CHEMISTRY MCQ BOOKLET

Grade 9 · Chapter 9 · Chemical Equilibrium

FBISE / National Book Foundation Model Textbook companion

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Independent MCQs on reversible reactions, dynamic equilibrium, Haber and Contact processes, and hydrate colour changes. Not copied from the book exercise. Total: 108 questions. Each item has four options, the correct letter, and a short explanation of why it is correct.

A. Important / Main Topics

1. A complete (irreversible) reaction proceeds until the limiting reactant is used up and:

(A) does not set up a reverse reaction that restores reactants in a closed system
(B) reactants and products keep swapping forever at equal rates
(C) always uses the symbol □
(D) always stays at dynamic equilibrium

Correct Answer: A

Explanation: This is correct because irreversible changes effectively go one way and do not establish chemical equilibrium.

2. A reversible reaction can proceed in both directions and is marked with:

(A) a single arrow only
(B) the symbol □
(C) only a state symbol (s)
(D) ΔH only

Correct Answer: B

Explanation: The double arrow □ shows that forward and reverse processes are both possible.

3. Reversible reactions of this type never go fully to completion because:

(A) no products ever form
(B) the flask is always open to the sky
(C) the reverse reaction keeps remaking reactants
(D) catalysts forbid products

Correct Answer: C

Explanation: This is correct because as products appear, the reverse path becomes important and leftover reactants remain.

4. Dynamic equilibrium means the forward rate is equal to the:

(A) zero rate of all collisions
(B) rate of painting iron
(C) rate of boiling only
(D) reverse rate

Correct Answer: D

Explanation: Both reactions continue, but they cancel so that amounts stop changing.

5. At equilibrium the reactions have not stopped; they:

(A) continue at equal and opposite rates
(B) have all rates equal to zero
(C) occur only in open beakers
(D) occur only if irreversible

Correct Answer: A

Explanation: “Dynamic” emphasises ongoing change with no net change in amounts.

6. A closed system is needed for chemical equilibrium so that:

(A) gases can escape freely

(B) no matter leaves, allowing forward and reverse to balance
(C) the flask can never have a catalyst
(D) temperature can never be constant

Correct Answer: B

Explanation: This is correct because if products escape, the reverse reaction cannot restore the original mixture.

7. At equilibrium the concentrations of reactants and products are:

(A) all zero
(B) always equal to each other
(C) constant (not necessarily equal)
(D) changing rapidly with no pattern

Correct Answer: C

Explanation: Constancy of concentrations is the observable mark; the values need not be 50:50.

8. A common misconception is that equilibrium means concentrations are equal; actually they are:

(A) always equal
(B) always zero
(C) undefined
(D) constant, and may be unequal

Correct Answer: D

Explanation: A reaction can lie far to the right and still be at equilibrium with little reactant left.

9. Conditions listed for keeping a given equilibrium are constant concentration, constant temperature, and constant:

(A) pressure–volume conditions for gases
(B) colour of litmus only
(C) oxidation number of Cr
(D) Avogadro's number

Correct Answer: A

Explanation: This is correct because changing T or the pressure/volume of gases disturbs the balance.

10. The Contact process equilibrium is:

(A) N□ + 3H□ □ 2NH□
(B) 2SO□ + O□ □ 2SO□
(C) CO□(g) □ CO□(aq) only
(D) H□ + OH□ → H□O

Correct Answer: B

Explanation: Sulfur dioxide is oxidized to sulfur trioxide in that reversible industrial step.

11. The Contact process uses vanadium(V) oxide V□O□ as a:

(A) reactant that is used up
(B) product SO□
(C) catalyst
(D) refrigerant

Correct Answer: C

Explanation: V□O□ speeds the SO□/O□/SO□ equilibrium without being consumed as the product.

12. Typical Contact-process conditions quoted are about 450 °C and:

(A) 1 atm only
(B) 10□⁶ atm
(C) 25 °C and 1 atm as the only possible values
(D) 200 atm

Correct Answer: D

Explanation: The chapter pairs a moderately high temperature with a high pressure around 200 atm.

