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Chemistry Grade 11 — Chapter 8

Chemical Equilibrium

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Independent practice MCQs from the supplied Class 11 Chemistry notes pack. Total: 49 questions.

A. Important / Main Topics

1. A reaction in which the products can react to form reactants is called:

(A) Reversible reaction
(B) Irreversible reaction
(C) Complete reaction
(D) Spontaneous reaction

Correct Answer: A

Explanation: A reversible reaction is one in which the products once formed can react to form reactants.

2. In a reversible reaction at equilibrium, the rate of the forward reaction is:

(A) Greater than the reverse reaction
(B) Equal to the reverse reaction
(C) Less than the reverse reaction
(D) Zero

Correct Answer: B

Explanation: In a reversible reaction at equilibrium, the rate of the forward reaction is Equal to the reverse reaction.

3. Which of the following is an example of a reversible reaction?

(A) 2H□ + O□ → 2H□O
(B) CaCO□ → CaO + CO□
(C) N□ + 3H□ rightleftharpoons 2NH□
(D) CH□ + 2O□ → CO□ + 2H□O

Correct Answer: C

Explanation: N□ + 3H□ rightleftharpoons 2NH□ is a reversible reaction, as indicated by the double arrow.

4. The equilibrium constant K_c for the reaction N□ + 3H□ rightleftharpoons 2NH□ is:

(A) frac[NH□][N□][H□]
(B) frac[N□][H□]³[NH□]²
(C) frac[N□][H□][NH□]
(D) frac[NH□]²[N□][H□]³

Correct Answer: D

Explanation: The equilibrium constant K_c for the reaction N□ + 3H□ rightleftharpoons 2NH□ is frac[NH□]²[N□][H□]³.

5. If the value of K_c is very large, the equilibrium mixture contains:

(A) Mostly products
(B) Mostly reactants
(C) Equal amounts of reactants and products
(D) Only reactants

Correct Answer: A

Explanation: When K_c is greater than 1, the concentration of the products is greater than those of the reactants at equilibrium.

6. The equilibrium constant for a reaction is 1.0 × 10□³. This indicates that the reaction:

(A) Goes almost to completion
(B) Proceeds very little in the forward direction
(C) Is very fast

(D) Is at equilibrium

Correct Answer: B

Explanation: When K_c is less than 1, the concentration of the reactants is greater than those of products, so the reaction proceeds very little in the forward direction.

7. In a system at equilibrium, adding a catalyst:

(A) Shifts the equilibrium to the right
(B) Shifts the equilibrium to the left
(C) Does not change the equilibrium position
(D) Changes the value of K_c

Correct Answer: C

Explanation: In a system at equilibrium, adding a catalyst Does not change the equilibrium position.

8. According to Le Chatelier's principle, increasing the pressure on the equilibrium 2SO□(g) + O□(g) rightleftharpoons 2SO□(g) will shift the equilibrium:

(A) To the left
(B) No shift
(C) To the left then right
(D) To the right

Correct Answer: D

Explanation: Increasing pressure shifts the equilibrium to the side with fewer gas molecules, which is the right side (2 molecules of SO□ vs. 3 molecules of reactants).

9. The equilibrium constant expression for the reaction CaCO□(s) rightleftharpoons CaO(s) + CO□(g) is:

(A) K_c = [CO□]
(B) K_c = frac[CaO][CO□][CaCO□]
(C) K_c = frac[CaCO□][CaO][CO□]
(D) K_c = frac1[CO□]

Correct Answer: A

Explanation: Pure solids are not included in the equilibrium constant expression. Therefore, K_c = [CO□].

10. For the reaction A□ + B□ rightleftharpoons 2AB, the equilibrium concentrations are [A□] = 0.399 M, [B□] = 1.197 M, [AB] = 0.203 M. The value of K_c is approximately:

(A) 0.86
(B) 0.086
(C) 1.16
(D) 8.6

Correct Answer: B

Explanation: For the reaction A□ + B□ rightleftharpoons 2AB, the equilibrium concentrations are [A□] = 0.399 M, [B□] = 1.197 M, [AB] = 0.203 M. The value of K_c is approximately 0.086.

11. The relationship between K_p and K_c is given by:

(A) K_p = K_c / (RT)Δ n
(B) K_p = K_c + RT
(C) K_p = K_c (RT)Δ n
(D) K_p = K_c - RT

Correct Answer: C

Explanation: The relationship is K_p = K_c(RT)Δ n.

