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Chemistry Grade 12 — Chapter 3

Chemical Equilibria

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Independent practice MCQs from the supplied Class 12 Chemistry notes pack. Total: 50 questions.

A. Important / Main Topics

1. The strength of an acid is determined by:

(A) The extent of its ionization in water
(B) Its molar mass
(C) Its density
(D) Its boiling point

Correct Answer: A

Explanation: The notes state that the extent of ionization and the acid dissociation constant K_a are used to distinguish strong and weak acids.

2. A large K_a value indicates:

(A) A weak acid
(B) A strong acid
(C) A neutral solution
(D) A strong base

Correct Answer: B

Explanation: The notes state that the greater the value of K_a, the stronger the acid.

3. The relationship between pK_a and K_a is:

(A) pK_a = log K_a
(B) pK_a = K_a²
(C) pK_a = -log K_a
(D) pK_a = 1/K_a

Correct Answer: C

Explanation: The notes define pK_a as the negative logarithm of K_a.

4. A buffer solution is one whose pH:

(A) Changes greatly when a small amount of acid or base is added
(B) Is always 7
(C) Is always below 7
(D) Does not change significantly when a small amount of acid or base is added

Correct Answer: D

Explanation: The notes define a buffer solution as one whose pH does not change significantly when a small amount of acid or base is added.

5. An acidic buffer has a pH:

(A) Less than 7
(B) Equal to 7
(C) Greater than 7
(D) Always 14

Correct Answer: A

Explanation: The notes state that acidic buffers, made from a weak acid and its salt with a strong base, have a pH less than 7.

6. The solubility product constant (Ksp) is the product of the molar concentrations of ions in a:

(A) Dilute solution
(B) Saturated solution

(C) Unsaturated solution
(D) Pure solvent

Correct Answer: B

Explanation: The notes define Ksp as the product of the molar concentrations of ions in a saturated solution of a slightly soluble ionic compound.

7. For the dissolution of AgCl, the Ksp expression is:

(A) Ksp = [Ag□] + [Cl□]
(B) Ksp = [AgCl]/([Ag□][Cl□])
(C) Ksp = [Ag□][Cl□]
(D) Ksp = [Ag□]²[Cl□]

Correct Answer: C

Explanation: The concentration of the pure solid (AgCl) is constant and is not included, giving Ksp = [Ag□][Cl□].

8. The common ion effect is the suppression of the ionization of a weak electrolyte by:

(A) Adding water
(B) Increasing the temperature
(C) Adding a catalyst
(D) Adding a strong electrolyte with an ion in common

Correct Answer: D

Explanation: The notes define the common ion effect as the suppression of the ionization of a weak electrolyte by the addition of a strong electrolyte that has an ion in common with it.

9. The partition coefficient (Kpc) is defined as the ratio of the concentrations of a solute in two:

(A) Immiscible solvents
(B) Miscible solvents
(C) Solid phases
(D) Gas phases

Correct Answer: A

Explanation: The notes define Kpc as the ratio of the concentrations of a solute in two different immiscible solvents in contact with each other at equilibrium.

10. The partition coefficient has:

(A) Units of mol/dm³
(B) No units
(C) Units of g/L
(D) Units of mol/s

Correct Answer: B

Explanation: The notes state that the partition coefficient is a ratio of two concentrations, so it has no units.

11. A strong base is one that:

(A) Accepts protons only partially
(B) Does not accept protons
(C) Accepts protons completely (or almost completely) in water
(D) Always has a pH of 7

Correct Answer: C

Explanation: The notes state that strong bases ionize completely in aqueous solution, while weak bases ionize only partially.

12. Which of the following is a strong acid?

(A) Acetic acid
(B) Hydrofluoric acid
(C) Carbonic acid
(D) Hydrochloric acid

Correct Answer: D

Explanation: The notes state that HCl is a strong acid that ionizes completely, unlike acetic acid, hydrofluoric acid, and carbonic acid.

13. The pH of blood is maintained by the:

(A) Bicarbonate buffer system
(B) Phosphate buffer system
(C) Acetate buffer system
(D) Ammonia buffer system

Correct Answer: A

Explanation: The notes state that the bicarbonate ion plays a crucial role in maintaining blood pH through the bicarbonate buffer system.

