AQA (GCSE Notes)

Chapter 3: Quantitative Chemistry

Q1. State the law of conservation of mass in simple terms.
Answer: The law of conservation of mass means that in a chemical reaction, the total mass of the reactants is always equal to the total mass of the products. No atoms are created or destroyed; they are just rearranged. This means the number and type of atoms on both sides of the chemical equation stay the same.

Q2. Why does the total mass of reactants equal the total mass of products in a chemical reaction?
Answer: The total mass of the reactants equals the total mass of the products because the atoms involved in the reaction are not lost or made. They are simply rearranged to form new substances. Since all atoms are conserved, their total mass remains constant throughout the reaction.

Q3. Explain how a balanced symbol equation supports the law of conservation of mass.
Answer: A balanced symbol equation ensures that the number of atoms of each element is the same on both sides of the reaction. This means no atoms are gained or lost, just rearranged. Because atoms have mass, and the number of atoms stays the same, the total mass is also conserved.

Q4. Why is it important to balance chemical equations?
Answer: It is important to balance chemical equations so that they accurately reflect the law of conservation of mass. A balanced equation shows the correct ratio of reactants to products and ensures that the same number of atoms of each element are present on both sides of the equation, which keeps the total mass consistent.

Q5. Describe what is meant by a balanced chemical equation.
Answer: A balanced chemical equation is one in which the number of atoms of each element is the same on both sides of the arrow. This shows that the mass is conserved during the reaction and that the equation obeys the law of conservation of mass.

Q6. What does a subscript number in a chemical formula show?
Answer: A subscript number in a chemical formula shows the number of atoms of that element in one molecule of the compound. For example, in H_2O, the subscript 2 means there are two hydrogen atoms for every one oxygen atom in each water molecule.

Q7. What does a number in front of a chemical formula in an equation mean?
Answer: A number in front of a chemical formula in an equation is called a coefficient. It tells you how many molecules or moles of that substance are involved in the reaction. For example, $2H_2$ means two molecules (or moles) of hydrogen gas.

Q8. In the equation $2H_2 + O_2 \rightarrow 2H_2O$, explain the role of the number 2 in front of H_2 and H_2O.
 Answer: The number 2 in front of H_2 means there are two molecules (or moles) of hydrogen reacting. The 2 in front of H_2O means that two molecules (or moles) of water are formed. These coefficients help balance the number of hydrogen and oxygen atoms on both sides, showing mass is conserved.

Q9. What would happen if you did not balance the number of atoms on both sides of an equation?
 Answer: If a chemical equation is not balanced, it suggests that atoms are either created or destroyed during the reaction, which is not possible. This would break the law of conservation of mass and lead to incorrect predictions about the amounts of substances involved.

Q10. Give an example of a chemical equation where the number of atoms of each element is the same on both sides.
 Answer: An example is: $2H_2 + O_2 \rightarrow 2H_2O$. On both sides, there are four hydrogen atoms and two oxygen atoms, meaning the equation is balanced and follows the law of conservation of mass.

Q11. How can a balanced equation help us calculate the mass of products formed?
 Answer: A balanced equation shows the mole ratio between reactants and products. If we know the mass of a reactant, we can convert it to moles, use the ratio to find the moles of the product, and then convert that to mass. This helps us predict how much product will be formed.

Q12. What do you understand by the term 'relative formula mass' (Mr)?
 Answer: Relative formula mass (Mr) is the sum of the relative atomic masses of all atoms in a chemical formula. It represents the mass of one mole of that compound and is used in calculations involving moles and mass.

Q13. How is relative formula mass calculated from a chemical formula?
 Answer: To calculate the relative formula mass, you add the relative atomic masses (Ar) of each atom in the formula, multiplied by how many times that atom appears. For example, in H_2O, it's $(2 \times 1) + (1 \times 16) = 18$.

Q14. What is the Mr of H_2O?
 Answer: The Mr of H_2O is calculated by adding the atomic masses: (2×1) for hydrogen and (1×16) for oxygen, which equals 18.

Q15. Why do we use relative atomic masses when calculating Mr?
 Answer: We use relative atomic masses because they give us a way to compare the mass of atoms on a scale where carbon-12 is exactly 12. These values are used to calculate the Mr of compounds so we can work out quantities in chemical reactions.

Q16. In the formula NaCl, what is the total Mr?
 Answer: In NaCl, sodium has an Ar of 23 and chlorine has an Ar of 35.5. Adding these gives a total Mr of 58.5.

Q17. How can you check that the total Mr of the products equals the total Mr of the reactants?
 Answer: To check this, calculate the Mr for each compound on both sides of the equation and ensure their totals are the same. This confirms that mass is conserved in the reaction.

Q18. In a balanced chemical equation, what must be equal on both sides?
 Answer: In a balanced chemical equation, the number of atoms of each element and the total mass must be equal on both sides. This ensures the law of conservation of mass is followed.

Q19. How can you calculate the percentage by mass of an element in a compound?
 Answer: To find the percentage by mass, divide the total mass of the element in the compound by the Mr of the compound and multiply by 100. This shows what portion of the compound's mass comes from that element.

Q20. Calculate the percentage by mass of carbon in CO_2.
 Answer: The Ar of carbon is 12, and CO_2 has a total Mr of 44 (12 + 2 × 16). The percentage by mass is (12 / 44) × 100 = 27.27%.

Q21. Why might the mass appear to increase when a metal reacts with oxygen in open air?
 Answer: When a metal reacts with oxygen in open air, it combines with oxygen from the air, which adds mass to the metal. The oxygen's mass wasn't originally measured with the metal, so the product appears heavier.

Q22. What happens to the mass during the thermal decomposition of a metal carbonate?
 Answer: During thermal decomposition, carbon dioxide gas is released into the air and is not weighed. This loss of gas makes it seem like the mass has decreased, even though it follows the conservation of mass when the gas is included.

Q23. Why does the mass seem to decrease in some reactions that produce a gas?
 Answer: In reactions that produce gas, the gas often escapes into the air and is not included in the final mass measurement. This makes it appear as though mass was lost, but the total mass is still conserved if the gas is accounted for.

Q24. Explain why a change in mass might be observed in an open system.
 Answer: In an open system, gases can enter or leave the reaction container. If a gas escapes, the measured mass may decrease. If a gas from the air is taken in, the mass may increase. These changes are due to unmeasured gases.

Q25. How does the particle model help explain mass changes in chemical reactions?
 Answer: The particle model shows that atoms and molecules are tiny particles that move and can be rearranged. In open systems, particles like gas can escape or enter. The model explains how these movements cause observed mass changes while still obeying the conservation of mass.

Q26. What is an open system in terms of chemical reactions?
 Answer: An open system in a chemical reaction is one where substances, especially gases, can enter or leave the reaction container. This means the system is not sealed, so gases produced may

escape into the air, or gases from the air might be absorbed. Because of this, the total measured mass may change during the reaction, even though the number of atoms is still conserved.

Q27. What is a closed system in chemical reactions?
Answer: A closed system is one in which no substances can enter or leave during the reaction. This setup prevents the escape of any gases or other substances, ensuring that the mass remains constant throughout the experiment. Closed systems are used to accurately observe the law of conservation of mass.

Q28. Explain how the mass of magnesium increases after burning in air.
Answer: When magnesium burns in air, it reacts with oxygen to form magnesium oxide. The mass increases because oxygen from the air combines with the magnesium. Since the oxygen was not originally part of the weighed magnesium, it adds to the total mass after the reaction.

Q29. Why does mass stay constant in a sealed container during a reaction?
Answer: In a sealed container, no substances can escape or enter, including gases. This means all reactants and products stay inside, so the total mass before and after the reaction remains the same. The sealed setup prevents loss or gain of mass from the surroundings.

Q30. Why might the total mass of products be less than expected if gas escapes?
Answer: If a gas produced in the reaction escapes into the air and is not collected or measured, the remaining products will appear to have less mass than expected. This happens in open systems, where escaping gas leads to a lower final mass even though all atoms are still accounted for.

Q31. Describe what is observed when calcium carbonate is heated strongly.
Answer: When calcium carbonate is heated strongly, it breaks down in a thermal decomposition reaction. The solid gradually turns into calcium oxide (a white solid), and carbon dioxide gas is released. You may observe fizzing or bubbling if the gas is collected in water.

Q32. What gas is released during the decomposition of metal carbonates?
Answer: Carbon dioxide gas (CO_2) is released during the thermal decomposition of most metal carbonates. This gas escapes into the air if the system is open, which can cause a decrease in the measured mass of the solid residue.

Q33. Why should gas be included when calculating total mass change?
Answer: Gas should be included because it is a product of the reaction and has mass. If it escapes and is not considered, it will appear that mass is lost, even though the atoms are still conserved. Including gas ensures the law of conservation of mass is correctly applied.

Q34. How can you confirm the conservation of mass in a reaction that involves gases?
Answer: To confirm conservation of mass in such reactions, conduct the experiment in a closed system so gases cannot escape. By weighing the sealed container before and after the reaction, you can see that the mass remains unchanged, proving that all atoms are accounted for.

Q35. Suggest an experiment to show that mass is conserved during a chemical reaction.
Answer: One simple experiment is mixing vinegar and baking soda in a sealed container placed on

a balance. The reaction produces carbon dioxide, but if the container is sealed, the gas cannot escape. The mass before and after the reaction remains the same, showing conservation of mass.

Q36. What equipment could you use to measure mass changes during a reaction?
Answer: You can use a digital balance to measure the mass accurately. For reactions involving gases, use a sealed container such as a conical flask with a stopper or a closed syringe system to prevent mass loss during the reaction.

Q37. Why is it important to use a sealed container in mass change experiments?
Answer: A sealed container prevents any gases from escaping or external substances from entering. This ensures that all reactants and products stay within the system, so any changes in mass are due to the reaction itself and not external factors. It helps verify the conservation of mass.

Q38. What error might occur in mass change experiments done in an open beaker?
Answer: In an open beaker, gases produced during the reaction can escape into the air. This causes the measured mass to decrease, even though no atoms are actually lost. This error leads to incorrect conclusions about mass conservation.

Q39. What would you observe if you heated zinc carbonate strongly?
Answer: When zinc carbonate is heated strongly, it decomposes into zinc oxide and carbon dioxide gas. You would observe the solid changing from pale green to yellow (zinc oxide) and the release of gas. If cooled, the zinc oxide may turn white again.

Q40. Give a reason why the mass of a solid product might be more than the metal it came from.
Answer: The mass of a solid product may be more than the starting metal because the metal has reacted with a gas, such as oxygen, from the air. The gas adds to the total mass of the product, such as in the formation of metal oxides.