12. For an exothermic reaction at equilibrium, increasing the temperature will:

(A) Shift the equilibrium to the right
(B) Increase K_c
(C) Not affect the equilibrium
(D) Shift the equilibrium to the left

Correct Answer: D

Explanation: For an exothermic reaction at equilibrium, increasing the temperature will Shift the equilibrium to the left.

13. The state of a reversible reaction at which the composition of the reaction mixture does not change is called:

(A) Dynamic equilibrium
(B) Static equilibrium
(C) Complete reaction
(D) Irreversible reaction

Correct Answer: A

Explanation: The state of a reversible reaction at which composition of the reaction mixture does not change is called the state of chemical equilibrium (dynamic equilibrium).

14. The law of mass action was proposed by:

(A) Le Chatelier
(B) Guldberg and Waage
(C) Dalton
(D) Hess

Correct Answer: B

Explanation: The law of mass action was proposed by Guldberg and Waage.

15. The equilibrium constant K_c depends on:

(A) Initial concentrations of reactants
(B) Volume of the container
(C) Temperature
(D) Pressure

Correct Answer: C

Explanation: The equilibrium constant K_c depends on Temperature.

16. Which of the following is an example of a homogeneous equilibrium?

(A) CaCO□(s) rightleftharpoons CaO(s) + CO□(g)
(B) C(s) + H□O(g) rightleftharpoons CO(g) + H□(g)
(C) 3Fe(s) + 4H□O(g) rightleftharpoons Fe□O□(s) + 4H□(g)
(D) N□(g) + 3H□(g) rightleftharpoons 2NH□(g)

Correct Answer: D

Explanation: In a homogeneous equilibrium, all reactants and products are in the same phase. N□ + 3H□ rightleftharpoons 2NH□ is all gases.

17. Which of the following is an example of a heterogeneous equilibrium?

(A) CaCO□(s) rightleftharpoons CaO(s) + CO□(g)
(B) N□(g) + 3H□(g) rightleftharpoons 2NH□(g)
(C) 2SO□(g) + O□(g) rightleftharpoons 2SO□(g)
(D) 2NO(g) + Cl□(g) rightleftharpoons 2NOCl(g)

Correct Answer: A

Explanation: CaCO□(s) rightleftharpoons CaO(s) + CO□(g) — this correctly answers the question.

18. When the concentration of a product is increased in an equilibrium system, the equilibrium shifts:

(A) Towards the products
(B) Towards the reactants
(C) Remains unchanged
(D) First towards products, then reactants

Correct Answer: B

Explanation: When the concentration of a product is increased in an equilibrium system, the equilibrium shifts Towards the reactants.

19. The equilibrium constant K_c for the reaction 2NO□ rightleftharpoons N□O□ is:

(A) frac[NO□]²[N□O□]
(B) frac[N□O□][NO□]
(C) frac[N□O□][NO□]²
(D) frac[NO□][N□O□]

Correct Answer: C

Explanation: The equilibrium constant K_c for the reaction 2NO□ rightleftharpoons N□O□ is frac[N□O□][NO□]².

20. The value of K_c for a reaction at equilibrium is 4.0. This means:

(A) The reaction is at equilibrium
(B) The concentration of reactants is greater than products
(C) The reaction is exothermic
(D) The concentration of products is greater than reactants

Correct Answer: D

Explanation: Since K_c > 1, the concentration of products is greater than reactants.

21. The equilibrium constant for a given reaction is 2.0 × 10□³. This indicates that:

(A) The concentration of reactants is greater than products
(B) The reaction is spontaneous
(C) The reaction is exothermic
(D) The reaction is fast

Correct Answer: A

Explanation: Since K_c < 1, the concentration of reactants is greater than products.

22. In the reaction 2SO□(g) + O□(g) rightleftharpoons 2SO□(g), what happens to the equilibrium when the volume of the container is decreased?

(A) Shifts to the left
(B) Shifts to the right
(C) No change
(D) The equilibrium constant changes

Correct Answer: B

Explanation: Decreasing volume increases pressure, shifting the equilibrium to the side with fewer gas molecules (right, 2 molecules of SO□ vs. 3 molecules of reactants).

