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Chemistry Grade 11 — Chapter 6

Energetics

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Independent practice MCQs from the supplied Class 11 Chemistry notes pack. Total: 50 questions.

A. Important / Main Topics

1. In an exothermic reaction, the enthalpy change (Δ H) is:

(A) Negative
(B) Positive
(C) Zero
(D) Unpredictable

Correct Answer: A

Explanation: For an exothermic process, in which heat is released by the system to the surrounding, Δ H is negative.

2. The SI unit of heat or thermal energy is the:

(A) Calorie
(B) Joule
(C) Newton
(D) Kelvin

Correct Answer: B

Explanation: Unit of heat or thermal energy used in SI system is the Joule (J).

3. The amount of heat required to raise the temperature of one gram of water from 14.5^circC to 15.5^circC is called:

(A) 1 Joule
(B) 1 Kelvin
(C) 1 Calorie
(D) 1 Enthalpy

Correct Answer: C

Explanation: A calorie is defined as the heat or thermal energy required to raise the temperature of one gram of water from 14.5^circC to 15.5^circC.

4. The relationship between heat of reaction and enthalpy change at constant pressure is:

(A) q_p = -Δ H
(B) q_p = 0
(C) q_p = Δ S
(D) q_p = Δ H

Correct Answer: D

Explanation: Because most chemical reactions occur at constant pressure, we can equate the heat change in these reactions to the change in enthalpy (q_p = Δ H).

5. Which of the following processes is endothermic?

(A) Sublimation of dry ice
(B) Combustion of methane
(C) Freezing of water
(D) Condensation of steam

Correct Answer: A

Explanation: Sublimation of dry ice requires the absorption of heat to change from solid to gas, making it an endothermic process.

6. The standard state for a gas is:

(A) 1 M concentration

(B) 1 atm pressure
(C) 0^circC
(D) 2 atm pressure

Correct Answer: B

Explanation: The standard state for a gas is 1 atm pressure.

7. The energy required to break a bond of the same type in one mole of a substance is called:

(A) Lattice energy
(B) Ionization energy
(C) Bond energy
(D) Electron affinity

Correct Answer: C

Explanation: Energy which is required to break the bond of the same type in one mole of a substance is known as bond energy.

8. When a reaction is reversed, the magnitude of Δ H remains the same but its:

(A) Value becomes zero
(B) Unit changes
(C) Magnitude doubles
(D) Sign changes

Correct Answer: D

Explanation: When a reaction is reversed, the magnitude of Δ H^circ remains the same but its sign changes.

9. In an endothermic reaction, the products have:

(A) Higher energy than reactants
(B) Lower energy than reactants
(C) The same energy as reactants
(D) No energy

Correct Answer: A

Explanation: In an endothermic reaction, the products have Higher energy than reactants.

10. The heat capacity of a substance is expressed in:

(A) Joules
(B) Joules per Kelvin
(C) Joules per gram per Kelvin
(D) Kelvin

Correct Answer: B

Explanation: Heat capacity is expressed in Joules per Kelvin (J/K).

11. Which of the following is a state function?

(A) Heat
(B) Work
(C) Enthalpy
(D) Path taken

Correct Answer: C

Explanation: Enthalpy is a state function; it does not depend on the path followed by a reaction.

12. The heat content of a system at constant pressure is called its:

(A) Internal energy
(B) Entropy
(C) Gibbs free energy
(D) Enthalpy

Correct Answer: D

Explanation: The change in energy at constant pressure is called the change in enthalpy.

13. 1 Kilocalorie (kcal) is approximately equivalent to:

(A) 4.184 kJ
(B) 4.184 J
(C) 41.84 kJ
(D) 0.4184 kJ

Correct Answer: A

Explanation: 1 Kilocalorie (kcal) is approximately equivalent to 4.184 Kilojoules (kJ).