13. The Haber process equilibrium is:

(A) N□ + 3H□ □ 2NH□
(B) 2SO□ + O□ □ 2SO□
(C) CuSO□·5H□O □ CuSO□ + 5H□O only
(D) glucose → lactic acid

Correct Answer: A

Explanation: This is correct because nitrogen and hydrogen combine reversibly to make ammonia.

14. The Haber process uses finely divided iron as a:

(A) product ammonia
(B) catalyst
(C) oxidizing agent Cl□
(D) hydrate water

Correct Answer: B

Explanation: Iron speeds the N□/H□/NH□ equilibrium so industry can make ammonia at a useful rate.

15. Typical Haber conditions quoted are about 400 °C and:

(A) 1 atm
(B) 450 °C only without pressure
(C) 200 atm
(D) vacuum only

Correct Answer: C

Explanation: High pressure favours the side with fewer gas molecules (2 NH□ versus 4 gas molecules on the left).

16. NO□ can be formed from nitrogen and oxygen with a spark; that reaction is an example of a:

(A) reaction that can be treated as reversible under suitable conditions
(B) strong-acid ionization only
(C) enzyme of muscle
(D) paint coating

Correct Answer: D

Explanation: The chapter uses the spark reaction of nitrogen oxides among its reversible examples.

17. In a fizzy drink, dissolved carbon dioxide is in equilibrium with:

(A) CO□ gas above the liquid: CO□(g) □ CO□(aq)
(B) solid iron rust
(C) only ammonia
(D) only SO□

Correct Answer: A

Explanation: This is correct because opening the bottle lets gas escape and pulls the equilibrium toward undissolved CO□(g).

18. When a fizzy drink is opened, CO□(g) leaves, so the equilibrium CO□(g) □ CO□(aq) shifts to:

(A) make more CO□(aq)
(B) replace the lost gas until fizzing slows
(C) form V□O□
(D) form pink CoCl□ hydrate only

Correct Answer: B

Explanation: This is correct because removing gaseous CO□ drives dissolved CO□ out of solution.

19. Blue CuSO□·5H□O heated forms white anhydrous CuSO□ and water; the equilibrium is:

(A) N□ + 3H□ □ 2NH□
(B) 2SO□ + O□ □ 2SO□
(C) CuSO□·5H□O □ CuSO□ + 5H□O
(D) HCl + H□O → H□O□ + Cl□

Correct Answer: C

Explanation: This is correct because hydrated copper(II) sulfate loses its water of crystallisation on heating.

20. Heating CuSO□·5H□O drives the hydrate equilibrium to the:

(A) left, remaking blue crystals immediately
(B) formation of ammonia
(C) Contact process
(D) right, producing white CuSO□ and steam/water

Correct Answer: D

Explanation: This is correct because heat favours dehydration of the blue pentahydrate.

21. Adding water to white anhydrous CuSO□ drives the same equilibrium to the:

(A) left, regenerating blue CuSO□·5H□O
(B) right, making more white powder
(C) Haber process
(D) spark formation of NO□ only

Correct Answer: A

Explanation: Water is a product of dehydration, so adding water reverses the change toward the hydrate.

22. Pink CoCl□·6H□O heated forms blue CoCl□; the equilibrium is:

(A) CoCl□·6H□O □ CoCl□ + 6H□O with heat driving it right
(B) N□ + 3H□ □ 2NH□
(C) CO□(g) □ CO□(aq) only
(D) Fe → Fe²□

Correct Answer: B

Explanation: The hexahydrate is pink; the anhydrous salt is blue.

23. Moisture turning blue CoCl□ pink is the hydrate equilibrium shifting:

(A) right, making more anhydrous salt
(B) to ammonia
(C) left, remaking CoCl□·6H□O
(D) to SO□

Correct Answer: C

Explanation: Water is added, so the reverse (hydration) path is favoured.

24. Irreversible reactions never establish equilibrium because there is no effective:

(A) forward reaction
(B) closed flask possible on Earth
(C) temperature
(D) reverse reaction restoring reactants

Correct Answer: D

Explanation: This is correct because without a reverse path, concentrations cannot settle into a dynamic balance.

25. A catalyst such as V□O□ or Fe in these industrial equilibria:

(A) helps the system reach equilibrium faster without being the product
(B) changes the equilibrium concentrations to 100% product
(C) makes the reaction irreversible
(D) opens the system so gases escape

Correct Answer: A

Explanation: This is correct because catalysts speed both directions and shorten the time to balance.