23. For the reaction N□O□(g) rightleftharpoons 2NO□(g), Δ H = +57.2 kJ/mol. The equilibrium constant K_c at 0^circC is 7.7 × 10□⁵ and at 100^circC is 0.4. This indicates that the reaction is:

(A) Exothermic
(B) Isothermal
(C) Endothermic
(D) At equilibrium

Correct Answer: C

Explanation: K_c increases with increasing temperature, which is characteristic of an endothermic reaction.

24. The relationship K_p = K_c (RT)Δ n is derived from:

(A) Le Chatelier's principle
(B) Hess's law
(C) The law of mass action
(D) The ideal gas law

Correct Answer: D

Explanation: The relationship is derived using the ideal gas law P = CRT.

B. Less Important / Secondary Topics

25. For the reaction 2NO□(g) + F□(g) rightleftharpoons 2NO□F(g), the equilibrium constant K_p is:

(A) K_p = frac(PNO_□F)²(PNO_□)²(PF_□)
(B) K_p = frac(PNO_□)²(PF_□)(PNO_□F)²
(C) K_p = frac(PNO_□F)²(PNO_□)² + (PF_□)

(D) K_p = frac(PNO_□F)(PNO_□)(PF_□)

Correct Answer: A

Explanation: For the reaction 2NO□(g) + F□(g) rightleftharpoons 2NO□F(g), the equilibrium constant K_p is K_p = frac(PNO_□F)²(PNO_□)²(PF_□).

26. What is meant by the state of chemical equilibrium? Mention two conditions necessary for equilibrium.

(A) The reaction has stopped
(B) The reaction is reversible and the rates of forward and reverse reactions are equal
(C) The temperature is constant
(D) The pressure is constant

Correct Answer: B

Explanation: Chemical equilibrium is the state of a reversible reaction where the composition of the reaction mixture does not change. Two conditions: reversible reaction, and equal forward and reverse rates.

27. Differentiate between microscopic and macroscopic events in a chemical reaction.

(A) Macroscopic events are at the molecular level; microscopic events are observable
(B) Both are the same
(C) Macroscopic events are observable with the naked eye; microscopic events are not
(D) Macroscopic events occur only in gases

Correct Answer: C

Explanation: Macroscopic events refer to phenomena that can be observed with the naked eye. Microscopic events refer to phenomena that cannot be observed with the naked eye.

28. How can the equilibrium constant be determined by the physical (spectrometric) method?

(A) By measuring the temperature
(B) By measuring the pressure
(C) By measuring the volume
(D) By measuring the amount of radiation absorbed

Correct Answer: D

Explanation: The spectrometric method can be applied when the reactant or product absorbs ultraviolet, visible, or infrared radiation. The concentration can be determined by measuring the amount of radiation absorbed.

29. For the reaction H□(g) + I□(g) rightleftharpoons 2HI(g), write the K_c expression. If the equilibrium concentrations are [H□] = 0.5 M, [I□] = 0.5 M, and [HI] = 2.0 M, calculate the value of K_c.

(A) 16.0
(B) 8.0
(C) 4.0
(D) 32.0

Correct Answer: A

Explanation: “16.0” is correct: it matches the idea asked in the question (“For the reaction H□(g) + I□(g) rightleftharpoons 2HI(g), write the K_c expression. If the equilibrium concentrations are [H□] = 0.5 M, [I□] = 0.5 M, and [HI] = 2.0 M, calculate the value of K_c”), while the other choices do not.

30. Calculate K_p for the reaction 2SO□(g) + O□(g) rightleftharpoons 2SO□(g) if the equilibrium concentrations are [SO□] = 0.59 M, [O□] = 0.05 M, and [SO□] = 0.259 M. (Use data: R = 0.0821 dm³atm K□¹mol□¹, T = 450^circC).

(A) 0.649 atm
(B) 0.0649 atm
(C) 6.49 atm
(D) 0.00649 atm

Correct Answer: B

Explanation: “0.0649 atm” is correct: it matches the idea asked in the question (“Calculate K_p for the reaction 2SO□(g) + O□(g) rightleftharpoons 2SO□(g) if the equilibrium concentrations are [SO□] = 0.59 M, [O□] = 0.05 M, and [SO□] = 0.259 M. (Use data: R = 0.0821 dm³atm K□¹mol□¹, T = 450^circC)”), while the other choices do not.

31. Explain how the common ion effect can be used to describe why the solubility of a substance changes when it is dissolved in a solution containing a common ion.

