CaMO USNCO Local Exam Pre-Test

Local Section Diagnostic

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Rules: You have 50 minutes to complete this 27 question multiple choice exam. You may use a non programmable calculator. You are not allowed to access the internet during this exam. I will not aid you during this exam.

DO NOT TURN THE PAGE UNTIL DIRECTED TO DO SO

$$E = E^\circ - \frac{RT}{nF}\ln Q \qquad \ln K = \left(\frac{-\Delta H^\circ}{R}\right)\left(\frac{1}{T}\right) + \text{constant} \qquad \ln\left(\frac{k_2}{k_1}\right) = \frac{E_a}{R}\left(\frac{1}{T_1} - \frac{1}{T_2}\right)$$

1. How many atoms are in 4.0×10^{-5} grams of Al?

   (a) 8.9×10^{17}

   (b) 2.4×10^{19}

   (c) 6.5×10^{20}

   (d) 2.0×10^{22}

2. Barium chloride reacts with sodium sulfate according to the following equation:

$$\mathrm{BaCl_2(aq) + Na_2SO_4(aq) \longrightarrow BaSO_4(s) + 2\,NaCl(aq)}$$

   A student mixes a solution containing 10.0 g $BaCl_2$ ($M = 208.2$) with a solution containing 10.0 g Na_2SO_4 ($M = 142.1$) and obtains 12.0 g $BaSO_4$ ($M = 233.2$). What is the percent yield of this reaction.

   (a) 60.0%

   (b) 73.1 %

   (c) 93.3 %

   (d) The isolated barium sulfate is most likely wet, since the yield would otherwise be greater than 100%

3. A 5.73 g sample of a liquid hydrocarbon burned in excess oxygen produces 17.48 g CO_2. What is the formula of the hydrocarbon?

   (a) C_5H_{12}

   (b) C_6H_6

   (c) C_6H_{10}

   (d) C_6H_{12}

4. A student determined the density of a solid to be 2.90, 2.91, and 2.93 g cm^{-3}. If the actual density of this solid is 2.70 g cm^{-3}, how should the student's results be described?

   (a) high accuracy and high precision

   (b) low accuracy and high precision

   (c) high accuracy and low precision

   (d) low accuracy and low precision

5. A flame test was performed to confirm the identity of a metal ion in solution. The result was a green flame. Which of the following metal ions is indicated?

   (a) copper

   (b) sodium

   (c) strontium

   (d) zinc

6. Which of the following is a weak electrolyte in aqueous solution?

   (a) HF
   (b) NaF
   (c) HCl
   (d) KCl

7. A sample of He gas in a flexible container at room temperature exhibits a certain pressure. What will be the new pressure when the absolute temperature and volume of the container are both halved? The pressure of the He will be

   (a) the same
   (b) doubled
   (c) halved
   (d) quadrupled

8. A gas mixture at 27 ° C and 1 atm contains equal masses of He, H_2, CO_2, and CH_4. How do their molecular velocities compare?

   (a) He = H_2 = CO_2 = CH_4
   (b) He ¡ H_2 ¡ CO_2 ¡ CH_4
   (c) H_2 ¡ He ¡ CH_4 ¡ CO_2
   (d) CO_2 ¡ CH_4 ¡ He ¡ H_2

9. The molecules in a sample of pure liquid dichloromethane, CH_2Cl_2, experience which of the following intermolecular forces?

   I dispersion forces
   II dipole-dipole forces
   III hydrogen bonding

   (a) I only
   (b) II only
   (c) I and II only
   (d) I, II, III

10. The standard enthalpy of formationn for $NH_3(g)$ $-46.1\,\mathrm{kJ\,mol^{-1}}$. Calculate ΔH° for the reaction:

$$2\,NH_3(g) \longrightarrow N_2(g) + 3\,H_2(g)$$

    (a) $-92.2\,\mathrm{kJ}$
    (b) $-46.1\,\mathrm{kJ}$
    (c) $46.1\,\mathrm{kJ}$
    (d) $92.2\,\mathrm{kJ}$

11. Which is a statement of the Second Law of Thermodynamics?

    (a) The energy of the universe is conserved.
    (b) The energy of the universe is decreasing.
    (c) The entropy of the universe is conserved.
    (d) The entropy of the universe is increasing.

12. A gold ring that weighs 3.81 g is heated to 84.0 °C and placed in 50.0 g of H_2O at 22.1 °C. What is the final temperature?

    (a) 22.2 °C
    (b) 24.0 °C
    (c) 26.5 °C
    (d) 53.1 °C

13. The activation energy for a reaction can be determined by measuring the reaction rate at different

    (a) temperatures.
    (b) catalyst concentrations.
    (c) reactant concentrations.
    (d) times on the reaction curve.

