

Multiple Choice

1) The number of CaSO_4 moles contained in 340.38 g of CaSO_4 are:

- ☐ A) 2.2 ☒ B) 2.5 C) 2.7 D) 2.9
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2) The mass (in g) of iron "Fe" present in 43.0 g of ferrous sulfate " FeSO_4 " is:

- ☐ A) 11.7 B) 13.5 C) 14.2 ☒ D) 15.8
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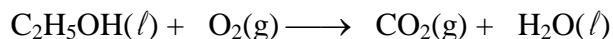
3) A compound of boron "B" and hydrogen "H" contains 82.13% boron by mass has the empirical formula:

- ☐ A) B_3H_7 B) B_2H_3 C) BH_3 D) BH_4
-

4) The molality (m) of an aqueous solution that contains 20.0% sodium acetate " CH_3COONa " by mass is:

- ☐ A) 3.5 ☒ B) 3.0 C) 2.5 D) 2.0
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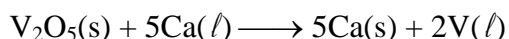
5) When the following chemical formula is balanced:



the sum of all coefficients is:

- ☐ A) 12 B) 10 ☒ C) 9 D) 7
-

6) When 125.0 g of vanadium pentaoxide " V_2O_5 " are allowed to react with 150.0 g of calcium "Ca" according to:



the theoretical yield (in g) of vanadium "V" is:

- ☐ A) 80.0 B) 77.0 C) 72.0 ☒ D) 70.0
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7) A mixture of 2.7 mol O_2 gas, 3.3 mol N_2 gas and 3.0 mol CO_2 gas has a total pressure of 2.0 atm at 25°C . What is the partial pressure (in mmHg) of the O_2 gas in this mixture?

- ☐ A) 439 ☒ B) 456 C) 475 D) 488
-

8) The pressure (in atm) exerted by 9.6×10^3 g of oxygen gas " O_2 " stored in a 100.0 L gas cylinder at 31.6°C is:

- ☐ A) 65.0 B) 68.0 C) 72.0 ☒ D) 75.0
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9) Regarding the Van der Waals constants ("a" and "b") which appear in the Real Gas Equation, which statement is true?

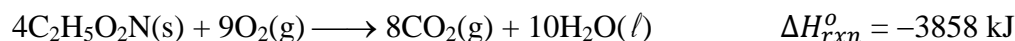
- i) The constant "a" accounts for the attractive forces between the gas molecules.
- ii) The constant "a" accounts for the volume occupied by the gas molecules.
- iii) The constant "b" accounts for the attractive forces between the gas molecules.
- iv) The constant "b" accounts for the volume occupied by the gas molecules.

☐ A) (i) only B) (ii) and (iv) ☒ C) (i) and (iv) D) (ii) only

10) A glass containing 200.0 g of water at 20.0°C was placed into a refrigerator. The water lost 12.552 kJ as it cooled to a constant temperature. Knowing that the specific heat of water is 4.184 J/g °C, calculate the final temperature of this water.

☐ A) 4.0 ☒ B) 5.0 C) 6.0 D) 7.0

11) Glycine "C₂H₅O₂N" is a biological energy source. The combustion of glycine is:

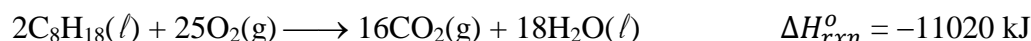


Given: $\Delta H_f^\circ[\text{CO}_2(\text{g})] = -393.5 \text{ kJ/mol}$, $\Delta H_f^\circ[\text{H}_2\text{O}(\ell)] = -285.8 \text{ kJ/mol}$

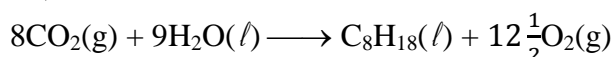
Calculate (in kJ/mol) $\Delta H_f^\circ[\text{C}_2\text{H}_5\text{O}_2\text{N}(\text{s})]$.

