GRADEUP

AQA (GCSE Notes)

Chapter 6: The Rate and Extent of Chemical Change

Q1. How can the rate of a chemical reaction be calculated using the quantity of a reactant?
Answer: The rate of a chemical reaction can be calculated using the quantity of a reactant by measuring how much of the reactant is used up over a period of time. The formula is:
Rate of reaction = Amount of reactant used ÷ Time taken
This method helps track how fast a reactant disappears as the reaction progresses. It's important to measure the amount in appropriate units like grams or moles, and time in seconds.

Q2. How do you calculate the rate of reaction using the quantity of a product formed?
Answer: The rate of reaction using the quantity of a product formed can be calculated by measuring the amount of product made in a certain time. The formula is:
Rate of reaction = Amount of product formed ÷ Time taken
This is useful when the product is a gas, solid, or a measurable liquid. The quantity could be measured in grams, cm^3, or moles depending on the type of product.

Q3. What are the units for rate of reaction when mass is measured in grams?
Answer: When mass is measured in grams, and time is measured in seconds, the units for rate of reaction are:
grams per second (g/s)
This means how many grams of reactant are used up or product formed in one second.

Q4. What are the units for rate of reaction when volume is measured in cm^3?
Answer: If volume is measured in cubic centimetres (cm^3) and time in seconds, the units for rate of reaction are:
cm^3/s (cubic centimetres per second)
This unit is commonly used when a gas is produced in a chemical reaction.

Q5. What is meant by the "mean rate of reaction"?
Answer: The "mean rate of reaction" refers to the average rate at which reactants are used up or products are formed during a reaction. It is calculated using the total change in quantity over the total time:
Mean rate = Total amount of reactant used or product formed ÷ Total time taken
This gives an overall idea of how fast the reaction occurred over the whole period.

Q6. How can moles be used to calculate the rate of reaction?
Answer: Moles can be used to calculate the rate of reaction by measuring how many moles of reactant are used or how many moles of product are formed over time. The formula is:
Rate = Number of moles ÷ Time taken
This method gives a more accurate measurement in cases where mass or volume can be misleading due to differences in molar mass or gas properties.

Q7. What is the unit for rate of reaction when using moles?
Answer: When using moles to calculate rate of reaction, and time in seconds, the units are:
mol/s (moles per second)
This unit shows how many moles of reactant are used or product formed each second.

Q8. How can a graph be used to determine the rate of a reaction?
Answer: A graph can be used to determine the rate of a reaction by plotting the quantity of reactant or product against time. The rate is found by calculating the gradient (slope) of the curve at a certain point. A steeper gradient means a faster rate. You can also draw a tangent at a specific time point to find the instantaneous rate.

Q9. How do you draw a tangent to a curve on a graph showing a chemical reaction?
Answer: To draw a tangent to a curve on a reaction graph, choose the point of interest, and draw a straight line that just touches the curve at that point without crossing it. The line should represent the direction the curve is heading at that point. This tangent is used to find the gradient, which gives the rate at that moment.

Q10. What does the slope of a tangent represent in a rate of reaction graph?
Answer: The slope of a tangent on a rate of reaction graph represents the **instantaneous rate** of reaction at that specific time. A steep slope shows a fast rate, while a gentle slope shows a slower rate. This helps determine how fast the reaction is happening at that exact moment.

Q11. Why might it be more useful to use moles rather than mass in some rate of reaction calculations?
Answer: It can be more useful to use moles instead of mass because moles give a direct comparison between different substances based on particle number, regardless of their individual mass. Different substances have different molar masses, so using grams can be misleading if you're comparing rates involving different chemicals. Moles standardise the measurement.

Q12. How can you estimate the rate of a reaction at a specific time from a graph?
Answer: To estimate the rate of reaction at a specific time from a graph, you draw a tangent to the curve at that point, then calculate the gradient of the tangent. The gradient is found by dividing the change in the y-axis (amount) by the change in the x-axis (time). This gives the rate of reaction at that exact time.

Q13. How do you calculate the gradient of a straight line on a graph?
Answer: To calculate the gradient of a straight line, you use the formula:
Gradient = Change in y ÷ Change in x
Choose two points on the line, subtract the y-values and divide by the difference in the x-values. This tells you how fast the quantity on the y-axis is changing with respect to time.

Q14. What is the effect of increasing the concentration of a reactant on the rate of reaction?
Answer: Increasing the concentration of a reactant increases the rate of reaction. This is because more particles are present in the same volume, leading to more frequent collisions between reactant particles. More collisions mean a higher chance of successful collisions that lead to a reaction.

Q15. How does increasing the surface area of a solid affect the rate of reaction?
Answer: Increasing the surface area of a solid increases the rate of reaction. This is because more particles are exposed and available to react. For example, powdered solids react faster than lumps because there is more area for the other reactant to collide with, leading to more frequent and successful collisions.

Q16. What impact does increasing the temperature have on the rate of reaction?
Answer: Increasing the temperature increases the rate of reaction. It causes particles to move faster and collide more often. Also, more particles have enough energy to overcome the activation energy barrier. This results in more frequent and more energetic collisions, making the reaction faster.

Q17. How does pressure affect the rate of reaction in gases?
Answer: In gases, increasing the pressure increases the rate of reaction. Higher pressure means gas particles are forced closer together, which leads to more frequent collisions. More collisions increase the chance of a successful reaction. Lowering the pressure does the opposite and slows down the reaction.

Q18. What role do catalysts play in chemical reactions?
Answer: Catalysts speed up chemical reactions without being used up themselves. They do this by lowering the activation energy needed for the reaction to happen. This means more particles have enough energy to react, so the reaction can happen more quickly and efficiently.

Q19. Why does increasing the concentration increase the rate of reaction?
Answer: Increasing the concentration means more particles of reactant are present in the same space. This leads to a higher chance of collisions between reacting particles. Since more collisions occur in the same amount of time, the reaction speeds up.

Q20. What is the effect of using powdered solids instead of lumps in reactions?
Answer: Using powdered solids instead of lumps increases the surface area available for reaction. More exposed surface allows more collisions between reactant particles, which increases the frequency of successful collisions. As a result, the rate of reaction increases.

Q21. How can the rate of a reaction be compared at different times using a graph?
Answer: You can compare the rate of a reaction at different times by drawing tangents at various points on the curve of a reaction graph. Then, calculate the gradient of each tangent. Steeper gradients mean faster rates. This helps track how the reaction slows down as it progresses.

Q22. Why does increasing temperature usually increase reaction rate?
Answer: Increasing temperature gives particles more kinetic energy. This makes them move faster and collide more often. More importantly, a greater proportion of particles will have the required activation energy to react. This leads to a higher rate of successful collisions and speeds up the reaction.

Q23. What happens to the particles in a reaction when temperature is increased?
Answer: When temperature increases, particles gain more energy and move faster. This leads to more frequent collisions between them. Also, more particles have enough energy to overcome the

activation energy barrier, increasing the number of successful collisions and making the reaction faster.

Q24. How do catalysts speed up a reaction without being used up?
Answer: Catalysts speed up reactions by providing an alternative reaction pathway that requires less activation energy. They help more particles to react successfully, but they are not chemically changed or used up during the reaction, so they can be reused multiple times.

Q25. How can a student measure the volume of gas produced in a reaction?
Answer: A student can measure the volume of gas produced using a gas syringe or by collecting the gas over water in an inverted measuring cylinder. These methods allow accurate measurement of the volume of gas produced during a reaction, which can then be used to calculate the rate of reaction.

Q26. What practical method can be used to measure mass loss during a reaction?
Answer: A practical method to measure mass loss during a reaction is to place the reaction container on a balance and record the mass at regular time intervals. As gas is produced and escapes from the container, the total mass decreases. This allows you to track how quickly the reaction is occurring by observing the rate at which the mass falls over time.

Q27. How would you plot a graph of reactant quantity against time?
Answer: To plot a graph of reactant quantity against time, place time on the x-axis and the amount of reactant on the y-axis. Measure the quantity of the reactant at regular intervals and plot these points. Join the points with a smooth curve to show how the amount of reactant decreases as the reaction progresses. A steeper curve at the start shows a faster reaction.

Q28. What does a steeper slope on a reaction rate graph tell you?
Answer: A steeper slope on a reaction rate graph indicates that the reaction is happening faster. The steeper the line, the more quickly the amount of reactant is decreasing or the amount of product is increasing. This means that particles are reacting more rapidly, likely due to increased temperature, concentration, surface area, or the presence of a catalyst.

Q29. How would you describe a reaction that slows down over time on a graph?
Answer: A reaction that slows down over time will be shown by a graph where the curve becomes less steep as time goes on. At the beginning, the rate is high due to the higher concentration of reactants, but as the reactants are used up, there are fewer particle collisions, so the rate slows. The graph will eventually flatten when the reaction stops.

Q30. Why is it important to keep all variables constant except one when investigating rate?
Answer: Keeping all variables constant except one ensures that the results are valid and that any changes in the reaction rate are only due to the variable you are testing. If multiple variables change, you cannot tell which one is affecting the rate, which makes your experiment unreliable and conclusions uncertain.

Q31. What equipment would you need to measure the rate of reaction involving gas?
Answer: To measure the rate of a reaction that produces gas, you can use a gas syringe or an inverted measuring cylinder in a water bath to collect the gas. A stopwatch is used to time the

reaction, and a balance may also be used to measure mass loss. These tools help record how much gas is produced in a given time to determine the rate.

Q32. What is meant by the term "initial rate of reaction"?
Answer: The initial rate of reaction is the rate at which the reaction proceeds right at the start, before any significant change in reactant concentrations occurs. It is usually the fastest part of the reaction and can be found by drawing a tangent to the curve at time zero on a graph of product formed or reactant used.

