Q32. An aqueous solution is 14.0% by mass of HCl. What quantity (in grams) of HCl is dissolved in 129 g of solvent?

A) 9.21 B) 18.06 C) 23.16 D) 21.00

Q33. An aqueous solution that is 16% by mass of H_2SO_4 has a density of 1.109 g/mL at 25°C. What is the molarity (in M) of the solution at 25°C?

A) 1.1 B) 1.6 C) 1.8 D) 6.1

Q34. The density of a 1.22 M aqueous solution of sucrose is 1.12 g/mL. What is the molality of the solution (in molal)? The molar mass of sucrose is 342.296 g/mol.

A) 1.74 B) 11.20 C) 4.90 D) 11.09

Q35. If the aqueous solubility of oxygen gas at 0°C and an O_2 pressure of 1 atm is 2.18×10^{-3} mol/L. What will be the concentration (in mol/L) of oxygen dissolved in water when the O_2 pressure is 0.2095 atm at 0°C?

A) 2.18×10^{-3} B) 4.57×10^{-4} C) 1.46×10^{-2} D) 9.14×10^{-4}

Q36: How many moles of glucose must be added to 30.92 moles pure water to give a solution with a vapor pressure 1.5 mmHg less than that of pure water at 20°C? The vapor pressure of pure water at 20°C is 17.5 mmHg.

A) 9.0 B) 33.8 C) 8.5 D) 2.9

Q37. What is the freezing point (in °C) of a solution containing 5.52 moles of ethylene glycol in 2075 g of water? K_f(water) = 1.86 °C /m. The Freezing point of water is 0°C.

A) -4.48 B) 4.95 C) -4.95 D) 1.43

Q38. A solution is prepared by dissolving 15.2 g of unknown solute in 91.1 g of benzene. If the boiling point of the solution is 2.1°C above that of pure benzene, what is the molar mass (in g/mol) of the solute? K_b(benzene) = 2.53 °C /m.

A) 830 B) 756 C) 422 D) 201

Q39. At 25°C, what is the osmotic pressure (in atm) of a 25.00-mL sample of an aqueous solution containing 0.54 g of a human protein whose molar mass is 6.86×10^4 g/mol?

A) 1.93×10^{-4} B) 7.70×10^{-3} C) 5.86×10^{-4} D) 6.54×10^{-2}

Q40: An aqueous solution of hemoglobin has an osmotic pressure of 5 mmHg at 298 K. How many grams of hemoglobin are there in 0.25 L of this solution? The molar mass of hemoglobin is 6.51×10^4 g/mol.

A) 4.376 B) 3.326 C) 0.043 D) 5.150

* * *

Q22. What is the energy (in Joules) of a photon with a wavelength of 475 nm?

A) 3.15×10^{-31} B) 4.19×10^{-19} C) 4.18×10^{-28} D) 1.05×10^{-48}

Q23. What is the wavelength (in nm) of light emitted in an electron transition from $n = 3$ to the $n = 1$ in the hydrogen atom?

A) 1.94×10^{-18} B) 1.45×10^{-18} C) 1.03×10^{-7} D) 1.03×10^{2}

Q24. The work function of gold metal is 8.16×10^{-19} J. What is the kinetic energy (in Joules) of the ejected electron if light of frequency 2.11×10^{15} s^{-1} is used to irradiate the metal?

A) 2.21×10^{-18} B) 1.71×10^{-19} C) 5.83×10^{-19} D) 1.40×10^{-18}

Q25. What is the wavelength (in nm) of an electron moving with a speed of 2.18×10^{6} m/s?

A) 3.34×10^{-10} B) 0.334 C) 1.44 D) 1.24×10^{-10}

Q26. Which of the following sets of quantum numbers (n, l, m_l, m_s) is correct?

A) (2, 1, 0, 0) B) (2, 0, 1, 1/2) C) (2, 1, 0, 1/2) D) (2, 2, 0, -1/2)

Q27. What is the maximum number of electrons that can be accommodated in a subshell for which angular momentum quantum number $l = 3$?

A) 2 B) 6 C) 10 D) 14

Q28. A ground-state atom of cobalt, Co, has _____ unpaired electrons and it is _____.

A) 3, paramagnetic B) 2, diamagnetic C) 3, diamagnetic D) 7, paramagnetic

Q29. What is the maximum number of electrons in an atom that can have the following set of quantum numbers (n = 4, $l = 3$, $m_l = -2$, $m_s = +1/2$)?

A) 1 B) 2 C) 6 D) 10

Q30. Which of the following is the correct orbital diagram for a ground state oxygen atom?

A)

1s	2s	2p	
↑↓	↑↓	↑	↑↑ ↑

B)

1s	2s	2p	
↑↓	↑↓	↑↓	↑↓

C)

1s	2s	2p	
↑↓	↑↓	↑↓	↑ ↑

D)

1s	2s	2p	
↑↓	↑↓	↑↑	↑ ↑

Q31. What is the mole fraction of KI in a solution made by dissolving 1.66 g of KI in 0.25 mol water?

