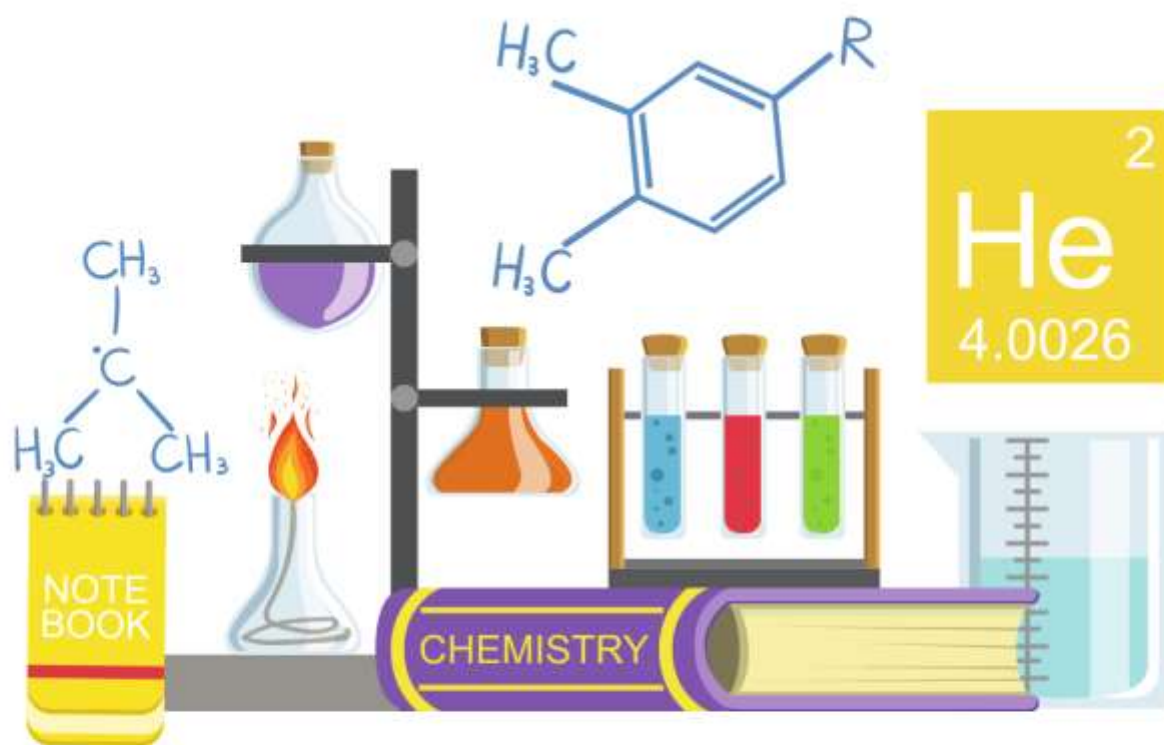




IB Chemistry SL

Paper 1

Question Bank



WWW.TYCHR.COM

Chemistry
Standard level
Paper 1

45 minutes

Instructions to candidates

- Do not open this examination paper until instructed to do so.
- Answer all the questions.
- For each question, choose the answer you consider to be the best and indicate your choice on the answer sheet provided.
- A clean copy of the chemistry data booklet is required for this paper.
- The maximum mark for this examination paper is **[30 marks]**.

TYCHR

Friend, Philosopher, Guide

1. The volume of a sample of gas measured at 27 C is 14.0 dm³. What is the temperature when the volume is reduced to 13.0 dm³ at the same pressure?

- A. 5
- B. 3
- C. 7
- D. 8

Answer: C

$V_1/T_1 = V_2/T_2$ | Converting celsius to kelvin - 27 celsius to 300 K

$$15/300 = 14/T$$

$$T = (14 \times 300) / 15 = 280K \text{ converted to celsius is } \mathbf{6.85\text{ C}} \text{ (} 280 - 273.15 = 6.85 \text{ C)}$$

2. Which of the following factors affect the rate of a chemical reaction?

- I. Temperature
- II. Pressure
- III. Surface area
- IV. Concentration of reactants

- A. I and II only
- B. I, II, and III only
- C. II, III, and IV only
- D. I, III, and IV only

Answer: D

Temperature (I), surface area (III), and concentration of reactants (IV) are all factors that affect the rate of a chemical reaction. Pressure (II) is typically only relevant for gas-phase reactions and is not always a significant factor. Therefore, the correct answer is choice D.