Q33. Why might the reaction rate decrease as the reaction continues?
Answer: As the reaction continues, the concentration of reactants decreases because they are being used up. With fewer reactant particles available, there are fewer successful collisions per second, so the reaction slows down. Also, products may interfere or the energy conditions may change slightly, contributing to the reduced rate.

Q34. How can data from a reaction be used to estimate the time for completion?
Answer: You can plot a graph of the amount of reactant used or product formed over time. When the graph levels off, it means the reaction has finished. By looking at the point where the curve flattens, you can estimate the time it took for the reaction to complete. This is when no more changes occur in the measured quantity.

Q35. What factors must be controlled to ensure a fair test when studying reaction rates?
Answer: To ensure a fair test, all variables except the one being investigated must be kept constant. These include temperature, concentration of other reactants, pressure (for gases), surface area of solids, volume of solution, and use of catalysts. Controlling these ensures accurate results that only reflect the effect of the variable being tested.

Q36. How does increasing pressure affect collisions between gas particles?
Answer: Increasing pressure in a gas reaction reduces the space between particles, causing them to collide more frequently. More collisions increase the chances of successful collisions with the right energy, which speeds up the reaction. This effect is more noticeable when the reaction involves gases on both sides of the equation.

Q37. How does collision theory explain the effect of temperature on reaction rate?
Answer: According to collision theory, increasing temperature gives particles more kinetic energy. This means they move faster and collide more often. More importantly, a greater proportion of particles have the required activation energy to react. This results in more successful collisions per second, increasing the rate of reaction.

Q38. What is meant by activation energy?
Answer: Activation energy is the minimum amount of energy that reacting particles must have to collide successfully and cause a reaction. If the particles collide with energy lower than the activation energy, the reaction will not occur. Activation energy is like a barrier that must be overcome for a chemical change to take place.

Q39. How do catalysts affect the activation energy of a reaction?
Answer: Catalysts lower the activation energy required for a reaction to occur. They provide an alternative reaction pathway that requires less energy. As a result, more particles have enough energy to react when they collide, which increases the rate of reaction without the catalyst being used up.

Q40. How would you explain the effect of surface area on reaction rate using collision theory?
Answer: According to collision theory, increasing surface area of a solid reactant exposes more particles to the other reactant. This leads to more frequent collisions at the surface where reactions take place. More collisions mean a higher chance of successful ones, so the reaction proceeds faster.

Q41. Why is it useful to repeat experiments when measuring reaction rate?
Answer: Repeating experiments helps identify any anomalies and ensures that the results are reliable and accurate. It allows you to calculate an average, which gives a more precise estimate of the reaction rate. Repeats also improve the validity of conclusions by showing consistency in the data.

Q42. What safety precautions should be taken when measuring reaction rates?
Answer: Safety precautions depend on the chemicals and equipment used. General precautions include wearing safety goggles, gloves, and a lab coat, working in a well-ventilated area, and handling acids, bases, or reactive substances with care. Make sure equipment is set up securely and clean up any spills immediately.

Q43. How could you investigate the effect of concentration on reaction rate in a lab?
Answer: To investigate the effect of concentration, you can react a fixed volume of one reactant with different concentrations of another reactant. Measure the rate using time taken for a visible change (like colour change or gas produced) and keep all other variables constant. Plot rate against concentration to analyse the effect.

Q44. What are some sources of error when measuring reaction rate?
Answer: Sources of error include inaccurate measurements of volume or mass, delays in starting or stopping the stopwatch, gas escaping from the apparatus, inconsistent temperature, or human error in reading instruments. These can affect the reliability of the rate calculation, so using precise equipment and good technique is important.

Q45. Why is drawing a tangent important for finding the rate at a specific point?
Answer: A tangent touches the curve at one point and shows the instantaneous rate at that point. It is especially useful for finding the initial rate of reaction. By calculating the gradient of the tangent (change in y ÷ change in x), you can determine how fast the reaction is proceeding at that moment.

Q46. What data would you collect in an experiment to measure mean rate of reaction?
Answer: You would collect the total amount of product formed or reactant used over a known period of time. For example, measure the volume of gas produced or the mass loss at regular intervals. Use this data to calculate the mean rate using the formula: mean rate = change in quantity / time taken.

Q47. What does a flat line on a graph of product formed over time indicate?
Answer: A flat line on a graph of product formed over time means that the reaction has stopped and no more product is being formed. This happens when all the reactants have been used up or the reaction has reached equilibrium in a reversible reaction. No further change is taking place in the system.

Q48. How can you check your answer when calculating the mean rate of reaction?
Answer: You can check your answer by redoing the calculation with the same data and seeing if the result is consistent. Also, verify that the units are correct and that you used the correct values for quantity change and time. Comparing with a graph or repeating the experiment helps confirm accuracy.

Q49. What mathematical steps are needed to find the rate of reaction from a graph?
Answer: First, draw a tangent to the curve at the point you want to measure the rate. Then, choose two points on the tangent line, find the vertical (y) and horizontal (x) difference between them, and use the formula: rate = change in y ÷ change in x. This gives the rate at that point in proper units.

Q50. How do different units (g/s, cm^3/s, mol/s) help us understand different types of reactions?
Answer: Different units match the type of reaction and the type of data collected. g/s is used when measuring mass change, cm^3/s for gas volume, and mol/s for mole changes. Choosing the right unit helps clearly describe the rate and makes it easier to compare with other reactions or data.

Q51. Explain why a chemical reaction only occurs when particles collide with enough energy.
Answer: A chemical reaction only happens when particles collide with enough energy to overcome the activation energy barrier. This energy is needed to break the existing bonds in the reactants. If the colliding particles don't have enough energy, they will simply bounce off each other and no reaction will take place. Only collisions with enough energy and the correct orientation will result in a successful reaction.

Q52. What is meant by the term activation energy in a chemical reaction?
Answer: Activation energy is the minimum amount of energy that reacting particles must have when they collide for a reaction to occur. It represents the energy barrier that must be overcome for bonds to break in the reactants and new bonds to form in the products. Without enough energy to overcome this barrier, the reaction will not proceed, even if the particles collide.

Q53. Describe how increasing the concentration of a solution affects the rate of a reaction.
Answer: Increasing the concentration of a solution means there are more particles of the reactant in the same volume. This leads to more frequent collisions between the particles. Since there are more collisions in a given time, the number of successful collisions also increases, which causes the rate of reaction to increase. This is explained by collision theory.

Q54. Why does increasing the pressure of a gas increase the rate of reaction?
Answer: Increasing the pressure of a gas compresses the gas particles into a smaller volume. This means the particles are closer together, which increases the frequency of collisions between them. As

the number of collisions per second rises, the chance of successful collisions that lead to a reaction also goes up, resulting in a faster reaction rate.

Q55. Explain how increasing the surface area of a solid reactant affects the rate of reaction.
Answer: When a solid is broken into smaller pieces or made into a powder, its surface area increases. A larger surface area allows more particles of the reactant to be exposed and available to collide with particles of another reactant. This increases the frequency of collisions and leads to more successful collisions per second, which increases the rate of reaction.

Q56. Describe the effect of increasing temperature on the energy of collisions in a reaction.
Answer: Increasing temperature gives the particles more kinetic energy. This means that when particles collide, they do so with more energy. As a result, a greater proportion of collisions have enough energy to overcome the activation energy barrier. Therefore, more of the collisions become successful, leading to a faster reaction rate.

Q57. Explain how increasing temperature affects both the frequency and energy of collisions.
Answer: When temperature is increased, particles move faster, which leads to more collisions per second (higher frequency). At the same time, the energy of each collision also increases because the particles have more kinetic energy. As a result, more collisions have enough energy to overcome the activation energy, increasing the number of successful collisions and the rate of reaction.

Q58. How does collision theory explain the effect of temperature on the rate of a reaction?
Answer: According to collision theory, reactions happen when particles collide with enough energy. Increasing temperature increases the kinetic energy of particles, making them move faster and collide more often. It also increases the proportion of collisions that are successful because more particles have energy greater than or equal to the activation energy. This makes the reaction happen faster.

Q59. Predict the effect on the rate of reaction if the concentration of a reactant is halved.
Answer: If the concentration of a reactant is halved, there are fewer particles in the same volume. This means collisions between reacting particles will occur less frequently. As a result, the number of successful collisions per second decreases, which slows down the rate of reaction. The rate will be lower compared to when the concentration is higher.

Q60. Predict the effect on rate if a gas is compressed into a smaller volume at constant temperature.
Answer: Compressing a gas into a smaller volume at constant temperature increases the pressure. This causes gas particles to be closer together, which increases the frequency of collisions between them. Since there are more collisions in a given time, the number of successful collisions also increases, leading to a faster rate of reaction.

Q61. Why does breaking a solid into smaller pieces increase the rate of reaction?
Answer: Breaking a solid into smaller pieces increases its surface area. More surface area means more of the solid is exposed to other reactants. This allows more particles to collide with the solid's surface at the same time. As a result, the frequency of collisions increases, which leads to more successful collisions and a faster rate of reaction.

Q62. How can surface area to volume ratio be used to explain the effect of particle size on reaction rate?
Answer: Smaller particles have a higher surface area to volume ratio compared to larger particles. This means more of the particle's surface is available for collisions with reactant particles. The larger the surface area relative to volume, the more collisions can happen per second, which increases the reaction rate. Larger particles have less surface area for collisions, so the reaction is slower.

Q63. What happens to the rate of reaction when large pieces of solid are replaced by powder?
Answer: When large pieces of solid are replaced by powder, the surface area of the reactant increases significantly. This provides more area for other reactant particles to collide with. As a result, the frequency of collisions increases, leading to more successful collisions per second and a much faster rate of reaction.

Q64. Describe the relationship between frequency of collisions and concentration.
Answer: There is a direct relationship between the concentration of a solution and the frequency of collisions. Higher concentration means more reactant particles are present in a given volume. This increases the chances of particles colliding. Therefore, the higher the concentration, the greater the frequency of collisions, which increases the rate of reaction.

