Exam-3 [Thermodynamics] NEET – Solutions

(System, Properties, Process, FLOT, Heat capacity, Enthalpy, Isothermal, Adiabatic process)

1. **During an isothermal expansion of an ideal gas its :**

   (1) internal energy increases
   (2) enthalpy decreases
   (3) enthalpy remains unaffected
   (4) enthalpy reduces to zero

   Explanation:

   Isothermal process me T constant hota hai. Ideal gas ke liye U aur H dono sirf T par depend karte hain. Agar T change nahi hua $\rightarrow \Delta U = 0$ aur $\Delta H = 0$.

   Solution:

$$\Delta U = 0, \quad \Delta H = 0$$

   So enthalpy remains unaffected.
   Final Answer: Option (3)

2. **The latent heat of vaporization of a liquid at 500 K and 1 atm pressure is 10 kcal/mol. What will be the change in internal energy (ΔU) of 3 mole of the liquid?**

   (1) 13 kcal
   (2) -13 kcal
   (3) 27 kcal
   (4) -27 kcal

   Explanation:

   Relation hai: $\Delta H = \Delta U + \Delta n_g RT$. Liquid $\rightarrow$ vapour: $\Delta n_g = 1$. Latent heat = enthalpy change per mole.

   Solution:

$$\Delta H = 10 \text{ kcal/mol}, \quad \Delta H(3 \text{ mol}) = 30 \text{ kcal}$$

$$\Delta H = \Delta U + \ n_g RT$$

$$\Delta U = \Delta H - \ n_g RT = 30 \text{ kcal} - (3 \times 2 \ \times 500) \text{ cal} = 27 \text{ kcal}$$

   Final Answer: Option (3) [27 kcal]

3. **One mole of an ideal gas at 300K is expanded isothermally from 1 L to 10 L. The ΔE for this process is: (R=2 cal mol^{-1}K^{-1})**

(1) 163.7 Cal
(2) zero
(3) 138.1 Cal
(4) 9 lit-atm

Explanation:

Isothermal process me $\Delta U = 0$ for ideal gas. Work aur heat transfer hota hai, but U depends only on T.

Solution:

$$\Delta E = 0$$

Final Answer: Option (2)

4. **When 1 mol gas is heated at constant volume, temp. is raised from 298K to 308K. Heat supplied = 500 J. Which statement is correct?**

(1) $q = w = 500$ J, $\Delta U = 0$
(2) $q = \Delta U = 500$ J, $w = 0$
(3) $w = 500$ J, $\Delta U = 0$
(4) $\Delta U = q$, $w = -500$ J

Explanation:

Constant volume $\rightarrow w = 0$. So all heat goes into internal energy: $q = \Delta U$.

Solution:

$$q = 500 \text{ J}, \quad \Delta U = 500 \text{ J}, \quad w = 0$$

Final Answer: Option (2)

5. **In a closed insulated container a liquid is stirred with a paddle. Which of the following is true?**

(1) $\Delta E = W \neq 0, q = 0$
(2) $\Delta E = W = q \neq 0$
(3) $\Delta E = 0, W = q \neq 0$
(4) $W = 0, \Delta E = q \neq 0$

Explanation:

Insulated system $\rightarrow q = 0$. Stirring means work is done on system. So $\Delta U = \Delta E = W$.

Solution:

$$q = 0, \quad \Delta E = W$$

Final Answer: Option (1)

6. **2 mole ideal gas at 27°C expanded reversibly from 2 L to 20 L. Find enthalpy change. (R=2 cal/mol K)**

(1) 9.21 (3) 4
(2) 0 (4) 9.2

Explanation:

Isothermal process me T constant hai. Enthalpy depends only on T. So $\Delta H = 0$.

Solution:

$$\Delta H = 0$$

Final Answer: Option (2)

7. **$C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O(l)$. Find $\Delta H - \Delta E$.**

(1) +3RT (3) +3RT
(2) −3RT (4) −3RT

Explanation:

Formula: $\Delta H - \Delta U = \Delta n_g RT$. Count moles of gas reactant/product.

