

Thermodynamics — CBSE Pattern Test 1

Class 11 Chemistry · 90 minutes · 40 marks · Sections A–D with answer key · Narayan Gurukul Academy

Test 1 — CBSE Pattern (90 minutes, 40 marks)

Class 11 Chemistry · Thermodynamics · Narayan Gurukul Academy (ClassApna)

General Instructions: (1) This paper has four sections — Section A (1×10), Section B (2×4), Section C (3×4) and Section D (5×2) — total 40 marks. Time allowed: 90 minutes.

(2) All questions are compulsory. No overall choice is given; internal choice, where allowed, is clearly marked.

(3) For MCQ questions choose the single correct option; for VSA answers write a single line.

(4) Take $g = 10 \text{ m/s}^2$. All symbols carry their usual meaning. Use of a calculator is not permitted.

Section A — MCQ & VSA ($10 \times 1 = 10$ marks)

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. 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

4. The first law is expressed as

- (A) $\Delta U = q + w$
- (B) $\Delta U = q - w$ only
- (C) $\Delta U = 0$ always
- (D) $q = w$

5. Enthalpy is defined as

- (A) $H = U + pV$
- (B) $H = U - pV$
- (C) $H = pV$
- (D) $H = U/pV$

6. Hess's law states that the enthalpy change of a reaction is

- (A) independent of the path followed
- (B) dependent on the path
- (C) always positive
- (D) always zero

7. Bond enthalpy is the energy required to

- (A) 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
8. 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
9. State the first law of thermodynamics.
10. Define entropy.

Section B — Short Answer I ($4 \times 2 = 8$ marks)

11. Distinguish between an open and a closed system with examples.
12. For an isothermal expansion of an ideal gas, what is the value of ΔU and why?
13. Write the relation between ΔH and ΔU .
14. What is the value of ΔG for a process at equilibrium?

Section C — Short Answer II ($4 \times 3 = 12$ marks)

15. State the first law of thermodynamics and apply it to an isothermal, an adiabatic and a cyclic process.
16. Define enthalpy and derive the relation $\Delta H = \Delta U + \Delta n_g RT$.
17. State Hess's law and explain its basis in the first law of thermodynamics.
18. Define entropy and Gibbs energy and derive the condition for spontaneity at constant temperature and pressure.

Section D — Long Answers ($2 \times 5 = 10$ marks)

19. Define bond enthalpy and the enthalpy of combustion. Calculate ΔH for $H_2(g) + Cl_2(g) \rightarrow 2HCl(g)$ given bond enthalpies $H-H = 436$, $Cl-Cl = 243$ and $H-Cl = 431 \text{ kJ mol}^{-1}$.
20. State the second law of thermodynamics and explain how the sign of ΔG predicts spontaneity. For a reaction with $\Delta H = +50 \text{ kJ mol}^{-1}$ and $\Delta S = +150 \text{ J K}^{-1} \text{ mol}^{-1}$, calculate ΔG at 298 K and state whether it is spontaneous.

Answer Key (Marking Scheme)

- Q1 — (A) an open system. Q2 — (A) neither energy nor matter. Q3 — (A) conservation of energy. Q4 — (A) $\Delta U = q + w$.
- Q5 — (A) $H = U + pV$. Q6 — (A) independent of the path followed. Q7 — (A) break one mole of a bond in the gaseous state. Q8 — (A) the disorder of a system.
- Q9 — $\Delta U = q + w$; energy is conserved.
- Q10 — A measure of the disorder (randomness) of a system.
- Q11 — Open exchanges matter and energy; closed exchanges energy only.
- Q12 — $\Delta U = 0$, because temperature is constant for an ideal gas.
- Q13 — $\Delta H = \Delta U + \Delta n_g RT$.
- Q14 — Zero.
- Q15 — $\Delta U = q + w$ applied to each case as in notes.

Q16 — $H = U + pV$; derivation as in notes.

Q17 — Independent of path; follows from the first law.

Q18 — $G = H - TS$; $\Delta G < 0$ spontaneous.

Q19 — $\Delta H = (436 + 243) - (2 \times 431) = -183 \text{ kJ mol}^{-1}$.

Q20 — $\Delta G = 50 - 298(0.150) = +5.3 \text{ kJ mol}^{-1}$, non-spontaneous.