A) 3.8 B) 0.038 C) 3.99 D) 0.27

Q12. A 0.6760-g sample of an unknown compound containing barium ions (Ba^{2+}) is dissolved in water and treated with an excess of Na_2SO_4. If 0.4105 g of $BaSO_4$ precipitate forms, what is the percent by mass of Ba in the original unknown compound? The molar mass of $BaSO_4$ is 233.4 g.

A) 64.27% B) 58.83% C) 24.15% D) 35.73%

Q13. A sample of air occupies 3.8 L when the pressure is 1.2 atm, what volume (in mL) does it occupy at 5.7 atm?

A) 800.0 B) 2.0 C) 0.8 D) 1950.0

Q14. At STP, 0.25 L of a gas has a mass of 0.18 g. What is the molar mass of the gas?

A) 28.02 B) 44.0 C) 32.0 D) 16.1

Q15. A mixture of gases contains 0.31 moles He, 0.25 moles Ne, and 0.29 moles Ar. The total pressure is 1.50 atm. What is the partial pressure (in atm) of Ne gas in the mixture?

A) 0.63 B) 0.44 C) 0.38 D) 0.29

Q16. If it takes 190 seconds for SF_6 gas to effuse through a porous wall, how long will it take for the same volume of N_2 gas to effuse at the same temperature and pressure?

A) 433.8 B) 36.4 C) 83.2 D) 28.02

Q17. What is the root-mean-square speed (in m/s) of Ne atoms at 298 K?

A) 19 B) 60 C) 607 D) 3637

Q18. The work done to compress a gas is 0.73 L·atm. As a result, 27 J of heat is given off to the surroundings, what is the change (in Joules) in internal energy of the gas?

A) 26.27 B) 46.95 C) 27.73 D) 100.95

Q19. Determine the amount of heat (in kJ) evolved when 1.604 g of CH_4 are combusted according to equation: $CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(l)$ $\Delta H_{rxn} = -890.4$ kJ/mol

A) 89.03 B) 8.903 C) 1428.2 D) 8905.11

Q20. An Aluminum (Al) sample having a mass of 8.94 g at 81.70°C was placed in a constant-pressure calorimeter of negligible heat capacity containing 100.0 g of water. The water temperature rose from 23.40°C to 24.50°C. What is the specific heat (in J/g·°C) of the Aluminum sample? Specific heat of water is 4.184 J/g·°C.

A) 46.80 B) 8.90 C) 0.63 D) 0.90

Q21. What is the wavelength (in nm) of light having a frequency of 7.24×10^{14} Hz?

A) 4.14×10^{2} B) 4.14×10^{-7} C) 2.18×10^{23} D) 9.14×10^{-49}

Choose the correct answer for each question and mark the corresponding letter on the answer sheet provided on page one.

Q1. How many picometers (pm) are there in 7.5×10^{-11} m?

A) 0.75 B) 75.0 C) 750.0 D) 7500.0

Q2. What is 194.5 Kelvins in degrees Fahrenheit (°F)?

A) 873.5 B) –173.3 C) –109 .3 D) –11.6

Q3. How many protons (p), neutrons (n), and electrons (e) in an atom of $^{137}Ba^{2+}$?

A) 56 p, 81 n, 58 e B) 137 p, 81 n, 56 e C) 56 p, 81 n, 56 e D) 56 p, 81 n, 54 e

Q4. Which one of the following elements is most likely to form a 3- ion?

A) Nitrogen B) Aluminum C) Magnesium D) Sulfur

Q5. What is the formula for the ionic compound containing magnesium ions and hypochlorite ions?

A) $MgCl_2$ B) $Mg(ClO_3)_2$ C) $MgClO_2$ D) $Mg(ClO)_2$

Q6. How many water molecules are there in 9.0 g sample of water?

A) 2.021×10^{23} B) 6.022×10^{23} C) 3.011×10^{23} D) 1.506×10^{23}

Q7. An element X combines with oxygen to form a compound with formula X_2O_3. If 10.02 g of this element combines with 8.91 g of oxygen, what is the element X?

A) Aluminum B) Iron C) Gold D) Silver

Q8. How many moles of carbon dioxide are produced when 0.45 moles of propane (C_3H_8) is combusted according to this equation?

$$C_3H_8 + 5O_2 \longrightarrow 3CO_2 + 4H_2O$$

A) 1.45 B) 1.35 C) 0.45 D) 0.15

Q9. What volume (in mL) of 11.3 M HCl must be mixed with water to make 1.00 L of 0.56 M HCl?

A) 49.6 B) 52.9 C) 20.2 D) 947.1

Q10. Which of the following is a strong acid?

A) HF B) HNO_3 C) CH_3COOH D) H_3PO_4

Q11. Which of the following is a Brønsted base?

A) HCl B) NH_4^+ C) SO_4^{2-} D) Na^+