Solution:

$$\Delta n_g = (3) - (1 + 5) = 3 - 6 = -3$$

$$\Delta H - \Delta U = \Delta n_g RT = -3RT$$

Final Answer: Option (2)

8. **Work done during expansion from 4 dm^3 to 6 dm^3 against 3 atm?**

(1) −608 J (3) −304 J
(2) +304 J (4) +608 J

Explanation:

Work = $-P_{ext}\Delta V$. 1 L-atm = 101.3 J.

Solution:

$$\Delta V = 2L,\ P = 3 \text{ atm}$$

$$w = -3 \times 2 \text{ L atm} = -6 \text{ L atm}$$

$$w = -6 \times 101.3 = -608\ J$$

Final Answer: Option (1)

9. **$Zn + H_2SO_4$ in bomb calorimeter. ΔU and w correspond to:**

(1) $\Delta U < 0, w = 0$
(2) $\Delta U < 0, w < 0$
(3) $\Delta U > 0, w = 0$
(4) $\Delta U > 0, w > 0$

Explanation:

Bomb calorimeter = constant V. So $w = 0$. Reaction exothermic $\rightarrow \Delta U < 0$.

Solution:

$$w = 0, \quad \Delta U < 0$$

Final Answer: Option (1)

10. **4.48 L gas at STP requires 12 cal to raise T by 15°C at constant V. Find C_v.**

(1) 3 cal/K mol
(2) 4 cal/K mol
(3) 7 cal/K mol
(4) 6 cal/K mol

Explanation:

4.48 L at STP = 0.2 mol. Formula: $q = nC_v\Delta T$.

Solution:

$$12 = nC_v\Delta T = 0.2 \times C_v \times 15$$
$$C_v = \frac{12}{3} = 4 \text{ cal/mol K}$$

Final Answer: Option (2)

11. **Molar heat capacity of water at Cp=75 J/K mol. 100 g water heated with 1.0 kJ. Find ΔT.**

(1) 1.2 K
(2) 2.4 K
(3) 4.8 K
(4) 6.6 K

Explanation:

Moles of water = 100/18 5.55 mol. Formula: $q = nC_p\Delta T$.

Solution:

$$1000 = 5.55 \times 75 \times \Delta T$$
$$\Delta T = \frac{1000}{416.7} \approx 2.4\ K$$

Final Answer: Option (2)

12. **Which of the following is correct option for free expansion of an ideal gas under adiabatic condition?**

(1) $q \neq 0, \Delta T < 0, w > 0$
(2) $q = 0, \Delta T = 0, w = 0$
(3) $q \neq 0, \Delta T = 0, w = 0$
(4) $q = 0, \Delta T > 0, w = 0$

Explanation:

Free expansion: external pressure = 0, so work $w = 0$. Adiabatic $\rightarrow q = 0$. For ideal gas, T depends only on internal energy, and $\Delta U = 0$. So $\Delta T = 0$.

Solution:

$$q = 0,\ w = 0,\ \Delta T = 0$$

Final Answer: Option (2)

13. **If 400 kJ work is done by the system and 150 kJ heat is given to the system then what will be effect on internal energy?**

(1) Increases by 250 kJ
(2) Decreases by 250 kJ
(3) Increases by 600 kJ
(4) Decreases by 600 kJ

Explanation:

First law: $\Delta U = q - w$. Here $q = +150$ (heat gained), $w = 400$ (done by system).

Solution:

$$\Delta U = 150 - 400 = -250 \text{ kJ}$$

Final Answer: Option (2)

14. **For gas A in a calorimeter heat evolved is 250 kJ/mol. For 0.2 mol of A, T rise = 298K to 300K. Find heat capacity of calorimeter.**

(1) 12.5 kJ/K
(2) 25 kJ/K
(3) 50 kJ/K
(4) 100 kJ/K

Explanation:

Heat released by 0.2 mol = $q = 250 \times 0.2 = 50$ kJ. $q = C\Delta T$, $\Delta T = 2$.