26. High pressure in Haber (200 atm) is used because the equation N□ + 3H□ □ 2NH□ has:

(A) more gas moles on the product side
(B) fewer gas moles on the product side (4 → 2)
(C) no gases
(D) only liquids

Correct Answer: B

Explanation: Squeezing the mixture favours the side with fewer gas molecules, ammonia.

27. The Contact equilibrium $2SO_2 + O_2 \rightleftharpoons 2SO_3$ also has fewer gas moles on the right (3 → 2), so high pressure:

(A) favours SO_2 and O_2 only
(B) has no effect even in theory
(C) favours SO_3
(D) turns the catalyst into ammonia

Correct Answer: C

Explanation: The side with two gas molecules is preferred when pressure is raised.

28. 450 °C in the Contact process is a compromise temperature: too low and the rate is poor; too high and:

(A) the catalyst becomes iron
(B) water always forms pink $CoCl_2$
(C) the system must open
(D) the exothermic formation of SO_3 is less favoured

Correct Answer: D

Explanation: Industry chooses a moderate temperature so equilibrium yield and rate are both accep.

29. 400 °C in Haber is likewise a compromise because ammonia formation is exothermic, so very high T:

(A) lowers the equilibrium amount of NH_3 even though it speeds the reaction
(B) always increases NH_3 yield without limit
(C) removes the need for a catalyst
(D) turns N_2 into $CuSO_4$

Correct Answer: A

Explanation: This is correct because heat favours the reverse, endothermic decomposition of ammonia.

30. If heat is applied to blue $CuSO_4 \cdot 5H_2O$, a Le Chatelier-style reading is that the system:

(A) absorbs the heat by dehydrating (moving right)
(B) releases heat by hydrating further
(C) forms N_2 and H_2
(D) becomes a closed Haber converter

Correct Answer: B

Explanation: The dehydration direction uses the supplied heat.

31. If a wet atmosphere surrounds blue $CoCl_2$, the system:

(A) loses water and stays blue
(B) makes SO_3
(C) takes up water and becomes pink hydrate
(D) makes NH_3

Correct Answer: C

Explanation: This is correct because extra water pushes hydration, the reverse of heating.

32. Dynamic equilibrium can exist only if both forward and reverse processes:

(A) have stopped
(B) require an open window
(C) are irreversible combustions
(D) are occurring

Correct Answer: D

Explanation: Equal nonzero rates are the definition of dynamic balance.

33. Concentrations remain constant at equilibrium even though molecules still react, because each forward event is matched by a:

(A) reverse event
(B) leak from the flask

(C) change of catalyst identity
(D) change of temperature

Correct Answer: A

Explanation: Net change is zero when the two rates match.

34. An open bottle of soda is a poor closed system for CO□ equilibrium because gas:

(A) cannot leave
(B) escapes, so the reverse dissolution cannot fully restore the original pressure of CO□
(C) turns into iron
(D) becomes V□O□

Correct Answer: B

Explanation: Matter leaves, so the original sealed-drink balance is destroyed.

35. White anhydrous CuSO□ is used as a test for water because water drives the equilibrium toward:

(A) more white powder
(B) ammonia
(C) blue pentahydrate
(D) NO□ spark products only

Correct Answer: C

Explanation: The colour change to blue signals that the hydrate has formed.

36. Cobalt chloride paper can indicate moisture because water converts blue CoCl□ to:

(A) white CuSO□
(B) green rust
(C) colourless Mn^{2}□
(D) pink CoCl□·6H□O

Correct Answer: D

Explanation: The pink hexahydrate is the hydrated form.

37. The Haber equation uses three H□ molecules per N□ because the mole ratio is:

(A) 1:3
(B) 1:1
(C) 2:1 for N□:H□
(D) 3:1 for NH□:N□ as written left to right

Correct Answer: A

Explanation: N□ + 3H□ □ 2NH□ is the balanced reversible.

