CHM 1045   Selected ACS questions

(Complete ACS guide and sample questions are available at the Tutoring Center)

ATOMIC STRUCTURE

4. The number of neutrons in the $^{37}_{17}Cl^-$ ion is

(A) 17   (B) 20   (C) 21   (D) 37

9. In what respect does an atom of magnesium, Mg differ from a magnesium ion, Mg^{2+}?

(A) The ion has an inert gas electron configuration; the atom does not..

(B) The positive charge on the nucleus of the ion is two units greater than the nuclear charge on the atom.

(C) The ion has two more protons than the atom.

(D) The ion has two more planetary electrons than the atom.

12. The element **X** occurs naturally to the extent of 20.0% ^{12}**X** and 80.0% ^{13}**X**. The atomic mass **X** is nearest.

(A) 12.2   (B) 12.5 (C) 12.8   (D) 13.0

18. What electron configuration is impossible?

(A) $1s^2\,2s^2 2p^6 3s^2$ (B) $1s^2 2s^2 2p^6 2d^2$

(C) $1s^2 2s^2 2p^6 3s^2 3p^6$ (D) $1s^2 2s^2 2p^5 3s^1$

22. An atom of Fe has two 4_s electrons and six 3d electrons. how many unpaired electrons would there be in the Fe^{2+} ion?

(A) One   (B) two   (C) three   (D) four

26. Which emission line in the hydrogen spectrum occurs at the highest frequency?

   (A) n=3□n=1   (B) n=4□n=2   (C) n=7□n=5   (D) n=10□n=8

Answers

4.B

 9.A

12.C

18.B

22.D

26.A

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MOLECULAR STRUCTURE AND BONDING

2. The molecule of the type ML_4 consists of four single bonds and no lone pairs. What structure is it expected to assume?
(A) Square planar   (B) trigonal planar
(C) trigonal pyramidal   (D) tetrahedral

5.Which is planar?
(A) NH_3 (B)SO_3^{2-}
(C) CO_3^{2-} (D)CCl_4

11. The structure of the CO_3^{2-} ion can be described in the Lewis formulation by these structures. This means that

      (A) Two carbon-to-oxygen bonds are single bonds; third is a double bond.

      (B) Three independent forms of the CO_3^{2-} ion coexist in equilibrium.

      (C) The electrons must be rapidly exchanging among the three forms.

(D) The CO_3^{2-} ion exists in only one form: and average of the three principal structures shown.

14. Which compound would be expected to have the largest dipole moment?
(A) CO_2 (linear)
(B) SO_2 (bent)
(C) BF_3 (trigonal planar)
(D) CF_4 (tetrahedral)

25. Which element is most likely to form a triple bond?
  (A) Pb   (B) F   (C) N   (D) S

Answers

    2.D

    11.D

    14.B

    25.C

STOICHIOMETRY

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1.   A compound is found to consist of 34.9% sodium, 16.4% boron and 48.6% oxygen. What it its simplest formula?

        (A) $NaBO_2$ (B) $NaBO_3$ (C) $Na_2B_4O_7$ (D) $NaBO_3$

4. What is the percent by mass of oxygen in $Ca(NO_3)_2$?
      (A) 29.3% (B) 47.1% (c) 58.5% (D) 94.1%

7. How many atoms are in 1.50 g of Al?
  (A) 0.0556   (B) 18.0   (C) 3.35×10^{22} (D) 2.44×10^{25}

18. A mixture containing 9 mol of F_2 and 4 mol of S is allowed to react. This equation represents the reaction that takes place.
          $3F_2 + S \square SF_6$
   How many moles F_2 remain after 3 mol of S have reacted?
   (A) 4 (B) 3 (C) 1 (D) 0

24. In acidic solution, the dichromate ion, $Cr_2O_7^{2-}$ (aq) will oxidize Fe^{2+} to Fe^{3+} and form Cr^{3+}. This net ionic equation represents the reaction that takes place during the reaction.

$$Cr_2O_7^{2-}{}_{(aq)} + 6Fe^{2+}{}_{(aq)} + 14H^+{}_{(aq)} \square\ 2Cr^{3+}{}_{(aq)} + 6Fe^{3+}{}_{(aq)} + 7H_2O_{(l)}$$
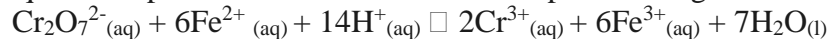
What volume of 0.100M $Cr_2O_7^{2-}{}_{(aq)}$ is required to oxidize 60.0mL of 0.250 M $Fe^{2+}{}_{(aq)}$?

(A) 25.0 mL
(B) 42.0 mL
(C) 58.4 mL
(D) 175 mL

Answers

1. A
4. C
7. C
18. D
24. A

STATES OF MATTER / SOLUTIONS

3. A particular solid is soft, a poor conductor of heat and electricity, and has a low melting point. Generally, such a solid is classified as

(A) Ionic
(B) Molecular
(C) Metallic
(D) Network Covalent

9. Which factor affects the vapor pressure of a liquid?

(A) Temperature
(B) Atmospheric pressure
(C) Volume of the liquid
(D) Surface of the liquid

13. Which set of temperature and pressure conditions will cause a gas to exhibit the greatest deviation from the ideal gas behavior?