Solution:

$$C = \frac{50}{2} = 25 \text{ kJ/K}$$

Final Answer: Option (2)

15. **During adiabatic expansion of an ideal gas in vacuum:**

(1) $q = 0,\ \Delta U \neq 0$

(2) $q = 0,\ \Delta U = 0$

(3) $q \neq 0,\ \Delta U = 0$

(4) $q \neq 0,\ \Delta U \neq 0$

Explanation:

Expansion into vacuum $\rightarrow w = 0$. Adiabatic $\rightarrow q = 0$. So $\Delta U = 0$.

Solution:

$$q = 0,\ \Delta U = 0$$

Final Answer: Option (2)

16. **Gas expands in insulated container: $P_{ext} = 2.5$ atm, $V : 2.5 \rightarrow 4.5$ L. Find ΔU.**

(1) -500 J

(2) -505 J

(3) $+505$ J

(4) 1136.25 J

Explanation:

Insulated $\rightarrow q = 0$. $\Delta U = w$. $w = -P\Delta V$.

Solution:

$$\Delta V = 2.0\,L,\ w = -2.5 \times 2 = -5\,L{-}atm$$

$$w = -5 \times 101.3 \approx -505\ J$$

Final Answer: Option (2)

17. **Correct relation between C_p and C_v for 1 mol ideal gas?**

(1) $C_p = RC_v$

(2) $C_p + C_v = R$

(3) $C_p - C_v = R$

(4) $C_p = RC_v$

Explanation:

Mayer's relation: $C_p - C_v = R$.

Solution:

$$C_p - C_v = R$$

Final Answer: Option (3)

18. **Correct relation between ΔH and ΔU?**

(1) $\Delta H = \Delta U + \Delta n_g RT$

(2) $\Delta H - \Delta U = \Delta nRT$

(3) $\Delta H - \Delta U = \Delta n_g R$

(4) $\Delta H - \Delta U = \Delta n_f RT$

Explanation:

General formula: $\Delta H = \Delta U + \Delta n_g RT$.

Solution:

$$\Delta H - \Delta U = \Delta n_g RT$$

Final Answer: Option (1)

19. **Match List-I with List-II**

Explanation:

Recall: Isothermal → constant T. Isochoric → constant V. Isobaric → constant P. Adiabatic → $q = 0$.

Solution:

$$A \to II,\ B \to III,\ C \to IV,\ D \to I$$

Final Answer: Option (2)

20. **Work done reversible isothermal expansion of 1 mol H_2 at 25°C from 20 atm to 10 atm. (R=2 cal, log2=0.3)**

(1) 0 cal
(2) -413.14 cal
(3) 413.14 cal
(4) 100.40 cal

Explanation:

Formula: $w = -2.303nRT \log \frac{P_1}{P_2}$.

Solution:

$$w = -2.303(1)(2)(298)(0.3)\ cal \approx -413\ cal$$

Final Answer: Option (2)

21. **1 mol ideal gas expands isothermally from 10 dm^3 to 20 dm^3 at 300 K. Find $\Delta U, q, w$. (R=8.3 J, ln2=0.693)**

(1) 0, 21.84 kJ, -1.726 J
(2) 0, 21.84 kJ, 21.84 kJ
(3) 0, 1.718 kJ, -1.718 kJ
(4) 0, -17.18 kJ, 1.718 kJ

Explanation:

Isothermal: $\Delta U = 0$. $w = -nRT \ln(V_2/V_1)$. $q = -w$.

Solution:

$$w = -1 \times 8.3 \times 300 \times 0.693 = 1727J \approx -1.73kJ$$

(q= +1.73 kJ) **Final Answer: Option (3)**

22. **When 2 L ideal gas expands isothermally into vacuum to 6 L, ΔU=?**

(1) 0
(2) 2
(3) 8
(4) 15

Explanation:

Free expansion + isothermal → $q = 0,\ w = 0$. For ideal gas, $\Delta U = 0$.

Solution:

$$\Delta U = 0$$

Final Answer: Option (1)