

Thermodynamics — Assignment 1

Class 11 Chemistry · Topic-wise question bank covering every concept of the chapter · Narayan Gurukul Academy

Instructions: (1) Attempt all questions. This worksheet walks through every concept of the chapter, topic by topic.
(2) The interactive MCQ version of these questions (with instant answer reveal) is available on the notes page.
(3) Universal values: $g = 10 \text{ m/s}^2$ unless stated. Give answers with correct SI units.

Systems, Work and Heat

MCQ Questions (choose the correct option)

1. A system that can exchange both energy and matter with its surroundings is called
 - (A) an open system
 - (B) a closed system
 - (C) an isolated system
 - (D) an adiabatic system
2. An isolated system can exchange
 - (A) neither energy nor matter
 - (B) both energy and matter
 - (C) only energy
 - (D) only matter
3. Work done on the system is taken as
 - (A) positive
 - (B) negative
 - (C) zero
 - (D) infinite
4. The internal energy of a system is a
 - (A) state function
 - (B) path function
 - (C) constant quantity
 - (D) non-thermodynamic quantity
5. In an adiabatic process, there is no exchange of
 - (A) heat
 - (B) work
 - (C) matter
 - (D) energy

1 Mark Questions

1. Define a thermodynamic system.
2. What is a state function? Give one example.
3. What is an isolated system?

2 Mark Questions

1. Distinguish between an open, a closed and an isolated system with examples.
2. Define work and heat in thermodynamics and state the sign convention used.

3 Mark Questions

1. Define a thermodynamic system and classify systems into open, closed and isolated with examples. Distinguish between state functions and path functions.
2. Explain internal energy as a state function and distinguish between work and heat as path functions.

First Law of Thermodynamics

MCQ Questions (choose the correct option)

1. The first law of thermodynamics is a statement of
 - (A) conservation of energy
 - (B) conservation of mass
 - (C) conservation of momentum
 - (D) increase of entropy
2. The first law is expressed as
 - (A) $\Delta U = q + w$
 - (B) $\Delta U = q - w$ only
 - (C) $\Delta U = 0$ always
 - (D) $q = w$
3. For an isothermal expansion of an ideal gas, ΔU is
 - (A) zero
 - (B) positive
 - (C) negative
 - (D) infinite
4. In an adiabatic process, the first law reduces to
 - (A) $\Delta U = w$
 - (B) $\Delta U = q$
 - (C) $\Delta U = 0$
 - (D) $q = w$
5. For a cyclic process, the change in internal energy is
 - (A) zero
 - (B) positive
 - (C) negative
 - (D) infinite

1 Mark Questions

1. State the first law of thermodynamics.
2. Express the first law mathematically.
3. What is the value of ΔU for a cyclic process?

2 Mark Questions

1. State the first law of thermodynamics and explain each term, stating the sign conventions.
2. Apply the first law to an isothermal expansion of an ideal gas.

3 Mark Questions

1. State the first law of thermodynamics and apply it to (i) an isothermal process, (ii) an adiabatic process and (iii) a cyclic process.
2. Explain the first law of thermodynamics and show that it is a statement of the conservation of energy.

Enthalpy and Calorimetry

MCQ Questions (choose the correct option)

1. Enthalpy is defined as
 - (A) $H = U + pV$
 - (B) $H = U - pV$
 - (C) $H = pV$
 - (D) $H = U/pV$
2. The heat change at constant pressure equals the change in
 - (A) enthalpy
 - (B) internal energy
 - (C) entropy
 - (D) free energy
3. Calorimetry is used to measure
 - (A) heat changes in a reaction
 - (B) the mass of a reactant
 - (C) the volume of a gas
 - (D) the pressure of a gas
4. For an exothermic reaction, ΔH is
 - (A) negative
 - (B) positive
 - (C) zero
 - (D) infinite
5. The relation between ΔH and ΔU is
 - (A) $\Delta H = \Delta U + \Delta n_g RT$
 - (B) $\Delta H = \Delta U - \Delta n_g RT$
 - (C) $\Delta H = \Delta U$
 - (D) $\Delta H = \Delta n_g RT$

1 Mark Questions

1. Define enthalpy.
2. What does a negative value of ΔH indicate?
3. Write the relation between ΔH and ΔU .

2 Mark Questions

1. Define enthalpy and show that the heat change at constant pressure equals ΔH .
2. Explain the principle of calorimetry with the equation used to measure heat changes.