Q65. Explain using collision theory why a reaction slows down as it proceeds.
Answer: As a reaction proceeds, the concentration of the reactants decreases because they are being used up. With fewer reactant particles present, the frequency of collisions decreases. According to collision theory, fewer collisions mean fewer successful collisions per second, which slows down the rate of reaction over time.

Q66. How does a catalyst affect the activation energy of a chemical reaction?
Answer: A catalyst lowers the activation energy needed for a reaction to occur. It provides an alternative reaction pathway with a lower energy barrier. This means more reacting particles have enough energy to overcome the activation energy, even at the same temperature. As a result, the rate of reaction increases without increasing temperature or pressure.

Q67. Why are catalysts not written in the chemical equation for a reaction?
Answer: Catalysts are not written in the chemical equation because they are not used up or changed permanently in the reaction. They help speed up the reaction by providing an alternative pathway, but they remain chemically unchanged at the end. Since they are not part of the overall chemical change, they are not included in the balanced chemical equation.

Q68. What feature of a catalyst allows it to be used again and again?
Answer: A catalyst remains chemically unchanged at the end of a reaction, which means it is not consumed or altered during the reaction. This property allows a small amount of catalyst to be used repeatedly in many reaction cycles. Since it doesn't get used up, it can continue to lower activation energy and speed up the reaction over and over again.

Q69. Explain why different reactions require different catalysts.
Answer: Different reactions involve different types of bonds and reactants, so they require different

catalysts that are specifically suited to their chemical properties. A catalyst must be able to interact with the reactants to lower their activation energy. Because this interaction depends on the nature of the substances involved, one catalyst does not work for all reactions.

Q70. Describe how a reaction profile changes when a catalyst is used.
Answer: When a catalyst is used, the reaction profile shows a lower activation energy compared to the same reaction without a catalyst. The overall energy change of the reaction remains the same, but the peak of the energy curve is lower. This indicates that less energy is needed for the reaction to proceed, which makes the reaction happen faster.

Q71. How do enzymes act as catalysts in biological systems?
Answer: Enzymes are biological catalysts that speed up chemical reactions in living organisms. They do this by lowering the activation energy required for the reaction. Enzymes are highly specific and work by binding to specific molecules (substrates) and helping to convert them into products more efficiently. They remain unchanged at the end of the reaction and can be reused.

Q72. Why does using a catalyst increase the rate of a reaction even though the number of collisions remains the same?
Answer: A catalyst does not increase the number of collisions, but it increases the number of successful collisions. It does this by lowering the activation energy needed for the reaction. With lower activation energy, more of the existing collisions have enough energy to result in a reaction, so the rate increases even though the total number of collisions stays the same.

Q73. Explain why catalysts are important in industrial chemical processes.
Answer: Catalysts are important in industry because they help reactions occur faster and often at lower temperatures and pressures. This saves energy and reduces costs. Catalysts also increase the yield of products in a shorter time, making the process more efficient. They are not used up and can be reused, which is also economically and environmentally beneficial.

Q74. What is meant by the term “reaction pathway” in a catalysed reaction?
Answer: In a catalysed reaction, the reaction pathway is the route that the reaction takes from reactants to products with the help of a catalyst. This pathway requires less energy because the catalyst provides an alternative route with a lower activation energy. The reaction still produces the same products, but the energy barrier is lower, so the reaction is faster.

Q75. Describe how a catalyst provides an alternative pathway for a reaction.
Answer: A catalyst works by interacting with the reactants to form an intermediate that requires less energy to reach the product stage. This creates a different route—the alternative pathway—with a lower activation energy compared to the uncatalysed reaction. Because less energy is needed, more particles can react, which increases the rate of the reaction.

Q76. A student added a metal salt to a reaction and noticed it sped up. How could they confirm the metal salt was acting as a catalyst?
Answer: A catalyst is not used up in a reaction, so the student could confirm this by recovering the metal salt unchanged at the end. They could filter or separate the catalyst after the reaction and

weigh it to ensure it has the same mass. They could also reuse it in a second reaction to see if it still increases the rate. If the reaction rate increases again, the substance likely acted as a catalyst.

Q77. Why might a catalyst be used even though it does not increase the amount of product formed?
Answer: A catalyst increases the rate of reaction, allowing products to form faster, which is useful in industrial processes where time and energy costs are important. Even though it doesn't increase the total product yield, speeding up the reaction can improve efficiency, reduce energy consumption, and allow for lower temperatures or pressures to be used.

Q78. In terms of energy, how does a catalysed reaction differ from an uncatalysed one?
Answer: A catalysed reaction has a lower activation energy compared to an uncatalysed reaction. This means more particles have enough energy to react when they collide, increasing the reaction rate. The catalyst provides an alternative pathway for the reaction, but it does not change the overall energy change of the reaction.

Q79. How can collision theory explain the difference in rate between a catalysed and uncatalysed reaction?
Answer: Collision theory states that particles must collide with enough energy and correct orientation to react. A catalyst lowers the activation energy, so more collisions have enough energy to be successful. This leads to a greater number of effective collisions per second, increasing the reaction rate compared to an uncatalysed reaction.

Q80. Predict the effect on the rate of reaction if temperature is reduced from 50°C to 20°C.
Answer: Reducing the temperature decreases the kinetic energy of particles, leading to fewer collisions and fewer particles having the required activation energy. This results in a lower rate of reaction because there are fewer successful collisions per second when the temperature drops from 50°C to 20°C.

Q81. Why does increasing temperature have a greater effect on rate than increasing concentration?
Answer: Increasing temperature gives particles more kinetic energy, making them move faster and collide more often with greater energy. This significantly increases the number of successful collisions. Increasing concentration increases collision frequency but doesn’t affect particle energy. So, temperature affects both frequency and energy, making it more effective.

Q82. Why do particles need to collide in the correct orientation for a reaction to occur?
Answer: In many reactions, only specific parts of particles must interact to form new bonds. If the particles do not collide in the right orientation, even if they have enough energy, the reaction will not take place. Correct orientation ensures the reacting parts of the molecules come into contact and can rearrange to form products.

Q83. Explain the importance of effective collisions in chemical reactions.
Answer: An effective collision is one where particles collide with enough energy and the correct orientation to cause a reaction. These collisions lead to bond breaking and forming, which is essential

for a chemical change. Without effective collisions, no products are formed, so the rate of reaction depends directly on how often effective collisions occur.

Q84. How can proportional reasoning help explain the effect of doubling concentration on rate?
Answer: Doubling the concentration means there are twice as many reacting particles in the same volume. This leads to twice as many collisions per unit time. If the probability of each collision being successful stays the same, then the reaction rate would approximately double, showing a proportional relationship between concentration and rate.

Q85. What happens to the rate of reaction when particles collide without sufficient energy?
Answer: When particles collide without sufficient energy, they do not overcome the activation energy barrier. As a result, no reaction occurs from those collisions, and the rate of reaction remains low. Only collisions with energy equal to or greater than the activation energy lead to product formation.

Q86. How does the rate of a gas reaction change if the gas is cooled?
Answer: Cooling a gas reduces the kinetic energy of its particles. This results in fewer collisions per second and fewer collisions having the required activation energy. Consequently, the number of effective collisions decreases, and the rate of the gas reaction slows down significantly.

Q87. Describe a way to increase the number of successful collisions in a reaction between a solid and a solution.
Answer: One way is to increase the surface area of the solid by using a powder instead of lumps. This exposes more particles of the solid to the solution, allowing more collisions to take place at the surface. More surface area means more opportunities for successful collisions, increasing the reaction rate.

Q88. Explain why powdered limestone reacts faster with acid than limestone chips.
Answer: Powdered limestone has a greater surface area compared to chips. This allows more particles of limestone to be exposed to the acid at the same time, leading to more frequent collisions between reacting particles. More collisions increase the number of successful collisions, making the reaction faster.

Q89. Predict how the rate of a reaction would change if both concentration and temperature are increased.
Answer: Increasing concentration raises the number of particles available to react, and increasing temperature raises their kinetic energy. This results in more frequent and more energetic collisions. Together, these changes greatly increase the number of successful collisions, significantly speeding up the reaction rate.

Q90. Why might a reaction with a low activation energy happen quickly at room temperature?
Answer: If the activation energy is low, many particles will already have enough energy to react at room temperature. This means a large proportion of collisions will be successful, leading to a fast reaction even without the need for heating. Low activation energy removes the barrier that slows other reactions.

GRADEUP

Q91. What type of reaction profile would show a large activation energy?
Answer: A reaction profile with a high peak between reactants and products shows a large activation energy. The bigger the energy difference between the reactants and the peak, the more energy is needed to start the reaction. This suggests the reaction is slow unless energy is supplied, such as by heating.

Q92. How can you use a reaction profile to identify a catalysed reaction?
Answer: A catalysed reaction profile will show a lower activation energy compared to the uncatalysed one. On the graph, the curve for the catalysed reaction will have a smaller peak, indicating that less energy is needed for the reaction to occur. The overall energy change remains the same.

Q93. What is the role of metal salts in the catalytic decomposition of hydrogen peroxide?
Answer: Metal salts like manganese(IV) oxide act as catalysts in the decomposition of hydrogen peroxide. They lower the activation energy required for the reaction, allowing the hydrogen peroxide to break down into water and oxygen more quickly. The metal salt remains unchanged at the end of the reaction.

Q94. Why is it important to use only the required amount of catalyst in a reaction?
Answer: Using more catalyst than needed doesn’t increase the reaction rate beyond a certain point, so it's wasteful. Catalysts can also be expensive, so using only the necessary amount saves cost. In some reactions, excess catalyst may complicate purification or interfere with desired product formation.

Q95. A reaction is too slow at room temperature. What change would you make to increase its rate?
Answer: To increase the rate, you could raise the temperature. This would increase the kinetic energy of the particles, causing more frequent and more energetic collisions. More collisions would have enough energy to overcome the activation energy, leading to a faster reaction.