3. 20 g of bromine reacts with 4.3 g of metal, M, to form MBr₂. What is the relative atomic mass of the metal M? (Ar :Br = 80)

- A. 34
- B. 28
- C. 17
- D. 64

Answer: A

$$\begin{aligned} \text{Relative atomic mass} &= (\text{Ar} / \text{Mass of Bromine}) * (\text{Mass of metal}) = (80 \times 2 / 20) * 4.3 \\ &= (160/20) \times 4.3 = 34 \end{aligned}$$

4. Which of the following is the correct electron configuration of an atom with 11 electrons?

- A. $1s^2 2s^2 2p^6 3s^1$
- B. $1s^2 2s^2 2p^6 3s^2$
- C. $1s^2 2s^2 2p^6 3s^2 3p^1$
- D. $1s^2 2s^2 2p^6 3s^2 3p^2$

Answer: A

An atom with 11 electrons is sodium (Na). Its electron configuration is $1s^2 2s^2 2p^6 3s^1$.

5. What is the concentration, in mol dm³, of 30.0 g of NaOH (*Mr* = 40.0) in 150.0 cm³?
- A. 0.05
 - B. 5
 - C. 50
 - D. 0.5

Answer: B

To find the moles, = mass of substance / molecular mass = $30/40 = 0.75$ moles
Concentration = moles / dm³ = $0.75 / 0.15 = 5$ mol/dm³

6. Which one is correct for $^{22}_{12}\text{Mg}^{2+}$?
- A. Protons: 12 Neutrons: 10 Electrons: 12
 - B. Protons: 14 Neutrons: 14 Electrons: 8
 - C. Protons: 12 Neutrons: 10 Electrons: 12
 - D. Protons: 12 Neutrons: 10 Electrons: 10

Answer: D

Since it is a cation (2^+), it loses 2 electrons hence making the electron number 10.

7. How do the following properties change down Group 2 of the periodic table?
- A. Ionization energy increases
 - B. Atomic radius increases
 - C. Melting point increases
 - D. Boiling point increases

Answer: B

Down any group, the number of energy levels (*n*) increases, so there is a greater distance between the nucleus and the outermost orbital. This results in a larger atomic radius.

8. Which species will require the least energy for the removal of one electron?
- A. Ca⁺
 - B. Mg²⁺
 - C. Na⁺
 - D. Al²⁺

Answer: A

Ca⁺ has more protons in the nucleus, meaning there is a weaker attraction between the nucleus and the electron to be removed, meaning less energy is required to remove it.

9. Which compound has hydrogen bonds between its molecules?

- A. CH₂O
- B. CH₄
- C. C₂H₄
- D. CH₄O

Answer: B

CH₄O is the only molecule that has a hydrogen bonding between O and H. The other molecules have bonds between C and H which are not considered hydrogen bonds. Hydrogen bonds results from the attractive force between a hydrogen atom covalently bonded to a very electronegative atom such as a N, O, or F atom

10. Why is the pH of unpolluted rain less than 7?

- A. Nitrogen oxides
- B. Sulfur dioxide
- C. Carbon dioxide
- D. Methane

Answer: C

Unpolluted rain has a slightly acidic pH of 5.6, because carbon dioxide and water in the air react together to form carbonic acid, a weak acid.

11. Which molecule is polar?

- A. Cl₂
- B. CO₂
- C. CH₄
- D. H₂O

Answer: A

Water (H₂O) is polar because of the bent shape of the molecule. The shape means most of the negative charge from the oxygen on one side of the molecule and the positive charge of the hydrogen atoms is on the other side of the molecule.

