

# CH 123

## General Chemistry

### Exam 1

### January 22, 2003

Name: \_\_\_\_\_  
(please print)

SSN: \* \* \* - \* \* - \_\_\_\_\_  
(last 4 digits)

Each question is worth 1 point.

Circle your answer clearly, otherwise no credit will be given.

Circle only one answer. If you circle two or more, you will receive no credit.

1. An aqueous solution of calcium bromide has a concentration of 0.441 molal. The percent by mass of calcium bromide in the solution is:
- 5.00%
  - 8.10%
  - 10.10%
  - 12.15%
  - 16.20%
2. The melting point of ethanol  $\text{CH}_3\text{CH}_2\text{OH}$  is  $-117.300\text{ }^\circ\text{C}$  at 1 atmosphere ( $K_f(\text{ethanol}) = -1.99\text{ }^\circ\text{C/m}$ ). In a laboratory experiment, students synthesized a new compound and found that when 10.60 grams of the compound were dissolved in 241.0 grams of ethanol, the solution began to melt at  $-117.778\text{ }^\circ\text{C}$ . The compound was also found to be nonvolatile and a non-electrolyte. What is the molecular weight they determined for this compound?
- 78 g/mol
  - 91 g/mol
  - 183 g/mol
  - 266 g/mol
  - 312 g/mol
3. For the decomposition of ammonia on a platinum surface at  $856\text{ }^\circ\text{C}$
- $$2\text{ NH}_3 \longrightarrow \text{N}_2 + 3\text{ H}_2$$
- the average rate of disappearance of  $\text{NH}_3$  over the time period from  $t = 0\text{ s}$  to  $t = 4746\text{ s}$  is found to be  $1.50\text{e-}6\text{ M s}^{-1}$ . The average rate of formation of  $\text{H}_2$  over the same time period is:
- $1.00\cdot 10^{-6}\text{ M s}^{-1}$
  - $1.50\cdot 10^{-6}\text{ M s}^{-1}$
  - $2.25\cdot 10^{-6}\text{ M s}^{-1}$
  - $4.50\cdot 10^{-6}\text{ M s}^{-1}$
  - $1.50\cdot 10^{-5}\text{ M s}^{-1}$
4. The gas phase decomposition of nitrogen dioxide at  $383\text{ }^\circ\text{C}$
- $$2\text{ NO}_2 \longrightarrow 2\text{ NO} + \text{O}_2$$
- is second order in  $\text{NO}_2$  with a rate constant of  $0.540\text{ M}^{-1}\text{s}^{-1}$ . If the initial concentration of  $\text{NO}_2$  is  $8.76\cdot 10^{-2}\text{ M}$ , the concentration of  $\text{NO}_2$  will be  $2.19\cdot 10^{-2}\text{ M}$  after how many seconds?
- 15.4 s
  - 31.7 s
  - 63.4 s
  - 126.8 s
  - 160.2 s

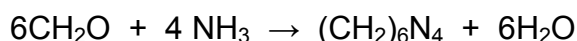
5. What is the mol fraction  $\text{Na}_2\text{SO}_4$  in a solution which is 11.5% by weight  $\text{Na}_2\text{SO}_4$  (molar mass  $\text{Na}_2\text{SO}_4 = 142.06 \text{ g/mol}$  and  $\text{H}_2\text{O} = 18.016 \text{ g/mol}$ )?
- 0.0810
  - 0.0914
  - 0.0745
  - 0.0173
  - 0.0162
6. If the mol fraction  $\text{NaCl}$  in a solution is 0.0175, what is the weight percent  $\text{NaCl}$  (molar mass  $\text{NaCl} = 58.44 \text{ g/mol}$  and  $\text{H}_2\text{O} = 18.016 \text{ g/mol}$ )?
- 5.46%
  - 5.77%
  - 10.2%
  - 11.5%
  - 17.7%
7. What is the mol fraction  $\text{NaNO}_3$  in a solution which is 2.15 m?
- 0.0180
  - 0.0268
  - 0.0373
  - 0.09387
  - 0.0785
8. A 1.34 M  $\text{NiCl}_2$  (molar mass = 129.6 g/mol) solution has a density of 1.12  $\text{g/cm}^3$ . What is the weight percent  $\text{NiCl}_2$  of the solution?
- 1.73%
  - 8.64%
  - 15.5%
  - 25.4%
  - 29.8%
9. A volumetric flask is necessary for the preparation of which one of the following concentration measurements?
- molality
  - X
  - mass %
  - molarity
  - ppm