38. The Contact equation uses one O□ per two SO□ because the ratio SO□:O□ is:

(A) 1:1
(B) 2:1
(C) 3:1
(D) 1:3 as in Haber

Correct Answer: B

Explanation: This is correct because 2SO□ + O□ □ 2SO□ balances sulfur and oxygen.

39. If SO□ is continuously removed in industry, the Contact equilibrium responds by making:

(A) less SO□
(B) only N□
(C) more SO□ to replace what was taken
(D) pink hydrate

Correct Answer: C

Explanation: Removing a product pulls the reversible reaction toward that product.

40. If NH□ is removed as it forms (liquefied), Haber's equilibrium makes:

(A) less ammonia
(B) only SO□

(C) only CuSO□
(D) further ammonia

Correct Answer: D

Explanation: This is correct because taking off product shifts the reversible manufacture toward more NH□.

41. A spark providing energy for N□ and O□ to form nitrogen oxides shows that some reversible systems need:

(A) an initial energy input to get going, after which equilibrium ideas can apply
(B) no energy ever
(C) an open system only
(D) paint

Correct Answer: A

Explanation: Activation may require a spark even though the reaction can be treated as reversible.

42. Constant temperature is required to discuss a given equilibrium mixture because changing T:

(A) never affects rates or position
(B) changes both rates and the equilibrium position for reactions with a heat effect
(C) only changes the colour of litmus
(D) opens the flask

Correct Answer: B

Explanation: Heat or cooling is a stress that the system responds to.

43. Constant volume/pressure matters for gaseous equilibria because changing volume changes:

(A) the identity of V□O□
(B) the formula of ammonia
(C) partial pressures / concentrations of the gases
(D) whether water is H□O

Correct Answer: C

Explanation: This is correct because gas equilibria respond to how compressed the mixture is.

44. The statement “reactions continue at equilibrium” contradicts the misconception that:

(A) rates can be equal
(B) closed systems are useful
(C) catalysts exist
(D) everything has stopped when amounts look constant

Correct Answer: D

Explanation: This is correct because macroscopic constancy hides microscopic back-and-forth.

45. V□O□ does not appear as a product in 2SO□ + O□ □ 2SO□ because it is a:

(A) catalyst
(B) reactant in equal moles with SO□
(C) hydrate
(D) fizzy-drink gas

Correct Answer: A

Explanation: The balanced equilibrium is written without the catalyst formula.

46. Fe in Haber is similarly absent from N□ + 3H□ □ 2NH□ because iron is the:

(A) ammonia molecule
(B) catalyst
(C) nitrogen source
(D) hydrogen source

Correct Answer: B

Explanation: Fe in Haber is similarly absent from N□ + 3H□ □ 2NH□ because iron is the catalyst.

47. Heating pink CoCl□·6H□O until it is blue is the forward dehydration; cooling in moist air:

(A) keeps it blue forever always

(B) makes Haber ammonia
(C) can reverse it to pink
(D) makes Contact SO□

Correct Answer: C

Explanation: The hydrate equilibrium is reversible with heat versus moisture.

48. Blue to white for copper sulfate on heating, and white to blue on adding water, proves the change is:

(A) irreversible combustion
(B) a complete one-way rusting
(C) nuclear
(D) reversible

Correct Answer: D

Explanation: Both directions can be demonstrated, which is the point of □.

49. If a reaction is described as complete/irreversible, you should not expect:

(A) a lasting dynamic equilibrium mixture of reactants with products in a closed flask
(B) products to form
(C) a chemical change
(D) energy change

Correct Answer: A

Explanation: This is correct because irreversible reactions do not settle into a reverse-balanced state.

50. In a sealed bottle of soda, CO□(aq) and CO□(g) reach a balance until:

(A) the seal is perfect forever without chemistry
(B) the cap is opened and gas leaves
(C) V□O□ is added
(D) iron catalyst is added

Correct Answer: B

Explanation: Opening is the classic disturbance of that gas–solution equilibrium.

51. Le Chatelier-style thinking on hydrates: heat is like a stress that favours the:

(A) hydrated side
(B) Haber iron catalyst
(C) anhydrous side plus water vapour
(D) fizzy-drink cap remaining closed

Correct Answer: C

Explanation: Dehydration is the endothermic direction that uses the added heat.