14. The standard enthalpy of formation of an element in its most stable state is:

(A) Always positive
(B) Zero
(C) Always negative
(D) Equal to its atomic mass

Correct Answer: B

Explanation: The standard enthalpy of formation of an element in its standard state is zero.

15. Which law states that the total enthalpy change of a reaction is independent of the pathway?

(A) First law of thermodynamics
(B) Second law of thermodynamics
(C) Hess's law
(D) Law of conservation of mass

Correct Answer: C

Explanation: Hess's Law states that the enthalpy change in a chemical reaction is the same whether the reaction takes place in a single step or in several steps.

16. Which equation represents the standard enthalpy of combustion of methane?

(A) CH□(g) → C(s) + 2H□(g)
(B) C(s) + 2H□(g) → CH□(g)
(C) CH□(g) + O□(g) → CO(g) + 2H□O(l)
(D) CH□(g) + 2O□(g) → CO□(g) + 2H□O(l)

Correct Answer: D

Explanation: The enthalpy change when one mole of a substance is completely burnt in excess of oxygen under standard conditions is called standard enthalpy of combustion.

17. For the reaction H□(g) + I□(g) → 2HI(g), Δ H^circ = +53.8 kJ. This reaction is:

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

Correct Answer: A

Explanation: A positive Δ H^circ indicates heat is absorbed, so the reaction is endothermic.

18. The enthalpy of hydration (Δ Hhyd) is the energy:

(A) Required to break the ionic lattice
(B) Released when gaseous ions are surrounded by water molecules
(C) Required to melt a solid
(D) Released when a bond is broken

Correct Answer: B

Explanation: The energy released when solute particles bind to water molecules in solution is equal to the enthalpy of hydration.

19. A reaction is spontaneous if:

(A) Δ G^circ > 0
(B) Δ G^circ = 0
(C) Δ G^circ < 0
(D) Δ H^circ > 0

Correct Answer: C

Explanation: If Δ G^circ < 0 or negative, the process is spontaneous in the forward direction.

20. Which of the following has the highest bond energy based on the data?

(A) H−I
(B) H−Br
(C) H−Cl
(D) H−F

Correct Answer: D

Explanation: Greater the electronegativity difference, higher will be the bond energy. HF has the greatest electronegativity difference among the given options.

21. The dissolution of NH□NO□ in water absorbs 25.7 kJ/mol of energy. The process is:

(A) Endothermic, and the flask becomes cold
(B) Exothermic, and the flask becomes hot
(C) Exothermic, and the flask becomes cold
(D) Endothermic, and the flask becomes hot

Correct Answer: A

Explanation: Since energy is absorbed, the process is endothermic, and the flask becomes cold.

22. For the reaction CaCl□(s) + H□O(l) → Ca²□(aq) + 2Cl□(aq), Δ Hsoln = -83.0 kJ/mol. This indicates that the:

(A) Lattice energy is greater than the hydration energy
(B) Hydration energy is greater than the lattice energy
(C) Reaction is endothermic
(D) Solution does not form

Correct Answer: B

Explanation: A negative Δ Hsoln indicates an exothermic process, meaning the hydration energy released is greater than the lattice energy required to break the crystal.

23. Using the following bond energies, calculate the enthalpy change for H□(g) + Cl□(g) → 2HCl(g): - H−H = 436 kJ/mol - Cl−Cl = 243 kJ/mol - H−Cl = 431.5 kJ/mol

(A) +184 kJ
(B) -248 kJ
(C) -184 kJ
(D) +248 kJ

Correct Answer: C

Explanation: "-184 kJ" is correct: it matches the idea asked in the question ("Using the following bond energies, calculate the enthalpy change for H□(g) + Cl□(g) → 2HCl(g): - H−H = 436 kJ/mol - Cl−Cl = 243 kJ/mol - H−Cl = 431.5 kJ/mol"), while the other choices do not.

24. Explain the role of hydration in the dissolving process. How does it determine whether the dissolution is exothermic or endothermic?

