

QUESTION NO: 1

Which phenomenon can be explained by assuming strong hydrogen bonding?

- A. The boiling point of water is higher than that of H_2S .
- B. H_2 reacts with Cl_2 to form 2HCl .
- C. The boiling point of C_7H_{16} is higher than that of H_2S .
- D. The boiling point of H_2Se is higher than that of H_2S .
- E. Dissolving benzene, C_6H_6 in hexane, C_6H_{14} .

QUESTION NO: 2

At 23.0°C , the vapor pressure of pure carbon tetrachloride and dioxane are 100 and 38.0 torr respectively. Assuming ideal behavior, what is the vapor pressure of a solution of 16.0 moles of carbon tetrachloride and 4.00 moles of dioxane at 23°C ?

- A. 87.6 torr
- B. 50.4 torr
- C. 74.2 torr
- D. 62.8 torr
- E. 138 torr

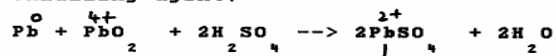
QUESTION NO: 3

A solution is prepared by mixing 35.05 g of ethylene glycol, $\text{C}_2\text{H}_6\text{O}_2$, with 136.47 g of water. The solution's density is 1.0270 g/ml. Determine the molarity of ethylene glycol in the solution.

- A. 3.381 M
- B. 0.5655 M
- C. 2.640 M
- D. 3.203 M
- E. 3.568 M

QUESTION NO: 4

In the following reaction, which substance behaves as the oxidizing agent?



- A. PbO_2
- B. Pb
- C. PbSO_4
- D. H_2SO_4
- E. H_2O

QUESTION NO: 5

Which aqueous solution has the smallest freezing point depression?

- A. 0.2 m K_3PO_4
- B. 0.2m $Ca(NO_3)_2$
- C. 0.2m $MgSO_4$
- D. 0.2m CH_3OH
- E. 0.2m $KClO_4$

QUESTION NO: 6

What volume of a 2.0 M $MgCl_2$ solution would be needed to make 3.0 L of a 1.0×10^{-2} M solution?

- A. 15 ml
- B. 6.0 ml
- C. 7.5 ml
- D. 60 ml
- E. 6.7 ml

QUESTION NO: 7

The boiling point constant for water is $0.520^\circ C/m$ and the normal boiling point of water is $100.00^\circ C$. A solution prepared by dissolving 13.8 g of an unknown nonelectrolyte in 100 g of water was found to boil at $100.92^\circ C$. Determine the molar mass of the unknown

- A. 78.0 g/mol
- B. 47.8 g/mol
- C. 66.0 g/mol
- D. 71.1 g/mol
- E. 246 g/mol

QUESTION NO: 8

The most important factor in determining the solubility of a solute in a solvent is,

- A. similar intermolecular forces
- B. osmotic pressure of the solvent
- C. melting point of solute
- D. boiling point of solute
- E. similar molar masses

QUESTION NO: 9

A liquid is considered to be boiling when

- A. its vapor pressure equals the pressure applied on the liquid.
- B. its vapor pressure equals one atmosphere.
- C. it begins to vaporize.
- D. equilibrium between the liquid and vapor phases exists.
- E. bubbles start appearing in the liquid.

QUESTION NO: 10

The edge of a unit cube of an element Y, containing two atoms per unit cubic cell was found (by X-ray diffraction) to be 3.16×10^{-8} cm. The density of the metal is 19.36 g/cm^3 . What is the approximate atomic mass of Y?

- A. 184 g/mol
- B. 65.4 g/mol
- C. 92.0 g/mol
- D. 238 g/mol
- E. 119 g/mol

QUESTION NO: 11

Which one of the following statements is TRUE?

- A. Dipole-dipole attractions between SO_2 molecules are weaker than the covalent bonds in SO_2 molecules.
- B. Covalent bonds are weaker than London forces between molecules.
- C. Covalent bonds have about the same strength as dipole-dipole attractions.
- D. Hydrogen bonds between water molecules are stronger than covalent bonds in water molecules.
- E. London dispersion forces are stronger than most ionic bonds.

QUESTION NO: 12

Determine the vapor pressure of a liquid at 25.0°C if its vapor pressure at 49.0°C is 101 torr and its heat of vaporization is 36.2 kJ/mole .

- A. 34.0 torr
- B. 16.5 torr
- C. 92.6 torr
- D. 101. torr
- E. 760 torr

QUESTION NO: 13

Considering the phase diagram of a certain substance, the phase transition with the smallest dependence on pressure is

- A. melting
- B. vaporization
- C. sublimation
- D. boiling
- E. condensation

QUESTION NO: 14

Considering liquids and solids, which one of the following statements is FALSE?