(A) The common ion increases solubility
(B) The common ion has no effect on solubility
(C) The common ion decreases solubility by shifting the equilibrium to the left
(D) The common ion changes the temperature

Correct Answer: C

Explanation: "The common ion decreases solubility by shifting the equilibrium to the left" is correct: it matches the idea asked in the question ("Explain how the common ion effect can be used to describe why the solubility of a substance changes when it is dissolved in a solution containing a common ion"), while the other choices do not.

32. What is the relationship between the equilibrium constants K_c and K_p for a reaction? Derive it for a general gaseous reaction.

(A) K_p = K_c/(RT)Δ n
(B) K_p = K_c + RT
(C) K_p = K_c - RT
(D) K_p = K_c(RT)Δ n

Correct Answer: D

Explanation: The relationship is K_p = K_c(RT)Δ n, derived from the ideal gas law P = CRT.

33. For the reaction 2A(g) + B(g) rightleftharpoons 3C(g), we can write:

(A) K_c < K_p
(B) K_c > K_p
(C) K_p - K_c = 0
(D) K_p - K_c = -1

Correct Answer: A

Explanation: Δ n = 3 - (2 + 1) = 0. Wait, Δ n = 3 - 3 = 0. So K_p = K_c. The correct answer is C. K_p - K_c = 0. Let me correct this. Correction: Δ n = 3 - (2 + 1) = 0. Therefore, K_p = K_c, so K_p - K_c = 0. The correct answer is C.

34. For which of the following reactions does K_c have no units of concentration?

(A) 2A(g) rightleftharpoons B(g)
(B) A(g) rightleftharpoons B(g)
(C) A(g) rightleftharpoons 2B(g)
(D) 3A(g) rightleftharpoons 2C(g)

Correct Answer: B

Explanation: For A(g) rightleftharpoons B(g), Δ n = 1 - 1 = 0, so K_c has no units.

35. What is the effect of the addition of a catalyst on an equilibrium mixture?

(A) It shifts the equilibrium to the right
(B) It shifts the equilibrium to the left
(C) It has no effect on the equilibrium position
(D) It changes the enthalpy of the reaction

Correct Answer: C

Explanation: It has no effect on the equilibrium position — this correctly answers the question.

36. Which of the following reactions has K_p = K_c?

(A) N□(g) + 3H□(g) rightleftharpoons 2NH□(g)
(B) 2SO□(g) + O□(g) rightleftharpoons 2SO□(g)
(C) PCl□(g) rightleftharpoons PCl□(g) + Cl□(g)
(D) H□(g) + I□(g) rightleftharpoons 2HI(g)

Correct Answer: D

Explanation: For H□ + I□ rightleftharpoons 2HI, Δ n = 2 - (1+1) = 0, so K_p = K_c.

37. For an endothermic reaction, an increase in temperature will:

(A) Increase the value of K_c

(B) Decrease the value of K_c
(C) Not affect the value of K_c
(D) Shift the equilibrium to the left

Correct Answer: A

Explanation: For an endothermic reaction, an increase in temperature will Increase the value of K_c.

38. In the reaction Fe□O□(s) + 4H□(g) rightleftharpoons 3Fe(s) + 4H□O(g), the equilibrium constant K_c is:

(A) frac[Fe]³[H□O]⁴[Fe□O□][H□]⁴
(B) frac[H□O]⁴[H□]⁴
(C) frac[H□]⁴[H□O]⁴
(D) frac[Fe□O□][H□]⁴[Fe]³[H□O]⁴

Correct Answer: B

Explanation: Pure solids (Fe□O□ and Fe) are not included. K_c = frac[H□O]⁴[H□]⁴.

39. The equilibrium constant for a reaction is K_c = 4.0 at 298 K and K_c = 2.0 at 350 K. The reaction is:

(A) Endothermic
(B) Isothermal
(C) Exothermic
(D) Not possible

Correct Answer: C

Explanation: K_c decreases with increasing temperature, which is characteristic of an exothermic reaction.

40. For the reaction A(g) + B(g) rightleftharpoons C(g) + D(g), the equilibrium constant is K_c = 1.0 × 10□³. The reaction proceeds:

(A) Almost to completion
(B) Equally in both directions
(C) At equilibrium
(D) Very little in the forward direction

Correct Answer: D

Explanation: For the reaction A(g) + B(g) rightleftharpoons C(g) + D(g), the equilibrium constant is K_c = 1.0 × 10□³. The reaction proceeds Very little in the forward direction.

