

Day 7: 25 Multiple Choice questions
 25 points **Section I Part A and B Practice**

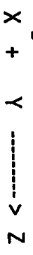
Start: Answer all questions on this day before stopping.

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, the pressure is 1.00 atmosphere and solutions are aqueous unless otherwise noted.

Questions 1 through 3



The followings are possible rate laws for the hypothetical reaction given above.

- (A) Rate = $k[X]$
- (B) Rate = $k[X]^2$
- (C) 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

4. 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.

Day 7: Continue

8. Which of the following is correctly named?
- (A) CsCl cesium (I) chloride
 (B) Fe₂O₃ iron (II) oxide
 (C) CBr₄ carbon tetrabromide
 (D) NO₂ dioxigen mononitride
 (E) MnO₂ manganese (IV) oxide

9. Which one of the following electron configurations for the atoms in their ground state is NOT correct?
- (A) Ca 1s²2s²2p⁶3s²3p⁶4s²
 (B) Bi [Xe] 6s²4f¹⁴5d¹⁰6p³
 (C) As [Ar] 4s²3d¹⁰4p³
 (D) Br [Ar] 4s²3d¹⁰4p⁵
 (E) P 1s²2s²2p⁶3p⁵

10. At constant temperature and pressure, the heats of formation of H₂O(g), CO₂(g), and C₂H₆(g) (in kilojoules per mole) are as follows:

Species	ΔH_f (kJ/mol)
H ₂ O(g)	-251
CO ₂ (g)	-393
C ₂ H ₆ (g)	-84

If ΔH values are negative for exothermic reactions, what is ΔH for 1 mole of C₂H₆ gas to oxidize to carbon dioxide gas and water vapor (Temperature and pressure are held constant)?

- (A) -8730 kJ/mole
 (B) -2910 kJ/mole
 (C) -1455 kJ/mole
 (D) 1455 kJ/mole
 (E) 2910 kJ/mole

Day 7: 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.
 (E) 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, NH₃
 (B) baking soda, NaHCO₃
 (C) table salt, NaCl
 (D) isopropyl alcohol, C₃H₇OH
 (E) vinegar, 5% HC₂H₃O₂

13. Acetaldehyde, CH₃CHO, decomposes into methane gas and carbon monoxide gas. This is a second-order reaction (rate is proportional to the concentration of the reactant). The rate of decomposition at 140°C 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 acetaldehyde is 0.050 mole/L?

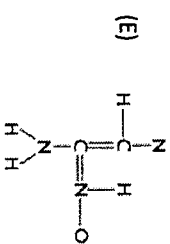
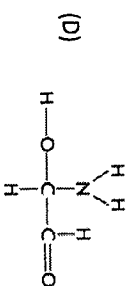
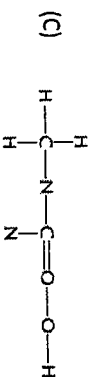
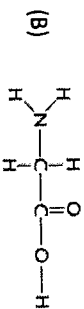
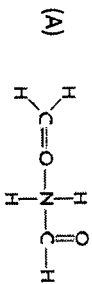
- (A) 0.50 mole / (L · sec)
 (B) 1.00 mole / (L · sec)
 (C) 1.50 mole / (L · sec)
 (D) 2.00 mole / (L · sec)
 (E) 2.50 mole / (L · sec)

14. Which of the following molecules listed below has the largest dipole moment?

- (A) Cl₂
 (B) HCl
 (C) SO₃
 (D) NO
 (E) N₂

Day 7: Continue

15. Which of the following is a correct Lewis structure for glycine ($\text{NH}_2\text{CH}_2\text{COOH}$)?



16. $2\text{NO}_2(\text{g}) \rightleftharpoons 2\text{NO}(\text{g}) + \text{Cl}_2(\text{g})$

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

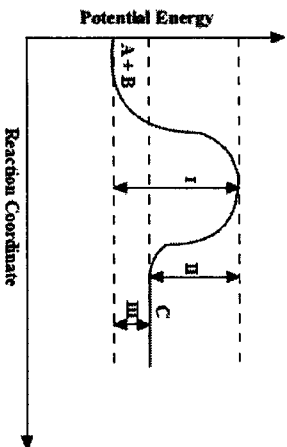
- (A) 0.174
- (B) 0.310
- (C) 256
- (D) 350.
- (E) 455