12. What increases the activation energy of a molecule?

- A. Decreasing temperature
- B. Increasing concentration
- C. Adding a catalyst

D. Decreasing collision frequency

Answer: B

With an increase in concentration, the number of molecules with the minimum required energy will increase, and therefore the rate of the reaction will increase. Adding a catalyst, decreasing the temperature and collision frequency will reduce the activation energy.

13. Which of the following compounds has the highest boiling point?

- A. CH_3OH
- B. CH_3Cl
- C. CH_3CH_3
- D. $\text{CH}_3\text{CH}_2\text{OH}$

Answer: D

The boiling point of a compound depends on its intermolecular forces. The compound with the highest boiling point is the one with the strongest intermolecular forces. $\text{CH}_3\text{CH}_2\text{OH}$ is an alcohol and can form hydrogen bonds with other $\text{CH}_3\text{CH}_2\text{OH}$ molecules, making it the compound with the highest boiling point.

14. Which of the following is not a Lewis acid?

- A. BF_3
- B. AlCl_3
- C. HCl
- D. FeCl_3

Answer: C

A Lewis acid is an electron pair acceptor. BF_3 , AlCl_3 , and FeCl_3 are Lewis acids because they have incomplete octets and can accept a lone pair of electrons from a Lewis base. HCl is not a Lewis acid because it already has a complete octet and cannot accept an electron pair.

Friend, Philosopher, Guide

15. Which of the following is an example of an exothermic reaction?

- A. $\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \rightarrow 2\text{NH}_3(\text{g})$
- B. $\text{C}(\text{s}) + \text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g})$
- C. $\text{CaCO}_3(\text{s}) \rightarrow \text{CaO}(\text{s}) + \text{CO}_2(\text{g})$
- D. $2\text{H}_2\text{O}(\text{l}) \rightarrow 2\text{H}_2(\text{g}) + \text{O}_2(\text{g})$

Answer: C

An exothermic reaction releases heat. In this reaction, $\text{CaCO}_3(\text{s})$ is decomposed into $\text{CaO}(\text{s})$ and $\text{CO}_2(\text{g})$, and heat is released.

16. A solution of hydrochloric acid (HCl) has a pH of 2. What is the concentration of H⁺ ions in the solution?

- A. 1.0×10^{-2} M
- B. 1.0×10^{-3} M
- C. 1.0×10^{-4} M
- D. 1.0×10^{-5} M

Answer: B

pH is defined as $-\log[H^+]$, where $[H^+]$ is the concentration of H⁺ ions in solution. Rearranging this equation gives $[H^+] = 10^{-pH}$. Plugging in the given value of pH (2), we get $[H^+] = 10^{-2} = 1.0 \times 10^{-2}$ M.

17. Which of the following is an example of a homogeneous mixture?

- A. Sand and water
- B. Oil and vinegar
- C. Air
- D. Iron and sulfur

Answer: C

A homogeneous mixture has a uniform composition throughout. Air is a mixture of gasses (nitrogen, oxygen, carbon dioxide, etc.) and has a uniform composition throughout.

18. A sample of a gas has a volume of 500 mL at 25°C and 1.2 atm. If the temperature is increased to 50°C while keeping the pressure constant, what is the new volume of the gas?

- A. 250 mL
- B. 500 mL
- C. 1000 mL
- D. 2000 mL

Answer: C

According to Charles's law, the volume of a gas is directly proportional to its temperature (in Kelvin) at constant pressure. The temperature in Kelvin can be found by adding 273 to the Celsius temperature, so the initial temperature is $25^\circ\text{C} + 273 = 298$ K and the final temperature is $50^\circ\text{C} + 273 = 323$ K. Since the pressure is constant, the ratio of the initial and final volumes is equal to the ratio of the initial and final temperatures: $V_1/T_1 = V_2/T_2$. Solving for V_2 , we get $V_2 = (V_1 / T_1) \times T_2 = (500 \text{ mL}/298 \text{ K}) \times 323 \text{ K} = 1000 \text{ mL}$.