10. Which of the following solutions would have the lowest vapor pressure?
- 1 m glucose ( $C_6H_{12}O_6$ )
  - 1 m  $MgCl_2$
  - 1 m  $NaNO_3$
  - 1 m  $NaBr$
  - pure  $H_2O$
11. In general, as the temperature increases, the rate of a chemical reaction
- increases due to an increased activation energy.
  - increases only for an endothermic reaction.
  - increases due to a greater number of effective collisions.
  - increases because bonds are weakened.
  - is not changed.
12. If the activation energy for the forward reaction of a given process is +110 kJ and the activation energy for the reverse reaction of the same process is +60.0 kJ, then the energy change for the overall process is
- 50 kJ
  - +50 kJ
  - 170 kJ
  - +170 kJ
  - 60 kJ
13. In basic solution,  $(CH_3)_3CCl$  reacts according to the equation
- $$(CH_3)_3CCl + OH^- \rightarrow (CH_3)_3COH + Cl^-$$
- The accepted mechanism for the reaction is
- $$(CH_3)_3CCl \rightarrow (CH_3)_3C^+ + Cl^- \text{ (slow)}$$
- $$(CH_3)_3C^+ + OH^- \rightarrow (CH_3)_3COH \text{ (fast)}$$
- What is the rate law expression for the reaction?
- rate =  $k[(CH_3)_3C^+][OH^-]$
  - rate =  $k[(CH_3)_3C^+][OH^-]$ ,
  - rate =  $k[Cl^-]$
  - rate =  $k[(CH_3)_3CCl]$
  - rate =  $k[(CH_3)_3CCl][OH^-]$
14. The reaction  $X \rightarrow Y$  follows first-order kinetics with  $k = 0.83/\text{min}$ . If the initial concentration of X is 3.6 M, what is the concentration of X after 15 minutes?
- 0.046 M
  - 0.230 M
  - $1.1 \times 10^{-1}$  M
  - $1.84 \times 10^{-3}$  M
  - $1.4 \times 10^{-5}$  M

15. For a reaction, the rate law is  $\text{rate} = k[\text{A}]^1[\text{B}]^0[\text{C}]^1$ . What are the units for  $k$  where the time unit is seconds (s)?

- a.  $(\text{mol}/\text{L}\cdot\text{s})$
- b.  $\text{L}/\text{mol}\cdot\text{s}$
- c.  $\text{L}^2/\text{mol}^2\cdot\text{s}$
- d.  $\text{mol}^2/\text{L}^2\cdot\text{s}$
- e.  $\text{mol}^3/\text{L}^3\cdot\text{s}$

16. For the reaction



the rate is expressed as  $1/6(\Delta[\text{H}_2\text{O}]/\Delta t)$ . An equivalent would be

- a.  $-\Delta[(\text{CH}_2)_6\text{N}_4]/\Delta t$
- b.  $6(\Delta[\text{CH}_2\text{O}]/\Delta t)$
- c.  $-6(\Delta[\text{CH}_2\text{O}]/\Delta t)$
- d.  $-1/4(\Delta[\text{NH}_3]/\Delta t)$
- e.  $-1/6(\Delta[\text{H}_2\text{O}]/\Delta t)$

17. Given the initial rate data for the reaction  $\text{A} + \text{B} \rightarrow \text{C}$ , determine the rate expression for the reaction.

<u>[A], M</u>	<u>[B], M</u>	<u><math>\Delta[\text{C}]/\Delta t</math> initial M/s</u>
0.10	0.20	5.00
0.20	0.20	10.0
0.10	0.15	2.81

- a.  $\Delta[\text{C}]/\Delta t = 1250[\text{A}][\text{B}]^2$
- b.  $\Delta[\text{C}]/\Delta t = 250[\text{A}][\text{B}]$
- c.  $\Delta[\text{C}]/\Delta t = 250[\text{A}]^2$
- d.  $\Delta[\text{C}]/\Delta t = 50.0[\text{A}]$
- e.  $\Delta[\text{C}]/\Delta t = 5.0[\text{A}][\text{B}]$

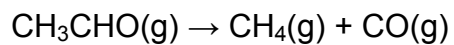
18. After five half-life periods for a first-order reaction, what is the molarity of a reagent initially at 0.366 M?

- a.  $1.14 \times 10^{-2}$
- b.  $3.12 \times 10^{-2}$
- c.  $6.57 \times 10^{-3}$
- d.  $3.12 \times 10^3$
- e.  $7.32 \times 10^{-2}$

19. Which of the following reactions will have the greatest rate at 298 K?  
Assume that the frequency factor A is the same for all reactions.

- a.  $\Delta E = +10 \text{ kJ/mol}$   $E_a = 25 \text{ kJ/mol}$
- b.  $\Delta E = -10 \text{ kJ/mol}$   $E_a = 25 \text{ kJ/mol}$
- c.  $\Delta E = -10 \text{ kJ/mol}$   $E_a = 15 \text{ kJ/mol}$
- d.  $\Delta E = -10 \text{ kJ/mol}$   $E_a = 50 \text{ kJ/mol}$
- e.  $\Delta E = -10 \text{ kJ/mol}$   $E_a = 15 \text{ kJ/mol}$

20. The reaction



proceeds via the rate expression  $\Delta[\text{CO}]/\Delta t = [\text{CH}_3\text{CHO}]^{3/2}$ . What is the overall order of the reaction?

- a. zero-order
- b. first-order
- c. second-order
- d. third-order
- e. three-halves-order