Multiple Choice

1) The mass in gram of 7.7×10^{22} atom of potassium "K" is:

A) 4.5 B) 5.0 C) 5.5 D) 4.0

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2) The number of $BaCl_2$ molecules present in 34.6 g of $BaCl_2$ compound is:

A) 3.0×10^{22} B) 3.0×10^{23} C) 2.0×10^{21} D) 1.0×10^{23}

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3) The percent by mass of phosphorous "P" in the phosphate rock $Ca_{10}F_2(PO_4)_6$ is:

A) 19.85 B) 18.42 C) 17.63 D) 16.25

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4) 11.2 g of iron "Fe" is heated in excess oxygen to give 16.0 g of iron oxide having the emperical formula:

A) FeO B) Fe_3O_4 C) Fe_2O_3 D) FeO_2

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5) The mass in gram of table sugar "$C_{12}H_{22}O_{11}$" in 300 mL of 0.15 M solution of table sugar is:

A) 12.5 B) 13.8 C) 14.3 D) 15.4

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6) The gas which has a density of 1.0 g/L at a pressure of 1.5 atm and 20^{o}C is most likely:

A) CH_4 B) N_2 C) O_2 D) CO_2

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7) The pair of gas mixture that could be most easily separated by gaseous effusion is:

A) O_2 and Ar B) O_2 and Kr C) He and Ne D) CO_2 and Xe

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8) One of the following statements is incorrect:

A) At the same temperature, the average kinetic energy of H_2 molecules and that O_2 molecules are equal.
B) Gas molecules exert no intermolecular forces on each other
C) Deviations from ideal gas law are greater low temperature and high pressure.
D) The average molecular speed at 25^{o}C of Ar is greater than that of Kr.

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9) The specific heat of silver "Ag" is 0.24 J/g ^{o}C, therefore the molecular heat capacity of silver in J/mol ^{o}C is:

A) 25.9 B) 27.3 C) 28.5 D) 30.8

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10) The heat of combustion of vaniline "$C_8H_8O_3$" is –25.4 kJ/g. In a bomb calorimeter that has a total heat capacity of 6350.0 J/^{o}C (for the calorimeter and the water) 1.25 g of vaniline was combusted consequently, the temperature rise (in ^{o}C) should be:

A) 3.5 B) 4.5 C) 4.5 D) 5.0

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11) The symbol ΔH_f^o [$HNO_3(l)$] refers to one of the following reactions occurring at 25°C:

A) $H(g) + N(g) + 3O(g) \rightarrow HNO_3(l)$
B) $1/2\ H_2(g) + 1/2\ N_2(g) + 3/2\ O_2(g) \rightarrow HNO_3(l)$
C) $H_2(g) + N_2(g) + 3O_2(g) \rightarrow 2HNO_3(g)$
D) $H_2(g) + N_2(g) + 3O_2(g) \rightarrow 2HNO_3(l)$

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12) The solubility of gas in water usually increases with

A) Increasing the partial pressure of the gas and increasing the temperature.
B) Decreasing the partial pressure of the gas and increasing the temperature.
C) Decreasing the partial pressure of the gas and decreasing the temperature.
D) Increasing the partial pressure of the gas and decreasing the temperature.

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13) The molar mass of a certain protein is 25000 g/mol. The osmotic pressure (in torr) at 27°C of an aqueous solution prepared from 1.34 g of this protein (a nonelectrolyte) in enough water to make 100.0 mL of solution is:

A) 10 B) 11 C) 12 D) 14

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14) The reaction A + 2B → products, was found to follow the rate law:

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

Predict by what factor the rate of this reaction will increase when the concentration of A is tripled and the concentration of B is also tripled.

A) 8 B) 12 C) 18 D) 27

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15) The reaction 2A + B → products, was found to follow the rate law?

$$\text{rate} = k[A]\,[B]^3$$

The units for the rate constant are:

A) $mol^3\ L^{-3}\ s^{-1}$ B) $mol^3\ L^3\ s^{-1}$ C) $mol^{-4}\ L^4\ s^{-1}$ D) $mol^4\ L^{-4}\ s^{-1}$

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16) For a chemical reaction at equilibrium:

A) The activation energy for the forward reaction and that for the reverse reaction must be equal.
B) The activation energy for the endothermic reaction is always greater than that for the exothermic reaction.
C) The activation energy for the exothermic reaction is always greater than that for the endothermic reaction.
D) The activation energy has nothing to do with the enthalpy of the reaction.