Q41. What is thermal decomposition? Give one example.
Answer: Thermal decomposition is a reaction where a single substance breaks down into two or more products when heated. An example is calcium carbonate ($CaCO_3$) breaking down into calcium oxide (CaO) and carbon dioxide (CO_2) when heated strongly.

Q42. How does mass change when a metal carbonate decomposes?
Answer: When a metal carbonate decomposes, carbon dioxide gas is released and may escape into the air, causing the measured mass to decrease. However, if all products are captured and weighed, the total mass remains the same, proving conservation of mass.

Q43. What role does oxygen play in increasing the mass of a metal after reaction?
Answer: When a metal reacts with oxygen, such as during burning, oxygen atoms from the air combine with the metal atoms to form an oxide. Since the oxygen atoms have mass and are now part of the product, they increase the total mass of the substance.

Q44. Why do symbol equations need to show correct chemical formulas?
Answer: Correct chemical formulas ensure that the number of atoms of each element is accurately

represented. This is important for balancing equations, understanding how much of each substance is involved, and applying the conservation of mass correctly.

Q45. Why is it incorrect to write H2O as HO2 in a balanced equation?
 Answer: Writing H2O as HO2 is incorrect because it changes the number and arrangement of atoms. H2O is water with 2 hydrogen and 1 oxygen atom, while HO2 has a different structure and properties. Incorrect formulas lead to incorrect calculations and violate the conservation of mass.

Q46. What safety precautions are needed when investigating mass change in reactions involving heat?
 Answer: Wear safety goggles and heat-resistant gloves, use tongs for handling hot equipment, conduct reactions in a well-ventilated area or fume hood, and ensure flammable substances are kept away. Always follow lab safety rules to prevent burns and inhalation of gases.

Q47. Why is weighing before and after a reaction useful in experiments?
 Answer: Weighing before and after allows you to compare the total mass and check whether it stayed the same. This helps confirm whether mass was conserved or if any substances, like gases, were lost or gained during the reaction.

Q48. How can a reaction be designed to prove that no atoms are lost?
 Answer: A reaction can be designed using a sealed container on a balance. If the mass stays the same before and after the reaction, it shows that all atoms remained within the system. Choosing reactions that produce gases helps clearly demonstrate mass conservation.

Q49. What does WS 1.2 focus on when interpreting chemical equations?
 Answer: WS 1.2 focuses on developing practical skills, such as using balanced equations to represent reactions and understanding how to apply the conservation of mass. It helps students interpret and use chemical symbols and equations accurately in experimental contexts.

Q50. Why is understanding mass changes in chemical reactions important in real-life applications?
 Answer: Understanding mass changes is important in areas like medicine, food production, and manufacturing. It ensures the correct amounts of substances are used and helps control waste and cost. It also supports safety and environmental responsibility by predicting material outputs.

Q51. What does the term "uncertainty" mean in the context of a scientific measurement?
 Answer: In science, "uncertainty" refers to the range within which the true value of a measurement is expected to lie. It reflects the possible error in a measurement due to limitations of the measuring instrument or method. It is not a mistake but a natural part of making any measurement, and helps communicate how precise the result is.

Q52. How can the range of a set of results be used to estimate uncertainty?
 Answer: The range of a set of results is the difference between the highest and lowest values recorded. To estimate uncertainty, scientists often take half the range and report it as ± uncertainty around the mean. This gives a realistic estimate of how much variation there was in the measurements.

Q53. Why do repeated measurements help reduce uncertainty?
 Answer: Repeating measurements helps identify random errors and provides more data to calculate a reliable average (mean). It reduces the effect of anomalies and increases the accuracy of the final result. With more repeated values, the estimate of uncertainty becomes more precise.

Q54. How can a graph be used to show the distribution of results from repeated measurements?
 Answer: A graph, such as a scatter plot or bar chart, can show the spread of individual data points. This visual distribution helps identify any outliers and gives a clearer picture of how consistent the results are. The range or spread on the graph indicates the uncertainty.

Q55. What is meant by the mean of a set of measurements?
 Answer: The mean is the average value of a set of numbers. It is calculated by adding all the values together and dividing the total by the number of measurements. The mean helps give a central value that represents the overall trend of the data set.

Q56. Describe how to calculate the uncertainty in a measured value.
 Answer: Uncertainty in a single measurement can be estimated based on the resolution of the instrument. For repeated measurements, the uncertainty can be calculated as half the range of the results. For example, if the highest value is 10.5 and the lowest is 9.5, the range is 1.0 and the uncertainty is ±0.5.

Q57. Why should scientists report uncertainty when presenting results?
 Answer: Reporting uncertainty helps others understand how accurate and reliable the measurement is. It shows transparency in the data and acknowledges that all measurements have limits. It also allows comparisons with other experiments and helps judge the quality of the data.

Q58. How can a single outlier affect the mean and uncertainty of a data set?
 Answer: A single outlier can shift the mean away from the true central value and increase the range, which makes the uncertainty appear larger than it really is. Identifying and possibly excluding outliers is important to ensure the results reflect accurate trends.

Q59. What is the standard way to express uncertainty in a measurement?
 Answer: Uncertainty is typically expressed as the measured value followed by ± and the uncertainty value. For example, if a length is measured as 5.0 cm with a possible variation of 0.1 cm, it is written as 5.0 cm ± 0.1 cm. This format clearly shows the estimated error.

Q60. Give an example of how to estimate uncertainty using the range of repeated measurements.
 Answer: Suppose three measurements of mass are 2.3 g, 2.5 g, and 2.4 g. The range is 2.5 - 2.3 = 0.2 g. The uncertainty is estimated as half the range: ±0.1 g. The mean is (2.3 + 2.5 + 2.4)/3 = 2.4 g. So the result is reported as 2.4 g ± 0.1 g.

Q61. Define the term mole in chemistry.
 Answer: A mole is a unit that measures the amount of substance. One mole contains 6.02×10^{23}

particles (atoms, molecules, or ions) of that substance. It allows chemists to count particles in manageable amounts using mass and relative atomic masses.

Q62. What is the unit used to measure chemical amount?
Answer: The unit used to measure the amount of a substance in chemistry is the mole. Its symbol is "mol", and it represents 6.02×10^{23} particles of the given substance.

Q63. How is the relative formula mass related to the mass of one mole?
Answer: The mass of one mole of a substance in grams is numerically equal to its relative formula mass (Mr). For example, if the Mr of a compound is 18, then one mole of that compound weighs 18 grams.

Q64. What does the Avogadro constant represent?
Answer: The Avogadro constant represents the number of particles (atoms, molecules, or ions) in one mole of any substance. It is a fixed number used to link the mass of substances to the number of particles they contain.

Q65. State the value of the Avogadro constant.
Answer: The Avogadro constant is 6.02×10^{23} particles per mole. This means one mole of any substance contains exactly 6.02×10^{23} particles.

Q66. Why does one mole of any substance contain the same number of particles?
Answer: By definition, a mole is based on a fixed number of particles—6.02×10^{23}—so it ensures consistency across substances. No matter the type of particle, one mole always has the same number, making calculations in chemistry simpler and more standardised.

Q67. How many atoms are there in one mole of hydrogen?
Answer: One mole of hydrogen atoms contains 6.02×10^{23} hydrogen atoms. If referring to hydrogen gas (H_2), one mole contains 6.02×10^{23} hydrogen molecules, which is equal to 1.204×10^{24} atoms since each H_2 molecule has 2 atoms.

Q68. Explain how to calculate the number of moles in a given mass of substance.
Answer: To calculate the number of moles, divide the mass of the substance (in grams) by its relative formula mass (Mr). The formula is:
Moles = Mass ÷ Mr
This gives the number of moles of particles present in the sample.

Q69. How can you find the mass of a substance if you know the number of moles and the relative formula mass?
Answer: To find the mass, multiply the number of moles by the relative formula mass (Mr). The formula is:
Mass = Moles × Mr
This tells you how much of the substance is present in grams.

Q70. What is the formula for calculating moles from mass and relative formula mass?
Answer: The formula for calculating moles is:

Moles = Mass ÷ Mr

This helps convert a mass in grams into the number of moles of particles.

Q71. Describe how to use standard form when working with the Avogadro constant.

Answer: The Avogadro constant is a very large number, so it's written in standard form as 6.02×10^{23}. When using it in calculations, make sure to keep it in this format and apply the rules of powers of 10 during multiplication or division to handle values easily.

Q72. Why must we use significant figures when recording chemical measurements?

Answer: Using significant figures shows the precision of a measurement and prevents false accuracy. It reflects the limitations of the measuring instrument and ensures results are consistent and scientifically reliable.

Q73. Give an example of changing the subject of a moles equation to calculate mass.

Answer: If the original formula is:

Moles = Mass ÷ Mr

To find Mass, change the subject:

Mass = Moles × Mr

For example, if Moles = 2 mol and Mr = 18, then Mass = 2 × 18 = 36 g.

Q74. What is the relationship between mass, moles, and Mr?

Answer: The relationship is expressed in the formula:

Moles = Mass ÷ Mr

This shows that the amount of substance in moles depends on the mass of the substance and its relative formula mass.

Q75. In terms of moles, how are atoms and molecules treated similarly?

Answer: Atoms and molecules are treated similarly in mole calculations because one mole of any substance—whether it is made of atoms (like helium) or molecules (like water)—contains the same number of particles: 6.02×10^{23}. This allows chemists to apply the same formulas when calculating the number of moles, mass, or number of particles, regardless of whether the substance is atomic or molecular.

Q76. How many molecules are in 2 moles of water?

Answer: To calculate the number of molecules, we multiply the number of moles by Avogadro's constant.

Solution:

Number of molecules = number of moles × Avogadro constant

$= 2 \text{ mol} \times 6.02 \times 10^{23}$ molecules/mol

$= 1.204 \times 10^{24}$ molecules

Q77. Why is it useful to express very large numbers like the Avogadro constant in standard form?

Answer: Standard form helps express very large numbers more clearly and efficiently. Writing 6.02 ×

10^{23} is easier and less error-prone than writing 602,000,000,000,000,000,000,000. It makes calculations simpler and more readable, especially in chemistry where large values are common.

Q78. Calculate the number of particles in 0.5 moles of a substance.

 Answer:

 Solution:

 Number of particles = number of moles × Avogadro constant

 = 0.5 mol × 6.02 × 10^{23}

 = 3.01 × 10^{23} particles

Q79. Explain the steps to convert grams to moles using relative formula mass.

 Answer:

 Solution:

 Step 1: Find the relative formula mass (Mr) of the substance.