- A. The net number of spheres in a face-centered cubic unit cell is 8.
- B. The electron sea model for metals explains the high thermal and electrical conductivity of metals.
- C. London dispersion forces in nonpolar substances increase as their molar mass increase.
- D. The triple point is the point in the phase diagram at which solid, liquid and gas for a certain substance can coexist in a closed system.
- E. The temperature above which the vapor cannot be liquefied irrespective of the pressure applied is called critical temperature.

QUESTION NO: 15

What bonds are present in ethylene, C_2H_4 ?

- A. Five sigma bonds and one pi bond.
- B. Four sigma bonds and one pi bond.
- C. Six sigma bonds and one pi bond.
- D. Six sigma bonds.
- E. Four sigma bonds and two pi bonds.

QUESTION NO: 16

An sp hybridized central atom can be used to describe the bonding in

- A. HCN
- B. CH_4
- C. SO_3^{2-}
- D. OF_2
- E. H_2CO

QUESTION NO: 17

The geometric shape which most closely describes the carbonate ion, CO_3^{2-} , is

- A. trigonal planar
- B. V-Shape
- C. tetrahedral
- D. trigonal pyramidal
- E. square planar

QUESTION NO: 18

Ammonium nitrate compound:

- A. Exhibits both ionic and covalent bonding
- B. Exhibits only ionic bonding
- C. Exhibits only covalent bonding
- D. Has the formula NH_3NO_3
- E. Does not conduct electricity when dissolved in water

QUESTION NO: 19

In which of the following molecules is (are) the bond(s) the most polar?

- A. SiF_4
- B. ClF
- C. OF_2
- D. PF_3
- E. SF_6

QUESTION NO: 20

Calculate the lattice energy of cesium chloride, CsCl , from the following data:

ΔH_f° of $\text{CsCl} = -447 \text{ kJ/mol}$

$\Delta H_{\text{sublimation}}$ of $\text{Cs} = 78.2 \text{ kJ/mol}$

$\Delta H_{\text{ionization}}$ of $\text{Cs} = 375 \text{ kJ/mol}$

$\Delta H_{\text{dissociation}}$ of $\frac{1}{2} \text{Cl}_2$ mole = 121 kJ

$\Delta H_{\text{electron affinity}}$ of $\text{Cl} = -348 \text{ kJ/mol}$

- A. -673 kJ/mol
- B. -794 kJ/mol
- C. 716 kJ/mol
- D. 100 kJ/mol
- E. 1490 kJ/mol

QUESTION NO: 21

Resonance Lewis structures can be drawn for all the ions and molecules of the following list except,

- A. BCl_3
- B. SCN^-
- C. CS_3^{2-}
- D. SO_2
- E. NO_3^-

QUESTION NO: 22

Considering the molecular orbital model which one of the following statements is TRUE?

- A. When a set of p orbitals overlap in space, two types of molecular orbitals will be produced, namely, sigma and pi molecular orbitals.
- B. Atoms retain their individual orbitals in their molecules.
- C. The bond order for the diatomic molecule He_2 is 1.
- D. The electron pairs occupying the pi molecular orbitals are localized on certain atoms in the molecule.
- E. Fluorine, F_2 , is a paramagnetic molecule.

QUESTION NO: 23

Element X has the following ionization energies:

First	419 kJ/mol
Second	3015 kJ/mol
Third	4411 kJ/mol

Element X most likely is

- A. K
- B. Ca
- C. Si
- D. Br
- E. Al

QUESTION NO: 24

Which set of quantum numbers is correct and consistent with $n = 4$?

- A. $l = 3, m_l = -3, m_s = +1/2$
- B. $l = 4, m_l = 2, m_s = -1/2$
- C. $l = 2, m_l = 3, m_s = +1/2$
- D. $l = 3, m_l = -2, m_s = +1$
- E. $l = 0, m_l = 1, m_s = +1/2$

QUESTION NO: 25

What is the number of unpaired electrons in an isolated free iron atom in the ground state?

- A. Four
- B. Zero
- C. Two
- D. Three
- E. Five

QUESTION NO: 26

Which one of the following atoms has the lowest electron affinity?

- A. P
- B. O
- C. F
- D. Cl
- E. S

QUESTION NO: 27

Suppose the energy change for a transition between ground and excited electronic state is 5.00×10^2 kJ/mol. Calculate the wavelength for the photon necessary to induce this transition.