14. The normal pH range of blood is approximately:

(A) 6.8–7.0
(B) 7.35–7.45
(C) 7.0–7.2
(D) 7.8–8.0

Correct Answer: B

Explanation: The notes state that the normal pH range of blood is approximately 7.35–7.45.

15. The higher the Ksp value of a compound, the:

(A) Less soluble it is in water
(B) More stable it is
(C) More soluble it is in water
(D) Less stable it is

Correct Answer: C

Explanation: The notes state that the higher the Ksp value of a compound, the more it is soluble in water.

16. Which of the following is a weak acid?

(A) HCl
(B) HBr
(C) HNO□
(D) HF

Correct Answer: D

Explanation: The notes state that hydrofluoric acid (HF) is a weak acid that only partially ionizes, while HCl, HBr, and HNO□ are strong acids.

17. For acetic acid, K_a = 1.8 × 10□⁵. What is its approximate pK_a?

(A) 4.7
(B) 5.7
(C) 1.8
(D) 10

Correct Answer: A

Explanation: 4.7 — this correctly answers the question.

18. Which is a stronger acid: acid A with K_a = 1 × 10□³ or acid B with K_a = 1 × 10□⁵?

(A) Acid B
(B) Acid A
(C) Both are equally strong
(D) Cannot be determined

Correct Answer: B

Explanation: Acid A has the larger K_a, so it is the stronger acid.

19. A buffer solution can be made by mixing:

(A) A strong acid and its salt
(B) Two strong acids

(C) A weak acid and its conjugate base (or a weak base and its conjugate acid)
(D) Two strong bases

Correct Answer: C

Explanation: The notes state that a buffer is made by mixing a weak acid and its conjugate base (or a weak base and its conjugate acid).

20. A buffer solution controls pH because the weak acid:

(A) Increases the pH
(B) Is a strong electrolyte
(C) Is a strong acid
(D) Neutralizes added base

Correct Answer: D

Explanation: In a buffer, the weak acid reacts with added base to form the conjugate base and water, preventing a large pH change.

21. In the acetate buffer, when a small amount of acid is added, it is neutralized by:

(A) CH□COO□
(B) CH□COOH
(C) Na□
(D) H□O

Correct Answer: A

Explanation: The conjugate base (CH□COO□) in the buffer reacts with added H□ to form more weak acid (CH□COOH), minimizing the pH change.

22. The pH of a buffer containing 1.0 M acetic acid and 1.0 M sodium acetate is approximately:

(A) 7.00
(B) 4.74
(C) 9.25
(D) 1.00

Correct Answer: B

Explanation: The pH of a buffer containing 1.0 M acetic acid and 1.0 M sodium acetate is approximately 4.74.

23. For a slightly soluble salt of the type AB□, the relationship between Ksp and molar solubility (s) is:

(A) $Ksp = s^2$
(B) $Ksp = 2s^2$
(C) $Ksp = 4s^3$
(D) $Ksp = 27s^4$

Correct Answer: C

Explanation: For a slightly soluble salt of the type AB□, the relationship between Ksp and molar solubility (s) is $Ksp = 4s^3$.

24. The Ksp of AgCl is 1.8×10^{-10}. The concentration of Ag□ in a saturated solution is approximately:

(A) 1.8×10^{-10} M
(B) 9.0×10^{-11} M
(C) 3.6×10^{-10} M
(D) 1.34×10^{-5} M

Correct Answer: D

Explanation: For AgCl, $Ksp = s^2$, so $s = \sqrt{1.8 \times 10^{-10}} \approx 1.34 \times 10^{-5}$ M.

25. The presence of a common ion in a saturated solution of a slightly soluble salt:

(A) Decreases the solubility
(B) Increases the solubility
(C) Has no effect
(D) Makes the solution unsaturated

Correct Answer: A

Explanation: The presence of a common ion in a saturated solution of a slightly soluble salt Decreases the solubility.

B. Less Important / Secondary Topics

26. If Q > Ksp in a precipitation reaction, the solution is:

(A) Supersaturated, a precipitate forms
(B) Unsaturated, no precipitate
(C) Saturated, no precipitate
(D) Always clear

Correct Answer: A

Explanation: If the reaction quotient Q is greater than Ksp, the solution is supersaturated and a precipitate forms until Q = Ksp.