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17) Solid phosphorous pentachloride "PCl_5" decomposes to liquid phosphorous trichloride "PCl_3" and chlorine gas according to the following equilibrium reaction:

$$PCl_5(s) \rightleftharpoons PCl_3(l) + Cl_2(g)$$

At a certain temperature and when the reaction reached equilibrium: 0.4 mol of PCl_5, 0.6 mol of PCl_3 and 0.6 mol of Cl_2 are present inside the 500 mL closed reaction vessel. Therefore, the K_c value is:

A) 1.80 B) 1.44 C) 1.2 D) 1.5

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18) Consider the following equilibrium reaction:

$$CH_4(g) + H_2O(g) \rightleftharpoons CO(g) + 3H_2(g)$$

At 1500°C when K_c = 6.4 an equilibrium mixture of these gases was found to have [CO] = 0.30 M, [H_2] = 0.8 M and [CH_4] = 0.4 M. Therefore, the equilibrium concentration of $H_2O(g)$ in this mixture was:

A) 0.06 M B) 1.0 M C) 0.024 M D) 0.2 M

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19) At 773°C, the equilibrium reaction:

$$CO(g) + 2\ H_2(g) \rightleftharpoons CH_3OH(g)$$

has K_c = 0.4, therefore, Kp for this reaction at 773°C is:

A) 9.93×10^{-5} B) 4.52×10^{-5} C) 2950 D) 1611

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20) Using the following equilibria:

$2CH_4(g) \rightleftharpoons C_2H_6(g) + H_2(g)$ $K_c = 9.5\times10^{-13}$

$CH_4(g) + H_2O(g) \rightleftharpoons CH_3OH(g) + H_2(g)$ $K_c = 2.8\times10^{-21}$

Consequently, for the following equilibrium:

$2CH_3OH(g) + H_2(g) \rightleftharpoons C_2H_6(g) + 2H_2O(g)$

the Kc value is:

A) 2.66×10^{-33} B) 7.45×10^{-54} C) 3.39×10^{8} D) 1.21×10^{29}

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21) At high temperature, 2.0 mol of HBr gas was placed in a 4.0 L closed and empty reaction vessel where it decomposed according to the following equilibrium reaction:

$$2HBr(g) \rightleftharpoons H_2(g) + Br_2(g)$$

At equilibrium, the concentration of Br_2 was measured to be 0.12 M. Therefore, the K_c value for this equilibrium at this temperature is:

A) 818×10^{-3} B) 4.65×10^{-3} C) 0.213 D) 0.554

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22) At 450°C, hydrogen iodide HI(g) decomposes according to the following equilibrium having K_c = 0.015625.

$$2HI(g) \rightleftharpoons H_2(g) + I_2(g)$$

A 0.66 mol of HI sample was injected into a 2.0 L reaction vessel hold at 450°C till equilibrium was reached. At equilibrium, the concentration of HI was:

A) 0.297 B) 0.152 C) 0.508 D) 0.264

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23) For the following equilibrium reaction:

$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$ $\Delta H^o = -198$ kJ

Which one of the following factors would cause the equilibrium constant to increase:

A) Compress the gas mixture into a small volume to increase the total pressure.
B) Increase the container volume to reduce the total pressure.
C) Remove the SO_3 produced.
D) Decrease the reaction temperature.

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24) In which one of the following solutions will acetic acid CH_3COOH (a weak acid) have the greatest degree of ionization?

A) 0.1 M CH_3COOH plus 0.1 M CH_3COONa
B) 0.1 M CH_3COOH plus 0.2 M CH_3COONa
C) 0.1 M CH_3COOH plus 0.3 M CH_3COONa
D) 0.1 M CH_3COONa

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25) Formic acid HCOOH is a weak monoprotic acid that has $K_a = 1.7\times10^{-4}$. The pH value of 0.50 M formic acid solution is:

A) 3.77 B) 2.03 C) 4.03 D) 4.63

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26) Ammonia (NH_4OH) is a weak base that has K_b = 1.8×10-5. The pH value of a 0.25 M ammonia solution is:

A) 2.67 B) 4.74 C) 11.33 D) 9.45

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27) Which of the following sets form a conjugated acid/base pair?
1) NH_4^+/NH_3 2) H_2CO_3/CO_3^{--} 3) $H_3PO_4/H_2PO_4^-$ 4) NH_3/NH_2^-

A) All of them B) 1 and 3 only C) 3 and 4 only D) 1, 3 and 4 only

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28) Knowing that K^b for the weak base (NO_2^-) is 2.2×10^{-11}. Calculate the hydrogen ion concentration [H^+] of a 0.50 M nitrous acid (HNO_2) solution.

A) 1.5×10^{-2} M B) 3.3×10^{-6} M C) 4.7×10^{-6} M D) 4.5×10^{-4} M

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29) Which of the following sets cannot form a buffer solution?
1. $HNO_3/NaNO_3$ (strong acid and its salt)
2. HCN/NaCN (weak acid and its salt)
3. NH_4OH/NH_4Cl (weak base and its salt)
4. HCl/NaCl (strong acid and its salt)

A) 2, 3 B) 1, 3 C) 2, 4 D) 1, 4

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30) The pH value of 1.2 M $C_2H_5NH_2$ (ethylamine, a weak base) solution is 12.41. Calculate the K_b value for ethylamine.

A) 1.3×10^{-25} B) 3.2×10^{-13} C) 5.5×10^{-4} D) 1.2×10^{-9}

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31) Calculate the pH of a buffer solution which contains 0.25 M benzoic acid C_6H_5COOH and 0.15 M sodium benzoate C_6H_5COONa. Given K_a = 6.5×10-5.

A) 4.19 B) 3.97 C) 6.5 D) 4.83