52. Le Chatelier-style thinking on hydrates: extra water is a stress that favours the:

(A) anhydrous powder
(B) Contact 200 atm converter
(C) spark NO□ only
(D) hydrated crystals

Correct Answer: D

Explanation: This is correct because the system consumes the added water by forming the hydrate.

53. Why 200 atm appears in both Haber and Contact notes:

(A) both are aqueous hydrates
(B) both equilibria have more gas moles on the left than the right
(C) both are soda-bottle CO□ only
(D) both use CoCl□ paper

Correct Answer: A

Explanation: Fewer gas molecules on the product side means high pressure helps the desired product.

54. Why a catalyst is still essential even though high pressure helps yield:

(A) catalysts change ΔH of Haber to endothermic

(B) without a catalyst the rate to equilibrium can be too slow for industry
(C) catalysts open the converter
(D) catalysts make reactions irreversible

Correct Answer: B

Explanation: A favourable position is useless if the mixture never gets there in a reasonable time.

55. Concentrations constant at equilibrium does not mean the forward reaction has:

(A) a matching reverse reaction
(B) a closed system
(C) stopped
(D) a catalyst possibly present

Correct Answer: C

Explanation: The forward process still occurs; it is merely balanced.

56. A classroom closed tube of NO□/N□O□ (related nitrogen-oxide chemistry) is useful because:

(A) gas can leak freely
(B) it is the Haber converter
(C) it is soda water
(D) the gases stay to establish a visible reversible brown/pale balance

Correct Answer: D

Explanation: A sealed vessel keeps the nitrogen oxides available for both directions.

57. If temperature were not held constant, an equilibrium discussion would be unclear because:

(A) the position of equilibrium can shift with T
(B) catalysts would melt always
(C) water would cease to be H□O
(D) arrows could not be drawn

Correct Answer: A

Explanation: Each temperature has its own balance point when ΔH is not zero.

58. The product SO□ in Contact can go on to make sulfuric acid; the equilibrium step itself is still:

(A) N□ + 3H□ □ 2NH□
(B) 2SO□ + O□ □ 2SO□
(C) CuSO□·5H□O □ CuSO□ + 5H□O
(D) CO□(g) □ CO□(aq)

Correct Answer: B

Explanation: Manufacture of H□SO□ uses that sulfur-trioxide equilibrium as a key reversible stage.

59. Ammonia from Haber is used in fertilizers; the equilibrium that produces it is still:

(A) 2SO□ + O□ □ 2SO□
(B) CoCl□·6H□O □ CoCl□ + 6H□O
(C) N□ + 3H□ □ 2NH□
(D) H□ + OH□ → H□O

Correct Answer: C

Explanation: The reversible combination of nitrogen and hydrogen is the source of the ammonia.

60. If someone writes Haber as N□ + 3H□ → 2NH□ with a single arrow only, they hide that:

(A) iron is a catalyst
(B) pressure is 200 atm
(C) temperature is 400 °C
(D) the reaction is reversible and does not go to absolute completion

Correct Answer: D

Explanation: The □ symbol is the chapter's reminder that ammonia can decompose again.

61. Dynamic equilibrium requires that the system is not being emptied of a reactant or product; that is why we specify a:

(A) closed system
(B) paint layer
(C) spark always
(D) pink colour always

Correct Answer: A

Explanation: Closure keeps the amounts available for both directions.

62. When forward rate equals reverse rate, net change in concentration is:

(A) a rapid rise
(B) zero
(C) a rapid fall to zero for all species
(D) undefined

Correct Answer: B

Explanation: This is correct because equal opposing rates cancel at the macroscopic level.

63. White CuSO□ plus a drop of water turning blue is evidence that:

(A) the Contact catalyst formed
(B) ammonia formed
(C) water of crystallisation can be restored
(D) the reaction is irreversible rusting

Correct Answer: C

Explanation: This is correct because the hydrate equilibrium has been driven back to CuSO□·5H□O.

64. Pink-to-blue cobalt chloride on warming is evidence that:

(A) water has been added
(B) SO□ has formed
(C) N□ has formed
(D) water has been driven off

Correct Answer: D

Explanation: This is correct because loss of the six water molecules leaves blue anhydrous CoCl□.