(A) Hydration always makes the process endothermic
(B) Hydration always makes the process exothermic
(C) Hydration has no role in determining the thermodynamics of dissolution
(D) If hydration energy is greater than lattice energy, the process is exothermic

Correct Answer: D

Explanation: The strength of solute-solvent interactions (hydration) compared to solute-solute interactions (lattice energy) determines whether the dissolution process is endothermic or exothermic.

25. Define enthalpy of solution and its relationship with lattice energy and enthalpy of hydration.

(A) Δ Hsolution = Δ Hlattice - Δ Hhyd
(B) Δ Hsolution = Δ Hlattice + Δ Hhyd
(C) Δ Hsolution = Δ Hhyd - Δ Hlattice
(D) Δ Hsolution = Δ Hlattice × Δ Hhyd

Correct Answer: A

Explanation: The enthalpy of solution is the difference between the lattice energy and the enthalpy of hydration.

B. Less Important / Secondary Topics

26. Why does water have a high specific heat capacity, and how does it relate to hydrogen bonding?

(A) Water has strong hydrogen bonding, requiring more energy to raise its temperature
(B) Water has weak intermolecular forces
(C) Water has low molar mass
(D) Water is a poor conductor of heat

Correct Answer: A

Explanation: Hydrogen bonding in water is strong, so more heat energy is required to overcome these forces to raise the temperature.

27. Explain how the Born-Haber cycle is used to calculate the electron affinity of an element.

(A) It directly measures electron affinity
(B) It uses Hess's Law to indirectly determine electron affinity from other enthalpy changes
(C) It measures the ionization energy
(D) It measures the lattice energy directly

Correct Answer: B

Explanation: Electron affinities of atoms are usually calculated from Born-Haber cycle because it is difficult to determine electron affinities directly.

28. What is the effect of a catalyst on the enthalpy change of a reaction?

(A) It increases the enthalpy change
(B) It decreases the enthalpy change
(C) It has no effect on the enthalpy change
(D) It reverses the enthalpy change

Correct Answer: C

Explanation: It has no effect on the enthalpy change — this correctly answers the question.

29. Which of the following is an example of an endothermic reaction?

(A) C(s) + O□(g) → CO□(g)
(B) 2H□(g) + O□(g) → 2H□O(l)
(C) C(s) + frac12O□(g) → CO(g)
(D) N□(g) + O□(g) → 2NO(g)

Correct Answer: D

Explanation: The formation of NO from N□ and O□ is an endothermic reaction, as shown in the textbook examples.

30. The standard enthalpy of atomization of Cl□ is +121 kJ/mol. This represents the energy required to:

(A) Break one mole of Cl□ molecules into atoms
(B) Form one mole of Cl□ from atoms
(C) Ionize one mole of Cl atoms
(D) Add an electron to one mole of Cl atoms

Correct Answer: A

Explanation: Standard enthalpy of atomization is the enthalpy change when one mole of gaseous atoms are formed from its element under standard conditions.

31. For a spontaneous process at constant temperature and pressure:

(A) Δ G > 0
(B) Δ G < 0
(C) Δ G = 0
(D) Δ H = 0

Correct Answer: B

Explanation: If Δ G is negative, the process is spontaneous in the forward direction.

32. Which of the following statements about entropy is correct?

(A) Entropy decreases when a solid melts
(B) Entropy increases when a gas condenses
(C) Entropy increases when a liquid evaporates
(D) Entropy is zero for all elements

Correct Answer: C

Explanation: When a liquid evaporates, its molecules gain more freedom of movement and become more disordered, so entropy increases.

33. The enthalpy of hydration is more exothermic for:

(A) Larger ions with lower charge
(B) Larger ions with higher charge
(C) Smaller ions with lower charge
(D) Smaller ions with higher charge

Correct Answer: D

Explanation: Smaller ions with higher charge have higher charge density, exert stronger attraction on water molecules, and release more energy.