Q96. Why does increasing surface area lead to more frequent collisions?
Answer: When surface area is increased, more particles of the reactant are exposed to the other reactant. This creates more opportunities for collisions to occur, especially in reactions involving solids and liquids or gases. More frequent collisions mean more chances for effective collisions, increasing the reaction rate.

Q97. Explain the combined effect of increasing temperature and adding a catalyst.
Answer: Increasing temperature makes particles move faster and collide more often with more energy. Adding a catalyst lowers the activation energy. Together, these changes cause a large increase in the number of successful collisions, making the reaction much faster than with either change alone.

Q98. A reaction produces gas. How could you measure the rate of reaction?
Answer: You could collect the gas in a syringe or over water and measure the volume at regular intervals. The rate can be found by how fast the gas volume increases. Alternatively, if the reaction

causes mass loss (like carbon dioxide escaping), you can measure the mass decrease on a balance over time.

Q99. Describe how you could investigate the effect of particle size on reaction rate in a school lab.

Answer: Use the reaction between hydrochloric acid and calcium carbonate. Use different forms of calcium carbonate: powdered, small chips, and large lumps. Measure the gas produced or mass lost over time for each. Compare the rates to see how particle size affects reaction speed. Use same volume and concentration of acid.

Q100. What is the difference between the rate of a catalysed and an uncatalysed reaction on a graph?

Answer: On a graph of product formed vs time, a catalysed reaction curve rises more steeply and levels off sooner than an uncatalysed one, showing a faster rate. On a reaction profile, the catalysed reaction has a lower peak, showing a lower activation energy. The final energy change remains the same.

Q101. What is meant by a reversible reaction in chemistry?

Answer: A reversible reaction is a chemical reaction where the products can react to form the original reactants again. This means the reaction can go both forwards and backwards under certain conditions. For example, if you heat ammonium chloride, it decomposes into ammonia and hydrogen chloride gases, but if you cool those gases, they can recombine to form ammonium chloride again.

Q102. Write a balanced symbol equation for a reversible reaction and label the forward and reverse reactions.

Answer: An example of a reversible reaction is:

$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$

Forward reaction: Nitrogen and hydrogen react to form ammonia.

Reverse reaction: Ammonia breaks down into nitrogen and hydrogen.

Q103. How is a reversible reaction represented using symbols?

Answer: A reversible reaction is shown using a double arrow symbol ($\rightleftharpoons$). This symbol indicates that the reaction can proceed in both directions—forward to form products and backward to form reactants. The arrow pointing right shows the forward reaction, and the arrow pointing left shows the reverse reaction.

Q104. Explain what happens to the products and reactants in a reversible reaction over time.

Answer: Over time, in a reversible reaction within a closed system, the amounts of reactants and products reach a state where they no longer change. This is called equilibrium. At this point, the rate of the forward reaction is equal to the rate of the reverse reaction, so the concentrations remain constant, even though both reactions continue to occur.

Q105. What effect does a change in temperature have on the direction of a reversible reaction?

Answer: Changing the temperature affects which direction the equilibrium shifts. If the forward reaction is exothermic (releases heat), increasing the temperature shifts the equilibrium to the left (reverse reaction). If the forward reaction is endothermic (absorbs heat), increasing the temperature shifts the equilibrium to the right (forward reaction).

Q106. What happens to the position of equilibrium if the temperature is increased in an exothermic reaction?
Answer: In an exothermic forward reaction, increasing the temperature causes the equilibrium to shift in the direction that absorbs heat—this is the reverse (endothermic) direction. As a result, the yield of the products from the exothermic reaction decreases, and more reactants are formed instead.

Q107. Explain how pressure affects the direction of a reversible reaction involving gases.
Answer: For reactions involving gases, increasing the pressure shifts the equilibrium toward the side with fewer gas molecules. This helps reduce pressure. Decreasing the pressure shifts the equilibrium toward the side with more gas molecules. This only applies when the number of gas molecules is different on each side of the equation.

Q108. What is meant by dynamic equilibrium?
Answer: Dynamic equilibrium is the state in a reversible reaction where the forward and reverse reactions occur at the same rate. This means the concentrations of reactants and products remain constant over time. It's called "dynamic" because the reactions are still happening, just at equal rates.

Q109. Describe the conditions needed for a reversible reaction to reach equilibrium.
Answer: A reversible reaction can only reach equilibrium in a closed system. This means that no substances are added or removed during the reaction. Also, the system must be left undisturbed for a while so that the rates of the forward and reverse reactions can balance each other.

Q110. Explain why equilibrium can only be reached in a closed system.
Answer: In a closed system, no reactants or products can enter or leave. This allows the forward and reverse reactions to happen continuously without any loss of materials. If the system were open, products could escape or reactants could be added, preventing the equilibrium from being established.

Q111. In a reversible reaction, what does it mean if the forward reaction is endothermic?
Answer: If the forward reaction is endothermic, it means that it absorbs heat from the surroundings. Therefore, increasing the temperature will favour the forward reaction, leading to a greater yield of products. The reverse reaction, in this case, would be exothermic and release heat.

Q112. What is the energy relationship between the forward and reverse reactions in a reversible reaction?
Answer: In a reversible reaction, the energy absorbed in the endothermic direction is equal to the energy released in the exothermic direction. This means that if the forward reaction takes in energy, the reverse reaction will give out the same amount of energy when going back to reactants.

Q113. Describe what happens to the temperature of the surroundings during the exothermic direction of a reversible reaction.
Answer: During the exothermic direction of a reversible reaction, heat is released into the

surroundings. This causes the temperature of the surroundings to increase. The energy released comes from the formation of new chemical bonds in the products.

Q114. How does changing the concentration of reactants affect a reversible reaction?
Answer: Increasing the concentration of reactants causes the equilibrium to shift to the right, favouring the formation of more products. This happens because the system tries to reduce the added reactants. If the concentration of products is increased instead, the equilibrium shifts to the left.

Q115. What does the ⇌ symbol in a chemical equation tell you?
Answer: The ⇌ symbol tells you that the reaction is reversible. It can proceed in both the forward direction (to form products) and the reverse direction (to form reactants). It also implies that the reaction can reach a state of equilibrium under suitable conditions.

Q116. If a reversible reaction is endothermic in the forward direction, what can be said about the reverse reaction?
Answer: If the forward reaction is endothermic, meaning it takes in heat, then the reverse reaction must be exothermic, meaning it releases heat. The two directions of the reaction always involve opposite energy changes of equal magnitude.

Q117. Explain what is meant by the term "position of equilibrium."
Answer: The position of equilibrium refers to the relative amounts of reactants and products in a system at equilibrium. If more products are present, the equilibrium lies to the right. If more reactants are present, it lies to the left. This position can change if conditions like temperature or pressure are altered.

Q118. How can the position of equilibrium be changed?
Answer: The position of equilibrium can be changed by altering temperature, pressure (for gases), or concentration. According to Le Chatelier's Principle, the system will adjust to oppose the change. For example, increasing temperature favours the endothermic direction, while increasing concentration of a reactant shifts equilibrium to the right.

Q119. Why does a change in pressure only affect reactions involving gases?
Answer: Pressure changes only affect gases because gases can be compressed or expanded. Solids and liquids are not significantly affected by pressure. In a gaseous reaction, changing the pressure affects how close the gas particles are, which influences the rate and direction of the reaction.

Q120. Give an example of a reversible reaction and describe how changing temperature affects the yield of products.
Answer: An example is the Haber process: $N_2 + 3H_2 \rightleftharpoons 2NH_3$. The forward reaction is exothermic. Increasing temperature shifts equilibrium to the left, reducing ammonia yield. Lowering the temperature shifts it to the right, increasing ammonia yield, though the reaction rate may become slower.

Q121. How can equilibrium be shifted to increase the yield of products?
Answer: To increase product yield, change conditions to favour the forward reaction. For example, if

the forward reaction is exothermic, lowering the temperature shifts equilibrium to the right. If there are fewer gas molecules on the product side, increasing pressure also shifts equilibrium to the right.

Q122. Describe how the Haber process is an example of a reversible reaction.
Answer: The Haber process involves the reaction of nitrogen and hydrogen to form ammonia: $N_2 + 3H_2 \rightleftharpoons 2NH_3$. This is reversible, so some ammonia decomposes back into nitrogen and hydrogen. Industrially, conditions are chosen to shift equilibrium toward the formation of ammonia while maintaining a reasonable reaction rate.

Q123. What role does energy transfer play in reversible reactions?
Answer: Energy transfer is key in reversible reactions. One direction absorbs energy (endothermic) and the other releases energy (exothermic). The direction the reaction favours depends on the temperature. Understanding energy transfer helps control the equilibrium position and improve product yield in industrial processes.

Q124. What is the effect of cooling an equilibrium mixture where the forward reaction is exothermic?
Answer: Cooling the mixture removes heat from the system. If the forward reaction is exothermic, the system responds by favouring this direction to release heat and counter the cooling. As a result, more products are formed, and the equilibrium shifts to the right.

Q125. How can we tell that equilibrium has been reached in a reversible reaction?
Answer: Equilibrium is reached when the rate of the forward reaction equals the rate of the reverse reaction. At this point, the concentrations of reactants and products stay constant. This does not mean the reaction has stopped, but that both directions are happening at the same rate.

Q126. Why does a reversible reaction not stop once equilibrium is reached?
Answer: At equilibrium, a reversible reaction does not stop because both the forward and reverse reactions are still happening. The key point is that they occur at the same rate. This means the amounts of reactants and products remain constant, not because the reactions have stopped, but because the rate at which the products are being formed is equal to the rate at which they are being converted back into reactants. This is called dynamic equilibrium.