 Step 2: Use the formula: Moles = Mass (g) ÷ Mr

 For example, if the mass is 18 g and the Mr is 18, then

 Moles = 18 ÷ 18 = 1 mol

Q80. Why is it important to know the Mr of a compound when calculating moles?

 Answer: Mr tells us how much one mole of a substance weighs. Without it, we cannot convert between grams and moles. For example, knowing that the Mr of H_2O is 18 allows us to know that 18 g of water is equal to 1 mole.

Q81. What mathematical skills are needed to work with mole calculations?

 Answer: You need to understand ratios, basic division and multiplication, use of formulas, conversion between grams and moles, use of standard form (e.g., 6.02 × 10^{23}), and rearranging equations when needed.

Q82. Why does one mole of CO_2 contain the same number of molecules as one mole of O_2?

 Answer: A mole is a fixed number of particles (6.02 × 10^{23}), regardless of the substance. So, 1 mole of any gas contains the same number of molecules as 1 mole of another gas, even if their masses and types of atoms differ.

Q83. What is the difference between atoms and molecules in the context of moles?

 Answer: Atoms are single elements (like Na or O), while molecules are combinations of atoms (like O_2 or H_2O). One mole of atoms contains 6.02 × 10^{23} atoms, and one mole of molecules contains 6.02 × 10^{23} molecules. The concept of a mole applies equally to both.

Q84. If you have 6.02 × 10^{23} ions of sodium, how many moles is that?

 Answer:

 Solution:

 Number of moles = number of particles ÷ Avogadro constant

 = 6.02 × 10^{23} ÷ 6.02 × 10^{23}

 = 1 mol

Q85. How can you use a balanced equation to find the mole ratio of reactants and products?
 Answer: The numbers in front of chemical formulas in a balanced equation show how many moles of each substance react or are produced. For example, in $2H_2 + O_2 \rightarrow 2H_2O$, the mole ratio is 2:1:2 for hydrogen, oxygen, and water.

Q86. What is meant by the term "formula unit" in mole calculations?
 Answer: A formula unit is the simplest ratio of ions in an ionic compound, such as NaCl. One mole of NaCl contains 6.02×10^{23} formula units, which includes one Na^+ and one Cl^- per unit.

Q87. How can you calculate the Mr of a compound from its formula?
 Answer:
 Solution:
 Step 1: Identify the atomic masses of each element (from the periodic table).
 Step 2: Multiply each by the number of atoms in the formula.
 Step 3: Add the total.
 For H_2O: $(2 \times 1) + (1 \times 16) = 2 + 16 = 18$

Q88. Why is understanding decimal and standard form important in mole calculations?
 Answer: Mole calculations often involve large numbers like the Avogadro constant. Writing them in standard form (e.g., 6.02×10^{23}) makes calculations manageable. Decimals are important for accuracy, especially when measuring quantities in grams or moles.

Q89. What is the mole of electrons and how is it different from the mole of atoms?
 Answer: A mole of electrons means 6.02×10^{23} electrons. The difference is in the particle type—electrons are subatomic particles, while atoms are complete chemical units. But in both cases, one mole contains the same number of particles.

Q90. How would you convert moles to number of particles?
 Answer:
 Solution:
 Use the formula: Number of particles = moles × Avogadro constant
 Example: 3 moles $\times 6.02 \times 10^{23} = 1.806 \times 10^{24}$ particles

Q91. Explain the link between moles and balanced equations.
 Answer: Balanced equations show the exact number of moles of each substance involved in a reaction. These mole ratios allow us to calculate how much of each reactant is needed or how much product will form.

Q92. What are the steps for calculating the number of moles in a known mass of NaCl?
 Answer:
 Solution:
 Step 1: Find the Mr of NaCl (Na = 23, Cl = 35.5, so Mr = 58.5)
 Step 2: Use the formula: Moles = Mass ÷ Mr
 Example: If you have 117 g of NaCl, then Moles = $117 \div 58.5 = 2$ mol

Q93. Why do chemists use the mole rather than individual particle counts?
 Answer: Counting individual particles is impractical because they are so small. Using the mole allows chemists to work with measurable amounts while still knowing the number of particles involved, thanks to the Avogadro constant.

Q94. How does using the mole simplify calculations in chemical reactions?
 Answer: It allows chemists to calculate mass, volume, or number of particles using consistent ratios from balanced equations. The mole bridges the atomic scale and the lab scale.

Q95. What is meant by "amount of substance"?
 Answer: It refers to the number of particles in a sample, measured in moles. It tells us how many atoms, molecules, or ions are present, not their mass or volume.

Q96. Why is it incorrect to compare the mass of 1 mole of hydrogen with 1 mole of carbon directly?
 Answer: Even though both are 1 mole and have the same number of particles, their masses are different. 1 mole of hydrogen weighs about 2 g (as H_2), while 1 mole of carbon weighs 12 g (as C atoms). Moles equal particle count, not mass.

Q97. How many atoms are there in 3 moles of magnesium?
 Answer:
 Solution:
 Number of atoms = moles × Avogadro constant
 = 3 mol × 6.02×10^{23}
 = 1.806×10^{24} atoms

Q98. Why is the concept of a mole essential in chemical formulas?
 Answer: It lets us connect the small scale of atoms and molecules to real, measurable quantities. Without the mole, it would be impossible to know how many particles are in a given mass or volume.

Q99. Describe the difference between molar mass and relative atomic mass.
 Answer: Molar mass is the mass of one mole of a substance (in grams), while relative atomic mass is the average mass of an atom compared to carbon-12, with no units. Molar mass uses g/mol, relative atomic mass has no units.

Q100. What is the significance of using 3 significant figures in mole calculations?
 Answer: Using 3 significant figures maintains accuracy and precision in chemical calculations, especially when working with scientific data. It reflects the quality of measurements and ensures results are not over- or under-represented.

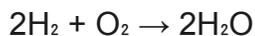**Q101. What does a balanced chemical equation show about the number of moles of each substance?**
 Answer: A balanced chemical equation shows the exact number of moles of each substance involved in the reaction. The numbers in front of the chemical formulas (called coefficients) tell us how many moles of each reactant combine and how many moles of each product are formed. This helps us understand the proportions in which substances react and are produced.

Q102. How can you use a balanced symbol equation to calculate the mass of a product?
 Answer: You can use the balanced equation to find the mole ratio between the reactant and the product. First, convert the mass of the reactant to moles using its relative formula mass. Then, use the mole ratio from the balanced equation to find the number of moles of the product. Finally, convert the moles of the product back into mass using its relative formula mass.

Q103. In a reaction where 2 moles of hydrogen react with 1 mole of oxygen, how many moles of water are formed?
 Answer: According to the balanced chemical equation:
 $2H_2 + O_2 \rightarrow 2H_2O$
 From this, 2 moles of hydrogen react with 1 mole of oxygen to produce 2 moles of water.
 So, **2 moles of water** are formed.

Q104. Describe the steps to calculate the mass of a product using moles and relative formula mass.
 Answer:
 Convert the mass of the reactant into moles using its relative formula mass:
 moles = mass ÷ relative formula mass
 Use the balanced chemical equation to find the mole ratio between the reactant and the product
 Multiply the moles of reactant by the ratio to find moles of product
 Convert the moles of product to mass using its relative formula mass:
 mass = moles × relative formula mass

Q105. How would you calculate the mass of a reactant needed to produce a given mass of product?
 Answer:
 Convert the mass of the product to moles using its relative formula mass
 Use the balanced chemical equation to find the mole ratio between the product and the reactant
 Multiply the moles of product by the ratio to find the moles of reactant
 Convert the moles of reactant to mass using its relative formula mass

Q106. If 1 mole of magnesium reacts with 2 moles of HCl, how much magnesium is needed to react with 73 g of HCl?
 Answer:
 Relative formula mass of HCl = 1 + 35.5 = 36.5
 Moles of HCl = 73 ÷ 36.5 = 2
 From the equation: $Mg + 2HCl \rightarrow MgCl_2 + H_2$
 2 moles of HCl react with 1 mole of Mg
 So, moles of Mg = 2 ÷ 2 = 1
 Relative atomic mass of Mg = 24
 Mass of Mg = 1 × 24 = 24 g
 Solution: Magnesium needed = **24 g**

Q107. Explain how to convert mass in grams to moles using relative formula mass.
 Answer: To convert mass in grams to moles, use the formula:

moles = mass ÷ relative formula mass
You divide the given mass of the substance by its relative formula mass (Mr). This gives you the amount of substance in moles, which can then be used in further calculations.

Q108. How can you calculate the mass of excess reactant remaining after a chemical reaction?

Answer:
First, calculate the moles of both reactants
Use the balanced equation to find the limiting reactant (the one that runs out first)
Calculate how much of the excess reactant is actually used in the reaction
Subtract the used amount (in moles) from the original amount to get moles remaining
Convert the remaining moles to mass using the relative formula mass

Q109. What is the importance of using the correct mole ratio in chemical calculations?

Answer: Using the correct mole ratio is important because it ensures that the amounts of reactants and products are calculated accurately. The mole ratio comes from the balanced chemical equation and reflects how much of each substance takes part in the reaction. If the wrong ratio is used, the calculated masses and volumes will be incorrect.

Q110. How can a balanced symbol equation help you calculate the amount of gas produced in a reaction?

Answer: A balanced equation tells you the mole ratio of reactants and products, including gases. If the volume of a gas is needed, use the number of moles of the gas and apply the molar gas volume (usually 24 dm³ per mole at room temperature and pressure). This helps calculate how much gas will be produced from a known amount of reactant.

Q111. A reaction uses 0.5 moles of oxygen. How can you calculate the mass of oxygen used?

Answer:
Relative atomic mass of O = 16
O_2 = 16 × 2 = 32
Mass = moles × relative formula mass = 0.5 × 32 = 16 g
Solution: Mass of oxygen used = **16 g**

Q112. If you know the mass of a product, how can you work backwards to find the mass of a reactant?

Answer:
Convert the mass of the product into moles using its relative formula mass
Use the balanced chemical equation to find the mole ratio between product and reactant
Multiply the moles of product by the appropriate ratio to get moles of reactant
Convert moles of reactant into mass using its relative formula mass

Q113. Why is it important to use the relative formula mass in mole calculations?

Answer: The relative formula mass (Mr) allows us to relate the mass of a substance to the number of moles. Without it, we cannot accurately convert between mass and moles. It ensures that

calculations are based on the actual chemical makeup of the substance and reflects the amount of atoms involved.

