THERMODYNAMICS - 2

1. The heat capacity of 10 mol of an ideal gas at a certain temperature is 300 JK^{-1} at constant pressure. The heat capacity of the same gas at the same temperature and at constant volume would be

(a) 383 JK^{-1} (b) 217 JK^{-1} (c) 134 JK^{-1} (d) 466 JK^{-1}

2. The internal pressure $(\partial U/\partial V)_T$ of a real gas is related to the compressibility factor $Z = p\bar{V}/RT$ by [$\bar{V}$ is the molar volume]

(a) $(\partial U/\partial V)_T = RT(\partial Z/\partial V)_T$ (b) $(\partial U/\partial V)_T = RT/(\bar{V}\ Z)$

(c) $(\partial U/\partial V)_T = (RT^2/\bar{V})(\partial Z/\partial V)_T$ (d) $(\partial U/\partial V)_T = (\bar{V}/RT^2)(\partial Z/\partial T)_V$

3. What is limitation of first law of the thermodynamics

(a) Does not predict about the direction of flow of heat

(b) Does not tell whether the reaction is feasible or not

(c) a and b both

(d) None of these

4. Entropy is

(1) It is the degree of disorder of randomness in a system

(2) Entropy is a state function and mixing is always positive

(3) Entropy is a intensive property

(4) Entropy of solid is minimum and gases is maximum

(5) Entropy increase with temperature, and complexity and atomicity

Right statement is

(a) 1, 2, 3, 4 (b) 1, 2, 4, 5 (c) 2, 3, 4 (d) 1, 3, 5

5. For which of the following pairs choose the substances with the higher entropy per mole at a given temperature

(i) O_2 gas at 5 atm or O_2 gas at 0.5 atm (ii) $Br_2(l)$ or $Br_2(g)$

(a) O_2 gas at 5 atm (ii) $Br_2(l)$ (b) O_2 gas at 0.5 atm (ii) $Br_2(l)$

(c) O_2 gas at 5 atm (ii) Br_2 gas (d) O_2 gas at 0.5 atm (iii) Br_2 gas

6. For which of the following process will ΔS° system be the most positive

(a) $2SO_2(g) + O_2(g) \rightarrow 2SO_3(g)$ (b) $2NH_3(g) \rightarrow N_2(g) + 3H_2(g)$

(c) $Hg(l) \rightarrow Hg(s)$ (d) $4Fe(s) + 3O_2(g) \rightarrow 2Fe_2O_3(s)$

7. The molar heat of vaporization for ethanol is 37.4 KJ/mole if the boiling point of ethanol is 78.0°C calculate ΔS in J/K for the vaporization of 0.500 mole ethanol.

(a) 53.3 (b) 107 (c) 0.053 (d) 240

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8. For the gaseous substance $\left(\frac{\partial P}{\partial T}\right)_v = ?$

(a) β/α (b) $-\beta/\alpha$ (c) α/β (d) $-\alpha/\beta$

9. For a gaseous substances $C_p - Cv =$

(a) $V\left(\frac{\partial P}{\partial T}\right)_v\left(\frac{\partial V}{\partial T}\right)_p$ (b) $T\left(\frac{\partial P}{\partial T}\right)_v\left(\frac{\partial V}{\partial T}\right)_p$ (c) $T\left(\frac{\partial T}{\partial P}\right)_v\left(\frac{\partial V}{\partial T}\right)_p$ (d) $T\left(\frac{\partial T}{\partial P}\right)_v\left(\frac{\partial T}{\partial V}\right)_p$

10. Among the following the system require higher amount of thermal energy to giving the temperature 80°C

(a) 200 gm at 40°C (b) 100 gm at 20°C (c) 150 gm at 50°C (d) 300 gm at 30°C

11. What is the internal pressure for 4 mole of Vandar walls gas.

(a) zero (b) $\frac{a}{V^2}$ (c) $\frac{4a}{V^2}$ (d) $\frac{16a}{V^2}$

12. Which relation is correct in this equation

(1) $P^{-1}V^{-\gamma}$ (2) $T^{-1}V^{1-\gamma}$ (3) $P^{1-\gamma}T^{-\gamma}$

(a) 1, 2, 3 (b) 1, 2 (c) 1, 3 (d) 2, 3

13. Which statement is correct

(1) $P_{iso} > P_{adia}$ (2) $V_{iso} > V_{adia}$ (3) $q_{rev} < q_{irren}$ (4) $w_{iso} > w_{adia}$

(a) 1, 2, 4 (b) 1, 2, 3, 4 (c) 2, 3 (d) 1, 4, 3

14. μ_{JT} for ideal and Vander walls gases respectively

(a) 0, 0 (b) $O, \frac{1}{C_p}\left(\frac{2a}{RT} - b\right)$ (c) $P, \frac{1}{C_p}\left(\frac{2a}{RT} - b\right)$ (d) $O, \frac{1}{C_v}\left(\frac{2a}{RT} - b\right)$

