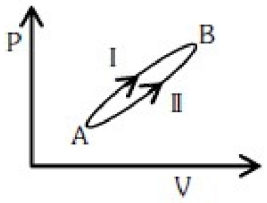
# Thermodynamics

1. **Assertion (A):** It is possible for both the pressure and volume of a monoatomic ideal gas of a given amount to change simultaneously without causing the internal energy of the gas to change.
**Reason (R):** The internal energy of an ideal gas of a given amount remains constant if temperature does not change. It is possible to have a process in which pressure and volume are changed such that temperature remains constant.
(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
(3) (A) is true but (R) is false
(4) Both (A) and (R) are false

2. A system of certain amount of an ideal gas is taken from state A to state B once by process I and next by process II. The amount of heat absorbed by gas is $Q_1$ and $Q_2$ respectively in the two processes.




**Assertion (A):** $Q_1 = Q_2$
**Reason (R):** Change in internal energy and work done in both processes are unequal.
(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
(3) (A) is true but (R) is false
(4) Both (A) and (R) are false

3. **Assertion (A):** Energy of molecules increase on increasing the temperature.
**Reason (R):** All substances expand on increasing the temperature.
(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
(3) (A) is true but (R) is false
(4) Both (A) and (R) are false

4. **Assertion (A):** Work done by a gas in isothermal expansion is more than the work done by the gas in the same expansion adiabatically.
**Reason (R):** Temperature remains constant in isothermal expansion but not in adiabatic expansion.
(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
(3) (A) is true but (R) is false
(4) Both (A) and (R) are false

5. **Assertion (A):** During the melting of a slab of ice at 273 K at 1 atm, positive work is done on the ice-water system by the atmosphere.
**Reason (R):** In above process, the internal energy of ice–water system increases.
(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
(3) (A) is true but (R) is false
(4) Both (A) and (R) are false

6. **Assertion (A):** During free expansion of an Ideal gas, entropy is zero.
**Reason (R):** Internal energy of an ideal gas is zero during free expansion.
(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
(3) (A) is true but (R) is false
(4) Both (A) and (R) are false

7. **Assertion (A):** In an ideal monoatomic gas, The Internal energy of gas is equal to translational Kinetic energy of all its molecules
**Reason (R):** The Internal energy may get contributes from Translational, Rotatory, vibrationally as well as from the Potential energy corresponding to the molecular force.
(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
(3) (A) is true but (R) is false
(4) Both (A) and (R) are false

8. **Assertion (A):** Bursting of balloon is not a equilibrium state.
**Reason (R):** Equilibrium state of a thermodynamic system is completely described by specific values of some macroscopic properties.
(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
(3) (A) is true but (R) is false
(4) Both (A) and (R) are false

9. **Assertion (A):** Work and heat both can be converted into each other in any condition.
**Reason (R):** Work and Heat both are different form of energy.
(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
(3) (A) is true but (R) is false
(4) Both (A) and (R) are false

10. **Assertion (A):** If volume of a gas is increasing but temperature of the gas is decreasing, then heat given to the gas may be positive, negative or zero.
**Reason (R):** Heat given to a gas is a path function, it is not a state function.
(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
(3) (A) is true but (R) is false
(4) Both (A) and (R) are false

11. **Assertion (A):** Molar heat capacity of a gas in any process can have any value – □ to +□
**Reason (R):** Molar heat capacity of a gas in an isothermal process is □
(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
(3) (A) is true but (R) is false
(4) Both (A) and (R) are false

12. **Assertion (A):** The area of entropy versus temperature graph of a cyclic process, is equal to work done.
**Reason (R):** Change in internal energy of cyclic process is zero.
(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
(3) (A) is true but (R) is false
(4) Both (A) and (R) are false

13. **Assertion (A):** Absolute zero temperature is not the zero energy temperature.
**Reason (R):** At absolute zero temperature the gas may possess potential energy.
(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
(3) (A) is true but (R) is false
(4) Both (A) and (R) are false