14. A catalyst speeds up a chemical reaction by

    (a) shifting the equilibrium.
    (b) increasing the activation energy.
    (c) decreasing the reaction enthalpy.
    (d) providing an alternate reaction pathway.

15. For the reaction:

$$(CH_3)_3CBr(aq) + OH^-(aq) \longrightarrow (CH_3)_3COH(aq) + Br^-(aq)$$

    it is found that halving the concentration of $(CH_3)_3CBr$ causes the reaction rate to be halved but halving the concentration of OH^- has no effect on the rate. What is the rate law?

    (a) Rate $= k\left[(CH_3)_3CBr\right]^{\frac{1}{2}}\left[OH^-\right]$
    (b) Rate $= k\left[(CH_3)_3CBr\right]^2\left[OH^-\right]$
    (c) Rate $= k\left[(CH_3)_3CBr\right]^{\frac{1}{2}}$
    (d) Rate $= k\left[(CH_3)_3CBr\right]$

16. What is the pH of a 0.0015 M solution of HNO_3?

    (a) 1.41
    (b) 2.82
    (c) 5.65
    (d) 11.18

17. In a solution of formic acid ($K_a = 1.7 \times 10^{-4}$), the $[H^+] = 2.3 \times 10^{-3}$. What is the concentration of formic acid in $\mathrm{mol\,L^{-1}}$?

    (a) 7.2×10^{-2}
    (b) 3.1×10^{-2}
    (c) 5.3×10^{-6}
    (d) 3.9×10^{-7}

18. For the equilibrium system:

$$\mathrm{CO(g) + 2\,H_2(g) \rightleftharpoons CH_3COH(l)}$$

    what is K_c?

    (a) $K_c = \dfrac{[CH_3OH]}{2[CO][H_2]}$
    (b) $K_c = \dfrac{[CH_3OH]}{[CO][H_2]^2}$
    (c) $K_c = \dfrac{1}{2[CO][H_2]}$
    (d) $K_c = \dfrac{1}{[CO][H_2]^2}$

19. Which change represents an oxidation

    (a) $NO_2^- \longrightarrow N_2$
    (b) $VO^{2+} \longrightarrow VO_3^-$
    (c) $ClO^- \longrightarrow Cl^-$
    (d) $CrO_4^{2-} \longrightarrow Cr_2O_7^{2-}$

20. Which is a consistent set of values for a specific redox reaction carried out under standard conditions?

	E°	ΔG°	Description
(a)	+	−	spontaneous
(b)	−	+	spontaneous
(c)	+	+	nonspontaneous
(d)	−	−	nonspontaneous

21. For a galvanic cell involving the half-reactions at standard conditions,

$$\mathrm{Au^{3+} + 3\,e^- \longrightarrow Au} \qquad E^\circ = 1.50\,\mathrm{V}$$
$$\mathrm{Tl^+\,e^- \longrightarrow Tl} \qquad E^\circ = -0.34\,\mathrm{V}$$

    what is E°_{cell}?

    (a) 0.48 V
    (b) 1.16 V
    (c) 1.84 V
    (d) 2.52 V

22. Which set of quantam numbers is not possible?

    (a) $n = 2$, $l = 1$, $m_l = +1$, $m_s = -\frac{1}{2}$
    (b) $n = 3$, $l = 2$, $m_l = +1$, $m_s = +\frac{1}{2}$
    (c) $n = 4$, $l = 4$, $m_l = -1$, $m_s = +\frac{1}{2}$
    (d) $n = 5$, $l = 2$, $m_l = 2$, $m_s = -\frac{1}{2}$

23. In which list are the ions arranged in order of decreasing size?

    (a) S^{2-}, Br−,K^{+}, Ca^{2+}
    (b) Br−,S^{2-}, K^{+}, Ca^{2+}
    (c) K^{+}, Ca^{2+}, S^{2-}, Br^{-}
    (d) Ca^{2+}, K^{+}, S^{2-}, Br^{-}

24. The removal of an electron from which gaseous atom requires the greatest amount of energy?

    (a) Na
    (b) Cl
    (c) K
    (d) Br

25. Which ionic solid has the greatest lattice energy?

    (a) NaCl
    (b) MgO
    (c) KBr
    (d) SrS

26. What is the shape of the ClF_3 molecule?

    (a) trigonal planar
    (b) trigonal pyramidal
    (c) T-shaped
    (d) tetrahedral

27. Which molecule has no permanent dipole moment?

    (a) BCl_3
    (b) NCl_3
    (c) $CHCl_3$
    (d) PCl_3

END OF TEST