Q114. In the equation: Ca + 2HCl → CaCl$_2$ + H$_2$, what is the mole ratio between HCl and CaCl$_2$?
 Answer: The balanced equation shows that 2 moles of HCl react with 1 mole of CaCl$_2$.
 So, the mole ratio is **2:1**

Q115. How do you convert the number of moles into mass using an equation?
 Answer:
 Use the formula: mass = moles × relative formula mass
 Multiply the number of moles by the substance's relative formula mass to get the mass in grams

Q116. If 2.4 g of magnesium reacts, how many grams of hydrogen gas will be produced?
 Answer:
 Relative atomic mass of Mg = 24
 Moles of Mg = 2.4 ÷ 24 = 0.1
 Equation: Mg + 2HCl → MgCl$_2$ + H$_2$
 1 mole of Mg gives 1 mole of H$_2$
 So, moles of H$_2$ = 0.1
 Relative formula mass of H$_2$ = 2
 Mass = 0.1 × 2 = 0.2 g
 Solution: Hydrogen gas produced = **0.2 g**

Q117. Explain why balancing a chemical equation is important for mass calculations.
 Answer: A balanced equation shows the correct mole ratios of reactants and products. This is essential for calculating accurate masses. Without balancing, you might use incorrect ratios, leading to wrong answers. It ensures the law of conservation of mass is followed, meaning the total mass of reactants equals the total mass of products.

Q118. What are the steps to follow when calculating mass from a balanced chemical equation?
 Answer:
 Write the balanced chemical equation
 Find the relative formula masses of the substances involved
 Convert the given mass to moles using moles = mass ÷ Mr
 Use the mole ratio to calculate moles of the desired substance
 Convert the moles back to mass using mass = moles × Mr

Q119. How can you calculate the limiting reactant in a chemical reaction?
 Answer:
 Calculate the moles of each reactant
 Use the balanced equation to find the mole ratio
 Compare the available moles with the required mole ratio
 The reactant that is present in the smaller amount compared to its required ratio is the limiting reactant

Q120. If a reaction forms 88 g of CO_2, how can you find the amount of oxygen used?
 Answer:
 Relative formula mass of CO_2 = 12 + (16 × 2) = 44
 Moles of CO_2 = 88 ÷ 44 = 2
 From the equation: $C + O_2 \rightarrow CO_2$
 1 mole of CO_2 needs 1 mole of O_2
 So, moles of O_2 = 2
 Relative formula mass of O_2 = 32
 Mass of O_2 = 2 × 32 = 64 g
 Solution: Oxygen used = **64 g**

Q121. In the reaction: $2Mg + O_2 \rightarrow 2MgO$, what mass of MgO is made from 12 g of Mg?
 Answer:
 Relative atomic mass of Mg = 24
 Moles of Mg = 12 ÷ 24 = 0.5
 From the equation: 2 moles of Mg produce 2 moles of MgO
 So, moles of MgO = 0.5
 Relative formula mass of MgO = 24 + 16 = 40
 Mass = 0.5 × 40 = 20 g
 Solution: Mass of MgO = **20 g**

Q122. How do you calculate the amount of product formed in a reaction with two reactants?
 Answer:
 Calculate the moles of both reactants
 Use the balanced equation to determine the limiting reactant
 Use the limiting reactant to find the amount of product formed using the mole ratio
 Convert the moles of product into mass using its relative formula mass

Q123. What is the formula for converting between moles and mass?
 Answer: The formula is:
 mass = moles × relative formula mass
 or
 moles = mass ÷ relative formula mass

Q124. How do you identify which reactant is in excess during a chemical reaction?
 Answer:
 Calculate the moles of both reactants
 Use the balanced equation to find the required mole ratio
 Compare the actual mole amounts to the ratio
 The reactant that has more moles than needed is the one in excess

Q125. If 6 g of carbon reacts with oxygen, what is the maximum mass of CO_2 that can be formed?
 Answer:
 Relative atomic mass of C = 12

Moles of C = 6 ÷ 12 = 0.5
From the equation: $C + O_2 \rightarrow CO_2$
1 mole of C forms 1 mole of CO_2
So, moles of CO_2 = 0.5
Relative formula mass of CO_2 = 44
Mass = 0.5 × 44 = 22 g
Solution: Maximum mass of CO_2 = **22 g**

Q126. Describe the method for balancing an equation using mole calculations from given masses.

Answer: First, calculate the number of moles of each substance using the formula: moles = mass ÷ Mr. Then, compare the number of moles of each reactant and product. Use these mole values to work out the simplest whole number ratio. Adjust the coefficients in the equation so that the number of atoms of each element is the same on both sides. This gives you a balanced equation.

Q127. How can you find the simplest whole number ratio of moles in a chemical reaction?

Answer: To find the simplest whole number ratio, divide all the mole values by the smallest number of moles among them. Round the results to the nearest whole number if necessary. This gives you the simplest ratio of the substances involved in the reaction, which can be used to balance the chemical equation.

Q128. Why must the number of atoms be balanced on both sides of a chemical equation?

Answer: The number of atoms must be balanced to follow the law of conservation of mass. This law states that matter cannot be created or destroyed in a chemical reaction. Therefore, the total number of each type of atom on the reactant side must be equal to the total on the product side to ensure mass is conserved.

Q129. In a reaction between 3 moles of A and 2 moles of B, what is the mole ratio?

Answer: The mole ratio is 3:2. This means 3 moles of substance A react with 2 moles of substance B. Ratios like this help determine the proportions of substances needed or produced in a chemical reaction.

Q130. How do you use algebraic equations to find unknown masses in a reaction?

Answer: Use the equation: moles = mass ÷ Mr. If you know the mole ratio and the mass of one substance, you can rearrange the equation to solve for the unknown mass. Multiply the number of moles (from the balanced equation) by the Mr of the unknown substance to find its mass.

Q131. What units are typically used for mass in chemical calculations?

Answer: The mass is usually measured in grams (g) in chemical calculations. This unit is standard because it aligns with the use of relative atomic and formula masses, which are based on grams per mole.

Q132. How do you substitute known values into the equation: moles = mass ÷ Mr?

Answer: Identify the given mass and the relative formula mass (Mr) of the substance. Then divide

the mass by the Mr. For example, if the mass is 20 g and Mr is 40, then moles = 20 ÷ 40 = 0.5 moles. Always ensure that the units are correct before substituting.

Q133. If the mass of one product is known, how do you find the mass of the other product?
 Answer:
 Convert the known mass of the first product into moles
 Use the balanced equation to find the mole ratio between the products
 Use this ratio to calculate the moles of the second product
 Convert the moles of the second product into mass using its relative formula mass

Q134. What information is needed to calculate the mass of a substance from a balanced equation?
 Answer: You need the balanced chemical equation, the relative formula mass (Mr) of the substance, the mass or moles of at least one other substance in the reaction, and the mole ratio from the equation. This allows you to convert between mass and moles accurately.

Q135. How would you calculate the theoretical yield of a chemical reaction?
 Answer:
 Start with the mass of the limiting reactant
 Convert the mass to moles using moles = mass ÷ Mr
 Use the balanced equation to find the mole ratio between the reactant and product
 Calculate the moles of product that would form
 Convert moles of product to mass using mass = moles × Mr
 This gives the theoretical yield in grams

Q136. What is the difference between actual yield and theoretical yield?
 Answer: The theoretical yield is the maximum amount of product that could be formed from a given amount of reactants, assuming perfect conditions. The actual yield is the amount of product actually obtained from the reaction. The actual yield is usually less due to factors like incomplete reactions or side reactions.

Q137. If 2.5 moles of a compound are produced, what mass is this if the Mr is 40?
 Answer:
 mass = moles × Mr = 2.5 × 40 = 100 g
 Solution: The mass of the compound is **100 g**

Q138. How can you calculate the percentage yield of a reaction?
 Answer: Use the formula:
 percentage yield = (actual yield ÷ theoretical yield) × 100
 This tells you how efficient the reaction was compared to the maximum possible yield.

Q139. What is meant by the term "stoichiometry"?
 Answer: Stoichiometry is the study of the quantitative relationships between reactants and products in a chemical reaction. It involves using balanced equations to calculate amounts of substances involved, such as mass, moles, or volume, based on mole ratios.

Q140. Why do we need to calculate masses in reactions before carrying out practical experiments?

 Answer: Calculating masses in advance helps to measure correct quantities of reactants, avoid waste, ensure safety, and predict how much product will form. It also allows us to identify limiting and excess reactants, which is important for efficient and controlled experiments.

Q141. How do you use mole ratios to determine which substance limits the amount of product formed?

 Answer:

 Calculate the moles of each reactant

 Use the balanced equation to find the mole ratio

 Compare the actual mole amounts to the required ratio

 The reactant that runs out first based on the ratio is the limiting reactant and determines how much product is formed

Q142. If a reaction is given in grams, how can you convert it to moles to balance the equation?

 Answer:

 Use the formula: moles = mass ÷ Mr

 Do this for each substance involved

 Then find the simplest whole number ratio between the moles

 Use these ratios as coefficients to balance the chemical equation

Q143. Explain how to calculate the mass of water formed when hydrogen reacts with oxygen.

 Answer:

 Write the balanced equation: $2H_2 + O_2 \rightarrow 2H_2O$

 Convert the given mass of hydrogen or oxygen into moles

 Use the mole ratio from the equation to find the moles of water formed

 Convert the moles of water to mass using mass = moles × Mr

 This gives you the mass of water produced

Q144. In the reaction: $N_2 + 3H_2 \rightarrow 2NH_3$, how many moles of NH_3 are formed from 9 g of H_2?

 Answer:

 Mr of H_2 = 2

 Moles of H_2 = 9 ÷ 2 = 4.5

 From the equation, 3 moles of H_2 produce 2 moles of NH_3

 So, (2 ÷ 3) × 4.5 = 3 moles of NH_3

 Solution: 3 moles of NH_3 are formed

Q145. Why is it necessary to change the subject of an equation in mass calculations?

 Answer: Changing the subject of an equation allows you to isolate and calculate the unknown value. For example, rearranging moles = mass ÷ Mr to mass = moles × Mr helps you find mass when moles are known. It ensures flexibility in solving different types of chemical problems.

Q146. How do you apply ratios and fractions in solving chemical mass problems?

 Answer: Ratios from balanced equations show how substances react. Use them to set up fractions

for converting between moles of different substances. For example, if 1 mole of A makes 2 moles of B, and you have 3 moles of A, then (2 ÷ 1) × 3 = 6 moles of B. These ratios help in finding unknown quantities.

Q147. What does the coefficient in front of a substance in a balanced equation tell you?
 Answer: The coefficient tells you how many moles of that substance are involved in the reaction. It represents the mole ratio and helps determine the proportions of reactants and products in a chemical equation.