34. When one mole of a substance is completely burnt in excess oxygen under standard conditions, the enthalpy change is called:

(A) Enthalpy of combustion
(B) Enthalpy of formation
(C) Enthalpy of neutralization
(D) Enthalpy of solution

Correct Answer: A

Explanation: The enthalpy change when one mole of a substance is completely burnt in excess of oxygen under standard conditions is called standard enthalpy of combustion.

35. The standard enthalpy of neutralization of strong acids and strong bases is approximately -57.4 kJ/mol. This value is due to the:

(A) Formation of salt
(B) Combination of H□ and OH□ ions
(C) Complete ionization of acid and base
(D) Heat of solution

Correct Answer: B

Explanation: Heat of neutralization is due to the formation of water from H□ and OH□ ions.

36. A reaction has Δ H^circ = +180 kJ and Δ S^circ = +0.250 kJ/K. At what approximate temperature does it become spontaneous?

(A) Below 720 K
(B) At all temperatures
(C) Above 720 K
(D) At no temperature

Correct Answer: C

Explanation: Δ G = Δ H - TΔ S. For spontaneity, Δ G < 0, so T > Δ H / Δ S = 180 / 0.250 = 720 K.

37. For the reaction N□(g) + 3H□(g) rightleftharpoons 2NH□(g), what is the relationship between K_p and K_c?

(A) K_p = K_c
(B) K_p = K_c(RT)²
(C) K_p = K_c(RT)□¹
(D) K_p = K_c(RT)□²

Correct Answer: D

Explanation: Δ n = 2 - (1 + 3) = -2. Therefore, K_p = K_c(RT)□².

38. Which of the following equations correctly represents the relationship between Gibbs free energy, enthalpy, and entropy?

(A) Δ G = Δ H - TΔ S
(B) Δ G = Δ H + TΔ S
(C) Δ G = TΔ S - Δ H
(D) Δ G = Δ H × TΔ S

Correct Answer: A

Explanation: Δ G = Δ H - TΔ S — this correctly answers the question.

39. Calculate the enthalpy change for the reaction C(s) + 2H□(g) → CH□(g) using Hess's Law: (i) CH□(g) + 2O□(g) → CO□(g) + 2H□O(l), Δ H^circ = -890.4 kJ/mol (ii) C(s) + O□(g) → CO□(g), Δ H^circ = -393.5 kJ/mol (iii) H□(g) + frac12O□(g) → H□O(l), Δ H^circ = -285.8 kJ/mol

(A) +74.6 kJ/mol
(B) -74.6 kJ/mol
(C) -890.4 kJ/mol
(D) +890.4 kJ/mol

Correct Answer: B

Explanation: "-74.6 kJ/mol" is correct: it matches the idea asked in the question ("Calculate the enthalpy change for the reaction C(s) + 2H□(g) → CH□(g) using Hess's Law: (i) CH□(g) + 2O□(g) → CO□(g) + 2H□O(l), Δ H^circ = -890.4 kJ/mol (ii) C(s) + O□(g) → CO□(g), Δ H^circ = -393.5 kJ/mol (iii) H□(g) + frac12O□(g) → H□O(l), Δ H^circ = -285.8 kJ/mol"), while the other choices do not.

40. Explain the relationship between Gibbs free energy, enthalpy, and entropy. Discuss the spontaneity of a reaction based on the sign and magnitude of Δ G^circ.

(A) A reaction is spontaneous if Δ G^circ > 0
(B) A reaction is always spontaneous if Δ H^circ < 0
(C) A reaction is spontaneous if Δ G^circ < 0
(D) A reaction is always spontaneous if Δ S^circ > 0

Correct Answer: C

Explanation: A negative Δ G^circ indicates a spontaneous process in the forward direction. The other options are incorrect because spontaneity depends on both enthalpy and entropy, not just one.

41. Explain the concept of bond energy. How does the electronegativity difference and bond length affect bond energy?

(A) Greater electronegativity difference and longer bond length increase bond energy
(B) Smaller electronegativity difference and shorter bond length increase bond energy
(C) Bond energy is independent of electronegativity and bond length
(D) Greater electronegativity difference and shorter bond length increase bond energy

Correct Answer: D

Explanation: Greater electronegativity difference and shorter bond length increase bond energy — this correctly answers the question.