(A) 100 °C and 4 atm
(B) 100 °C and 2 atm
(C) -100 °C and 4 atm
(D) 0 °C and 2 atm

18. What volume of 12M HCl solution is required to prepare exactly 500. mL if a 0.60 M HCl solution?

    (A) 10. mL
    (B) 14 mL
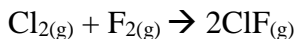   (C) 25 mL
    (D) 40. mL

Answers

    3. B
    9. A
    13. C
    18. C

ENERGETICS

1. When a 45.0 g sample of an alloy at 100.0 °C is dropped into 100.0 g water at 25.0 °C, the final temperature is 37.0 °C. What is the specific heat of the alloy? (Specific Heat of H_2O: 4.184 $J*g^{-1}*°C^{-1}$)

    (A) 0.423 $J*g^{-1}*°C^{-1}$
    (B) 1.77 $J*g^{-1}*°C^{-1}$
    (C) 9.88 $J*g^{-1}*°C^{-1}$
    (D) 48.8 $J*g^{-1}*°C^{-1}$

6. Calculate $\Delta H° =$ for the chemical equation

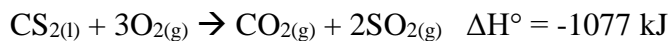$$Cl_{2(g)} + F_{2(g)} \rightarrow 2ClF_{(g)}$$

Bond Energies $(kJ*mol^{-1})$: F-F (159), Cl-Cl (243), Cl-F (255)

    (A) -147 kJ
    (B) -108 kJ
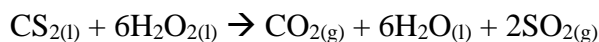   (C) +171 kJ
    (D) +912 kJ

7. More heat is derived from cooling one gram of steam at 100 °C to water at 50 °C than from cooling one gram of liquid water at 100 °C to 50 °C because

    (A) The steam is hotter than the water.
    (B) The steam occupies a greater volume than the water.
    (C) The density of water is greater than that of steam.
    (D) The heat of conduction is evolved.

16. Given these values of $\Delta H°$:

$$CS_{2(l)} + 3O_{2(g)} \rightarrow CO_{2(g)} + 2SO_{2(g)} \quad \Delta H° = -1077 \text{ kJ}$$

$$H_{2(g)} + O_{2(g)} \rightarrow H_2O_{2(l)} \qquad\qquad \Delta H° = -188 \text{ kJ}$$

$$H_{2(g)} + \tfrac{1}{2} O_{2(g)} \rightarrow H_2O_{(l)} \qquad\qquad \Delta H° = -286 \text{ kJ}$$

What is the value of $\Delta H°$ for the reaction?

$$CS_{2(l)} + 6H_2O_{2(l)} \rightarrow CO_{2(g)} + 6H_2O_{(l)} + 2SO_{2(g)}$$

(A) -1175 kJ*mol^{-1}
(B) -1151 kJ*mol^{-1}
(C) -1665 kJ*mol^{-1}
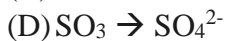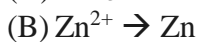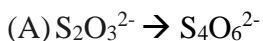(D) -3921 kJ*mol^{-1}

Answers

1. B
6. B
7. D
16. C

ELECTROCHEMISTRY AND REDOX

6. Which change requires an oxidizing agent to produce the indicated product?

(A) $S_2O_3^{2-} \rightarrow S_4O_6^{2-}$
(B) $Zn^{2+} \rightarrow Zn$
(C) $ClO^- \rightarrow Cl^-$
(D) $SO_3 \rightarrow SO_4^{2-}$

7. Which statement is true for this reaction?

$$Zn_{(s)} + CuSO_{4(aq)} \rightarrow Cu_{(s)} + ZnSO_{4(aq)}$$
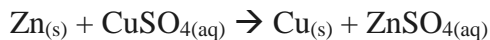
(A) Metallic Zinc is the reducing agent.
(B) Metallic Zinc is reduced.
(C) Copper ion is oxidized.
(D) Sulfate ion is the oxidizing agent.

8. In this reaction, which substance behaves as the oxidizing agent?

$$Pb_{(s)} + PbO_{2(s)} + 2H_2SO_{4(aq)} \rightarrow 2PbSO_{4(s)} + 2H_2O_{(l)}$$

(A) Pb
(B) $PbSO_4$
(C) PbO_2
(D) H_2SO_4

Answers

6. A
7. A
8. C

DESCRIPTIVE CHEMISTRY/PERIODICITY

13. Which statement best reflects the organization of the modern periodic table?

(A) Elements are always arranged in the order of increasing atomic weights.
(B) Metallic properties increase going from bottom to top in a family of elements.
(C) Nonmetallic properties tend to predominate for elements at the far right portion of the table.
(D) Each transition element is placed in the column of the main group element that it most closely resembles.

18. Which of these elements has the smallest atomic radius?

(A) Flourine
(B) Chlorine
(C) Bromine
(D) Iodine

22. Which isoelectronic ion is the smallest?

(A) Al^{3+}
(B) Na^+
(C) F^-
(D) O^{2-}

25. Which of the elements has the highest electronegativity?

(A) Oxygen

(B) Iodine
(C) Cesium
(D) Lithium

Answers

13. C

18. A

22. A

25. A

LAB CHEMISTRY

4. What is the correctly reported mass of water based on this data?

Experimental Data

Mass of beaker and water 29.62g

Mass of beaker only 28.3220 g

(A) 1.3 g
(B) 1.30 g
(C) 1.298 g
(D) 1.980 g

Answer: B