14. **Assertion (A):** For gas molecules absolute zero temperature is not the temperature of zero energy.
**Reason (R):** Only the kinetic energy of the molecules is represented by temperature.
(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
(3) (A) is true but (R) is false
(4) Both (A) and (R) are false

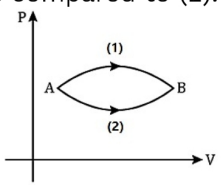
15. **Assertion (A):** On sudden expansion a gas cools.
**Reason (R):** On sudden expansion, no heat is supplied to system and hence gas does work at the expense of its internal energy.
(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
(3) (A) is true but (R) is false
(4) Both (A) and (R) are false

16. **Assertion (A):** At low density, variables of gases P, V and T follows the equation $PV = \mu RT$
**Reason (R):** At low density real gases are more closely to ideal gases
(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
(3) (A) is true but (R) is false
(4) Both (A) and (R) are false

17. **Assertion (A):** The internal energy of a given sample of an ideal gas depends only on its temperature according to kinetic theory of gases.
**Reason (R):** The ideal gas molecules do not exert intermolecular forces, thus its potential energy is always zero and internal energy only depends on the temperature.
(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
(3) (A) is true but (R) is false
(4) Both (A) and (R) are false

18. **Assertion (A):** Internal energy change is zero if the temp is constant, irrespective of the process being cyclic or non-cyclic.
**Reason (R):** $dU = n\ C_v dT$ for all process and is independent of path.
(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
(3) (A) is true but (R) is false
(4) Both (A) and (R) are false

19. **Assertion (A):** A gas is taken from state A to state B through two different paths. Molar specific heat capacity in path (1) is more as compared to (2).




**Reason (R):** $C = \frac{\Delta Q}{n\Delta T}$
$\Delta Q = \Delta U + W$
and W is equal to area under P-V diagram.
(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
(3) (A) is true but (R) is false
(4) Both (A) and (R) are false

20. **Assertion (A):** In isothermal process whole of the heat energy supplied to the body is converted into internal energy.
**Reason (R):** According to the first law of thermodynamics $\Delta Q = \Delta U - P\Delta V$
(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
(3) (A) is true but (R) is false
(4) Both (A) and (R) are false

21. **Assertion (A):** Total entropy change in one cycle of carnot engine is zero.
**Reason (R):** Entropy is a state function.
(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
(3) (A) is true but (R) is false
(4) Both (A) and (R) are false

22. **Assertion (A):** The efficiency of a carnot cycle depends on the nature of the gas used.
**Reason (R):** Adiabatic process is a part of carnot cycle and work done in adiabatic process does not depend on nature of gas.
(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
(3) (A) is true but (R) is false
(4) Both (A) and (R) are false

23. **Assertion (A):** It is not possible for a system, unaided by an external agency to transfer heat from a body at lower temperature to another body a higher temperature.
**Reason (R):** According to Clausius statement "No process is possible whose sole result is the transfer of heat from a cooled object to a hotter object".
(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
(3) (A) is true but (R) is false
(4) Both (A) and (R) are false

24. **Assertion (A):** Air quickly leaking out of a balloon becomes cooler.
**Reason (R):** The leaking air undergoes adiabatic expansion.
(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
(3) (A) is true but (R) is false
(4) Both (A) and (R) are false

25. **Assertion (A):** If heat is supplied to an ideal gas in an isothermal process, the internal energy of the gas increases.
**Reason (R):** When an ideal gas expands adiabatically, it does positive work and its internal energy increases.
(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
(3) (A) is true but (R) is false
(4) Both (A) and (R) are false

26. **Assertion (A):** In adiabatic expansion of monoatomic ideal gas, if volume increases by 12%, then pressure decreases by 20%.
**Reason (R):** In adiabatic process $PV^{5/3}$ = constant.
(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
(3) (A) is true but (R) is false
(4) Both (A) and (R) are false

