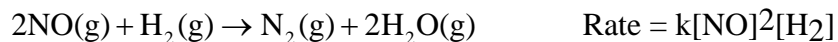


PRACTICE PROBLEMS FOR TEST 2 (March 11, 2009)

1) What is the overall order of the following reaction, given the rate law?



- A) 1st order
- B) 2nd order
- C) 3rd order
- D) 4th order
- E) 0th order

Answer: C

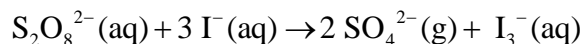
2) Given the following rate law, how does the rate of reaction change if the concentration of Y is doubled?

$$\text{Rate} = k [\text{X}][\text{Y}]^2$$

- A) The rate of reaction will increase by a factor of 2.
- B) The rate of reaction will increase by a factor of 4.
- C) The rate of reaction will increase by a factor of 5.
- D) The rate of reaction will decrease by a factor of 2.
- E) The rate of reaction will remain unchanged.

Answer: B

3) Determine the rate law and the value of k for the following reaction using the data provided.



$[\text{S}_2\text{O}_8^{2-}]_i$ (M)	$[\text{I}^-]_i$ (M)	Initial Rate ($\text{M}^{-1}\text{s}^{-1}$)
0.30	0.42	4.54
0.44	0.42	6.65
0.44	0.21	3.33

- A) Rate = $120 \text{ M}^{-2}\text{s}^{-1} [\text{S}_2\text{O}_8^{2-}]^2[\text{I}^-]$
- B) Rate = $36 \text{ M}^{-1}\text{s}^{-1} [\text{S}_2\text{O}_8^{2-}][\text{I}^-]$
- C) Rate = $86 \text{ M}^{-2}\text{s}^{-1} [\text{S}_2\text{O}_8^{2-}][\text{I}^-]^2$
- D) Rate = $195 \text{ M}^{-3}\text{s}^{-1} [\text{S}_2\text{O}_8^{2-}]^2[\text{I}^-]^2$

$$\text{E) Rate} = 23 \text{ M}^{-1/2} \text{ s}^{-1} [\text{S}_2\text{O}_8^{2-}][\text{I}^-]^{1/2}$$

4) Which of the following represents the integrated rate law for a first-order reaction?

$$\text{A) } \ln \frac{[\text{A}]_t}{[\text{A}]_0} = -kt$$

$$\text{B) } \frac{1}{[\text{A}]_t} - \frac{1}{[\text{A}]_0} = kt$$

$$\text{C) } [\text{A}]_t - [\text{A}]_0 = -kt$$

$$\text{D) } k = A e^{\left(\frac{E_a}{RT}\right)}$$

$$\text{E) } \ln \frac{k_2}{k_1} = \frac{E_a}{R} \left(\frac{1}{T}\right) + \ln A$$

Answer: A

5) What data should be plotted to show that experimental concentration data fits a first-order reaction?

A) 1/[reactant] vs. time

B) [reactant] vs. time

C) ln[reactant] vs. time

D) ln(k) vs. 1/T

E) ln(k) vs. E_a

Answer: C

6) The first-order decay of radon has a half-life of 3.823 days. How many grams of radon remain after 7.22 days if the sample initially weighs 250.0 grams?

A) 4.21 g

B) 183 g

C) 54.8 g

D) 76.3 g

E) 67.5 g

Answer: E

7) The first-order decomposition of N_2O_5 at 328 K has a rate constant of $1.70 \times 10^{-3} \text{ s}^{-1}$. If the initial concentration of N_2O_5 is 2.88 M, what is the concentration of N_2O_5 after

12.5 minutes?

- A) 0.124 M
- B) 0.805 M
- C) 2.82 M
- D) 0.355 M
- E) 0.174 M

Answer: B

8) The second-order decomposition of HI has a rate constant of $1.80 \times 10^{-3} \text{ M}^{-1} \text{ s}^{-1}$. How much HI remains after 27.3 s if the initial concentration of HI is 4.78 M?

- A) 4.55 M
- B) 0.258 M
- C) 3.87 M
- D) 2.20 M
- E) 2.39 M

Answer: C

9) The half-life for the second-order decomposition of HI is 15.4 s when the initial concentration of HI is 0.67 M. What is the rate constant for this reaction?

- A) $1.0 \times 10^{-2} \text{ M}^{-1} \text{ s}^{-1}$
- B) $4.5 \times 10^{-2} \text{ M}^{-1} \text{ s}^{-1}$
- C) $9.7 \times 10^{-2} \text{ M}^{-1} \text{ s}^{-1}$
- D) $2.2 \times 10^{-2} \text{ M}^{-1} \text{ s}^{-1}$
- E) $3.8 \times 10^{-2} \text{ M}^{-1} \text{ s}^{-1}$

Answer: C

10) Derive an expression for a "1/3-life" for a first-order reaction.

A) $\frac{\ln \frac{[A]_t}{[A]_0}}{-k}$

B) $\frac{0.462}{k}$

C) $\frac{\ln \frac{[A]_t}{[A]_0}}{-3k}$

D) $\frac{1.099}{k}$

E) $\frac{3}{k}$

Answer: D

11) MIX AND MATCH

61) k	A) frequency factor
62) $t_{\frac{1}{2}}$	B) activation energy
63) E_a	C) half-life
64) A	D) reaction order
65) n , in Rate = $k[A]^n$	E) rate constant

Answer:

61 – E

62 – C

63 – B

64 – A

65 – D

12) Which of the following compounds will be most soluble in ethanol ($\text{CH}_3\text{CH}_2\text{OH}$)?