☐ A) -645 B) -632 C) -585 ☒ D) -537

12) Given:



☐ What is $\Delta H_{\text{rxn}}^\circ$ (in kJ/mol) for:



☒ A) +5510 B) -5510 C) +11020 D) +22040

13) A gas is allowed to expand from 2.0 L volume to 22.0 L volume against an external pressure of 0.50 atm. If the gas at the same time absorbs 1200.25 J of heat from the surrounding. Calculate (in J) ΔE of this gas system.

☐ A) -2213.5 B) +2213.5 ☒ C) +187 D) +373

14) At 30.0°C, the vapor pressure of pure benzene "C₆H₆" is 120.0 torr and that of pure toluene "C₇H₈" is 40.0 torr. What is the vapor pressure (in torr) of an ideal solution that is formed from 1.0 mol of benzene and 3.0 mol of toluene at 30.0°C?

☐ A) 80.0 ☒ B) 60.0 C) 90.0 D) 70.0

15) Given:

K_f (water) = $1.86^{\circ}\text{C}/\text{m}$ and K_b (water) = $0.52^{\circ}\text{C}/\text{m}$. What is the freezing point (in $^{\circ}\text{C}$) of an aqueous solution of a nonvolatile-nonelectrolyte solute that boils at 102.8°C ?



A) -7.0

B) -8.0

C) -9.0

D) -10.0

16) The osmotic pressure of an 0.01 M aqueous solution of CaCl_2 (an electrolyte nonvolatile solute) is found to be 0.602 atm at 25°C . What is the Van't Hoff factor "I" of this solution?



A) 2.46

B) 2.63

C) 2.75

D) 2.86

17) The reaction $\text{A} + 2\text{B} \longrightarrow \text{Product}$ is found to follow the rate law:

$$\text{Rate} = k [\text{A}]^2 [\text{B}]$$

Predict by what factor the rate of the reaction will increase when the concentration of "A" is tripled and the concentration of "B" is doubled, while the temperature remains constant.



A) 9

B) 12

C) 18

D) 24

18) For a first order reaction it took 462 s for the reaction to be 75% complete. What is the half life " $t_{1/2}$ " period (in s) of this reaction?



A) 287

B) 265

C) 252

D) 231

19) For a first order reaction, regarding its half life period " $t_{1/2}$ ", which statement is true?



A) $t_{1/2}$ increases with increasing temperature.

B) $t_{1/2}$ decreases with increasing temperature.

C) $t_{1/2}$ is always constant and never changes by changing temperature.

D) $t_{1/2}$ changes only by changing the concentration of the reactant.

20) The forward reaction of an equilibrium process has: $\Delta H_{\text{rxn}} = -80.0\text{ kJ/mol}$ and its activation energy " E_a " = 48.0 kJ/mol , therefore, the reverse reaction for this process is:



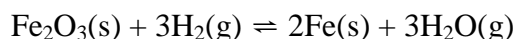
A) Exothermic having $E_a = 128.0\text{ kJ/mol}$.

B) Exothermic having $E_a = 32.0\text{ kJ/mol}$.

C) Endothermic having $E_a = 128.0\text{ kJ/mol}$.

D) Endothermic having $E_a = 32.0\text{ kJ/mol}$.

21) The correct equilibrium constant expression for the following reaction:



is:



A) $K_c = \frac{[\text{Fe}_2\text{O}_3][\text{H}_2]^3}{[\text{Fe}]^2[\text{H}_2\text{O}]^3}$

B) $K_c = \frac{[\text{Fe}]^2[\text{H}_2\text{O}]^3}{[\text{Fe}_2\text{O}_3][\text{H}_2]^2}$

C) $K_c = \frac{[\text{H}_2]^3}{[\text{H}_2\text{O}]^3}$

D) $K_c = \frac{[\text{H}_2\text{O}]^3}{[\text{H}_2]^3}$

- 22) For the following reactions occurring at 250.0°C, arrange them in order of increasing tendency to proceed to completion:

(least → greatest tendency)

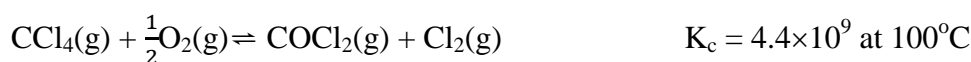
- i) $2\text{NOCl(g)} \rightleftharpoons 2\text{NO(g)} + \text{Cl}_2\text{(g)}$ $K_p = 1.7 \times 10^{-2}$
 ii) $\text{N}_2\text{O}_4\text{(g)} \rightleftharpoons 2\text{NO}_2\text{(g)}$ $K_p = 1.5 \times 10^3$
 iii) $2\text{SO}_3\text{(g)} \rightleftharpoons 2\text{SO}_2\text{(g)} + \text{O}_2\text{(g)}$ $K_p = 1.3 \times 10^{-5}$
 iv) $2\text{NO}_2\text{(g)} \rightleftharpoons 2\text{NO(g)} + \text{O}_2\text{(g)}$ $K_p = 5.5 \times 10^{-5}$



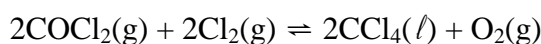
- A) iii < iv < i < ii
 C) iv < iii < ii < i

- B) ii < i < iv < iii
 D) iv < iii < i < ii
-

- 23) Given the following equilibrium:

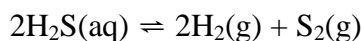


calculate K_c at 700°C for the following manipulated equilibrium:



- A) 1.14×10^{-10} B) 1.94×10^{19} C) 5.17×10^{-20} D) 2.35×10^{-18}
-

- 24) An equilibrium mixture for the reaction:



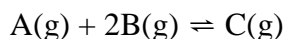
on analysis was found to contain:

1.0 mol H_2S , 4.0 mol H_2 and 0.8 mol S_2 in a 4.0 L vessel. Calculate K_c for this reaction:



- A) 4.6 B) 3.2 C) 1.6 D) 0.8
-

- 25) 1.0 mol of A and 1.8 mol of B were initially placed into a 5.0 L reaction vessel and the following reaction was allowed to achieve equilibrium:



After the reaction reached equilibrium 1.0 mol of B was found. Calculate the value of K_c for this reaction



- A) 3.33 B) 6.67 C) 12.86 D) 16.67
-

- 26) $K_c = 0.083$ at 900.0°C for the following equilibrium:

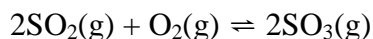


What is the value of K_p at 900.0°C for this equilibrium?



- A) 8.0 B) 9.0 C) 10.0 D) 11.0
-

- 27) For the following equilibrium occurring at 25°C, $K_p = 3 \times 10^{24}$:



Calculate K_c for this reaction at 25°C.

- ☐ A) 2.25×10^{20} B) 5.25×10^{21} ☒ C) 7.34×10^{25} D) 1.23×10^{23}
-

- 28) For the following equilibrium:



Determine the concentration (in mol/L) of Z in equilibrium with 0.4 mol of X and 0.5 mol of Y inside a 1.0 L reaction vessel.

- ☐ A) 3.2 ☒ B) 8.0 C) 4.8 D) 2.0
-

- 29) For the reaction:

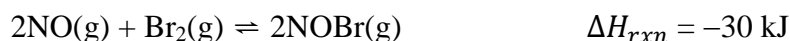


The following system was prepared by injecting: 0.1 mol PCl_3 , 0.15 mol Cl_2 and 0.6 mol PCl_5 into a 1.0 L reaction vessel at 25°C. Which response is correct?

