $H_2(g)$  collected is different from the volume of  $O_2(g)$  collected during the same time.
- (e) Identify another substance, including its phase, which is also collected in both test tubes along with  $O_2(g)$  and  $H_2(g)$  .

STOP. Correct your answers and note how many correct points

Day 8 Question 2: Space for Work and Answers

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8

### Day 9: 23 points 2 Free Response Questions Section II Part B practice

START: Answer all questions on this day before stopping.

Note: NO CALCULATORS should be used for questions on this day. You may use any of the Reference Materials provided on Pg 337-340

- 1. For each of the following three reactions, write a balanced equation for the reaction in part (i) and answer the question about the reaction in part (ii). In part (i), coefficients should be in terms of lowest whole numbers. Omit formulas for any ions or molecules that are unchanged by the reaction substances in solutions as ions if the substances are extensively ionized. Assume that solutions are aqueous unless otherwise indicated. Represent 15 points)
- (a) Methanol and acetic acid are mixed and then gently warmed.
- (i) Balanced equation:
- (ii) Draw the structure of the organic compound formed
- (b) Solid potassium carbonate is added to 2  $m{M}$  sulfuric acid
- (i) Balanced equation:
- (ii) How many molecules of the acid will react with 27.6 grams of the potassium carbonate.
- (c) Potassium hydroxide is added to a solution of iron (III) sulfate.
- (i) Balanced equation:
- (ii) What type of chemical bonding is or are present in a formula unit

of iron (III) sulfate.

## Day 9: Continue

Your responses to question 2 will be scored on the basis of the accuracy and relevance of the information cited. Explanations should be clear and well organized. Examples and equations may be included in your responses where appropriate. Specific answers are preferable to broad, diffuse responses. (8 points)

2. The first three ionization energies  $(l_1, l_2, and l_3)$  for magnesium and argon are given in the following table:

Ar	Mg	ı <u> </u>	Atom
1520	738	(KJ/mol)	$I_{l}$
2665	1,450	(KJ/mol)	$I_2$
3945	7730	(KJ/mol)	$I_3$

- (a) Write the complete electron configurations for magnesium and argon.
- (b) Draw the Lewis diagrams for Mg and Ar.
- (c) Based on the data table information:
- (i) State one similarity found in ionization energies of both atoms.
- (ii) Explain why the difference between the  $2^{nd}$  and  $3^{rd}$  ionization energy of Mg is much greater than the difference between the  $2^{nd}$  and  $3^{rd}$  ionization energy of Ar.
- (d) If chlorine gas is passed into separate containers of heated magnesium and heated argon, explain what compounds (if any) might be formed, and explain your answer in terms of the electron configurations of these two elements.
- (e) An unknown element, Y, has the following three ionization energies:

6912	4560	496	Ч
	ol) (KJ/mol)	(KJ/mol)	
	$I_2$	L	Atom

On the basis of the ionization energies given, what is the formula and name of the compound produced when chlorine reacts with element Y. Explain your reasoning.

(Day 9)	
STOP. Correct your answers and note how many correct	y correct <b>points</b>
Day 9 Question 2: Space for Work and Answers	

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