3 Mark Questions

1. Define enthalpy and derive the relation $\Delta H = \Delta U + \Delta n_g RT$. State the conditions under which $\Delta H = \Delta U$.
2. Explain how a bomb calorimeter is used to determine the enthalpy of combustion of a substance.

Hess's Law of Constant Heat Summation

MCQ Questions (choose the correct option)

- Hess's law states that the enthalpy change of a reaction is
 - independent of the path followed
 - dependent on the path
 - always positive
 - always zero
- Hess's law is a consequence of
 - the first law of thermodynamics
 - the second law
 - the third law
 - the octet rule
- Hess's law is useful for determining
 - enthalpies of reactions that cannot be measured directly
 - the rate of a reaction
 - the order of a reaction
 - the equilibrium constant
- According to Hess's law, if a reaction is reversed, the sign of ΔH is
 - reversed
 - unchanged
 - doubled
 - halved

1 Mark Questions

- State Hess's law of constant heat summation.
- Why is Hess's law useful?
- What happens to ΔH when a reaction is reversed?

2 Mark Questions

- State Hess's law and explain its basis in the first law of thermodynamics.
- Use Hess's law to explain why ΔH for a reaction is independent of the route.

3 Mark Questions

- State Hess's law and explain how it follows from the first law of thermodynamics. Describe one application of the law.
- Use Hess's law to calculate the enthalpy of formation of a compound from the enthalpies of combustion of related substances.

Bond Enthalpy and Enthalpy of Combustion

MCQ Questions (choose the correct option)

- Bond enthalpy is the energy required to
 - break one mole of a bond in the gaseous state

- (B) form one mole of a bond
 - (C) melt a solid
 - (D) vaporise a liquid
2. The enthalpy of combustion is the heat change when one mole of a substance
- (A) is completely burnt in oxygen
 - (B) is formed
 - (C) is dissolved in water
 - (D) is neutralised
3. The enthalpy of combustion of a substance is generally
- (A) negative
 - (B) positive
 - (C) zero
 - (D) infinite
4. The standard enthalpy of formation of an element in its standard state is
- (A) zero
 - (B) positive
 - (C) negative
 - (D) infinite

1 Mark Questions

1. Define bond enthalpy.
2. Define the enthalpy of combustion.
3. What is the standard enthalpy of formation of an element in its standard state?

2 Mark Questions

1. Define bond enthalpy and the enthalpy of combustion, giving one example of each.
2. Calculate ΔH for a reaction from the bond enthalpies of the bonds broken and formed.

3 Mark Questions

1. Define bond enthalpy, the enthalpy of combustion and the enthalpy of formation, and explain how bond enthalpies can be used to estimate the enthalpy of a reaction.
2. Explain the significance of the enthalpy of combustion and the standard enthalpy of formation, giving examples.

Entropy and Spontaneity

MCQ Questions (choose the correct option)

1. Entropy is a measure of
 - (A) the disorder of a system
 - (B) the energy of a system
 - (C) the volume of a system
 - (D) the pressure of a system
2. For a spontaneous process, the change in entropy of the universe is
 - (A) positive
 - (B) negative
 - (C) zero

- (D) infinite
3. Gibbs energy is defined as
- (A) $G = H - TS$
 - (B) $G = H + TS$
 - (C) $G = T - HS$
 - (D) $G = HS$
4. A process is spontaneous at constant T and p when
- (A) ΔG is negative
 - (B) ΔG is positive
 - (C) ΔG is zero
 - (D) ΔG is infinite
5. The second law of thermodynamics states that the entropy of the universe
- (A) increases in a spontaneous process
 - (B) decreases
 - (C) remains constant
 - (D) becomes zero

1 Mark Questions

1. Define entropy.
2. State the condition for spontaneity in terms of ΔG .
3. State the second law of thermodynamics.

2 Mark Questions

1. Define entropy and state the second law of thermodynamics.
2. Define Gibbs energy and state the criterion for spontaneity at constant T and p.

3 Mark Questions

1. Define entropy and Gibbs energy and derive the condition for spontaneity of a process at constant temperature and pressure.
2. State the second law of thermodynamics and explain how the sign of ΔG predicts whether a process is spontaneous, non-spontaneous or at equilibrium.