15. Match the following

(1) 2a / Rb (A) T_i

(2) a / Rb (B) T_B

(3) 8a / 27 Rb (C) T_C

	1	2	3
(a)	B	C	A
(b)	A	B	C
(c)	C	B	A
(d)	A	C	B

16. dU for Isothermal Process for Vander walls gas and Ideal gas respectively

(a) $-n^2a\left[\frac{1}{V^2} - \frac{1}{V^1}\right]$, O(zero) (b) O(Zero), O(Zero)

(c) $n^2a\left[\frac{1}{V^2} - \frac{1}{V^1}\right]$, O Zero (d) $n^2a\left[\frac{1}{V^1} - \frac{1}{V^2}\right]$, T

17. For an irreversible isothermal expansion of a perfect gas from V_i to V_f, the change in entropy of the gas is

(a) NR $ln(V_f/V_i)$ (b) Zero (c) less than zero (d) greater than zero

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18. Match the following:

P.	$\left(\frac{\partial U}{\partial S}\right)_V$	1.	A
Q.	$\left(\frac{\partial U}{\partial V}\right)_S$	2.	S
R.	$\left(\frac{\partial G}{\partial P}\right)_T$	3.	P
S.	$\left(\frac{\partial G}{\partial T}\right)_P$	4.	P
		5.	H
		6.	V

(a) P – 3, Q – 4, R – 6, S – 2 (b) P – 3, Q – 1, R – 2, S – 5

(c) P – 1, Q – 3, R – 5, S – 2 (d) P – 4, Q – 3, R – 6, S – 5

19. Standard entropy of crystalline carbon monoxide (in KJ/mol) at 0° K is around.

(a) 0.03 (b) 2.50 (c) zero (d) 5.76

20. If a gas obeys the equation of state $P(v - nB) = nRT$ the ratio $\frac{(C_P - C_V)}{(C_P - C_V)_{ideal}}$ is

(a) > 1 (b) < 1 (c) 1 (d) (1 – b)

21. Two moles of a monatomic perfect gas initially 4.0 bar and 47° C under goes reversible expansion in an insulated container. The temperature at which the presser reduces to 3.0 bar is.

(a) 200 K (b) 285 K (c) 310 K (d) 320 K

22. Choose the correct criterion of spontaneity in terms of the proporties of the system alone.

(a) $(dS)_{U, V} > 0$ (b) $(dS)_{T, P} > 0$ (c) $(dS)_{H, P} < 0$ (d) $(dG)_{T, V} < 0$

23. A diabatic reversible expansion of a monatomic gas (M) and a diatomic gas (D) at an initial temperature i, has been carried out independently from initial volume to final volume V_2. The final temperature (T_M for monatomic and T_D for diatomic) attained will be

(a) $T_M = T_D > T_i$ (b) $T_M < T_D < T_i$ (c) $T_M > T_D > T_i$ (d) $T_M = T_D = T_i$

24. For the reaction

$$2Cl(g) \rightarrow Cl_2(g)$$

The thermodynamic properties

(a) ΔG, ΔH and ΔS are positive (b) ΔG, ΔH and ΔS are negative

(c) ΔG and ΔH are negative and ΔS is positive

(d) ΔG is negative and ΔH and ΔS are positive

25. The change in entropy when one mole of an ideal gas is compressed to one fourth of its initial volume and simultaneously heated to twice its initial temperature is

(a) $(C_V - R)\, ln4$ (b) $(C_V - 2R)\, ln2$ (c) $(C_V - 2R)\, ln4$ (d) $(C_V + 2R)\, ln2$

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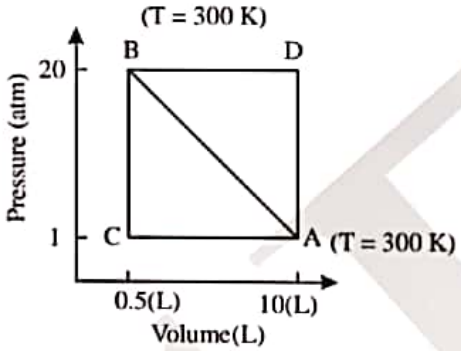
26. The internal pressure, $\pi_T = T\left(\frac{\partial P}{\partial T}\right)_V - P$ for one mole a vanderwalls gas is

(a) $\frac{a}{V^2}$ (b) $\frac{a}{V^2}\left(\frac{RT}{V-b}\right)$ (c) Zero (d) $\frac{RT}{V-b}$

27. Consider the following P-V diagram for an ideal gas that follows the diagonal path from A to B



The work done (in atm-L) on the gas in the process is

(a) 9.5 (b) 99.75 (c) 190 (d) 10 *ln* 20

28. One mole of an ideal gas ($C_P = 29.234\ JK^{-1}\ mol^{-1}$) is expanded reversibly and adiabatically from 1 dm^3 to 10 dm^3. The initial temperature is 750 K, the final temperature will be