Q148. If the mass of the reactants is known, how can you calculate the mass of the products?
 Answer:
 Convert the mass of the reactants into moles
 Use the balanced equation to find the mole ratio between the reactant and product
 Calculate the moles of product
 Convert the moles of product into mass using its Mr

Q149. What is the process to calculate the balanced equation from experimental mass data?
 Answer:
 Convert the given masses of substances into moles
 Divide all mole values by the smallest number of moles to get a ratio
 Round to whole numbers if necessary
 Use these ratios as coefficients to write the balanced chemical equation

Q150. How can comparing mole ratios help verify the correctness of a balanced equation?
 Answer: Comparing the calculated mole ratios with the ratios in the equation helps check if the equation is balanced. If the mole ratios from experimental or given data match the ratio in the equation, then the equation is correctly balanced. If not, it needs adjustment to follow the law of conservation of mass.

Q151. What is meant by the term 'limiting reactant' in a chemical reaction?
 Answer: The limiting reactant is the substance that is completely used up first during a chemical reaction. Once it is used up, the reaction stops, and no more product can form. It limits the amount of product that can be made, which is why it is called the limiting reactant. The other reactant, which is not fully used, is called the excess reactant.

Q152. How does the limiting reactant affect the amount of product formed in a reaction?
 Answer: The limiting reactant determines the maximum amount of product that can be formed. Because the reaction cannot continue once this reactant is used up, the amount of product formed is directly related to the amount of limiting reactant available. Even if other reactants are present in larger amounts, they cannot increase the product yield beyond what the limiting reactant allows.

Q153. Describe how to identify the limiting reactant when given the masses of two reactants.
 Answer:
 Convert the mass of each reactant to moles using moles = mass ÷ Mr
 Use the balanced chemical equation to determine the mole ratio between the reactants

Compare the mole ratio of the actual amounts with the required ratio
The reactant that provides fewer moles than needed is the limiting reactant

Q154. What happens to the excess reactant after a reaction is complete?
Answer: The excess reactant is not fully used up during the reaction. After the limiting reactant is consumed, the reaction stops, and some amount of the excess reactant is left unreacted. This leftover substance remains in the reaction mixture and can be recovered or discarded, depending on the situation.

Q155. Why is it useful to use an excess of one reactant in a chemical reaction?
Answer: Using an excess of one reactant ensures that the other reactant (usually the more expensive or important one) reacts completely. This can help increase the yield of the desired product, simplify the reaction process, and reduce waste of valuable reactants. It is a common technique in industrial and laboratory reactions.

Q156. If one reactant is in excess, how can you determine the maximum amount of product formed?
Answer:
Identify the limiting reactant
Convert the mass of the limiting reactant into moles
Use the balanced chemical equation to find the mole ratio between the limiting reactant and the product
Use this ratio to calculate the moles of product formed
Convert the moles of product into mass using mass = moles × Mr

Q157. In a reaction, 5 g of A reacts with 10 g of B. How can you tell which is the limiting reactant?
Answer:
Calculate the moles of A and B using moles = mass ÷ Mr
Use the balanced equation to find the required mole ratio
Compare the actual mole amounts of A and B to the required ratio
The reactant that does not meet the required ratio is the limiting reactant because it will run out first

Q158. How can you calculate the mass of product formed when the limiting reactant is known?
Answer:
Convert the mass of the limiting reactant into moles
Use the balanced equation to find the mole ratio between the limiting reactant and the product
Calculate the moles of product that will be formed
Convert the moles of product into mass using mass = moles × Mr

Q159. What is the relationship between moles of limiting reactant and moles of product formed?
Answer: The moles of product formed depend on the moles of the limiting reactant and the mole ratio in the balanced chemical equation. For example, if the ratio is 1:2, then 1 mole of limiting

reactant will produce 2 moles of product. The limiting reactant controls the total number of moles of product that can be made.

Q160. Why is the limiting reactant important when planning a chemical reaction in industry?
Answer: In industry, knowing the limiting reactant helps to accurately predict how much product can be formed, which is important for cost, efficiency, and safety. It allows manufacturers to avoid wasting expensive chemicals and ensures that reactions are controlled and efficient, leading to better production planning and profit.

Q161. How can you use mole ratios to determine the limiting reactant in a reaction?
Answer:
Calculate the moles of each reactant
Use the balanced equation to find the required mole ratio between them
Divide the moles of each reactant by its coefficient in the equation
The reactant with the smaller result is the limiting reactant

Q162. What is the first step in finding the limiting reactant in a reaction?
Answer: The first step is to calculate the number of moles of each reactant using the formula: moles = mass ÷ Mr. Once you have the moles, you can compare them using the balanced chemical equation to determine which reactant is limiting.

Q163. In a reaction between magnesium and hydrochloric acid, how do you determine which is limiting?
Answer:
Calculate the moles of magnesium and hydrochloric acid using their given masses and Mr values
Use the balanced equation: $Mg + 2HCl \rightarrow MgCl_2 + H_2$
Compare the mole ratio of 1:2 with the actual mole amounts
Whichever reactant does not satisfy the required ratio is the limiting reactant

Q164. A reaction produces less product than expected. What could this indicate about the reactants used?
Answer: It may indicate that the limiting reactant was not present in sufficient amount or that there were losses during the reaction. It could also mean the reaction was incomplete, side reactions occurred, or some of the product was lost during collection. This results in a lower actual yield than expected.

Q165. How can you calculate the amount of excess reactant left after a reaction?
Answer:
Calculate the moles of both reactants
Identify the limiting reactant and use it to determine how much of the excess reactant was actually used based on the mole ratio
Subtract the used moles from the starting moles of the excess reactant
Convert the remaining moles to mass using mass = moles × Mr

GRADEUP

Q166. What is meant by concentration of a solution?
Answer: Concentration refers to the amount of solute dissolved in a certain volume of solution. It tells us how strong or weak a solution is. A more concentrated solution has more solute in the same volume, while a more dilute one has less solute.

Q167. What unit is commonly used to measure concentration in chemistry?
Answer: The most common unit used is grams per cubic decimetre (g/dm^3), which shows how many grams of solute are present in $1 dm^3$ of solution. Another common unit is moles per cubic decimetre (mol/dm^3), especially in more advanced chemistry.

Q168. How is concentration related to the mass of solute and the volume of solution?
Answer: Concentration is calculated by dividing the mass of the solute by the volume of the solution. The formula is: concentration = mass ÷ volume. This shows that if the mass of solute increases or the volume decreases, the concentration becomes higher.

Q169. If you know the concentration and volume of a solution, how can you calculate the mass of solute?
Answer:
Use the formula: mass = concentration × volume
Multiply the concentration (in g/dm^3) by the volume (in dm^3) to find the mass of solute in grams

Q170. Write the formula that links mass, volume, and concentration of a solution.
Answer: The formula is:
concentration = mass ÷ volume
You can rearrange it as needed:
mass = concentration × volume
volume = mass ÷ concentration

Q171. A solution has a concentration of 20 g/dm^3 and a volume of 0.5 dm^3. How much solute is in it?
Answer:
mass = concentration × volume = 20 × 0.5 = 10 g
Solution: The mass of solute is **10 g**

Q172. How do you change the subject of the formula concentration = mass ÷ volume to find mass?
Answer: To find mass, multiply both sides of the equation by volume. This gives:
mass = concentration × volume

Q173. What is the concentration if 10 g of solute is dissolved in 250 cm^3 of solution?
Answer:
First, convert 250 cm^3 to dm^3: 250 ÷ 1000 = 0.25 dm^3
Then use the formula: concentration = mass ÷ volume = 10 ÷ 0.25 = 40 g/dm^3
Solution: The concentration is **40 g/dm^3**

Q174. How would increasing the mass of solute in a solution affect its concentration?
Answer: Increasing the mass of solute while keeping the volume the same will increase the concentration of the solution. This is because more solute particles are present in the same amount of solvent, making the solution stronger.

Q175. How would increasing the volume of solvent in a solution affect its concentration?
Answer: Increasing the volume of solvent while keeping the solute amount the same will decrease the concentration. The same amount of solute is now spread over a larger volume, making the solution more dilute.

Q176. How can you convert a volume in cm³ to dm³ when calculating concentration?
Answer: To convert from cm^3 to dm^3, divide the volume by 1000. This is because 1 dm^3 is equal to 1000 cm^3. For example, 250 cm^3 ÷ 1000 = 0.25 dm^3. This conversion is necessary when using the concentration formula: concentration = mass ÷ volume, where volume must be in dm^3 to give the concentration in g/dm^3.

Q177. A solution contains 5 g of solute in 200 cm³. What is its concentration in g/dm³?
Answer:
Convert volume to dm^3: 200 ÷ 1000 = 0.2 dm^3
Use the formula: concentration = mass ÷ volume = 5 ÷ 0.2 = 25 g/dm^3
Solution: The concentration is **25 g/dm³**

Q178. If you dilute a solution, what happens to its concentration?
Answer: When you dilute a solution by adding more solvent, the total volume increases while the amount of solute stays the same. This causes the concentration to decrease because the solute is now spread out in a larger volume, making the solution less concentrated.

Q179. A solution has a volume of 1.5 dm³ and contains 12 g of solute. What is its concentration?
Answer:
Use the formula: concentration = mass ÷ volume = 12 ÷ 1.5 = 8 g/dm^3
Solution: The concentration is **8 g/dm³**

Q180. Explain the effect of doubling the volume of a solution while keeping the solute mass constant.
Answer: If you double the volume of a solution without changing the amount of solute, the concentration will be halved. This is because the same mass of solute is now spread over twice the volume, resulting in a more dilute solution.

Q181. A student prepares a solution with 6 g of salt in 0.3 dm³ of water. What is the concentration?
Answer:
Use the formula: concentration = mass ÷ volume = 6 ÷ 0.3 = 20 g/dm^3
Solution: The concentration is **20 g/dm³**

Q182. How do you calculate the new concentration after dilution?
 Answer:
 Use the formula:
 new concentration = original concentration × (original volume ÷ new volume)
 This shows how the concentration decreases as the volume increases, while the amount of solute stays the same.

Q183. Why is it important to measure solution concentration accurately in a chemical reaction?
 Answer: Accurate concentration measurements ensure the reaction goes as planned, with the correct amount of each substance. It helps avoid excess reactants or incomplete reactions, leading to reliable results, proper yields, and safe chemical handling.

Q184. Describe a method to prepare 250 cm³ of a 4 g/dm³ salt solution.
 Answer:
 First, convert volume to dm³: 250 ÷ 1000 = 0.25 dm³
 Calculate the required mass of salt: mass = concentration × volume = 4 × 0.25 = 1 g
 Weigh 1 g of salt and dissolve it in a small amount of water
 Transfer the solution to a 250 cm³ volumetric flask and fill up to the mark with more water
 Mix well to ensure complete dissolution

Q185. If the concentration of a solution is too high, how can it be adjusted?
 Answer: To lower the concentration, add more solvent (usually water) to the solution. This increases the total volume while the amount of solute stays the same, which decreases the concentration and makes the solution more dilute.