Q127. How can we favour the formation of products in an endothermic reversible reaction?
Answer: To favour the formation of products in an endothermic reversible reaction, we increase the temperature. According to Le Chatelier's Principle, the system will try to oppose this change by absorbing the added heat, which favours the forward reaction if it is endothermic. As a result, the equilibrium position shifts to the right, increasing the amount of products formed.

Q128. Describe what is observed when ammonium chloride is heated and cooled again.
Answer: When ammonium chloride is heated, it breaks down into ammonia and hydrogen chloride gases, which appear as white fumes. This shows the forward reaction occurring. When the gases are cooled, they recombine to form solid ammonium chloride, which appears as white crystals. This demonstrates a reversible reaction and shows how temperature affects the direction of the reaction.

Q129. Why is the amount of energy the same in both directions of a reversible reaction?
Answer: The amount of energy involved in a reversible reaction is the same in both directions because energy is conserved. If the forward reaction is exothermic and releases a certain amount of energy, then the reverse reaction must absorb the same amount of energy to convert the products back into reactants. This is due to the law of conservation of energy.

Q130. What happens to the equilibrium position if more product is removed as it forms?
Answer: If more product is removed as it forms, the equilibrium position shifts to the right (towards the products) to replace the product that has been removed. This happens because the system tries to counteract the change by favouring the forward reaction, resulting in the formation of more products to restore equilibrium.

Q131. What is meant by the term “closed system” in the context of reversible reactions?
Answer: A closed system means that no substances can enter or leave the system, but energy can still be transferred. In the context of reversible reactions, this is important because it allows the forward and reverse reactions to happen continuously without any loss of reactants or products, enabling the system to reach and maintain equilibrium.

Q132. Explain the relationship between energy change and direction in a reversible reaction.
Answer: In a reversible reaction, if the forward reaction is exothermic (releases energy), then the reverse reaction is endothermic (absorbs energy), and vice versa. The direction in which the reaction favours depends on external conditions like temperature. Energy change determines how the equilibrium position shifts in response to temperature changes based on Le Chatelier's Principle.

Q133. What does it mean if equilibrium lies to the left?
Answer: If equilibrium lies to the left, it means that there are more reactants than products in the mixture at equilibrium. The reverse reaction is favoured under the current conditions, and only a small amount of the reactants has been converted into products. This suggests that the conditions are more suitable for the reverse reaction.

Q134. How can a chemist use changes in conditions to favour the reverse reaction?
Answer: A chemist can favour the reverse reaction by changing conditions such as decreasing the temperature if the forward reaction is endothermic or increasing the temperature if the forward reaction is exothermic. They could also increase the concentration of products or decrease the concentration of reactants. In gaseous reactions, increasing the pressure might also help if the reverse reaction produces fewer gas molecules.

Q135. Describe how increasing the temperature affects both endothermic and exothermic directions of a reversible reaction.
Answer: Increasing the temperature will favour the endothermic direction of a reversible reaction because the system tries to absorb the added heat. If the forward reaction is endothermic, the equilibrium will shift to the right, producing more products. If the forward reaction is exothermic, the equilibrium will shift to the left, reducing the amount of products.

Q136. Why is it important to know whether a reaction is reversible in industry?
Answer: In industry, knowing whether a reaction is reversible helps optimise conditions for maximum yield and efficiency. Reversible reactions may not go to completion, so companies must use conditions that favour the desired product side. Understanding equilibrium allows them to adjust temperature, pressure, and concentrations to make the process more cost-effective and productive.

Q137. What happens to the concentrations of reactants and products at equilibrium?
Answer: At equilibrium, the concentrations of reactants and products remain constant over time. This does not mean the reactions have stopped, but that the rate at which the reactants form products is equal to the rate at which the products revert to reactants. The actual concentrations depend on the position of equilibrium and the specific conditions of the reaction.

Q138. Explain how Le Chatelier's Principle applies to reversible reactions.
Answer: Le Chatelier's Principle states that if a change is made to a system at equilibrium, the system will adjust to counteract the change and restore equilibrium. For example, increasing the temperature favours the endothermic direction, and increasing pressure favours the side with fewer gas molecules. The principle helps predict how a system will respond to changes in temperature, pressure, or concentration.

Q139. Give a reason why a reversible reaction might never reach completion.
Answer: A reversible reaction might never reach completion because both the forward and reverse reactions occur simultaneously and eventually reach a state of dynamic equilibrium. At this point, the forward and reverse reactions happen at the same rate, and no net change in concentration occurs. Only in very specific conditions will one direction be so favoured that the reaction appears to go to completion.

Q140. What does it mean if the forward and reverse reactions occur at the same rate?
Answer: If the forward and reverse reactions occur at the same rate, the system is said to be at dynamic equilibrium. This means that the amounts of reactants and products remain constant over time, even though both reactions are still happening. It is a balanced and stable condition in a closed system where the reaction does not stop but continues at equal rates in both directions.

Q141. What is the result of increasing the concentration of products in a reversible reaction?
Answer: Increasing the concentration of products in a reversible reaction will shift the equilibrium position to the left, favouring the reverse reaction. According to Le Chatelier's Principle, the system will try to reduce the added product by converting more of it back into reactants. This helps the system return to a state of equilibrium under the new conditions.

Q142. How does adding a catalyst affect the position of equilibrium?
Answer: Adding a catalyst does not affect the position of equilibrium. A catalyst speeds up both the forward and reverse reactions equally, allowing the system to reach equilibrium faster, but it does not change the concentrations of reactants or products at equilibrium. It simply helps the system achieve equilibrium more quickly.

Q143. What happens to the rate of reaction when a catalyst is added to a reversible reaction?
Answer: When a catalyst is added to a reversible reaction, the rate of both the forward and reverse reactions increases. This means that the system reaches equilibrium faster, but the position of equilibrium and the final concentrations of reactants and products remain unchanged. The catalyst provides an alternative reaction pathway with lower activation energy.

Q144. Describe the energy change when the forward reaction absorbs heat.
Answer: When the forward reaction absorbs heat, it is an endothermic reaction. Energy is taken in from the surroundings, often making the environment cooler. The products have more energy than the reactants because the energy absorbed is used to break bonds or cause changes in the molecular structure. This energy change is positive in value.

Q145. In a sealed container, how does a change in volume affect gaseous equilibrium?
Answer: In a sealed container, decreasing the volume increases the pressure. This causes the equilibrium to shift toward the side of the reaction with fewer gas molecules. Conversely, increasing the volume decreases the pressure, causing the equilibrium to shift toward the side with more gas molecules. This behaviour helps the system oppose the pressure change.

Q146. What does it mean when we say the system has reached "dynamic" equilibrium?
Answer: Dynamic equilibrium means that the forward and reverse reactions in a reversible reaction are occurring at the same rate, so the concentrations of reactants and products remain constant. It is "dynamic" because the reactions are still happening, just in a balanced way. This state only occurs in a closed system where no substances can enter or leave.

Q147. How does decreasing the concentration of a reactant affect the position of equilibrium?
Answer: Decreasing the concentration of a reactant causes the equilibrium to shift to the left, favouring the reverse reaction. According to Le Chatelier's Principle, the system tries to increase the amount of reactant by converting products back into reactants. This shift helps balance the change and re-establish equilibrium.

Q148. Explain why equilibrium is a balance between the forward and reverse reactions.
Answer: Equilibrium is a balance between the forward and reverse reactions because both reactions are happening at the same rate. This balance means that the overall amounts of reactants and products stay the same, even though reactions continue. The system is stable and dynamic, and changes in conditions can shift this balance to favour one direction.

Q149. What would be observed if equilibrium shifts to favour the products?
Answer: If equilibrium shifts to favour the products, more product is formed and the concentration of reactants decreases. This could be observed as an increase in colour intensity (if the product is coloured), gas formation, temperature change, or precipitate formation depending on the reaction. The visible outcome depends on the nature of the reaction.

Q150. Why is it important that the rates of the forward and reverse reactions are equal at equilibrium?
Answer: It is important that the rates of the forward and reverse reactions are equal at equilibrium

because this is what keeps the concentrations of reactants and products constant. If the rates were not equal, the system would keep changing and equilibrium would not be established. Equal rates ensure that the system remains stable and no further net change occurs.

Q151. What happens to the position of equilibrium when the concentration of a reactant is increased?
Answer: When the concentration of a reactant is increased, the position of equilibrium shifts to the right, meaning more products are formed. This happens because the system tries to use up the added reactant by favouring the forward reaction. As a result, the equilibrium moves in the direction that reduces the effect of the change, which aligns with Le Chatelier's Principle.

Q152. How does decreasing the concentration of a product affect the equilibrium of a reversible reaction?
Answer: When the concentration of a product is decreased, the equilibrium shifts to the right to produce more of that product. This is because the system tries to replace the lost product, so the forward reaction is favoured. This helps the system counteract the change and re-establish equilibrium, following Le Chatelier's Principle.

Q153. Why does the system shift its equilibrium position when concentration is changed?
Answer: The system shifts its equilibrium position when concentration is changed to counter the change and restore balance. According to Le Chatelier's Principle, any change in the conditions of a system at equilibrium causes the system to respond in a way that reduces the effect of that change. This helps the system reach a new equilibrium state.

Q154. Describe how Le Chatelier's Principle applies when more of a product is removed from the system.
Answer: When more of a product is removed from a system at equilibrium, Le Chatelier's Principle states that the system will try to oppose this change by making more of the removed product. Therefore, the equilibrium shifts to the right, increasing the rate of the forward reaction until a new equilibrium is established.

Q155. What is meant by the term "equilibrium" in a reversible reaction?
Answer: In a reversible reaction, equilibrium means that the forward and reverse reactions are occurring at the same rate. At this point, the concentrations of reactants and products remain constant over time, even though the reactions are still happening. This balance is dynamic, not static.

Q156. Explain how a system at equilibrium responds to an increase in the concentration of a product.
Answer: When the concentration of a product is increased, the system responds by shifting the equilibrium to the left, which favours the reverse reaction. This reduces the concentration of the product by forming more reactants, helping to restore the balance according to Le Chatelier's Principle.