65. A complete combustion that cannot reverse under the same conditions is grouped as:

(A) irreversible, so it does not establish this chapter's equilibrium
(B) reversible with □
(C) always Haber
(D) always a hydrate

Correct Answer: A

Explanation: This is correct because one-way reactions never meet the reverse-rate requirement.

66. Industry uses 450 °C rather than room temperature for Contact mainly to get a:

(A) lower rate
(B) useful rate over the V□O□ catalyst
(C) pink cobalt colour
(D) soda fizz

Correct Answer: B

Explanation: Even with a catalyst, a moderately high temperature is needed for a practical speed.

67. Industry uses 400 °C rather than a much lower T for Haber mainly because:

(A) yield of NH□ would be worse at high T but rate would be tiny at very low T without enough energy
(B) N□ becomes a hydrate
(C) iron melts at 25 °C
(D) the flask must be open

Correct Answer: C

Explanation: The quoted temperature is a working compromise between yield and rate.

68. 200 atm is high compared with 1 atm; qualitatively this:

(A) favours the side with more gas moles
(B) has no meaning for Haber or Contact
(C) hydrates CoCl□
(D) favours the side with fewer gas moles

Correct Answer: D

Explanation: This is correct because both featured industrial equilibria have fewer gas molecules on the product side.

69. Fizzy drinks illustrate a physical equilibrium of a gas dissolving, written:

(A) CO□(g) □ CO□(aq)
(B) 2SO□ + O□ □ 2SO□
(C) N□ + 3H□ □ 2NH□
(D) H□ + I□ → 2HI

Correct Answer: A

Explanation: It is still a reversible balance, even though no new compound is formed.

70. If the drink is shaken and opened, extra CO□ leaves because shaking:

(A) closes the system
(B) helps gas escape, disturbing CO□(g) □ CO□(aq)
(C) adds V□O□
(D) makes CuSO□ blue

Correct Answer: B

Explanation: This is correct because loss of CO□(g) pulls more CO□ out of solution.

71. The hydrate CuSO□·5H□O is blue because of:

(A) anhydrous copper sulfate colour
(B) the iron Haber catalyst
(C) water of crystallisation in the crystal structure
(D) dissolved CO□ only

Correct Answer: C

Explanation: The pentahydrate's colour is the familiar blue; the anhydrous salt is white.

72. Anhydrous CoCl□ is blue while CoCl□·6H□O is:

(A) also blue
(B) white like anhydrous CuSO□
(C) metallic iron
(D) pink

Correct Answer: D

Explanation: The colour pair is the moisture indicator.

73. "Never go fully to completion" for a reversible reaction means some:

(A) reactant remains alongside product at equilibrium
(B) product is forbidden forever
(C) catalyst is missing
(D) closed flask is missing always

Correct Answer: A

Explanation: Both sides of □ are present when rates match.

74. If concentrations were still changing, the mixture would not yet be at:

(A) a closed flask
(B) equilibrium
(C) a temperature
(D) a formula

Correct Answer: B

Explanation: Constant concentrations are required before we call it equilibrium.

75. Forward and reverse rates being equal is about kinetics at balance; it does not require that:

(A) the flask is closed
(B) temperature is defined
(C) the two chemical equations have the same mole amounts of every species as each other in a 1:1 recipe sense of equal concentrations
(D) reactions continue

Correct Answer: C

Explanation: Equal rates can occur with very different concentrations of reactants versus products.

76. Removing water vapour while heating CuSO□·5H□O helps dehydration because you are removing a:

(A) catalyst
(B) reactant N□
(C) spark
(D) product of the forward (right-hand) change

Correct Answer: D

Explanation: Carrying steam away stops water from driving the reverse hydration.

77. Adding a drying agent near pink CoCl□·6H□O would tend to:

(A) pull water away and favour blue anhydrous salt
(B) keep it pink by adding water
(C) make ammonia
(D) make SO□

Correct Answer: A

Explanation: Lowering water availability is the same kind of stress as heating to drive off water.

78. The □ symbol should not be used for a reaction the chapter calls irreversible because that would wrongly suggest:

(A) products can form
(B) a reverse reaction establishing equilibrium
(C) atoms rearrange
(D) energy can change

Correct Answer: B

Explanation: A single arrow is the honest notation when the reverse path does not operate.

