Test 2 Key The Key
General Chemistry CH116
UMass Boston
Spring 2008

Name_____

The key is for both versions.
Since the order of the answers are different, check the answer, not the answer number.
For the long answer questions in Version B, they are given afeter the version A answers.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

1) A solid has a very high melting point, great hardness, and poor electrical conduction. This is a(n)   1) _____
   _____ solid.

   A) covalent network

   | **Correct answer** |
   | **Page 472** |

   B) ionic

   C) metallic

   D) metallic <u>and</u> covalent network

   E) molecular

2) Which one of the following is most soluble in hexane (C_6H_{14})?   2) _____
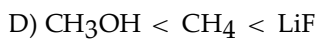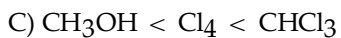
   A) CH_3CH_2OH

   B) **$CH_3CH_2CH_2CH_2CH_2OH$**

   | **Correct answer** |
   | **Page 538** |

   C) $CH_3CH_2CH_2OH$

   D) CH_3OH

   E) $CH_3CH_2CH_2CH_2OH$

3) Which of the following choices has the compounds correctly arranged in order of increasing solubility in water? (least soluble to most soluble)

3) _____

A) $CH_4 < NaNO_3 < CHCl_3$

B) $LiF < NaNO_3 < CHCl_3$

C) $CH_3OH < Cl_4 < CHCl_3$

D) $CH_3OH < CH_4 < LiF$

E) $CCl_4 < CHCl_3 < NaNO_3$

Correct answer
most non polar
is CCl 3 ,
CHCl3 is polar
NaNO3 is
ionic.

4) The concentration of nitrate ion in a solution that contains 0.900 M aluminum nitrate is _____ M.

4) _____

A) 2.70
you need to know Al (NO3)3
CH 115

B) 0.900

C) 0.300

D) 0.450

E) 1.80

5) A saturated solution _____.

5) _____

A) contains no double bonds

B) cannot be attained

C) contains as much solvent as it can hold

D) **contains dissolved solute in equilibrium with undissolved solid**
Page 536

E) will rapidly precipitate if a seed crystal is added

6) Which of the following liquids will have the lowest freezing point?   6) _____

   A) pure H_2O

   B) aqueous glucose (0.60 m)

   C) aqueous FeI_3 (0.24 m)
     0.72 m concentration of solute particles.

   D) aqueous KF (0.50 m) *Correct answer*
     1.0 m concentration of solute particles.

   E) aqueous sucrose (0.60 m)

7) Which one of the following is <u>not</u> a valid expression for the rate of the reaction below?   7) _____

$$4NH_3 + 7O_2 \rightarrow 4NO_2 + 6H_2O$$
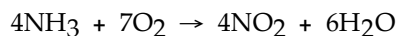
A) $-\dfrac{1}{4}\dfrac{\Delta[NH_3]}{\Delta t}$

B) $\dfrac{1}{4}\dfrac{\Delta[NO_2]}{\Delta t}$

C) $-\dfrac{1}{7}\dfrac{\Delta[O_2]}{\Delta t}$

D) $\dfrac{1}{6}\dfrac{\Delta[H_2O]}{\Delta t}$

E) **All of the above are valid expressions of the reaction rate.**

8) The rate law of a reaction is rate = k[D][X]. The units of the rate constant are _____.   8) _____

   A) mol $L^{-1}s_{-2}$

   B) mol $L^{-1}s^{-1}$

   C) L^2 mol$^{-2}s^{-1}$

   D) L mol$^{-1}s^{-1}$
     Correct Answer
     Page 585
     k= rate/ [D][X]=

$$\dfrac{\frac{moles}{L}/s}{\left[\frac{moles}{r}\right]\left[\frac{moles}{r}\right]} = \dfrac{1}{\left[\frac{moles}{r}\right]_s} = \dfrac{L}{moles \; x \; s} = L \; s^{-1}moles^{-1}$$

   E) mol^2 $L^{-2}s^{-1}$

The data in the table below were obtained for the reaction:

$$2\,ClO_2\,(aq) + 2\,OH^-\,(aq) \rightarrow ClO_3^-\,(aq) + ClO_2^-\,(aq) + H_2O\,(1)$$