The reaction:

- ☐ A) is at equilibrium.
☐ B) will consume PCl_3 and Cl_2 until equilibrium is reached.
☒ C) will form more PCl_3 and Cl_2 until equilibrium is reached.
☐ D) will form more PCl_5 until equilibrium is reached.
-

- 30) Consider the following equilibrium:



Which of the following changes will cause the concentration of the NOBr to increase:

- ☐ A) Increase the temperature and decrease the total pressure by increasing the container volume.
☐ B) Decrease the temperature and decrease the total pressure by increasing the container volume.
☐ C) Increase the temperature and increase the total pressure by compressing the gas mixture into a smaller volume.
☒ D) Decrease the temperature and increase the total pressure by compressing the gas mixture into a smaller volume.
-

- 31) The formula of the hydronium ion is:

- ☒ A) H_3O^+ B) OH^- C) H_3O^- D) H_2O
-

32) Identify the conjugated acid of HPO_4^{2-} :

- A) H_3PO_3 ☒ B) H_2PO_4^- C) H_3PO_4 D) PO_4^{3-}
-

33) Identify the conjugated base of NH_4^+ :

- ☐ A) NH_4^+ B) NH_3 C) NH_2^- ☒ D) N^{3-}
-

34) For the base, NO_2^- , $K_b = 2.2 \times 10^{-11}$ at 25°C , therefore, K_a for the acid HNO_2 at 25°C is:

- ☐ A) 2.2×10^{-3} B) 11.8×10^{-4} ☒ C) 4.5×10^{-4} D) 11.8×10^{-5}
-

35) The pH value of the 0.20 M phenoxide ion solution (phenoxide ion $\text{C}_6\text{H}_5\text{O}^-$ is a weak base having $K_b = 7.7 \times 10^{-5}$) is:

- ☐ ☒ A) 11.59 B) 9.89 C) 4.11 D) 2.41
-

36) The concentration (in mol/L) of the aqueous HCl (strong acid) solution having pH = 2.3, is:

- ☐ A) 3.0×10^{-3} B) 4.0×10^{-3} ☒ C) 5.0×10^{-3} D) 6.0×10^{-3}
-

37) Which of the following weak monoprotic acids has the strongest conjugated base:

- ☐ A) CH_3COOH ($K_a = 1.8 \times 10^{-5}$) B) $\text{C}_6\text{H}_5\text{COOH}$ ($K_a = 6.5 \times 10^{-5}$)
C) HOCl ($K_a = 3.2 \times 10^{-8}$) ☒ D) HCN ($K_a = 4.9 \times 10^{-10}$)
-

38) In which one of the following acetic acid " CH_3COOH " (a weak monoprotic acid) aqueous solutions will acetic acid has the greatest degree of ionization:

- ☐ ☒ A) 0.1M CH_3COOH , alone.
B) 0.1M CH_3COOH together with 0.05 M HCl.
C) 0.1M CH_3COOH together with 0.1 M HCl.
D) 0.1M CH_3COOH together with 0.1 M CH_3COONa .
-

39) Which one of the following mixtures is suitable for making a buffer solution with an optimum pH of 9.25?

- ☐ A) HOCl/NaOCl ($K_a[\text{HOCl}] = 3.2 \times 10^{-8}$)
☒ B) $\text{C}_6\text{H}_5\text{COOH}/\text{C}_6\text{H}_5\text{COONa}$ ($K_a[\text{C}_6\text{H}_5\text{COOH}] = 6.5 \times 10^{-5}$)
C) $\text{NH}_3/\text{NH}_4\text{Cl}$ ($K_b[\text{NH}_3] = 1.8 \times 10^{-5}$)
D) HCNO/NaCNO ($K_a[\text{HCNO}] = 2.0 \times 10^{-4}$)
-

- 40) Calculate the pH value of a buffer prepared by dissolving 0.55 mol sodium acetate " CH_3COONa " and 0.3 mol acetic acid " CH_3COOH " in enough water to obtain exactly 1.0 L solution (knowing that $K_a [\text{CH}_3\text{COOH}] = 1.8 \times 10^{-5}$):



A) 4.0

B) 4.5

C) 5.0

D) 5.5