Q157. Predict the effect on the yield of products when the concentration of a reactant is increased.

Answer: When the concentration of a reactant is increased, the equilibrium shifts to the right, favouring the forward reaction. This leads to the formation of more products, increasing the yield. The system tries to use up the added reactant and restore equilibrium.

Q158. What does it mean if a system is said to be no longer at equilibrium?
Answer: If a system is no longer at equilibrium, it means that the rates of the forward and reverse reactions are not equal. This can happen when there is a change in conditions such as concentration, temperature, or pressure. The system will adjust itself over time to reach a new equilibrium.

Q159. How can the concentration of substances in a reaction mixture affect the rate at which equilibrium is re-established?
Answer: Changing the concentration of substances affects how quickly equilibrium is re-established because it alters the rate of the forward or reverse reaction. For example, increasing a reactant increases the rate of the forward reaction. The system responds quickly to restore equilibrium by shifting the position and balancing the rates again.

Q160. What change in concentration would shift the equilibrium to the left?
Answer: Adding more product or removing some of the reactants would shift the equilibrium to the left. This favours the reverse reaction, where products are converted back into reactants, helping the system reduce the effect of the concentration change and restore equilibrium.

Q161. Give one example of how equilibrium can be disturbed by changing concentration.
Answer: An example is the reaction: $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$. If more H_2 is added, the equilibrium shifts to the right to produce more NH_3. This is the system's way of using up the extra hydrogen and countering the change, following Le Chatelier's Principle.

Q162. Describe the effect of removing one product from a system at equilibrium.
Answer: Removing one product from a system at equilibrium causes the equilibrium to shift to the right to replace the removed product. This increases the rate of the forward reaction, forming more product and restoring the balance, as predicted by Le Chatelier's Principle.

Q163. If more reactants are added to a system at equilibrium, what will happen to the amount of product?
Answer: If more reactants are added, the equilibrium shifts to the right to form more products. This results in an increased amount of product being produced until a new equilibrium is reached, in line with Le Chatelier's Principle.

Q164. Explain why changing concentration does not change the equilibrium constant.
Answer: The equilibrium constant is only affected by temperature, not by changes in concentration. When concentration is changed, the system shifts to restore equilibrium, but the ratio of product to reactant concentrations at equilibrium remains the same for a given temperature, so the equilibrium constant does not change.

Q165. What happens to the forward and reverse reaction rates when a reactant is increased?
Answer: When a reactant is increased, the rate of the forward reaction increases because there are

more particles available to react. This causes more products to form. The reverse reaction eventually increases too, but the initial effect is a shift towards the products to restore equilibrium.

Q166. In a reaction where A + B ⇌ C + D, what effect would increasing [A] have?
Answer: Increasing the concentration of A would shift the equilibrium to the right, favouring the forward reaction. More C and D would be formed as the system tries to use up the excess A and restore equilibrium, in accordance with Le Chatelier's Principle.

Q167. How does the equilibrium position shift when a product is added?
Answer: When a product is added, the equilibrium position shifts to the left. This favours the reverse reaction, converting some of the products back into reactants to reduce the added product's concentration and maintain balance.

Q168. Describe how concentration changes can help increase the yield in industrial chemical processes.
Answer: In industry, increasing the concentration of reactants can shift equilibrium towards the products, increasing yield. Similarly, continuously removing products from the system also shifts equilibrium to the right. These techniques help maximise production efficiency using Le Chatelier's Principle.

Q169. Why does a decrease in the concentration of a product cause more reactants to react?
Answer: A decrease in the concentration of a product disturbs the equilibrium, so the system responds by shifting to the right. This means more reactants react to replace the lost product, restoring equilibrium in line with Le Chatelier's Principle.

Q170. Predict what will happen if both reactants and products are increased at the same time.
Answer: If both reactants and products are increased, the effect on the equilibrium depends on the relative amounts added. The system will adjust to minimise the change, but the shift in equilibrium will depend on which side is increased more. The equilibrium position might not change significantly if the increase is balanced.

Q171. What is the role of Le Chatelier's Principle in predicting the outcome of concentration changes?
Answer: Le Chatelier's Principle helps predict how a system will respond to concentration changes. It states that the system will shift its equilibrium to counteract the change. If a reactant is added, the system makes more products; if a product is removed, the system also shifts to make more product.

Q172. How can you use concentration data to determine the new equilibrium position?
Answer: By comparing the concentrations of reactants and products before and after a change, you can see which direction the reaction shifted. An increase in product concentration after adding a reactant suggests a rightward shift, while an increase in reactant concentration after removing product also shows a forward shift.

Q173. What evidence shows that equilibrium has been re-established after a concentration change?
Answer: Evidence that equilibrium has been re-established includes the concentrations of all

substances becoming constant again over time. Even though the reaction continues, the forward and reverse rates become equal, indicating that dynamic equilibrium has been restored.

Q174. What is meant by the phrase "the system counteracts the change"?
Answer: "The system counteracts the change" means that when a condition such as concentration is changed, the reaction adjusts its direction to reduce the effect of that change. For example, adding a reactant causes the system to make more products to reduce the added amount, restoring equilibrium.

Q175. What happens to the concentrations of other substances when one is removed at equilibrium?
Answer: When one substance is removed at equilibrium, the system shifts to replace it. This causes the concentrations of other substances to change. For instance, if a product is removed, the forward reaction speeds up, using more reactants and producing more product, until equilibrium is restored.

Q176. How is dynamic equilibrium affected by a sudden increase in reactant concentration?
Answer: When the concentration of a reactant is suddenly increased in a system at dynamic equilibrium, the system is no longer in balance. According to Le Chatelier's Principle, the equilibrium will shift to oppose this change. It will move in the direction that uses up the added reactants, which is the forward direction. As a result, more products will form until a new equilibrium is established with higher product concentration.

Q177. Why might a chemical plant deliberately decrease the concentration of a product?
Answer: A chemical plant might deliberately remove or decrease the concentration of a product to shift the equilibrium towards the right, favouring the formation of more products. This is done to increase the overall yield of the desired product. By continuously removing the product, the system tries to replace it, thereby producing more product and driving the reaction forward.

Q178. What does it mean if the equilibrium shifts to the right?
Answer: If the equilibrium shifts to the right, it means that the forward reaction is being favoured. More reactants are being converted into products. This usually happens in response to a change in conditions like an increase in reactant concentration or a decrease in product concentration. The system adjusts to make more products and less reactants to reach a new equilibrium.

Q179. What will happen to the backward reaction if a product is removed?
Answer: If a product is removed, the backward reaction will become less favoured. The equilibrium will shift to the right to produce more of the removed product. This means that the forward reaction speeds up relative to the backward one until a new equilibrium is reached. Over time, the backward reaction may regain balance, but the overall effect is an increase in product formation.

Q180. Can a system reach equilibrium again after a change in concentration? Explain how.
Answer: Yes, a system can reach a new equilibrium after a concentration change. When a reactant or product is added or removed, the system is temporarily out of balance. The reaction shifts to oppose the change by favouring either the forward or backward reaction. As the rates of the forward

and reverse reactions adjust, the system reaches a new equilibrium with different concentrations of substances than before.

Q181. What would you expect to happen if both a reactant and a product are increased?
Answer: If both a reactant and a product are increased, the effect on equilibrium depends on how much each is changed. The system will try to oppose both increases, but the dominant shift depends on the relative change in concentrations. If the reactant increase is greater, the equilibrium may shift right to use it. If the product increase is more significant, it may shift left. A balance between these changes will determine the final shift.

Q182. If a product is removed continuously, what happens to the yield of the reaction?
Answer: If a product is continuously removed from a reaction at equilibrium, the system will keep shifting to the right to produce more of that product. This leads to a higher overall yield of the product. The removal prevents the backward reaction from increasing significantly, so more and more reactant is converted into product over time, making the process more efficient.

Q183. How do the concentrations of all substances respond when one is increased?
Answer: When one substance's concentration is increased, the system shifts to reduce that increase by reacting it. The concentrations of the other substances change depending on the direction of the shift. For example, if a reactant is increased, more products are formed, so product concentrations rise, and the concentration of the added reactant slowly decreases as it is used up.

Q184. What type of data would help predict the effect of concentration changes?
Answer: Useful data includes the balanced chemical equation, which shows the mole ratio of reactants and products. Also important are initial concentrations of substances, information on which direction is endothermic or exothermic, and equilibrium constants. This data helps predict how the system will shift and what changes in concentration will occur when conditions are altered.

Q185. Explain why removing a product increases the rate of the forward reaction.
Answer: Removing a product decreases its concentration, disturbing the equilibrium. According to Le Chatelier's Principle, the system will shift to oppose this by producing more product. This makes the forward reaction more active because it is the direction that forms the missing product. As a result, the rate of the forward reaction temporarily increases until a new equilibrium is reached.

Q186. Describe a situation where equilibrium shifts to favour the reverse reaction.
Answer: Equilibrium will shift to favour the reverse reaction if the concentration of the product is suddenly increased. The system opposes this by trying to reduce the amount of product, so it converts more of it back into reactants. This shifts the equilibrium to the left, increasing the rate of the backward reaction and reducing the product concentration over time.

Q187. In what way does Le Chatelier's Principle help chemists in production settings?
Answer: Le Chatelier's Principle helps chemists predict how changes in conditions will affect the yield of a reaction. In industrial settings, this allows them to manipulate temperature, pressure, and concentration to favour the production of desired products. For example, removing products or

increasing reactants can shift equilibrium to produce more product, improving efficiency and profitability.

Q188. What will happen if a catalyst is added during a change in concentration?
Answer: A catalyst does not affect the position of equilibrium, even if concentration changes. It speeds up both the forward and backward reactions equally, helping the system reach equilibrium faster. During a concentration change, a catalyst just ensures that the new equilibrium is achieved more quickly, but it does not change the final concentrations of the substances.