Experiment Number	$[ClO_2]$ (M)	$[OH^-]$ (M)	Initial Rate (M/s)
1	0.060	0.030	0.0248
2	0.020	0.030	0.00276
3	0.020	0.090	0.00828

9) What is the overall order of the reaction?   9) _____

    A) 1

    B) 0

    C) 2

    D) 4

    E) 3
       The reaction is First order with respect to OH– and second order with respact to ClO2
       Overall reaction rate is 1+2=3
       Page 586

The reaction A $\rightarrow$ B is first order in [A]. Consider the following data.

time (s)	[A] (M)
0.0	1.60
10.0	0.40
20.0	0.10

10) The half–life of this reaction is _____ s.   10) _____

    A) 3.0

    B) 7.1

    C) 0.14

    D) 0.97

    E) 5 **Correct Answer**
       Just read the table for [A]= 0.8M

11) A reaction was found to be third order in A. Increasing the concentration of A by a factor of 3 will   11) _____
cause the reaction rate to _____.

    A) decrease by a factor of the cube root of 3

    B) increase by a factor of 9
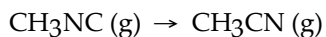
    C) triple

    D) increase by a factor of 27
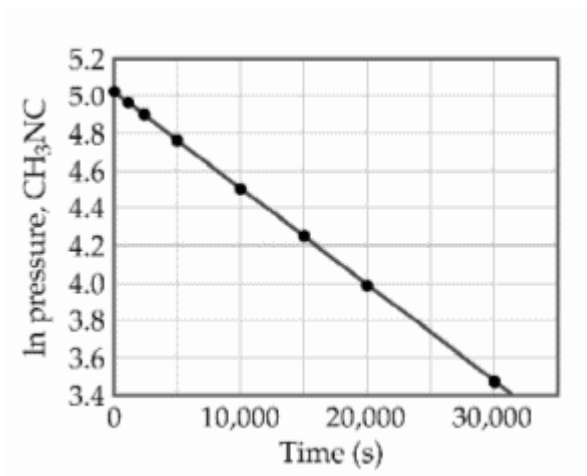   **Correct answer**
       Page 586.

    E) remain constant

12) At elevated temperatures, methylisonitrile (CH_3NC) isomerizes to acetonitrile (CH_3CN):   12) _____

$$CH_3NC\ (g) \rightarrow CH_3CN\ (g)$$

The reaction is first order in methylisonitrile. The attached graph shows data for the reaction obtained at 198.9°C.

The rate constant for the reaction is _____ s^{-1}.

A) -5.2×10^{-5}

B) $+6.2$

C) $+1.9 \times 10^{4}$

D) -1.9×10^{4}

E) $+5.2 \times 10^{-5}$

Correct Answer
The slope of this line is –k, the rate constant .
Page 589

13) Nitrogen dioxide decomposes to nitric oxide and oxygen via the reaction: 13) _____

$$2NO_2 \rightarrow 2NO + O_2$$
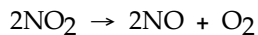
In a particular experiment at 300°C, **[NO_2]** drops from **0.0100 to 0.00650 M in 100 s.** The rate of appearance of **O_2** for this period is _____ M/s.

A) 7.0×10^{-3}

B) 1.8×10^{-5}
   Correct answer
   Rate = change in concentrtion
   $\qquad\qquad$ **change in time**
   $\qquad = $ **(0.0100–0.0065) M** $\quad = 3.5 \times 10^{-5}$ **M/s=** **Rate of disappearence of**
   $\qquad\qquad$ **100** $\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad$ **NO2**

   Rate of appearanceof Oxygen = $\quad$ **$\frac{1}{2}$** $\quad$ **x** $\qquad$ **Rate of disappearence of**
   $\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad$ **NO2**
   $\qquad\qquad\qquad\qquad\qquad = 1.89 \times 10^{-5}$