- A. 2.39×10^2 nm
- B. 3.97×10^{-31} m
- C. 9.93×10^{-14} nm
- D. 2.00×10^{-2} m
- E. 9.58×10^{-21} m

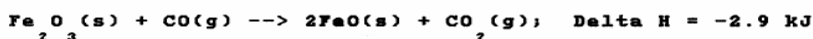
QUESTION NO: 28

A 10.0 g sample of silver is heated to 100°C and then added to 20.0 g of water at 23.0°C in an insulated calorimeter. At thermal equilibrium temperature of the system was measured as 25.0°C . The specific heat capacity of water is $4.2 \text{ J/g}\cdot^\circ\text{C}$. What is the specific heat capacity of silver?

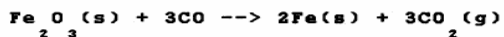
- A. $0.22 \text{ J/g}\cdot^\circ\text{C}$
- B. $8.4 \text{ J/g}\cdot^\circ\text{C}$
- C. $0.11 \text{ J/g}\cdot^\circ\text{C}$
- D. $17 \text{ J/g}\cdot^\circ\text{C}$
- E. $34 \text{ J/g}\cdot^\circ\text{C}$

QUESTION NO: 29

Give the following data



Calculate Delta H for the following reaction:



- A. -25.5 kJ
- B. -14.2 kJ
- C. -8.4 kJ
- D. +8.4 kJ
- E. -19.7 kJ

QUESTION NO: 30

Considering the principles of thermochemistry which one of the following statements is FALSE?

- A. The enthalpy of a system is a state property but its internal energy is not.
- B. At constant pressure q equals ΔH .
- C. ΔH for the reaction $\text{C}(\text{s}) + \text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g})$ is known as standard enthalpy of formation of CO_2 .
- D. For a constant volume process $\Delta E = q$.
- E. A system and its surroundings are called universe.

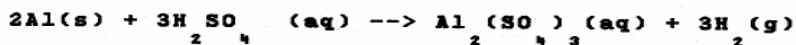
QUESTION NO: 31

The Kelvin temperature of one liter of gas is doubled and its pressure is tripled, volume will then be

- A. $2/3$ liter
- B. $1/6$ liter
- C. $3/2$ liters
- D. 6 liters
- E. $1/3$ liter

QUESTION NO: 32

How many liters of hydrogen gas at STP can be produced by the reaction of 9.00 g of Al with excess dilute H_2SO_4 ?



- A. 11.2 L
- B. 5.61 L
- C. 33.6 L
- D. 67.2 L
- E. 3.74 L

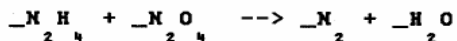
QUESTION NO: 33

The kinetic molecular theory of gases assumes that

- A. the volume of gas molecules is negligible.
- B. gas molecules exert no pressure on the walls.
- C. all gas molecules travel at the same velocity.
- D. the pressure is adjusted according to the intermolecular attraction and repulsion forces between gas molecules.
- E. the average kinetic energy of the gas molecules is independent of temperature.

QUESTION NO: 34

Consider the following unbalanced equation:



When this equation is balanced, how many moles of N_2 will be produced for every mole of N_2O that reacts?

- A. Three
- B. One
- C. Two
- D. Four
- E. Five

QUESTION NO: 35

How many moles of potassium ions, K^+ , are in 50.0 ml of 0.254 M K_3PO_4 solution?

- A. 0.0381
- B. 0.0127
- C. 0.497
- D. 1.49
- E. 0.762

QUESTION NO: 36

How many milliliters of 0.7059 M NaOH are required to react with 18.75 ml of 1.024 M HF?

- A. 24.43
- B. 5.670
- C. 40.95
- D. 42.90
- E. 21.45

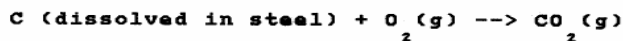
QUESTION NO: 37

A hydrocarbon undergoes complete combustion to give 0.44 g of CO_2 and 0.27 g of H_2O . What is the simplest (empirical) formula of the hydrocarbon?

- A. CH_3
- B. C_2H_3
- C. CH_4
- D. $\text{C}_{44}\text{H}_{27}$
- E. C_2H_8

QUESTION NO: 38

The carbon content of steel can be determined by burning the steel and measuring the CO_2 produced according to the following equation:



If 7.10 g sample of steel possesses 0.56 mass% C, how many grams of CO_2 should be produced?

- A. 0.15 g
- B. 0.011 g
- C. 0.04 g
- D. 1.1 g
- E. 44 g

QUESTION NO: 39

The proper name of the compound with the formula $\text{Fe}(\text{NO}_3)_3$ is

- A. iron (II) nitrate
- B. iron (III) nitrate
- C. iron (I) nitrate
- D. iron (II) nitride
- E. iron (I) dinitrate

QUESTION NO: 40

The stable isotope of fluorine is ^{19}F . The charge on the nucleus of the fluoride ion, F^- , is

- A. 9+
- B. 1+
- C. 1-
- D. 7+
- E. 10+