Q186. How would you calculate the volume of solution needed to provide a certain mass of solute?
 Answer:
 Use the formula: volume = mass ÷ concentration
 This tells you how much solution you need to provide the desired mass of solute when the concentration is known

Q187. A solution contains 18 g of solute in 600 cm³. How would you express the concentration in g/dm³?
 Answer:
 Convert volume to dm³: 600 ÷ 1000 = 0.6 dm³
 Use the formula: concentration = mass ÷ volume = 18 ÷ 0.6 = 30 g/dm³
 Solution: The concentration is **30 g/dm³**

Q188. How can you use the concentration of an acid to calculate the amount needed for neutralisation?
 Answer:
 Use the concentration and volume of the alkali to calculate the number of moles of alkali
 Use the balanced equation to find the mole ratio between the acid and the alkali

Use the ratio to calculate the required moles of acid
Convert the moles of acid into volume using: volume = moles ÷ concentration

Q189. A student adds more solute to a solution. What happens to the concentration?
Answer: When more solute is added to the same volume of solution, the concentration increases because there are now more solute particles in the same amount of liquid, making the solution stronger or more concentrated.

Q190. What is the meaning of the term 'solute' in the context of a solution?
Answer: A solute is the substance that is dissolved in a solvent to form a solution. For example, in a saltwater solution, salt is the solute and water is the solvent. The solute is usually present in a smaller amount compared to the solvent.

Q191. Why is volume measured in dm³ when calculating concentration?
Answer: Volume is measured in dm³ because concentration is typically expressed in g/dm³ or mol/dm³. Using dm³ keeps the units consistent and simplifies calculations. It also matches the definition of molar concentration used in chemistry.

Q192. Describe how to prepare a solution of known concentration using a volumetric flask.
Answer:
Weigh the exact amount of solute needed for the required concentration
Add the solute to a volumetric flask using a funnel
Add distilled water to dissolve the solute, swirling to mix
Continue adding distilled water until the solution reaches the mark on the flask
Stopper and invert the flask several times to ensure uniform mixing

Q193. How can errors in measuring solution volumes affect calculated concentration?
Answer: If the volume is measured incorrectly (too much or too little), the calculated concentration will also be incorrect. A smaller volume than actual will result in a falsely high concentration, while a larger volume than actual will give a falsely low concentration, leading to errors in experiments.

Q194. How is percentage concentration different from g/dm³ concentration?
Answer: Percentage concentration tells you how much solute is present per 100 parts of solution, often in mass percent (% w/w or % w/v), while g/dm³ gives the amount of solute in grams per 1 dm³ of solution. g/dm³ is an absolute concentration, while percentage is a relative measure.

Q195. What safety measures should be taken when preparing concentrated solutions?
Answer: Wear safety goggles, gloves, and a lab coat to protect skin and eyes. Work in a well-ventilated area or fume hood. Always add acid to water, not water to acid, to prevent splashing. Label the solution clearly and dispose of any waste according to safety guidelines.

Q196. Explain how inaccurate measurements of solute or solvent affect concentration calculations.
Answer: If you measure the solute or solvent incorrectly, the concentration will be wrong. Too much solute will make the concentration too high, and too little solute will make it too low. Similarly, errors in

volume measurements lead to incorrect dilution or concentration levels, affecting experimental results.

Q197. If two solutions have the same solute mass but different volumes, how do their concentrations compare?
 Answer: The solution with the smaller volume will have a higher concentration, while the one with the larger volume will have a lower concentration. This is because the same amount of solute is spread over different volumes, affecting how concentrated the solution is.

Q198. A solution is made by dissolving 15 g of substance X in water to make 1 dm³. What is its concentration?
 Answer:
 Use the formula: concentration = mass ÷ volume = 15 ÷ 1 = 15 g/dm³
 Solution: The concentration is **15 g/dm³**

Q199. How would you calculate the mass of solute required to make 500 cm³ of a 10 g/dm³ solution?
 Answer:
 Convert volume to dm³: 500 ÷ 1000 = 0.5 dm³
 mass = concentration × volume = 10 × 0.5 = 5 g
 Solution: The required mass of solute is **5 g**

Q200. How can understanding concentration help in controlling the outcome of chemical reactions?
 Answer: Knowing the concentration helps control how fast a reaction occurs and how much product is formed. It ensures the correct amount of reactants are used, improves accuracy in results, avoids waste, and is especially important in reactions like neutralisation where precise amounts are needed to complete the reaction.

Q201. What is meant by the term percentage yield in a chemical reaction?
 Answer: Percentage yield is a measure of how much product is actually made in a chemical reaction compared to the maximum amount that could be made (theoretical yield). It shows how efficient a reaction is and is expressed as a percentage using the actual and theoretical yields.

Q202. Why is the actual yield often less than the theoretical yield?
 Answer: The actual yield is often lower than the theoretical yield because of factors like incomplete reactions, product losses during separation or purification, side reactions, or practical errors in measuring and handling substances. These factors prevent all the reactants from turning into the desired product.

Q203. How can reversible reactions affect the yield of a product?
 Answer: In a reversible reaction, the products can change back into reactants. This means the reaction may not go to completion, and some of the product gets converted back. As a result, the overall yield of the product is lower than expected, reducing the percentage yield.

Q204. Give one reason why product may be lost when separated from a reaction mixture.
 Answer: One common reason is that some product may remain stuck to the equipment, such as inside a filter paper or left in a beaker. This leads to a loss of product during the process of separating it from the reaction mixture, reducing the actual yield.

Q205. Explain how unexpected side reactions can reduce the yield of a reaction.
 Answer: Side reactions occur when the reactants react in a different way than intended, forming unwanted by-products. These reactions use up some of the reactants, which means less of them are available to form the main product, reducing the actual yield of the desired substance.

Q206. Write the formula used to calculate percentage yield.
 Answer:
 percentage yield = (actual yield ÷ theoretical yield) × 100

Q207. A reaction produces 20 g of product, but the theoretical yield was 25 g. What is the percentage yield?
 Answer:
 percentage yield = (20 ÷ 25) × 100 = 80%
 Solution: The percentage yield is **80%**

Q208. How can you calculate the theoretical yield from a balanced equation?
 Answer:
 Convert the mass of a reactant to moles using moles = mass ÷ Mr
 Use the mole ratio in the balanced equation to find moles of product
 Convert moles of product to mass using mass = moles × Mr
 This gives the theoretical yield of the product

Q209. Why is percentage yield always less than or equal to 100%?
 Answer: Percentage yield cannot be more than 100% because you cannot get more product than what the balanced equation allows. A yield over 100% usually means a mistake in measurement or contamination. Losses during the process usually make the actual yield lower than the theoretical one.

Q210. What does a percentage yield of 100% indicate?
 Answer: A percentage yield of 100% means that the amount of product obtained is exactly equal to the theoretical yield. This indicates a perfectly efficient reaction with no loss of product and no side reactions, which is ideal but rarely achieved in practice.

Q211. A reaction has a percentage yield of 50%. What does this mean?
 Answer: It means that only half the amount of product that could have been formed was actually produced. The other 50% of the product was either not formed due to incomplete reaction, lost during handling, or turned into by-products due to side reactions.

Q212. How does loss during purification affect percentage yield?
 Answer: During purification, some of the product may be lost, for example when filtering,

transferring, or evaporating. These losses reduce the actual yield, which lowers the percentage yield. Even if the reaction itself is efficient, poor purification techniques can affect the final result.

Q213. Describe one way to increase the yield of a reaction in the lab.
Answer: One way is to use a reactant in excess to ensure the limiting reactant is completely used. Another method is to carefully transfer and handle all substances to avoid loss, or to change conditions like temperature or pressure to favour the forward reaction in reversible reactions.

Q214. Why is percentage yield important in industrial chemical processes?
Answer: In industry, a high percentage yield means more product is made from the same amount of reactants, saving money and resources. It also reduces waste and makes the process more efficient, which is important for cost-effectiveness and environmental sustainability.

Q215. How does incomplete reaction of a limiting reactant affect yield?
Answer: If the limiting reactant does not fully react, then less product will be made than expected. Since the limiting reactant controls the maximum possible amount of product, its incomplete use directly lowers the actual yield and the percentage yield.

Q216. A student calculates a percentage yield of 110%. What mistake might they have made?
Answer: A percentage yield above 100% is not possible and suggests an error. The student might have measured the product incorrectly, possibly including impurities or excess solvent, or made a mistake in the theoretical yield calculation, leading to an incorrect result.

Q217. What type of error in measurement could lead to an inaccurate yield?
Answer: Using uncalibrated or dirty equipment, reading scales or volumes incorrectly, spilling product during transfer, or not drying the product completely can all lead to incorrect mass readings. These errors result in inaccurate actual yield and affect the percentage yield calculation.

Q218. Describe the difference between actual yield and theoretical yield.
Answer: Actual yield is the amount of product actually obtained from a chemical reaction, measured after the experiment. Theoretical yield is the maximum amount of product that could be formed based on calculations using the balanced equation and starting materials. Actual yield is usually less due to losses.

Q219. In what situation would percentage yield be especially important in pharmaceuticals?
Answer: In pharmaceuticals, it is important to make the correct amount of a drug with minimal waste. A high percentage yield ensures that expensive materials are used efficiently and that the drug is produced in the right amount, which helps reduce cost and maintain quality and availability.

Q220. Why might a high yield not always be the main consideration when choosing a reaction pathway?
Answer: A reaction pathway with high yield might use harmful chemicals, be too expensive, take too long, or produce a lot of waste. Other factors like atom economy, cost of materials, energy use, and environmental impact must also be considered when choosing the best pathway.

Q221. What is meant by the term atom economy?
 Answer: Atom economy is a measure of how well a chemical reaction makes use of all the atoms in the reactants. It compares the relative formula mass of the desired product to the total mass of all products, showing how much waste is produced. Higher atom economy means less waste.

Q222. Write the formula used to calculate atom economy.
 Answer:
 atom economy = (Mr of desired product ÷ total Mr of all products) × 100

Q223. Why is atom economy important in sustainable chemistry?
 Answer: Atom economy is important because it shows how efficiently a reaction uses materials. Reactions with high atom economy produce less waste, use fewer resources, and are better for the environment. This helps make chemical processes more sustainable and cost-effective.