C) 7.0×10^{-5}

D) 3.5×10^{-5}

E) 3.5×10^{-3}

Solubility (g of salt in 100 g H_2O) vs Temperature (°C)
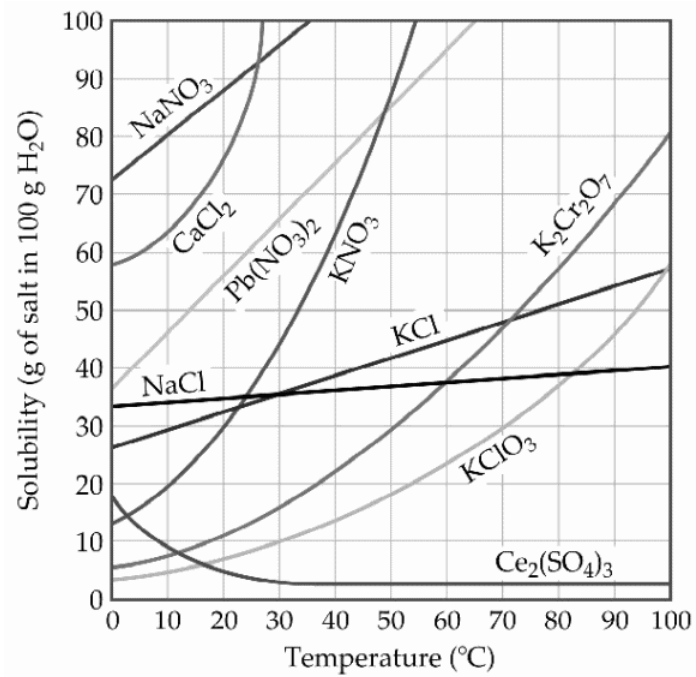
14) A sample of potassium nitrate (49.0 g) is dissolved in 101 g of water at 100 °C, with precautions taken to avoid evaporation of any water. The solution is cooled to 30.0 °C and no precipitate is observed. This solution is _____.

A) unsaturated

B) placated

C) supersaturated   **At 30 ºC 100 g water can dissolve only 45 g KNO3**

D) saturated

E) hydrated

A -> 2 C
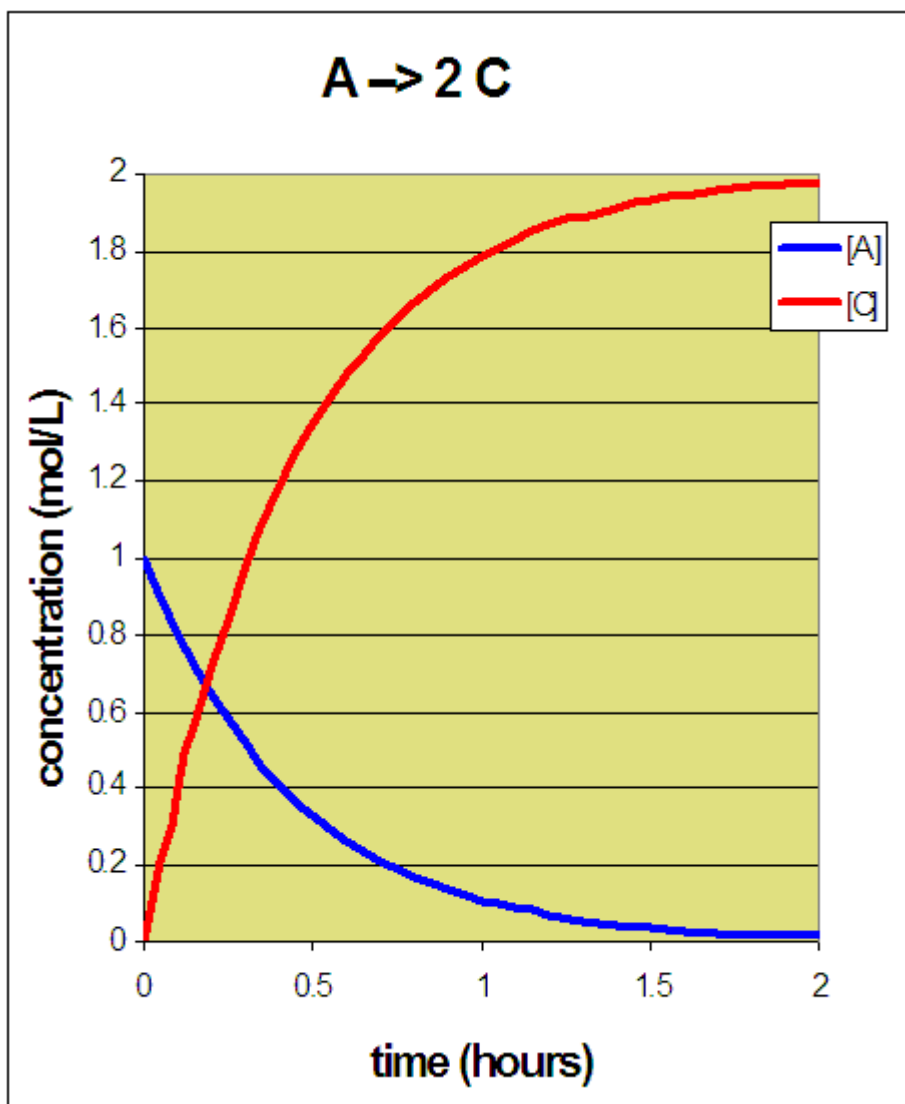
15)