27. The common ion effect is a direct consequence of:

(A) The Nernst equation
(B) Le Chatelier's principle
(C) The Arrhenius equation
(D) The Boltzmann distribution

Correct Answer: B

Explanation: The common ion effect is a shift in equilibrium caused by adding a common ion, which is explained by Le Chatelier's principle.

28. In a buffer solution of acetic acid and sodium acetate, the common ion is:

(A) CH□COOH
(B) Na□
(C) CH□COO□
(D) H□

Correct Answer: C

Explanation: The common ion is the acetate ion (CH□COO□), which is provided by the sodium acetate and suppresses the ionization of the weak acid.

29. For the partition coefficient Kpc = [solute in ether]/[solute in water], if Kpc = 10, the solute is:

(A) Equally soluble in both solvents
(B) More soluble in water
(C) Insoluble
(D) More soluble in ether

Correct Answer: D

Explanation: A value greater than 1 indicates that the solute is more soluble in the solvent in the numerator (ether).

30. A factor that affects the numerical value of the partition coefficient is:

(A) The polarity of the solute
(B) The color of the solution
(C) The volume of the container
(D) The pressure of the gas

Correct Answer: A

Explanation: The notes state that the polarity of the solute and the polarity of the solvents affect the partition coefficient.

31. In the Winkler method, a high BOD indicates:

(A) High dissolved oxygen
(B) High organic pollution
(C) Low organic waste
(D) A neutral solution

Correct Answer: B

Explanation: A high BOD indicates a greater quantity of organic waste and a lower level of dissolved oxygen, which is a sign of pollution.

32. The buffer system in blood plasma involves:

(A) CH□COOH and CH□COO□
(B) NH□OH and NH□Cl
(C) H□CO□ and HCO□□
(D) HCl and NaCl

Correct Answer: C

Explanation: The buffer system in blood plasma involves H□CO□ and HCO□□.

33. The pH of a basic buffer is:

(A) Less than 7
(B) Equal to 7
(C) Always 14
(D) Greater than 7

Correct Answer: D

Explanation: The notes state that basic buffers, made from a weak base and its salt with a strong acid, have a pH greater than 7.

34. A weak electrolyte is one that:

(A) Ionizes only partially in water
(B) Ionizes completely in water
(C) Does not ionize at all
(D) Is always a strong acid

Correct Answer: A

Explanation: The notes state that a weak electrolyte ionizes only partially in water.

35. The Ksp expression for CaF□ is:

(A) Ksp = [mathrmCa²□][F□]
(B) Ksp = [mathrmCa²□][F□]²
(C) Ksp = [mathrmCa²□]²[F□]
(D) Ksp = [CaF□]/([mathrmCa²□][F□]²)

Correct Answer: B

Explanation: For mathrmCaF□□s□ rightleftharpoons Ca²□ + 2F□, the Ksp expression is [mathrmCa²□][F□]².

36. For a weak acid HA with K_a = 1.8 × 10□⁵, in a buffer where [HA] = 0.1 M and [A□] = 0.1 M, the pH is approximately:

(A) 5.74
(B) 3.74
(C) 4.74
(D) 7.00

Correct Answer: C

Explanation: For a weak acid HA with K_a = 1.8 × 10□⁵, in a buffer where [HA] = 0.1 M and [A□] = 0.1 M, the pH is approximately 4.74.

37. A buffer is made from 0.1 M acetic acid and 0.01 M sodium acetate. Compared with an equal mixture of 0.1 M each, this buffer will have:

(A) A higher pH
(B) The same pH
(C) A pH of exactly 7
(D) A lower pH

Correct Answer: D

Explanation: Decreasing the concentration of the conjugate base relative to the acid lowers the ratio [A□]/[HA], and therefore lowers the pH.

38. A slightly soluble salt MX has Ksp = 1.0 × 10□¹². Its molar solubility is:

(A) 1.0 × 10□⁶ M
(B) 1.0 × 10□¹² M
(C) 1.0 × 10□⁴ M

(D) 1.0 × 10□²⁴ M

Correct Answer: A

Explanation: For an AB-type salt, Ksp = s², so s = sqrt1.0 × 10□¹² = 1.0 × 10□⁶ M.

39. A salt AB□ has Ksp = 4 × 10□⁸. Its molar solubility is:

(A) 2.0 × 10□⁴ M
(B) 2.15 × 10□³ M
(C) 1.0 × 10□⁸ M
(D) 4.0 × 10□⁸ M

Correct Answer: B

Explanation: For AB□, Ksp = 4s³, so s³ = 1 × 10□⁸ and s ≈ 2.15 × 10□³ M.