27. **Assertion (A):** In an isochoric process, work done by the gas is zero.
**Reason (R):** In a process, if initial volume is equal to the final volume, work done by the gas is zero.
(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
(3) (A) is true but (R) is false
(4) Both (A) and (R) are false

28. **Assertion (A):** The specific heat of a gas in an adiabatic process is zero but it is infinite in an isothermal process.
**Reason (R):** Specific heat of a gas is directly proportional to heat exchanged with the system and inversely proportional to change in temperature.
(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
(3) (A) is true but (R) is false
(4) Both (A) and (R) are false

29. **Assertion (A):** In adiabatic compression, the temperature of system gets decreased.
**Reason (R):** Adiabatic compression is a slow process.
(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
(3) (A) is true but (R) is false
(4) Both (A) and (R) are false

30. **Assertion (A):** All processes in which P and V are proportional, take place at constant temperature.
**Reason (R):** Work done in a thermodynamical process is path independent.
(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
(3) (A) is true but (R) is false
(4) Both (A) and (R) are false

31. **Assertion (A):** During adiabatic expansion of an ideal gas, temperature falls but entropy remains constant.
**Reason (R):** During adiabatic expansion, work is done by the gas using a part of internal energy and no heat exchange takes place the system and the surrounding.
(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
(3) (A) is true but (R) is false
(4) Both (A) and (R) are false

32. **Assertion (A):** In a free adiabatic expansion of an ideal gas, the final state is the same is the initial state.
**Reason (R):** As temperature of a gas increases work done by it is positive.
(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
(3) (A) is true but (R) is false
(4) Both (A) and (R) are false

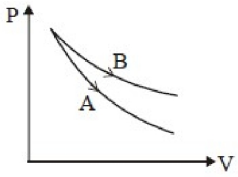
33. **Assertion (A):** In adiabatic process, work done on the system is equal to negative of change in internal energy.
**Reason (R):** In adiabatic process change of heat zero.
(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
(3) (A) is true but (R) is false
(4) Both (A) and (R) are false

34. **Assertion (A):** In cyclic process change in internal energy is zero.
**Reason (R):** In cyclic process net work done is zero.
(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
(3) (A) is true but (R) is false
(4) Both (A) and (R) are false

35. **Assertion (A):** State variables (P, V and T) of any gas at low densities obey the equation PV = nRT.
**Reason (R):** Real gases are good approximation of an ideal gas at low density.
(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
(3) (A) is true but (R) is false
(4) Both (A) and (R) are false

36. **Assertion (A):** The internal energy of a real gas is function of both, temperature and volume.
**Reason (R):** For any gas internal kinetic energy depends on temperature and internal potential energy depends on volume.
(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
(3) (A) is true but (R) is false
(4) Both (A) and (R) are false

37. **Assertion (A):** The curve A and B in figure, show P-V graphs for an isothermal and an adiabatic process for an ideal gas. The isothermal process is represented by B.




**Reason (R):** On P-V graph, modulus of slope of the adiabatic curve is greater than the modulus of the slope of the isothermal curve.
(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
(3) (A) is true but (R) is false
(4) Both (A) and (R) are false

38. **Assertion (A):** An ideal gas expands isothermally, during this process, it absorbs 25 J heat. In the first law of thermodynamics, work done on the gas will be –25J.
**Reason (R):** There will be no change in the internal energy of the gas during isothermal expansions.
(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
(3) (A) is true but (R) is false
(4) Both (A) and (R) are false

| ANSWER KEY | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Que.** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** | **15** | **16** | **17** | **18** | **19** | **20** |
| **Ans.** | 1 | 4 | 3 | 2 | 2 | 4 | 2 | 1 | 4 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 4 |
| **Que.** | **21** | **22** | **23** | **24** | **25** | **26** | **27** | **28** | **29** | **30** | **31** | **32** | **33** | **34** | **35** | **36** | **37** | **38** | | |
| **Ans.** | 1 | 4 | 1 | 1 | 4 | 4 | 3 | 1 | 4 | 4 | 1 | 4 | 4 | 3 | 1 | 1 | 1 | 1 | | |