A) trimethylamine ($\text{N}(\text{CH}_3)_3$)

B) acetone (CH_3COCH_3)

C) ethylene glycol ($\text{HOCH}_2\text{CH}_2\text{OH}$)

D) hexane ($\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_3$)

E) None of these compounds should be soluble in methanol.

Answer: C

13) Determine the solubility of N_2 in water exposed to air at 25°C if the atmospheric pressure is 1.2 atm. Assume that the mole fraction of nitrogen is 0.78 in air and the Henry's law constant for nitrogen in water at this temperature is $6.1 \times 10^{-4} \text{ M/atm}$.

A) $1.5 \times 10^{-4} \text{ M}$

B) $6.5 \times 10^{-4} \text{ M}$

C) $5.7 \times 10^{-4} \text{ M}$

D) $1.8 \times 10^{-4} \text{ M}$

E) $3.6 \times 10^{-4} \text{ M}$

Answer: C

14) Which of the following concentration units are temperature dependent?

- A) Mole fraction
- B) Molality
- C) Mass percent
- D) Molarity
- E) None of the above.

Answer: D

15) Calculate the molality of a solution formed by dissolving 27.8 g of LiI in 500.0 mL of water.

- A) 0.254 *m*
- B) 0.394 *m*
- C) 0.556 *m*
- D) 0.241 *m*
- E) 0.415 *m*

Answer: E

16) Calculate the molality of a solution that is prepared by mixing 25.5 mL of CH_3OH ($d = 0.792 \text{ g/mL}$) and 387 mL of $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$ ($d = 0.811 \text{ g/mL}$).

- A) 0.630 *m*
- B) 0.812 *m*
- C) 1.57 *m*
- D) 2.01 *m*
- E) 4.98 *m*

Answer: D

17) Commercial grade HCl solutions are typically 39.0% (by mass) HCl in water. Determine the molality of the HCl, if the solution has a density of 1.20 g/mL.

- A) 39.0 *m*
- B) 17.5 *m*
- C) 6.39 *m*
- D) 10.7 *m*
- E) 9.44 *m*

Answer: B

18) An aqueous solution is 0.387 M in HCl. What is the molality of the solution if the density is 1.23 g/mL?

- A) 0.115 *m*
- B) 0.387 *m*
- C) 0.315 *m*
- D) 0.411 *m*
- E) 0.318 *m*

Answer: E

19) A solution is prepared by dissolving 38.6 g sucrose ($C_{12}H_{22}O_{11}$) in 495 g of water. Determine the mole fraction of sucrose if the final volume of the solution is 508 mL.

- A) 4.09×10^{-3}
- B) 7.80×10^{-2}
- C) 1.28×10^{-3}
- D) 7.23×10^{-2}
- E) 2.45×10^{-3}

Answer: A

20) Calculate the mole fraction of total ions in an aqueous solution prepared by dissolving 0.400 moles of $MgCl_2$ in 850.0 g of water.

- A) 0.00841
- B) 0.0254
- C) 0.00848
- D) 0.0248
- E) 0.0167

Answer: D

21) Determine the vapor pressure of a solution at 25°C that contains 76.6 g of glucose ($C_6H_{12}O_6$) in 250.0 mL of water. The vapor pressure of pure water at 25°C is 23.8 torr.

- A) 70.8 torr
- B) 72.9 torr
- C) 23.1 torr
- D) 22.9 torr
- E) 7.29 torr

Answer: C

22) Determine the vapor pressure of a solution at 55°C that contains 34.2 g NaCl in 375 mL of water. The vapor pressure of pure water at 55°C is 118.1 torr.

- A) 115 torr
- B) 87.1 torr
- C) 108 torr
- D) 112 torr
- E) 92.8 torr

Answer: D

23) Determine the freezing point depression of a solution that contains 30.7 g glycerin ($C_3H_8O_3$, molar mass = 92.09 g/mol) in 376 mL of water. Some possibly useful constants for water are $K_f = 1.86^\circ C/m$ and $K_b = 0.512^\circ C/m$.

- A) $0.887^\circ C$
- B) $-1.65^\circ C$
- C) $3.33^\circ C$
- D) $-3.33^\circ C$
- E) $0.654^\circ C$

Answer: B

24. When a solute such as ammonium sulfate is dissolved in a solvent like water, one of the observed effects is

- ! a. a decrease in the vapor pressure of the solvent
- b. an increase in the vapor pressure of the solute
- c. an increase in the melting point of the liquid
- d. a decrease in the boiling point of the liquid
- e. scattering of light beams by the solute particles in the solution

25. At 28.0 °C, the vapor pressure of *n*-propyl mercaptan, C_3H_7SH , is 175 torr, while that of acetonitrile, CH_3CN , is 102 torr. What is the vapor pressure, at 28.0 °C, of a solution made by mixing 100.0 g of C_3H_7SH and 100.0 g CH_3CN , if Raoult's Law is obeyed?

- a. 35.7 torr
- ! b. 128 torr
- c. 139 torr
- d. 149 torr
- e. 277 torr