79. In qualitative Contact-process reasoning, a student should remember catalyst, temperature, and:

(A) litmus colour
(B) only soda fizz
(C) pressure, because gas moles change
(D) only CoCl□ paper

Correct Answer: C

Explanation: V□O□, about 450 °C, and about 200 atm are the quoted trio.

80. In qualitative Haber reasoning, remember iron catalyst, about 400 °C, and about:

(A) 1 atm
(B) 450 °C as the pressure
(C) pink hydrate
(D) 200 atm

Correct Answer: D

Explanation: Those are the chapter's headline industrial conditions for ammonia.

B. Less Important / Secondary Topics

81. Which symbol correctly flags a reversible reaction?

(A) □

(B) → only, for every reaction
(C) ΔH° only
(D) (aq) only

Correct Answer: A

Explanation: The equilibrium arrows are the special notation for reversibility.

82. Equal forward and reverse rates describe:

(A) an irreversible explosion only
(B) dynamic equilibrium
(C) an open leaking flask only
(D) a catalyst being used up

Correct Answer: B

Explanation: That kinetic equality is the definition used in the chapter.

83. A sealed fizzy-drink bottle is closer to a closed system than an open beaker because:

(A) gas can leave freely
(B) it contains V□O□
(C) CO□ cannot escape until the cap is opened
(D) it runs Haber

Correct Answer: C

Explanation: The cap keeps the gas in so CO□(g) □ CO□(aq) can balance.

84. Constant concentrations at equilibrium mean the amounts have:

(A) all become zero
(B) become equal always
(C) started leaking
(D) stopped changing net, while reactions continue

Correct Answer: D

Explanation: Constancy is net, not a shutdown of chemistry.

85. V□O□ belongs with which industrial equilibrium?

(A) Contact SO□/SO□
(B) Haber ammonia
(C) copper sulfate hydrate only
(D) soda water only

Correct Answer: A

Explanation: Vanadium(V) oxide is the Contact-process catalyst.

86. Finely divided iron belongs with:

(A) Contact SO□
(B) Haber NH□
(C) CoCl□ paper
(D) blue vitriol heating only

Correct Answer: B

Explanation: Finely divided iron is the catalyst used in the Haber process.

87. 450 °C is the temperature quoted with:

(A) Haber iron
(B) a soda fridge only
(C) Contact V□O□
(D) standard 25 °C tables only

Correct Answer: C

Explanation: Contact is the 450 °C / 200 atm / V□O□ set.

88. 400 °C is the temperature quoted with:

(A) Contact V□O□

(B) anhydrous CuSO□ test only
(C) pink cobalt only
(D) Haber Fe

Correct Answer: D

Explanation: Haber is the 400 °C / 200 atm / Fe set.

89. Both Haber and Contact quote about 200 atm because both product sides have:

(A) fewer gas molecules than the left
(B) more gas molecules
(C) no gases
(D) only hydrates

Correct Answer: A

Explanation: This is correct because high pressure supports the compressed, fewer-mole product side.

90. Heating blue vitriol (CuSO□·5H□O) produces a:

(A) pink cobalt salt
(B) white anhydrous salt
(C) yellow sodium flame only
(D) purple permanganate

Correct Answer: B

Explanation: This is correct because the pentahydrate loses water and the solid turns white.

91. Water on white CuSO□ produces a:

(A) white colour remaining
(B) Haber ammonia smell only
(C) blue colour of the pentahydrate
(D) Contact SO□ mist only

Correct Answer: C

Explanation: That reverse change is the water test.

92. Heating pink cobalt chloride hexahydrate produces:

(A) still pink crystals only
(B) white CuSO□
(C) liquid iron
(D) blue anhydrous CoCl□

Correct Answer: D

Explanation: Dehydration is accompanied by the blue colour.

93. Damp air on blue CoCl□ produces:

(A) pink hydrate
(B) a deeper blue anhydrous salt
(C) SO□
(D) NH□ liquid

Correct Answer: A

Explanation: This is correct because hydration restores the pink hexahydrate.