(a) 1000 K (b) 750 K (c) 300 K (d) 100 K

29. The relationship between volume change in an isothermal process (ΔV_i) and an adiabatic process. (ΔV_a) for a pressure change from P_1 to P_2 is

(a) $\Delta V_i > \Delta V_a$ (b) $\Delta V_i < \Delta V_a$ (c) $\Delta V_i = \Delta V_a$ (d) $\Delta V_i = \Delta V_a = 0$

30. Using Joule – Thomson effect, find the current expression for ΔT:

(a) $\Delta T = -\frac{(\partial H/\partial P)_T}{C_P}(\Delta P)$ (b) $\Delta T = -\frac{(\partial H/\partial T)_P}{C_P}(\Delta P)$

(c) $\Delta T = -\frac{(\partial U/\partial V)_T}{C_V}(\Delta P)$ (d) $\Delta T = -\frac{(\partial U/\partial T)_V}{C_V}(\Delta P)$

31. An adiabatic process is an

(a) isobaric process (b) isochoric process (c) isenthalpic process (d) isentropic process

32. For one mole of an ideal gas, $\left(\frac{\partial S}{\partial V}\right)_T$ is equal to

(a) P/T (a) T/P (c) PT (d) P/V

33. Which one of the following relations is correct

(a) $\left(\frac{\partial T}{\partial V}\right)_S = \left(\frac{\partial P}{\partial S}\right)_V$ (b) $-\left(\frac{\partial T}{\partial P}\right)_S = \left(\frac{\partial V}{\partial S}\right)_P$ (c) $\left(\frac{\partial P}{\partial T}\right)_V = \left(\frac{\partial S}{\partial V}\right)_T$ (d) $\left(\frac{\partial S}{\partial P}\right)_T = \left(\frac{\partial V}{\partial T}\right)_P$

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34. The change in enthalpy with respect to change in pressure at constant temperature $\left(\frac{\partial H}{\partial P}\right)_T$ is

(a) $-T\left(\frac{\partial V}{\partial T}\right)_P + V$ (b) $T\left(\frac{\partial V}{\partial T}\right)_P - V$ (c) $-T\left(\frac{\partial V}{\partial T}\right)_P - V$ (d) $T\left(\frac{\partial V}{\partial T}\right)_P + V$

35. Find the value of $\left(\frac{\partial C_P}{\partial P}\right)_T$

(a) $T\left(\frac{\partial^2 V}{\partial T^2}\right)_P$ (b) $-T\left(\frac{\partial^2 V}{\partial T^3}\right)_P$ (c) $T\left(\frac{\partial^2 P}{\partial V^2}\right)_T$ (d) $T\left(\frac{\partial^2 P}{\partial T^2}\right)_V$

36. If a gas obey ideal gas behavior then find the value of $TE\alpha^2V$

i.e. $TE\alpha^2V = ?$

Hind $\text{elasticity} = \frac{\text{stress}}{\text{strain}}$

(a) –R (b) R (c) P (d) –P

37. The change in entropy when three moles of argon gas are heated at constant volume from 200 K to 300 K is

(a) 15.16 JK^{-1} mol^{-1} (b) –15.16 JK^{-1} mol^{-1} (c) –5.05 JK^{-1} mol^{-1} (d) 5.05 JK^{-} mol^{-1}

38. For a system of constant composition, the pressure P is given by

(a) $-\left(\frac{\partial U}{\partial S}\right)_V$ (b) $-\left(\frac{\partial U}{\partial V}\right)_S$ (c) $-\left(\frac{\partial V}{\partial S}\right)_T$ (d) $\left(\frac{\partial U}{\partial V}\right)_T$

39. Calculate the coefficient of performance (β) of an engine operating between 110°C and 25°C. (The efficiency of carwat engine is 22.2%)

(a) 3.5 (b) 0.222 (c) 0.778 (d) 0.1556

40. ΔH and ΔU for the reaction

$$Fe_2O_3(s) + 3H_2(g) \rightarrow 2Fe(s) + 3H_2O(l)$$

at constant temperature are related as

(a) $\Delta H = \Delta U$ (b) $\Delta H = \Delta U + RT$ (c) $\Delta H = \Delta U + 3RT$ (d) $\Delta H = \Delta E - 3RT$

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ANSWER KEY

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1.b	2. c	3. c	4. b	5. d	6. b	7. a
8. c	9. b	10. d	11. d	12. b	13. a	14. b
15. b	16. a	17. d	18. a	19. d	20. c	21. b
22. a	23. b	24. b	25. b	26. a	27. c	28. c
29. a	30. a	31. d	32. a	33. c	34. a	35. a
36. b	37. d	38. d	39. a	40. d		

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