Day 7: Continue

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

- (A) CH
- (B) CH_2
- (C) CH_3
- (D) C_2H_2
- (E) C_2H_3

18. The potential energy diagram for the reaction $\text{A} + \text{B} \rightarrow \text{C}$ is shown above.



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

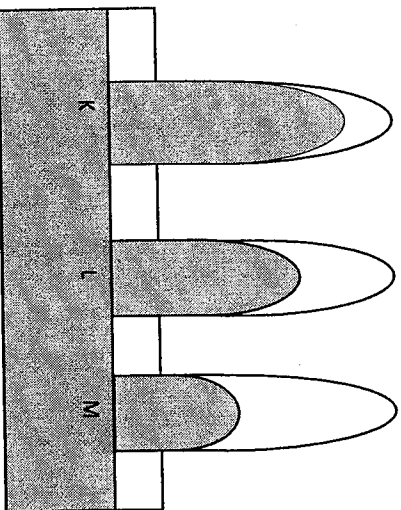
- (A) I only
- (B) II only
- (C) III only
- (D) I and II only
- (E) I, II, and III

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_2 ?

- (A) 1.5 atm
- (B) 2.7 atm
- (C) 4.5 atm
- (D) 6.0 atm
- (E) 8.0 atm

Day 7: Continue

20.



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

- (A) Manometer K contained the water, manometer L contained the glucose solution, and manometer M contained the NaCl solution.
- (B) Manometer K contained the water, manometer L contained the NaCl solution, and manometer M contained the glucose solution.
- (C) Manometer K contained the glucose solution, manometer L contained the water, and manometer M contained the NaCl solution.
- (D) Manometer K contained the NaCl solution, manometer L contained the glucose solution, and manometer M contained the water.

Day 7: Continue

21. Given $[\text{Cr}(\text{NH}_3)_6](\text{NO}_3)_3$, what is the oxidation number of the Cr?

- (A) 0
- (B) +1
- (C) +2
- (D) +3
- (E) +5

22. $\text{CaCO}_3(\text{s}) + 2\text{H}^+(\text{aq}) \rightarrow \text{Ca}^{2+}(\text{aq}) + \text{H}_2\text{O}(\text{l}) + \text{CO}_2(\text{g})$

If 150 grams of $\text{CaCO}_3(\text{g})$ were consumed, what was the volume of $\text{CO}_2(\text{g})$ at STP?

- (A) 11-liter
- (B) 22-liter
- (C) 34-liter
- (D) 45-liter
- (E) 56-liter

23. $\text{Zn}(\text{s}) + \text{Cu}^{2+} \rightarrow \text{Zn}^{2+} + \text{Cu}(\text{s})$

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

- (A) The zinc electrode contained more mass than the copper electrode.
- (B) The Zn^{2+} electrolyte was 0.5M $\text{Zn}(\text{NO}_3)_2$, while the Cu^{2+} electrolyte was 1.0M $\text{Cu}(\text{NO}_3)_2$.
- (C) The Zn^{2+} solution was colorless while the Cu^{2+} solution was blue.
- (D) The solutions in the half-cells began at different temperatures.
- (E) The salt bridge contained NaBr as the electrolyte.

Day 7: Continue

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
- (D) Thorium-232
- (E) Thorium-228

25. What ions would you find in solution if potassium perchlorate was dissolved in water?

- (A) KCl , O_2
- (B) K^+ , Cl^- , O_2^-
- (C) KCl , O_2^-
- (D) K^+ , ClO_4^-
- (E) K^+ , Cl^- , O_2^-

Day 7

STOP. Correct your answers and note how many correct **points**

Day 8: 2 Free Response Questions
20 points *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 AT YOUR 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.

1. (10 points)

The reaction $2\text{NO}_2(\text{g}) + \text{Cl}_2(\text{g}) \rightarrow 2\text{NO}_2\text{Cl}(\text{g})$ was studied at 20°C and the following data were obtained:

Experiment	Initial $[\text{NO}_2]$ (mole/L)	Initial $[\text{Cl}_2]$ (mole/L)	Initial Rate increase of NO_2Cl (mole/L · sec)
1	0.100	0.005	1.35×10^{-7}
2	0.100	0.010	2.70×10^{-7}
3	0.200	0.010	5.40×10^{-7}

- (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 $[\text{Cl}_2]$?
- (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 9: 2 Free Response Questions
23 points **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. Assume that solutions are aqueous unless otherwise indicated. Represent substances in solutions as ions if the substances are extensively ionized. Omit formulas for any ions or molecules that are unchanged by the reaction. (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 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.