94. Opening a soda bottle favours CO□(g) because you have:

(A) added more CO□ gas
(B) removed CO□ gas from the headspace
(C) added V□O□
(D) cooled to make more hydrate

Correct Answer: B

Explanation: Escaping gas is removal of a product of the reverse of dissolution, so more gas comes out of solution.

95. An irreversible reaction is one that:

(A) uses □ and never finishes

(B) must use Fe catalyst
(C) does not establish equilibrium because the reverse path is ineffective
(D) must use 200 atm

Correct Answer: C

Explanation: No reverse reaction means no dynamic balance.

96. If products keep leaving an open chimney, equilibrium of a gas reaction cannot hold because the system is not:

(A) hot
(B) catalysed
(C) coloured
(D) closed

Correct Answer: D

Explanation: Matter must remain available for the reverse reaction.

97. A catalyst speeds arrival at Haber or Contact equilibrium but does not:

(A) replace the need to choose T and P for a desired position
(B) affect rate
(C) get regenerated
(D) help both directions

Correct Answer: A

Explanation: Position is set by conditions such as temperature and pressure; the catalyst is about speed.

98. Removing NH□ as liquid from a Haber converter is like removing a product, so the mixture makes:

(A) N□ and H□ only
(B) more ammonia
(C) CuSO□·5H□O
(D) pink CoCl□

Correct Answer: B

Explanation: Continuous product removal is a qualitative Le Chatelier shift to the right.

99. Removing SO□ similarly helps Contact make:

(A) only unused O□ leftover with no SO□
(B) ammonia
(C) further SO□
(D) fizzy CO□

Correct Answer: C

Explanation: The equilibrium replaces the sulfur trioxide that was taken off.

100. A spark in N□/O□ is mentioned because some reversible nitrogen-oxide chemistry needs:

(A) a hydrate colour
(B) 200 atm always
(C) iron catalyst always
(D) activation to get started

Correct Answer: D

Explanation: The spark supplies energy to form NO□ in that example.

101. Constant pressure–volume is listed among equilibrium conditions mainly for:

(A) gaseous reactions whose amounts depend on compression
(B) solid hydrates with no gas
(C) litmus tests
(D) rusting half-equations only

Correct Answer: A

Explanation: Haber and Contact are the gas-phase industrial illustrations.

102. Saying “the reaction has stopped” at equilibrium is wrong because:

(A) rates are zero
(B) forward and reverse still occur
(C) the flask must be open
(D) no chemicals remain

Correct Answer: B

Explanation: Dynamic means continuing, balanced change.

103. Concentrations being equal would be a special case; generally at equilibrium they are:

(A) equal by definition
(B) always 1 mol·dm□³
(C) constant at whatever values the position requires
(D) always zero for reactants

Correct Answer: C

Explanation: Do not confuse equal rates with equal concentrations.

104. The left-hand side of Haber has four gas molecules and the right has:

(A) four as well
(B) three H□ only as products
(C) one N□ as product
(D) two NH□ molecules

Correct Answer: D

Explanation: That 4-to-2 drop is why pressure matters.

105. The left-hand side of Contact has three gas molecules and the right has:

(A) two SO□ molecules
(B) three as well
(C) one O□ as the only product
(D) five water molecules

Correct Answer: A

Explanation: That 3-to-2 drop is why pressure is used.

106. Heat on a hydrate equilibrium is analogous to adding energy so the system:

(A) makes more hydrate
(B) shifts toward anhydrous salt + water
(C) always makes NH□
(D) always dissolves CO□

Correct Answer: B

Explanation: Dehydration is the heat-absorbing direction for those examples.

107. Water added to an anhydrous salt is analogous to adding a product/reactant so the system:

(A) stays anhydrous
(B) reaches Haber 200 atm
(C) shifts toward the hydrate
(D) sparks NO□

Correct Answer: C

Explanation: This is correct because the hydrate consumes the extra water.

108. Which pair is a physical (dissolving) equilibrium rather than a new compound forming?

(A) N□ + 3H□ □ 2NH□
(B) 2SO□ + O□ □ 2SO□
(C) CuSO□·5H□O □ CuSO□ + 5H□O
(D) CO□(g) □ CO□(aq)

Correct Answer: D

Explanation: The drink example is gas dissolving, not a change of chemical identity like ammonia synthesis.