What chemical equation is consistant with the data given above:

A) A--> 2C
   Correct answer
   As the key shows the wrong answer, and I failed to notice everone is getting the points for this question.

B) A--> C

C) C--> A

D) C-->2A

15) _____

8

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

16) What is the osmotic pressure **(in atm)** of a 0.040 M solution of a non–electrolyte at 30.0 °C?   16) _____

$PV = nRT$

$P = \dfrac{n}{V}RT = MRT$

$0.40 \, \dfrac{moles}{L} \times 0.0821 \, L.atm \,/mol.K \times 303K$

0.9950 atm

17) A solution contains 150.8 grams of NaCl in 678.3 grams of water. Calculate the vapor   17) _____
pressure lowering (in torr) of the solution at 25.0 °C. (Note: the vapor pressure of pure
water at 25.0 °C is 23.76 torr.)

$$150 \, g \, NaCl \times \dfrac{1 \, mole}{58.5 \, g} = 2.5641 \, moles$$

$$678.3 \, g \, H_2O \times \dfrac{1 \, mole}{18 \, g} = 37.68 \, moles$$

$$\text{Mole fraction of water, } X = \dfrac{37.68}{37.68 + 2.5641} = 0.9359$$

$$P_A = X \, P_o = 0.9359 \times 23.76 = 22.23 \, torr$$

$$\text{Change in pressure} = 23.76 - 22.23 = 1.52 \, torr$$

The Verssion B :

9

$$160 \text{ g NaCl} \times \frac{1 \text{ mole}}{58.5 \text{ g}} = 2.7350 \text{ moles}$$

$$678.3 \text{ g H}_2\text{O} \times \frac{1 \text{ mole}}{18 \text{ g}} = 37.68 \text{ moles}$$

Mole fraction of water, $X = \frac{37.68}{37.68+2.7350} = 0.9323$

$P_A = X P_o = 0.9323 \times 23.76 = 22.152 \text{ torr}$

Change in pressure $= 23.76 - 22.153 = 1.60 \text{ torr}$

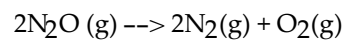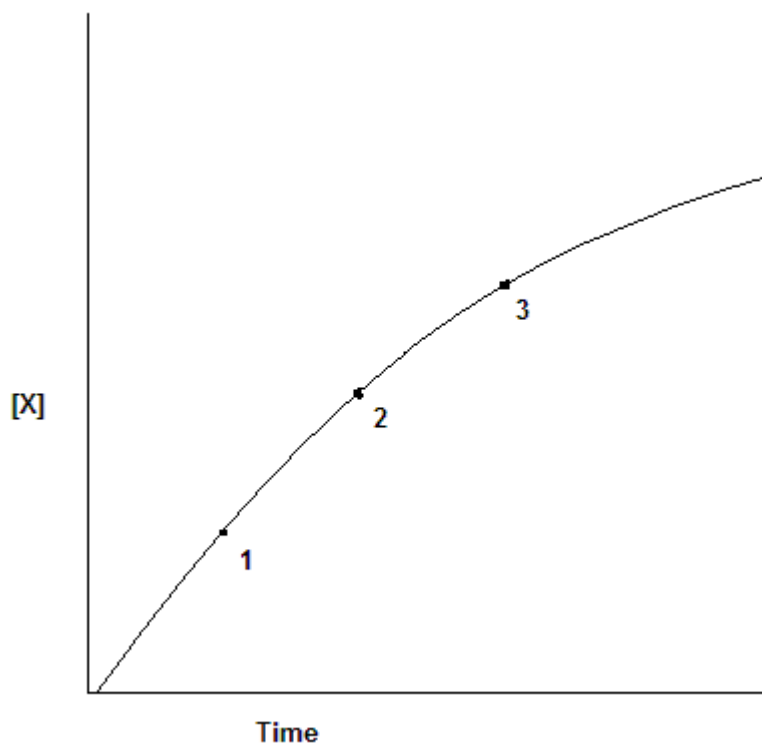18) For the reaction aA + Bb → cC + dD   the rate law is _____.   18) _____