Q224. How does a higher atom economy benefit the environment?
 Answer: A higher atom economy means fewer waste products are made, which reduces pollution and the need for waste disposal. It also means less raw material is needed, conserving natural resources and making the chemical process cleaner and more environmentally friendly.

Q225. What does an atom economy of 100% mean?
 Answer: An atom economy of 100% means that all the atoms from the reactants are used to make the desired product, with no waste. This is ideal in green chemistry because it means maximum efficiency and minimum environmental impact.

Q226. Why is atom economy usually less than 100% in many reactions?
 Answer: Atom economy is usually less than 100% because many chemical reactions produce by-products that are not useful. These side products use up atoms from the reactants, which are not included in the desired product. As a result, not all atoms are efficiently turned into the desired product, lowering the atom economy.

Q227. How can atom economy be calculated using relative formula masses?
 Answer: Atom economy can be calculated by dividing the relative formula mass (Mr) of the desired product by the total Mr of all products, then multiplying by 100. The formula is:
 atom economy = (Mr of desired product ÷ total Mr of all products) × 100

Q228. Why are reactions with low atom economy less efficient?
 Answer: Reactions with low atom economy are less efficient because they waste more atoms from the reactants by producing unwanted by-products. This leads to more waste, higher disposal costs, and greater environmental impact. Less of the input materials end up in the desired product.

Q229. Give an example of a reason why a high atom economy reaction might still not be chosen.
 Answer: A reaction with high atom economy might require expensive reactants, take too long, or be difficult to control. It might also need very high temperatures or pressures, making it unsafe or costly. These practical issues could lead chemists to choose another route with lower atom economy but better overall results.

Q230. What is the relationship between atom economy and waste products?
 Answer: Atom economy and waste products are closely linked. A high atom economy means that more of the reactants' atoms are used in the desired product, resulting in fewer waste products. A low atom economy means more waste is generated because more atoms end up in by-products.

Q231. How is atom economy different from percentage yield?
 Answer: Atom economy is based on the chemical equation and shows how efficiently reactant atoms are used to form the desired product. Percentage yield, on the other hand, is based on the actual experiment and shows how much product was actually made compared to the theoretical amount. One measures efficiency of atom use, the other measures practical output.

Q232. A reaction produces two products, only one of which is useful. How does this affect atom economy?
 Answer: If only one of the products is useful, the atom economy will be lower because the atoms in the unwanted product are not counted in the desired output. These atoms are considered waste, which lowers the atom economy of the reaction.

Q233. Why is atom economy an important factor when designing new reactions?
 Answer: Atom economy helps chemists design reactions that are more efficient, produce less waste, and are better for the environment. High atom economy reactions use fewer raw materials and reduce costs, making them more sustainable for industrial and laboratory use.

Q234. A student calculates an atom economy of 85%. What does this mean?
 Answer: It means that 85% of the total mass of all products comes from the desired product. This shows that the reaction is fairly efficient in using the reactant atoms, with only 15% ending up as waste or by-products.

Q235. How do side products affect the atom economy of a reaction?
 Answer: Side products lower the atom economy because they use up atoms from the reactants that don't become part of the desired product. These unwanted products reduce the percentage of useful material formed, making the reaction less efficient overall.

Q236. Describe one way a reaction pathway can be improved to increase atom economy.
 Answer: A reaction can be improved by using different reactants or catalysts that favour the formation of only the desired product. Another way is to redesign the process to reduce or eliminate side reactions, so fewer by-products are formed and more atoms go into making the main product.

Q237. How can atom economy help in reducing costs in chemical manufacturing?
 Answer: High atom economy means more of the reactants are turned into the desired product, which reduces the need for excess materials and cuts down on waste. This lowers raw material costs, waste disposal fees, and energy usage, making the process more cost-effective.

Q238. A reaction has high yield but low atom economy. What does this suggest?
 Answer: This suggests that although most of the desired product was successfully made, a lot of the reactant atoms ended up in waste products. The reaction is efficient in practice but not in terms of atom use, which may lead to environmental and cost issues.

Q239. In what situation would a company accept a low atom economy reaction?
 Answer: A company might accept a low atom economy reaction if it has other advantages, such as being cheap, fast, or producing a high-value product. If the waste products can be reused or safely disposed of, and the benefits outweigh the drawbacks, the reaction may still be chosen.

Q240. How is atom economy useful for choosing between two different reaction routes?
 Answer: Atom economy allows chemists to compare how efficiently each route turns reactants into the desired product. The reaction with higher atom economy will produce less waste and use materials more effectively, making it a better choice for both cost and environmental reasons.

Q241. What are the environmental advantages of a reaction with high atom economy?
 Answer: A high atom economy means less waste is produced, reducing pollution and the need for harmful waste disposal. It also means fewer raw materials are needed, which conserves resources. Overall, it supports cleaner and greener chemical practices.

Q242. Why should chemists aim for reactions with both high atom economy and high yield?
 Answer: High atom economy ensures efficient use of materials, while high yield ensures most of the product is actually obtained. Together, they make a reaction both economically and environmentally efficient, reducing waste and improving the overall performance of the process.

Q243. How does the balanced symbol equation help in calculating atom economy?
 Answer: The balanced symbol equation shows the correct mole ratios and the identity of all products. It allows you to identify the desired product and calculate its relative formula mass compared to the total mass of all products, which is essential for finding atom economy.

Q244. Explain why the relative formula mass of desired product is used in the atom economy formula.
 Answer: The relative formula mass of the desired product is used because atom economy measures how much of the total mass of products is useful. It helps determine what fraction of the total output is actually the product we want, making it a measure of efficiency.

Q245. What is meant by the 'desired product' in the context of atom economy?
 Answer: The desired product is the main product that the reaction is intended to make. It is the useful substance that chemists aim to produce. Any other products formed are usually considered by-products or waste and are not included in the numerator when calculating atom economy.

Q246. A reaction with a 90% yield and 40% atom economy is carried out. What does this tell you?
 Answer: It tells you that although most of the desired product was obtained in the experiment (high yield), the reaction also produced a lot of waste (low atom economy). So the process is good in terms of output but poor in terms of sustainability and material efficiency.

Q247. Give one industrial example where atom economy is a key consideration.
 Answer: In the pharmaceutical industry, atom economy is important because the raw materials are often expensive and complex. Reactions must be efficient to reduce costs and avoid waste of valuable materials, especially when making large quantities of medicines.

Q248. What factors other than atom economy might influence the choice of a reaction route?
 Answer: Other factors include the cost and availability of reactants, reaction conditions (temperature and pressure), reaction time, energy usage, safety, environmental regulations, and ease of product separation. These practical issues may outweigh atom economy in some cases.

Q249. How can atom economy support green chemistry principles?
 Answer: Atom economy aligns with green chemistry because it reduces waste, uses resources efficiently, and minimises the environmental impact of chemical processes. Designing reactions with high atom economy helps achieve cleaner, safer, and more sustainable chemistry.

Q250. Why might a reaction with high atom economy still create environmental concerns?
 Answer: A reaction with high atom economy could still be harmful if it uses toxic reactants, produces dangerous gases, requires a lot of energy, or involves hazardous conditions. Even if little waste is made, these factors can still pose risks to health and the environment.

Q251. What does the unit mol/dm³ represent in terms of solution concentration?
 Answer: The unit mol/dm³ (moles per cubic decimetre) represents the number of moles of solute present in 1 dm³ (1 litre) of solution. It is a standard unit used to express the concentration of a solution in chemistry and shows how many moles of a substance are dissolved in a given volume.

Q252. How is concentration in mol/dm³ calculated using moles and volume?
 Answer: Concentration in mol/dm³ is calculated by dividing the number of moles of solute by the volume of solution in dm³.
 Formula: concentration = moles ÷ volume

Q253. Write the formula that links concentration, number of moles, and volume.
 Answer:
 concentration (mol/dm³) = number of moles ÷ volume (dm³)

Q254. How can you calculate the number of moles of solute in a solution if concentration and volume are known?
 Answer: You can calculate the number of moles by multiplying the concentration of the solution by its volume (in dm³).
 Formula: moles = concentration × volume

Q255. What does it mean if a solution has a concentration of 2 mol/dm³?
 Answer: It means that every 1 dm³ (1000 cm³) of the solution contains 2 moles of solute. This tells us how much solute is present in a given volume, which is important for measuring how strong or weak a solution is.

Q256. Describe how the mass of solute can be calculated from concentration and volume.
 Answer:
 First, use the formula: moles = concentration × volume
 Then use: mass = moles × Mr
 This way, you can find how much of a substance (in grams) is present in a given volume of solution.

Q257. How would you prepare 250 cm³ of a 1 mol/dm³ solution of sodium chloride?
 Answer:
 Convert 250 cm³ to dm³: 250 ÷ 1000 = 0.25 dm³
 moles = concentration × volume = 1 × 0.25 = 0.25 mol
 Mr of NaCl = 23 + 35.5 = 58.5
 mass = moles × Mr = 0.25 × 58.5 = 14.625 g
 Weigh 14.625 g of NaCl, dissolve it in some distilled water, and make up the volume to 250 cm³ in a volumetric flask.

Q258. Convert 0.5 dm³ to cm³.
 Answer: 0.5 dm³ = 500 cm³

Q259. Convert 300 cm³ to dm³.
 Answer: 300 cm³ = 0.3 dm³

Q260. If a solution has a concentration of 0.2 mol/dm³, how many moles are in 500 cm³?
 Answer:
 Convert 500 cm³ to dm³: 500 ÷ 1000 = 0.5 dm³
 moles = concentration × volume = 0.2 × 0.5 = 0.1 mol

Q261. What is the difference between concentration in mol/dm³ and g/dm³?
 Answer: mol/dm³ measures how many moles of solute are in each dm³ of solution, while g/dm³ measures the mass in grams of solute per dm³. The first tells you the number of particles, and the second tells you the actual mass.

Q262. How can you convert concentration from mol/dm³ to g/dm³?
 Answer:
 Use the formula:
 concentration (g/dm³) = concentration (mol/dm³) × Mr

Q263. A 0.5 mol/dm³ solution contains 0.1 mol of solute. What is the volume?
 Answer:
 volume = moles ÷ concentration = 0.1 ÷ 0.5 = 0.2 dm³ = 200 cm³

Q264. What is the concentration if 0.05 mol of solute is dissolved in 100 cm³ of solution?
 Answer:
 Convert 100 cm³ to dm³: 100 ÷ 1000 = 0.1 dm³
 concentration = moles ÷ volume = 0.05 ÷ 0.1 = 0.5 mol/dm³

Q265. Describe how titration can be used to find the concentration of an acid.
 Answer: In titration, a known volume and concentration of alkali is placed in a flask, and acid is added slowly from a burette. An indicator shows when neutralisation happens. The volume of acid used allows you to calculate its concentration using the balanced equation and the formula:
 moles = concentration × volume

Q266. If 25 cm³ of alkali reacts with 30 cm³ of acid, and the acid's concentration is known, how can you find the alkali's concentration?
 Answer:
 Convert volumes to dm³
 Calculate moles of acid using concentration × volume
 Use the balanced equation to find moles of alkali
 Then use concentration = moles ÷ volume to find alkali's concentration

Q267. Why is it important to measure solution volumes accurately in titration experiments?
 Answer: Accurate measurements ensure correct results. Small errors in volume can lead to wrong calculations of concentration, which affects the reliability of the experiment. Precise measurements help get repeatable and valid results.