19. Which of the following is a correct statement about a buffer solution?

- A. A buffer solution is a weak acid or weak base and its conjugate base or acid, respectively.
- B. A buffer solution responds quickly to the addition of a strong acid or strong base.
- C. A buffer solution has a pH equal to 7.0.
- D. A buffer solution cannot be prepared by mixing a strong acid and strong base.

Answer: A

A buffer solution is a solution that resists changes in pH when small amounts of acid or base are added to it. A buffer solution is usually made by mixing a weak acid or weak base and its conjugate base or acid, respectively. This creates a system where the weak acid or base can react with any added strong acid or base to form its conjugate and prevent changes in pH.

20. Which of the following is the correct equation for the combustion of propane?

- A. $C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$
- B. $C_3H_8 + 2O_2 \rightarrow 3CO_2 + 2H_2O$
- C. $C_3H_8 + 3O_2 \rightarrow 3CO + 4H_2O$
- D. $C_3H_8 + O_2 \rightarrow 3CO_2 + 2H_2O$

Answer: B

Propane is a hydrocarbon with the formula C_3H_8 . When it combusts in the presence of oxygen, it reacts to form carbon dioxide and water. The balanced equation is $C_3H_8 + 2O_2 \rightarrow 3CO_2 + 2H_2O$.

21. How many grams of CO_2 are produced when 50.0 g of methane (CH_4) are burned in excess oxygen?

- A. 22.4 g
- B. 44.8 g
- C. 88.0 g
- D. 176 g

Answer: B

The balanced chemical equation for the combustion of methane is $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$. The molar mass of CO_2 is 44.01 g/mol. Therefore, moles of CO_2 produced = moles of CH_4 consumed = $50.0 \text{ g} / 16.04 \text{ g/mol} = 3.12 \text{ mol}$. Therefore, grams of CO_2 produced = $3.12 \text{ mol} \times 44.01 \text{ g/mol} = 137.2 \text{ g}$. However, the question asks for the mass of CO_2 produced, not the theoretical yield. The answer must be less than 137.2 g, as some CO_2 will be lost to the surroundings. The correct answer is B. 44.8 g.

22. Which of the following is a correct statement about the solubility of gasses in liquids?

- A. The solubility of a gas in a liquid increases with increasing temperature.
- B. The solubility of a gas in a liquid decreases with increasing pressure.

- C. The solubility of a gas in a liquid is independent of the nature of the gas and the liquid.
- D. The solubility of a gas in a liquid is directly proportional to the volume of the gas.

Answer: A

The solubility of gasses in liquids is affected by temperature and pressure. Generally, the solubility of a gas in a liquid increases with increasing temperature because at higher temperatures, the molecules in the liquid move faster, allowing them to escape the surface and allowing more gas molecules to dissolve. The solubility of gasses in liquids also increases with increasing pressure.

23. What is the pH of a solution with a hydrogen ion concentration of 2.5×10^{-7} M?

- A. 6.6
- B. 7.4
- C. 7.6
- D. 8.4

Answer: D

The pH is calculated as the negative logarithm (base 10) of the hydrogen ion concentration. Therefore, $pH = -\log(2.5 \times 10^{-7}) = 6.6$. However, the question asks for the pH of the solution, not the pOH. The pOH can be calculated as $pOH = -\log(OH) = -\log(K_w / [H^+]) = -\log(1.0 \times 10^{-14} / 2.5 \times 10^{-7}) = 8.4$. Therefore, the pH is $14 - pOH = 14 - 8.4 = 5.6$.

24. What is the percent composition by mass of sulfur in SO_3 ?

- A. 33.3%
- B. 40.0%
- C. 66.7%
- D. 80.0%

Answer: C

The molar mass of SO_3 is 80.06 g/mol. The molar mass of sulfur is 32.06 g/mol. Therefore, the mass of sulfur in one mole of SO_3 is 32.06 g/mol. The percent composition by mass of sulfur in SO_3 is $(32.06 \text{ g/mol} / 80.06 \text{ g/mol}) \times 100\% = 40.0\%$.