$$\text{Rate} = k[A]^m[B]^n$$

19) For the following reaction indicate how the rate of disapperance of each reactant is related   19) _____
to the rate of appearance of each product:

$$2N_2O \text{ (g)} \text{ --> } 2N_2\text{(g)} + O_2\text{(g)}$$

$$\frac{1}{2}\frac{[\Delta N_2 O]}{\Delta t} = \frac{1}{2}\frac{[\Delta N_2]}{\Delta t} = \frac{[\Delta O_2]}{\Delta t}$$

Time

[X]

20)

Consider the above graph of the concentration of a substance over time.

a. Is X a reactant or a product_____

Product

b. Why is the average rate of the reaction greater between 1 and 2 than between 2 and 3.

Because the amoubnt of the reactant is reducing as the time goes by and the rate of the reaction is dependent on it.

ESSAY. Write your answer in the space provided or on a separate sheet of paper.

21) A solution of unknown nonvolatile electolite was prepared by dissolving 0.250 g of the substances in 40.0 g of CCl_4. The boiing point of the resultant solution was 0.357 °C higher than the pure solvent . Calculate the molar mass of the solute.
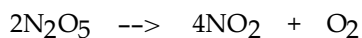
Kb for CCl_4 = 5.02°C/m

$$Molality = \frac{\Delta T_b}{K_b} = \frac{0.375°C}{5.02°C/m} = 0.0711m$$

$$Molality = \frac{moles\ of\ substance}{Kg\ of\ Solvent}$$

$$moles = Molality \times Kg\ of\ solvent = 0.0711\ m \times 0.04\ Kg$$

$$= 2.84 \times 10^{-3} moles$$

$$Molar\ mass = \frac{mass}{moles} = \frac{0.250g}{2.84 \times 10^{-3}moles} = 88.0\ g/mole\ of\ substance$$

22) The decomposition of N_2O_5 in a solvent proceeds a s follows:

$$2N_2O_5 \ \text{-->} \ 4NO_2 \ + \ O_2$$

The rate is first orderin N_2O_5. At 64°C the rate constant is 4.82 x 10 –3/s.

(a) Write the rate law of the reaction.

$$R = k\,[N_2O_5]$$

(b) What is the rate of the reaction when $[N_2O_5$]= 0.0240 M

$$R = 4.82 \times 10^{-3}\ /s \times 0.0240\ M = 0.200\ M/s$$

$$= 1.16 \times 10^{-4}\ M/s$$

For version B

$$R = 5.82 \times 10^{-3}\ /s \times 0.0240\ M = 0.13968\ M/s$$

$$= 1.39 \times 10^{-4}\ M/s$$

(c) What happens to the rate of the when the concentration of N_2O_5 is doubled to 0.0480M?

The rate doubles when the concentration of N_2O_5 doubles.

$$R = 4.82 \times 10^{-3} \text{ /s} \times 0.0480 \text{ M} = 2.31 \times 10^{4} \text{ M/s}$$

Version B

The rate doubles when the concentration of N_2O_5 doubles.

$$R = 5.82 \times 10^{-3} \text{ /s} \times 0.0480 \text{ M} = 2.79 \times 10^{4} \text{ M/s}$$

1) A
2) B
3) E
4) A
5) D
6) D
7) E
8) D
9) E
10) E
11) D
12) C
13) B
14) C
15) B
16) 1.0
17) 2.85
18) $k[A]^m[B]^n$
19)
20)
21)
22)