Q189. How is the equilibrium position linked to the amounts of substances present?
Answer: The position of equilibrium shows the relative amounts of reactants and products at equilibrium. If the equilibrium lies to the right, there are more products than reactants. If it lies to the left, there are more reactants. Changes in conditions like concentration, temperature, or pressure can shift the equilibrium position, changing these amounts accordingly.

Q190. Why does equilibrium shift towards the side with fewer moles when concentration is reduced?
Answer: This statement is incorrect as it confuses the effect of pressure with concentration. When concentration is reduced (for example, by removing a substance), the system shifts to increase the concentration of the removed substance. The direction of the shift depends on which substance was removed, not the number of moles. Mole number affects pressure-related changes, not concentration-based ones.

Q191. Is it always possible to predict the exact amounts of products formed after a concentration change?
Answer: No, it's not always possible to predict exact amounts without detailed data. While Le Chatelier's Principle can show the direction of the shift, it doesn't provide numerical values. To predict exact amounts, you would need equilibrium constants, initial concentrations, and sometimes temperature data to perform calculations and determine the new equilibrium state.

Q192. What happens to the ratio of products to reactants at equilibrium after changing concentration?
Answer: When concentration is changed, the ratio of products to reactants also changes temporarily. The system adjusts to re-establish equilibrium, and this results in a new ratio that reflects the shifted equilibrium. If more product is made, the ratio of product to reactant increases; if more reactant is formed, the ratio decreases accordingly.

Q193. What is the difference between a shift to the left and a shift to the right?
Answer: A shift to the right means the forward reaction is favoured and more products are formed. A shift to the left means the backward reaction is favoured and more reactants are formed. These shifts occur when the system tries to counter a change in concentration, temperature, or pressure and return to a new state of equilibrium.

Q194. Describe how concentration changes affect closed systems versus open systems.
Answer: In a closed system, concentration changes affect the equilibrium because all substances

are contained and the system can adjust by shifting reactions. In an open system, substances may enter or leave, making it hard to maintain equilibrium. Removing substances in an open system can prevent equilibrium from being established or cause it to be lost permanently.

Q195. Why must a reaction vessel be closed for equilibrium to be maintained?
Answer: A closed vessel ensures that no substances enter or escape the system. This is essential for dynamic equilibrium, where the forward and backward reactions happen at equal rates. In an open vessel, substances can leave or enter, disrupting the balance and preventing the reaction from reaching or maintaining equilibrium.

Q196. What condition must be true for equilibrium to be disturbed by a concentration change?
Answer: For concentration changes to disturb equilibrium, the system must be in a closed environment where no matter can escape. Also, the reaction must be reversible. If a reactant or product is added or removed in such a system, the equilibrium is disturbed, and the reaction shifts in the direction that helps restore balance.

Q197. What does Le Chatelier's Principle assume about how a system behaves?
Answer: Le Chatelier's Principle assumes that a system at equilibrium will adjust itself to counteract any change made to it. Whether the change is in concentration, temperature, or pressure, the system responds in a way that opposes the change, aiming to restore a new equilibrium position.

Q198. Why is it important to understand concentration effects in reversible reactions?
Answer: Understanding how concentration affects equilibrium helps chemists control the yield and direction of reversible reactions. This knowledge is crucial in industrial processes where maximising product formation is necessary. By adjusting concentrations strategically, chemists can push reactions to produce more of the desired substances efficiently.

Q199. Can increasing the concentration of a product ever increase product yield? Explain.
Answer: Normally, increasing product concentration shifts the equilibrium left, reducing product formation. However, in some multi-step processes, adding a product of one step can drive the next step forward, indirectly increasing overall yield. But for a single reaction, increasing product concentration usually decreases product yield due to equilibrium shifting backward.

Q200. What is the long-term effect on equilibrium if concentration changes are repeated?
Answer: If concentration changes are repeatedly made, the system will keep shifting to counter each change, possibly favouring one direction over time. This can lead to increased formation of products or reactants depending on the changes. Eventually, the system can become unbalanced or be driven to completion if products are removed continuously.

Q201. What happens to the position of equilibrium if the temperature is increased for an endothermic reaction?
Answer: The position of equilibrium shifts to the right (towards the products) when the temperature is increased for an endothermic reaction. This is because the system tries to oppose the change by absorbing the added heat. Since endothermic reactions take in heat, the forward reaction is favoured, and more products are formed.

Q202. Why does the yield of products decrease when the temperature is raised in an exothermic reaction?

Answer: In an exothermic reaction, heat is released as a product. When the temperature is increased, the system tries to absorb the extra heat by favouring the endothermic direction, which is the reverse reaction. This shift reduces the amount of products formed in the forward reaction, decreasing the overall yield.

Q203. If a reversible reaction is exothermic in the forward direction, what effect will decreasing the temperature have on the position of equilibrium?

Answer: Decreasing the temperature will shift the position of equilibrium to the right, favouring the exothermic forward reaction. This is because the system will try to release heat to counter the temperature drop. As a result, more products will be formed.

Q204. Explain how an increase in temperature affects the equilibrium position in a reversible exothermic reaction.

Answer: In a reversible exothermic reaction, an increase in temperature adds heat to the system. According to Le Chatelier's Principle, the equilibrium will shift in the direction that absorbs heat—this is the reverse (endothermic) reaction. Therefore, the forward reaction is suppressed, and the amount of product decreases.

Q205. What is meant by the term "position of equilibrium"?

Answer: The position of equilibrium refers to the relative concentrations of reactants and products in a reversible reaction when the rates of the forward and reverse reactions are equal. If the position lies to the right, more products are present; if it lies to the left, more reactants are present.

Q206. How does Le Chatelier's Principle explain the effect of temperature changes on equilibrium?

Answer: Le Chatelier's Principle states that if a system at equilibrium is disturbed, the system will shift to counteract the disturbance. When temperature changes, the system responds by favouring the reaction (endothermic or exothermic) that will absorb or release heat to restore equilibrium. This shift affects the amounts of products and reactants.

Q207. A reaction at equilibrium is exothermic in the forward direction. Predict the effect of increasing temperature on the yield of products.

Answer: Increasing the temperature will cause the equilibrium to shift towards the reverse (endothermic) reaction, reducing the yield of products. This is because the system tries to absorb the extra heat by favouring the reverse direction that requires energy.

Q208. A reversible reaction is endothermic in the forward direction. What happens to the yield if temperature is decreased?

Answer: If the temperature is decreased, the equilibrium shifts to the exothermic (reverse) direction to release heat. Since the forward reaction is endothermic, its rate slows down, and less product is formed, reducing the yield.

Q209. Why does decreasing the temperature favour the exothermic reaction?
Answer: When temperature is decreased, the system loses heat. According to Le Chatelier's Principle, it will try to generate more heat to balance this loss. The exothermic reaction releases heat, so the equilibrium shifts in that direction to restore balance.

Q210. A student increases the temperature of a system at equilibrium. What information must they know to predict the shift in equilibrium?
Answer: The student must know whether the forward reaction is endothermic or exothermic. This is essential to determine which direction the system will shift in response to the temperature increase, based on whether it will absorb or release heat.

Q211. How can you use a balanced symbol equation to determine the effect of pressure changes on equilibrium?
Answer: By counting the number of gas molecules (moles) on each side of the balanced equation, you can predict the effect of pressure changes. If one side has more gas molecules, increasing pressure will shift the equilibrium to the side with fewer gas molecules, and vice versa.

Q212. Describe what happens to the equilibrium position when pressure is increased in a reaction involving gases.
Answer: When pressure is increased, the equilibrium shifts to the side of the reaction with fewer gas molecules. This reduces the total pressure in the system, opposing the change and helping to restore equilibrium.

Q213. In a gaseous reaction, how do you identify which side has fewer molecules?
Answer: Count the number of gaseous moles on each side of the balanced chemical equation. The side with the smaller total number of gaseous moles has fewer molecules.

Q214. Explain the effect of decreasing pressure on the position of equilibrium in a gaseous system.
Answer: Decreasing pressure causes the equilibrium to shift to the side with more gas molecules. This shift increases the pressure again, as the system tries to oppose the reduction in pressure.

Q215. A gaseous reaction has more molecules on the right side of the equation. What will happen if pressure is increased?
Answer: The equilibrium will shift to the left (towards the side with fewer gas molecules) to reduce the pressure. This is because increasing pressure favours the direction with fewer gas molecules.

Q216. How does the number of gas molecules affect the response of a system to pressure changes?
Answer: The number of gas molecules determines which direction the system will shift when pressure changes. If there are fewer gas molecules on one side, increasing pressure favours that side; decreasing pressure favours the side with more gas molecules.

Q217. Give a reason why increasing pressure favours the reaction that produces fewer gas molecules.
Answer: Increasing pressure raises the concentration of gas molecules. The system reduces this

pressure by shifting the equilibrium to the side with fewer gas molecules, which helps lower the total gas concentration and restore balance.

Q218. Why does decreasing pressure shift the equilibrium to the side with more gas molecules?
Answer: When pressure decreases, the system responds by trying to raise it again. This is achieved by shifting equilibrium to the side with more gas molecules, increasing the total gas concentration and hence the pressure.

Q219. If a reversible reaction has the same number of gas molecules on both sides, what effect does changing the pressure have?
Answer: Changing the pressure has no effect on the position of equilibrium if the number of gas molecules is the same on both sides. The system has no preference for either side in terms of pressure changes.

Q220. A reaction is at equilibrium in a sealed container. The pressure is suddenly decreased. What happens to the system?
Answer: The equilibrium will shift to the side with more gas molecules to increase the pressure and oppose the change. This helps restore balance in the sealed system.

Q221. What data would you need to predict how pressure changes affect a reaction at equilibrium?
Answer: You need the balanced chemical equation to count the number of gas molecules on each side. Only gaseous reactants and products are relevant to pressure changes.