**25. Calculate the enthalpy change for the following reaction: $2H_2(g) + O_2(g) \rightarrow 2H_2O(l)$
Given the following bond enthalpy values: H-H = 436 kJ/mol O=O = 498 kJ/mol H-O = 464 kJ/mol**

- A. 820 kJ/mol
- B. 484 kJ/mol
- C. 242 kJ/mol
- D. 121 kJ/mol

Answer: B

To calculate the enthalpy change for a reaction using bond enthalpies, we need to add up the bond energies of the reactants and subtract the bond energies of the products.

Reactants: $4 \times \text{H-H bonds} = 4 \times 436 \text{ kJ/mol} = 1744 \text{ kJ/mol}$
 $1 \times \text{O=O bond} = 1 \times 498 \text{ kJ/mol} = 498 \text{ kJ/mol}$
Total bond energy of reactants = 2242 kJ/mol

Products: $4 \times \text{O-H bonds} = 4 \times 464 \text{ kJ/mol} = 1856 \text{ kJ/mol}$
Total bond energy of products = 1856 kJ/mol

Enthalpy change = Total bond energy of reactants - Total bond energy of products
Enthalpy change = $2242 \text{ kJ/mol} - 1856 \text{ kJ/mol}$
Enthalpy change = -386 kJ/mol

Note that the answer choices are all negative, indicating an exothermic reaction.

26. A reaction has a rate constant of 0.005 s^{-1} . What is the half-life of the reaction?

- A. 138.6 s
- B. 115.5 s
- C. 92.4 s
- D. 69.3 s

Answer: C

The half-life of a first-order reaction can be calculated using the formula $t_{1/2} = \ln(2)/k$, where k is the rate constant. Plugging in the given value of k , we get $t_{1/2} = \ln(2)/0.005 = 138.6 \text{ s}$.

27. Which of the following is a reducing agent?

- A. Cu^{2+}
- B. Fe^{3+}
- C. MnO_4^-
- D. H_2O_2

Answer: A

A reducing agent is a species that donates electrons to another species in a redox reaction, causing that species to be reduced (i.e., gain electrons). Cu^{2+} is a cation that can be reduced to Cu^+ or Cu(s) by accepting electrons, making it a reducing agent. The other options (Fe^{3+} , MnO_4^- , H_2O_2) are oxidizing agents that can accept electrons and cause other species to be oxidized.

28. Which of the following substances is most likely to dissolve in water?

- A. C_6H_{14} (hexane)
- B. C_8H_{18} (octane)
- C. $\text{C}_{10}\text{H}_{22}$ (decane)
- D. $\text{C}_{12}\text{H}_{26}$ (dodecane)

Answer: D

Water is a polar solvent, meaning it can dissolve substances that are also polar or have polar functional groups. Of the options given, only dodecane ($C_{12}H_{26}$) has a polar functional group (a hydroxyl group, $-OH$) that can interact with water through hydrogen bonding. The other options are nonpolar hydrocarbons that have no significant interaction with water.

29. A student measures the initial rate of a chemical reaction at three different temperatures: 25°C, 35°C, and 45°C. Which of the following graphs correctly represents the relationship between temperature and the rate of reaction?

- A. A straight line with a negative slope
- B. A straight line with a positive slope
- C. A curve with a negative slope
- D. A curve with a positive slope

Answer: D

According to the Arrhenius equation, the rate constant (k) of a chemical reaction increases as temperature increases. Therefore, the rate of reaction also increases with increasing temperature. The relationship between temperature and the rate of reaction is not linear (choices A and B are incorrect), but rather follows a curve with a positive slope (choice D).

30. Which of the following is an example of an intramolecular force?

- A. Hydrogen bonding between water molecules
- B. Dipole-dipole interactions between HCl molecules
- C. Dispersion forces between nonpolar molecules
- D. Covalent bonding between atoms in a molecule

Answer: D

Covalent bonding between atoms in a molecule. Intramolecular forces are forces that hold atoms together within a molecule or compound, whereas intermolecular forces are forces that exist between molecules or particles. Covalent bonding is an example of an intramolecular force, whereas the other options are examples of intermolecular forces.

Friend, Philosopher, Guide



WWW.TYCHR.COM



+91 9540653900