42. Which of the following is a correct statement about the Born-Haber cycle for NaCl?

(A) The lattice energy is determined indirectly using Hess's Law
(B) The lattice energy is determined directly
(C) The lattice energy is always positive
(D) The lattice energy equals the enthalpy of formation

Correct Answer: A

Explanation: Lattice energy cannot be determined directly. It is determined indirectly by means of Born-Haber cycle, which is a special application of Hess's Law.

43. The standard enthalpy of formation of methane cannot be measured directly. Why?

(A) Methane is a gas
(B) Carbon and hydrogen do not react directly to form methane under standard conditions
(C) Methane is unstable

(D) The reaction is too fast

Correct Answer: B

Explanation: Enthalpy of formation of methane cannot be measured directly because carbon and hydrogen do not react directly to form methane under standard conditions. It can be determined indirectly from the enthalpies of combustion using Hess's Law.

44. Which of the following has the highest bond energy based on the data provided?

(A) F−F (158 kJ/mol)
(B) Br−Br (193 kJ/mol)
(C) Cl−Cl (242 kJ/mol)
(D) I−I (151 kJ/mol)

Correct Answer: C

Explanation: Cl−Cl has the highest bond energy among the halogens. F−F is an exception due to lone pair repulsion.

45. Calculate the enthalpy of solution of NaCl given: - Lattice energy = -786 kJ/mol - Enthalpy of hydration = -783 kJ/mol

(A) +3 kJ/mol
(B) -1569 kJ/mol
(C) +1569 kJ/mol
(D) -3 kJ/mol

Correct Answer: D

Explanation: “-3 kJ/mol” is correct: it matches the idea asked in the question (“Calculate the enthalpy of solution of NaCl given: - Lattice energy = -786 kJ/mol - Enthalpy of hydration = -783 kJ/mol”), while the other choices do not.

46. Which of the following statements about the standard enthalpy of formation is correct?

(A) It can be positive or negative
(B) It is always positive
(C) It is always negative
(D) It is always zero

Correct Answer: A

Explanation: The standard enthalpy of formation can be positive or negative depending on whether the formation of the compound from its elements is endothermic or exothermic.

47. What is the enthalpy of neutralization of a strong acid and a strong base?

(A) Always positive
(B) Always negative
(C) Always zero
(D) Depends on the acid and base used

Correct Answer: B

Explanation: The neutralization of a strong acid and a strong base is always exothermic, so the enthalpy of neutralization is negative.

48. Which of the following is a correct statement about the relationship between heat and temperature?

(A) Heat is a measure of temperature
(B) Temperature is a measure of heat
(C) Heat is a form of energy; temperature is a measure of average kinetic energy
(D) Heat and temperature are the same

Correct Answer: C

Explanation: Heat is a form of energy produced by the movement of molecules. Temperature is a measure of the average kinetic energy of molecules.

49. The standard enthalpy of combustion of carbon (graphite) is -393.5 kJ/mol. This means that:

(A) 393.5 kJ of heat is absorbed when 1 mole of carbon burns
(B) 393.5 kJ of heat is released when 1 g of carbon burns
(C) 393.5 kJ of heat is absorbed when 1 g of carbon burns

(D) 393.5 kJ of heat is released when 1 mole of carbon burns

Correct Answer: D

Explanation: The negative sign indicates heat is released. The value is for one mole of carbon.

50. Which of the following is an application of Hess's Law?

(A) Determining the enthalpy of formation of compounds that cannot be prepared directly

(B) Determining the rate of reaction

(C) Determining the equilibrium constant

(D) Determining the molecular mass

Correct Answer: A

Explanation: Hess's law is particularly useful for determining enthalpies of formation of compounds that cannot be prepared directly from their elements.