Q268. Describe one source of error in measuring solution concentration using titration.
 Answer: One common error is reading the burette incorrectly, such as not reading at eye level or misjudging the meniscus. Another is adding too much solution past the endpoint, which affects the final result and gives an incorrect concentration.

Q269. How can dilution affect the concentration of a solution?
 Answer: Dilution means adding more solvent to a solution. This increases the total volume while keeping the same amount of solute, which reduces the concentration because the solute is now spread out in a larger volume.

Q270. A solution has 0.2 mol in 250 cm³. What is its concentration?
 Answer:
 Convert volume to dm³: 250 ÷ 1000 = 0.25 dm³
 concentration = moles ÷ volume = 0.2 ÷ 0.25 = 0.8 mol/dm³

Q271. Describe the steps to prepare 100 cm³ of a 0.1 mol/dm³ solution from a 1 mol/dm³ solution.
 Answer:
 Use dilution formula: $C_1V_1 = C_2V_2$
 (1 mol/dm³) × V_1 = (0.1 mol/dm³) × 100 cm³
 V_1 = 10 cm³
 Measure 10 cm³ of the 1 mol/dm³ solution, add distilled water to make it up to 100 cm³

Q272. What happens to concentration when a solution is diluted?
 Answer: When a solution is diluted, its concentration decreases because the solute is spread out in a greater volume, even though the amount of solute stays the same.

Q273. A solution of hydrochloric acid has a concentration of 1 mol/dm³. What does this mean in terms of moles per litre?
 Answer: It means that each litre (1 dm³) of the solution contains exactly 1 mole of hydrochloric acid.

Q274. Why is it important to use correct units when calculating concentration?
 Answer: Using correct units ensures accurate and meaningful results. Wrong units can lead to

calculation errors and incorrect conclusions. Units like dm³ must be used consistently when applying concentration formulas.

Q275. What volume of a 2 mol/dm³ solution contains 0.4 mol of solute?

Answer: Use the formula:
volume = moles ÷ concentration
volume = 0.4 mol ÷ 2 mol/dm³ = 0.2 dm³
Convert to cm³: 0.2 × 1000 = **200 cm³**
So, the solution has a volume of **200 cm³**.

Q276. If a student doubles the volume of a solution but keeps the amount of solute the same, what happens to the concentration?
 Answer: When the volume is doubled but the amount of solute stays the same, the concentration is halved. This is because concentration is inversely proportional to volume when the number of moles remains constant.

Q277. What is the volume of gas occupied by 2 moles of oxygen at room temperature and pressure?
 Answer: At room temperature and pressure (rtp), 1 mole of any gas occupies 24 dm³. So, 2 moles × 24 dm³ = **48 dm³**.

Q278. State the volume of one mole of any gas at room temperature and pressure.
 Answer: One mole of any gas occupies **24 dm³** at room temperature and pressure (rtp).

Q279. How can the volume of a gas be calculated from its mass and relative formula mass?
 Answer:
 Step 1: Calculate moles = mass ÷ Mr
 Step 2: Volume = moles × 24 (at rtp)
 This gives the volume in dm³.

Q280. A gas has a mass of 44 g and an Mr of 44. What volume does it occupy at room temperature?
 Answer:
 To find the volume of a gas at room temperature and pressure (rtp), we first calculate the number of moles using the formula:
 moles = mass ÷ Mr
 moles = 44 g ÷ 44 = 1 mole

At rtp, 1 mole of any gas occupies **24 dm³**. This value is used in calculations because it is a scientifically established fact based on gas behaviour under standard conditions.

Now use the formula:
 volume = moles × 24
 volume = 1 × 24 = 24 dm³

So, the gas occupies 24 dm³ at room temperature and pressure.

Q281. What is the formula used to calculate the volume of a gas at rtp from moles?
 Answer:
 The formula used to calculate the volume of a gas at room temperature and pressure (rtp) is:

volume (dm³) = moles × 24

This is because **1 mole of any gas occupies 24 dm³** at rtp. This formula allows you to find the volume of gas when the number of moles is known.

Q282. Calculate the number of moles of gas in 72 dm³ at room temperature.
 Answer:
 At room temperature and pressure (rtp), **1 mole of any gas occupies 24 dm³**.
 To calculate the number of moles:

moles = volume ÷ 24 = 72 ÷ 24 = 3 moles

So, **there are 3 moles of gas in 72 dm³** at rtp.

Q283. A chemical reaction produces 3 moles of nitrogen gas. What is the total volume of gas produced at room temperature?
 Answer:
 At room temperature and pressure (rtp), **1 mole of any gas occupies 24 dm³**.
 To calculate the volume of 3 moles of nitrogen gas:

volume = moles × 24 = 3 × 24 = 72 dm³

So, **the total volume of nitrogen gas produced is 72 dm³** at rtp.

Q284. How can you find the mass of a gas from its volume and relative formula mass?
 Answer:
 Step 1: Calculate moles = volume ÷ 24
 Step 2: mass = moles × Mr
 This gives the mass of the gas.

Q285. How is the volume of a gas related to the number of moles?
 Answer: The volume of a gas is directly proportional to the number of moles at room temperature and pressure. More moles mean more volume. The relationship is:
 volume = moles × 24 dm³

Q286. Explain how the balanced symbol equation helps calculate gas volumes in a reaction.
 Answer: A balanced equation shows the mole ratio of gases involved. Since volume is directly proportional to moles at rtp, you can use the mole ratios to find the volumes of gases used or produced in a reaction.

Q287. If 1 mole of hydrogen reacts to produce 1 mole of a gas, what is the volume of the gas formed at rtp?

 Answer:

 At room temperature and pressure (rtp), **1 mole of any gas occupies 24 dm³**.
 Since 1 mole of hydrogen produces 1 mole of gas, the volume of the gas formed will be:

volume = 1 × 24 = 24 dm³

So, **the gas formed will have a volume of 24 dm³** at rtp.

Q288. Describe the relationship between gas volumes and balanced equations.
 Answer: In a balanced equation, the coefficients represent the mole ratios of gases. Since gas volume is proportional to moles at rtp, these coefficients also show the volume ratios in dm³.

Q289. What is the total volume of gases produced when 2 moles of methane combust completely?
 Answer:
 The balanced equation for the complete combustion of methane is:
 $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$
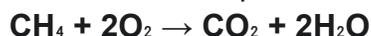
From the equation:
 1 mole of CH_4 produces 1 mole of CO_2 and 2 moles of H_2O (total 3 moles of gas).
 So, 2 moles of CH_4 will produce:
 2 × 3 = **6 moles of gas**

At room temperature and pressure, 1 mole of gas = 24 dm³
 Total volume = 6 × 24 = 144 dm³

So, **144 dm³ of gases are produced** when 2 moles of methane combust completely.

Q290. How can changing temperature or pressure affect the volume of a gas?
 Answer: Gas volume increases with temperature and decreases with pressure. At higher temperatures, particles move faster and spread out. At higher pressure, particles are forced closer together, reducing volume.

Q291. A reaction produces 48 dm³ of carbon dioxide. How many moles is this?
 Answer:
 At room temperature and pressure (rtp), **1 mole of any gas occupies 24 dm³**.
 To calculate the number of moles:

moles = volume ÷ 24
 moles = 48 ÷ 24 = 2 moles

So, **48 dm³ of carbon dioxide is equal to 2 moles**.

Q292. How many dm³ will 0.25 mol of a gas occupy at room temperature?
 Answer:

At room temperature and pressure (rtp), 1 mole of any gas occupies **24 dm³**.
To calculate the volume:

volume = moles × 24
 volume = 0.25 × 24 = 6 dm³

So, **0.25 mol of a gas will occupy 6 dm³** at rtp.

Q293. Describe how to rearrange the equation to make number of moles the subject when calculating gas volumes.
 Answer:
 To find the number of moles from a gas volume at room temperature and pressure, we use the formula:

volume = moles × 24

Here, 24 is the molar volume in dm³ because 1 mole of any gas occupies 24 dm³ at room temperature and pressure (rtp).
 To make **moles** the subject, divide both sides of the equation by 24:

moles = volume ÷ 24

This rearranged formula allows you to calculate how many moles of gas are present when you know its volume in dm³ at rtp.

Q294. A sample of nitrogen gas weighs 28 g. What volume does it occupy at room temperature?
 Answer:
 Mr of N_2 = 28
 moles = 28 ÷ 28 = 1 mol
 volume = 1 × 24 = **24 dm³**

Q295. Explain why equal moles of gases occupy equal volumes under the same conditions.
 Answer: All gases contain the same number of particles per mole. Under the same temperature and pressure, these particles occupy the same amount of space regardless of the type of gas. So, 1 mole of any gas = 24 dm³ at rtp.

Q296. Calculate the volume of 0.1 mol of oxygen gas at rtp.
 Answer:
 volume = 0.1 × 24 = **2.4 dm³**

Q297. How can you calculate the amount in moles from gas volume?
 Answer:
 Use the formula: **moles = volume ÷ 24**

Q298. A balanced equation shows that 2 moles of HCl react with 1 mole of Mg. If 48 dm³ of HCl is used, how many dm³ of H_2 gas will be produced?

Answer:

According to the equation, 2 mol HCl → 1 mol H_2

So, 48 dm³ HCl = 48 ÷ 24 = 2 mol HCl

This gives 1 mol H_2 = 24 dm³

Answer: **24 dm³ of H_2 gas**

Q299. What is the molar volume of a gas and how is it used in calculations?

Answer: Molar volume is the volume occupied by 1 mole of any gas at rtp, which is **24 dm³**. It is used to convert between moles and volume using the formula:

volume = moles × 24

Q300. How does using volume in gas calculations help in real-world chemical manufacturing?

Answer: Using volume helps in measuring and controlling gases during production. It allows accurate predictions of how much gas is needed or produced, helping with equipment sizing, safety planning, cost estimation, and environmental control.