40. A saturated solution of AgCl is treated with NaCl. The solubility of AgCl:

(A) Increases
(B) Remains the same
(C) Decreases
(D) Becomes zero

Correct Answer: C

Explanation: Adding NaCl provides the common ion Cl□, which shifts the dissolution equilibrium of AgCl to the left, decreasing its solubility.

41. A buffer solution contains equal concentrations of a weak acid and its conjugate base. Its pH is:

(A) Equal to 7
(B) Always greater than 7
(C) Always less than 7
(D) Equal to the pK_a of the acid

Correct Answer: D

Explanation: A buffer solution contains equal concentrations of a weak acid and its conjugate base. Its pH is Equal to the pK_a of the acid.

42. A partition coefficient of 0.1 for a solute between water and octanol (water in the numerator) means the solute is:

(A) More soluble in octanol
(B) More soluble in water
(C) Equally soluble in both
(D) Insoluble

Correct Answer: A

Explanation: Kpc = [water]/[octanol] = 0.1 means the concentration in octanol is 10 times that in water, so it is more soluble in octanol.

43. Two solutions have Ksp values of 1 × 10□¹⁰ (salt A) and 1 × 10□¹² (salt B). Assuming the same stoichiometry, which salt is more soluble?

(A) Salt B
(B) Salt A
(C) Both are equally soluble
(D) Cannot be determined

Correct Answer: B

Explanation: For salts with the same stoichiometry, a higher Ksp indicates greater solubility, so salt A is more soluble.

44. The common ion effect is most significant for:

(A) Strong electrolytes
(B) Non-electrolytes
(C) Weak electrolytes
(D) Gases

Correct Answer: C

Explanation: Strong electrolytes are already fully ionized, so adding a common ion cannot suppress their ionization further; the effect is significant for weak electrolytes.

45. In a titration, a buffer region is observed before the equivalence point when:

(A) A strong acid is titrated with a strong base
(B) A strong acid is titrated with a weak base
(C) Two strong electrolytes are mixed
(D) A weak acid is titrated with a strong base

Correct Answer: D

Explanation: The buffer region occurs when a weak acid and its conjugate base are both present in significant amounts, which happens during the titration of a weak acid with a strong base.

46. A buffer solution's capacity to resist pH change is greatest when:

(A) The concentrations of the weak acid and conjugate base are equal and large
(B) The concentrations are very small
(C) The pH is very low
(D) The pH is very high

Correct Answer: A

Explanation: Buffer capacity is highest when the concentrations of the acid and conjugate base are equal and large, which corresponds to pH = pK_a.

47. A weak acid has K_a = 1 × 10□⁵. Its conjugate base has a K_b value of:

(A) 1 × 10□⁵
(B) 1 × 10□⁹
(C) 1 × 10□¹⁴
(D) 1 × 10□¹⁹

Correct Answer: B

Explanation: A weak acid has K_a = 1 × 10□⁵. Its conjugate base has a K_b value of 1 × 10□⁹.

48. The pH of a buffer made from a weak base and its conjugate acid is determined by:

(A) The concentration of the strong acid only
(B) The volume of the solution only
(C) The pK_a of the conjugate acid and the ratio of their concentrations
(D) The temperature only

Correct Answer: C

Explanation: The pH of a basic buffer is determined by the pK_a of the conjugate acid and the ratio of the concentrations of the base and its conjugate acid.

49. In the Winkler method, the amount of iodine produced is proportional to the:

(A) Amount of manganese sulphate
(B) Amount of sulphuric acid
(C) Amount of starch
(D) Amount of dissolved oxygen

Correct Answer: D

Explanation: The amount of iodine produced is proportional to the amount of dissolved oxygen in the original water sample.

50. A buffer solution is prepared from 0.2 M acetic acid and 0.1 M sodium acetate. If pK_a of acetic acid is 4.74, the pH is:

(A) 4.44
(B) 4.74
(C) 5.04
(D) 7.00

Correct Answer: A

Explanation: A buffer solution is prepared from 0.2 M acetic acid and 0.1 M sodium acetate. If pK_a of acetic acid is 4.74, the pH is 4.44.