Q222. Explain why the effect of pressure only applies to gases.
Answer: Pressure mainly affects gases because they are compressible and their volume changes significantly with pressure. Liquids and solids are nearly incompressible, so changes in pressure have little to no effect on their behaviour in reactions.

Q223. In a sealed container, the pressure is increased. Describe the shift in equilibrium if the forward reaction involves fewer gas molecules.
Answer: The equilibrium will shift to the right (forward direction), since the forward reaction produces fewer gas molecules. This shift reduces the total pressure, counteracting the increase.

Q224. Why does the system shift to oppose a change in pressure?
Answer: According to Le Chatelier's Principle, any change in a system at equilibrium causes the system to adjust to minimise that change. So, when pressure changes, the system shifts to restore equilibrium by favouring the side with a number of gas molecules that counteracts the pressure change.

Q225. What is the role of collision frequency in pressure changes affecting equilibrium?
Answer: Pressure changes affect the collision frequency of gas molecules. Higher pressure increases the number of collisions, favouring the side with fewer molecules to reduce collision frequency. Lower pressure decreases collisions, favouring the side with more molecules to increase them and restore equilibrium.

Q226. If a gaseous system at equilibrium has 2 moles of gas on the left and 4 moles on the right, what happens when pressure increases?
Answer: When pressure increases, the equilibrium will shift to the side with fewer gas molecules to reduce the pressure. Since there are 2 moles of gas on the left and 4 on the right, the equilibrium will shift to the left. This helps reduce the total number of gas molecules and counteracts the increase in pressure according to Le Chatelier's Principle.

Q227. A chemical reaction at equilibrium is carried out in a closed vessel. What effect will increasing temperature and pressure have on an exothermic reaction?
Answer: Increasing temperature in an exothermic reaction shifts the equilibrium to the left (reactants) because heat is a product. Increasing pressure will shift the equilibrium to the side with fewer gas molecules. So, if the forward reaction is exothermic and produces fewer gas molecules, pressure shift will favour products while temperature shift will favour reactants. The final effect depends on the number of gas molecules on each side.

Q228. How can you predict the effect of pressure using the balanced equation of a reaction?
Answer: To predict the effect of pressure, count the number of moles of gaseous reactants and products in the balanced equation. If there are more gas molecules on one side, increasing pressure will shift the equilibrium to the side with fewer gas molecules. If the number of gas molecules is equal on both sides, changing pressure has no effect on equilibrium.

Q229. What would happen to the equilibrium if the pressure is reduced in a gaseous reaction where the forward reaction produces more gas molecules?
Answer: If pressure is reduced, the equilibrium shifts to the side with more gas molecules to increase pressure again. In this case, since the forward reaction produces more gas molecules, the equilibrium will shift to the right, favouring the formation of products.

Q230. In a chemical plant, why is pressure carefully controlled during equilibrium reactions?
Answer: Pressure is carefully controlled to influence the position of equilibrium and maximise product yield. Higher pressure can favour the side with fewer gas molecules, increasing product formation. However, very high pressure can be expensive and dangerous due to the need for stronger equipment and safety risks. So, a compromise pressure is used for safety and efficiency.

Q231. How can the effect of temperature on equilibrium be useful in industrial processes?
Answer: Knowing whether a reaction is endothermic or exothermic helps choose the right temperature to favour the desired direction of equilibrium. For endothermic reactions, high temperature increases product yield. For exothermic reactions, low temperature increases product yield. This helps industries optimise yield and reduce costs, though a balance is needed to maintain a reasonable reaction rate.

Q232. Why might increasing temperature not always be used in industry, even if it increases yield?
Answer: Although increasing temperature can increase yield in endothermic reactions, it can also make the process more expensive and energy-consuming. Moreover, higher temperatures may

cause unwanted side reactions or reduce equipment lifespan. Also, very high temperatures may reduce the economic value of the process if the gain in yield is not worth the extra cost.

Q233. A forward reaction is endothermic. Predict the direction of equilibrium shift when heat is added.
Answer: When heat is added, the equilibrium shifts in the direction that absorbs heat. Since the forward reaction is endothermic, it absorbs heat. Therefore, the equilibrium will shift to the right (towards products), increasing the yield of products to counter the added heat.

Q234. How does Le Chatelier's Principle help in deciding the best temperature for a reversible reaction?
Answer: Le Chatelier's Principle says that a system at equilibrium will oppose any change. For temperature, if the reaction is exothermic, decreasing temperature favours the forward reaction. If endothermic, increasing temperature favours the forward reaction. This helps in choosing a temperature that gives a good yield and acceptable reaction rate in industrial processes.

Q235. Why is a compromise temperature often used in equilibrium reactions?
Answer: A compromise temperature is used to balance the rate of reaction and product yield. Low temperatures may give a better yield for exothermic reactions but make the reaction slow. High temperatures increase the rate but may reduce yield. So, industries use a temperature that gives a good yield at a reasonable rate without high energy costs.

Q236. Explain why increasing temperature increases the rate of both the forward and reverse reactions.
Answer: Increasing temperature gives particles more kinetic energy, so they collide more frequently and with greater energy. This makes it easier for them to overcome the activation energy barrier, increasing the rate of both the forward and reverse reactions. However, the direction favoured depends on whether the reaction is endothermic or exothermic.

Q237. A reaction is exothermic in one direction. How would cooling the system affect the amount of product formed?
Answer: Cooling removes heat from the system. Since the forward reaction is exothermic (releases heat), the equilibrium will shift to the right to produce more heat. This increases the amount of product formed, as the system tries to oppose the temperature decrease by favouring the exothermic direction.

Q238. If a reaction is endothermic forward and the system is heated, what would happen to the reverse reaction?
Answer: If the forward reaction is endothermic and heat is added, the equilibrium shifts to the right to absorb the extra heat. This means the reverse reaction, which is exothermic, will be less favoured, so its rate will decrease relative to the forward reaction, leading to more product formation.

Q239. In a gaseous reaction, the number of moles is not given. How can you determine the effect of pressure?
Answer: To determine the effect of pressure, you need the balanced chemical equation to count the

number of gas molecules (moles) on each side. If this information is missing, you cannot predict the effect of pressure on equilibrium. You must look at the coefficients of gaseous species in the balanced equation.

Q240. A sealed system is in equilibrium. The pressure is increased, and the temperature is decreased. What two changes will influence the equilibrium shift?
Answer: Increasing pressure will shift equilibrium towards the side with fewer gas molecules. Decreasing temperature will shift the equilibrium towards the exothermic direction. The actual direction of shift depends on the specific reaction and the number of gas molecules on each side and whether the forward or reverse reaction is exothermic.

Q241. Why is it important to know whether a reaction is endothermic or exothermic when changing temperature?
Answer: Knowing whether a reaction is endothermic or exothermic tells you how temperature will affect the equilibrium. In endothermic reactions, increasing temperature favours the forward reaction. In exothermic reactions, decreasing temperature favours the forward reaction. This helps predict yield and set conditions to favour product formation.

Q242. A chemical reaction produces ammonia and involves fewer gas molecules in the forward direction. What would increasing pressure do?
Answer: Since the forward reaction produces fewer gas molecules, increasing pressure will shift the equilibrium to the right, favouring ammonia production. This is because the system tries to reduce pressure by forming fewer gas molecules, according to Le Chatelier's Principle.

Q243. Explain the balance between rate of reaction and yield when considering temperature changes.
Answer: Higher temperature increases the rate of reaction because particles move faster and collide more often. But for exothermic reactions, high temperature decreases yield. So, industries must balance the need for a fast reaction with the desire for a high yield, often choosing a compromise temperature that gives a good rate and acceptable yield.

Q244. How does temperature affect the energy distribution of reacting particles in equilibrium?
Answer: As temperature increases, the average energy of particles increases. More particles have energy equal to or greater than the activation energy, so more collisions are successful. This increases the rate of both forward and reverse reactions and can change the position of equilibrium depending on the reaction's enthalpy change.

Q245. A reversible reaction has equal gas molecules on both sides. What will happen if pressure is increased?
Answer: If there are equal gas molecules on both sides, increasing pressure has no effect on the equilibrium position. The system has no way to reduce pressure by shifting to a side with fewer gas molecules, so the concentrations of reactants and products stay the same.

Q246. What happens to equilibrium if both pressure and concentration of a reactant are increased?

Answer: Increasing pressure will shift equilibrium to the side with fewer gas molecules. Increasing concentration of a reactant shifts equilibrium to the right (products) to reduce the added reactant. The combined effect depends on the number of gas molecules, but generally, both changes can favour product formation if aligned properly.

Q247. Why might increasing pressure be dangerous in industrial reactors?

Answer: High pressure can be dangerous because it increases the risk of equipment failure, such as explosions or leaks. It also requires thick-walled, expensive machinery to withstand the pressure. That's why industries use the lowest pressure that gives a good yield to keep the process safe and cost-effective.

Q248. A system is disturbed by temperature change. How does the system know which way to shift?

Answer: The system "responds" based on Le Chatelier's Principle. If temperature increases, the system shifts in the direction that absorbs heat (endothermic). If temperature decreases, it shifts in the direction that releases heat (exothermic). This automatic response helps the system oppose the temperature change and restore equilibrium.

Q249. Why are endothermic reactions favoured by increased temperature?

Answer: Endothermic reactions absorb heat. So, when temperature increases, the system shifts to absorb the added heat, favouring the forward reaction if it's endothermic. This leads to more product formation because the system tries to oppose the temperature rise by moving in the heat-absorbing direction.

Q250. Describe how equilibrium is re-established after a sudden increase in pressure in a gaseous system.

Answer: After a sudden pressure increase, the system shifts equilibrium to the side with fewer gas molecules to reduce pressure. This shift continues until a new balance is reached between the forward and reverse reactions at the new pressure. The concentrations of reactants and products adjust, and a new equilibrium is established.