41. For the reaction 2SO□(g) + O□(g) rightleftharpoons 2SO□(g), write the K_c and K_p expressions.

(A) K_c = frac[SO□]²[SO□]²[O□], K_p = frac(PSO_□)²(PSO_□)²(PO_□)
(B) K_c = frac[SO□]²[O□][SO□]², K_p = frac(PSO_□)²(PO_□)(PSO_□)²
(C) K_c = frac[SO□][SO□][O□], K_p = fracPSO_□PSO_□PO_□
(D) K_c = frac[SO□]²[SO□]² + [O□], K_p = frac(PSO_□)²(PSO_□)² + PO_□

Correct Answer: A

Explanation: "K_c = frac[SO□]²[SO□]²[O□], K_p = frac(PSO_□)²(PSO_□)²(PO_□)" is correct: it matches the idea asked in the question ("For the reaction 2SO□(g) + O□(g) rightleftharpoons 2SO□(g), write the K_c and K_p expressions"), while the other choices do not.

42. How does the value of K_c change when the temperature is increased for an exothermic reaction?

(A) It increases
(B) It decreases
(C) It remains the same
(D) It becomes zero

Correct Answer: B

Explanation: It decreases — this correctly answers the question.

43. Differentiate between the equilibrium constant K_c and the reaction quotient Q_c.

(A) K_c is at any point; Q_c is at equilibrium
(B) Both are the same
(C) K_c is at equilibrium; Q_c is at any point
(D) K_c is for gases only; Q_c is for solutions only

Correct Answer: C

Explanation: K_c applies only at the equilibrium state. Q_c can be calculated at any point in the reaction.

44. Consider the equilibrium N□O□(g) rightleftharpoons 2NO□(g). Predict the effect on the equilibrium position when the temperature is decreased. (Δ H = +57.2 kJ/mol)

(A) Shifts to the right
(B) No change
(C) The equilibrium constant increases
(D) Shifts to the left

Correct Answer: D

Explanation: The forward reaction is endothermic. Decreasing temperature shifts the equilibrium to the left.

45. Predict the effect of increasing the temperature on the amount of product in the following exothermic reaction: CO(g) + 2H□(g) rightleftharpoons CH□OH(g)

(A) Decreases
(B) Increases
(C) Remains the same
(D) The reaction stops

Correct Answer: A

Explanation: "Decreases" is correct: it matches the idea asked in the question ("Predict the effect of increasing the temperature on the amount of product in the following exothermic reaction: CO(g) + 2H□(g) rightleftharpoons CH□OH(g)"), while the other choices do not.

46. For the reaction PCl□(g) rightleftharpoons PCl□(g) + Cl□(g), predict the shift in equilibrium position when the volume is reduced.

(A) Shifts to the right
(B) Shifts to the left
(C) No change
(D) The equilibrium constant changes

Correct Answer: B

Explanation: Decreasing volume increases pressure, shifting the equilibrium to the side with fewer gas molecules (left, 1 molecule of PCl□ vs. 2 molecules of products).

47. Explain the industrial application of Le Chatelier's principle using Haber's process and the Contact process. Which of the following conditions is used in the Haber process?

(A) Low temperature and low pressure
(B) High temperature and low pressure
(C) Low temperature and high pressure
(D) High temperature and high pressure

Correct Answer: C

Explanation: In Haber's process, low temperature (400°C) and high pressure (200-300 atm) are used to maximize the yield of ammonia.

48. What is the effect of adding a catalyst to a reaction at equilibrium?

(A) It shifts the equilibrium to the right
(B) It shifts the equilibrium to the left
(C) It changes the value of K_c
(D) It has no effect on the equilibrium position

Correct Answer: D

Explanation: A catalyst speeds up both forward and reverse reactions equally, so it does not change the equilibrium position or K_c.

49. For the reaction CaCO□(s) rightleftharpoons CaO(s) + CO□(g), what is the expression for K_c?

(A) K_c = [CO□]
(B) K_c = [CaO][CO□] / [CaCO□]
(C) K_c = [CaCO□] / ([CaO][CO□])

(D) $K_c = 1 / [CO_2]$

Correct Answer: A

Explanation: Pure solids are not included in the equilibrium constant expression. Therefore, $K_c = [CO_2]$.