CHEMISTRY

BOOKS - NCERT CHEMISTRY (ENGLISH)

THERMODYNAMICS

Multiple Choice Questions

1. Thermodynamics is not concerned about.

   A. energy changes involved in a chemical reaction

   B. the extent to which a chemical reaction proceeds

   C. the rate at which a reaction proceeds

   D. the feasibility of a chemical reaction

Answer: C

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2. Which of the following statement is correct ?

A. The presence of reacting species in a covered beaker is an example

of open system

B. There is an exchange of energy as well as matter between the

system and the surroundings in a closed system

C. The presence of reactants in a closed vessel made up of copper is

an example of a closed system

D. The presence of reactants in a thermos flask or any other closed

insulated vessel is an example of a closed system

Answer: C

3. The state of gas can be described by quoting the relationship between

A. pressure, volume, temperature

B. temperature, amount, pressure

C. amount, volume, temperature

D. pressure, volume, temperature, amount

Answer: D

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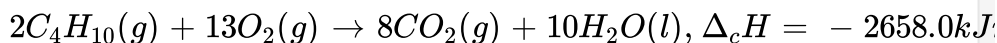**4.** The volume of gas is reduced to half from its original volume. The specific heat will be

A. reduce to half

B. be double
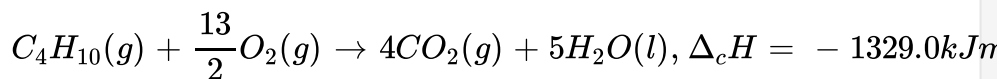
C. remain constant

D. increase four times

Answer: C

5. During complete combustion of one mole of butane ,2658Kj of heat is released. The thermochemical reaction for above change is

A.

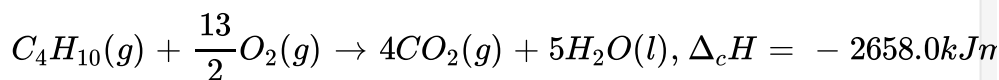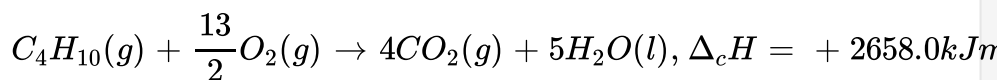$$2C_4H_{10}(g) + 13O_2(g) \rightarrow 8CO_2(g) + 10H_2O(l), \Delta_cH = -2658.0kJ$$

B.

$$C_4H_{10}(g) + \frac{13}{2}O_2(g) \rightarrow 4CO_2(g) + 5H_2O(l), \Delta_cH = -1329.0kJn$$

C.

$$C_4H_{10}(g) + \frac{13}{2}O_2(g) \rightarrow 4CO_2(g) + 5H_2O(l), \Delta_cH = -2658.0kJn$$

D.

$$C_4H_{10}(g) + \frac{13}{2}O_2(g) \rightarrow 4CO_2(g) + 5H_2O(l), \Delta_cH = +2658.0kJn$$

Answer: C

6. $\delta_f U^{\ominus}$ of formation of $CH_4(g)$ at a certain temperature is $-393 Jmol^{-1}$. The value of $\delta H^{\ominus}$ is:

A. zero

B. $< \Delta_f U^{\ominus}$

C. $> \Delta_f U^{\ominus}$

D. equal to $\Delta_f U^{\ominus}$

Answer: B

7. In an adibatic process, no transfer of heat takes place between system and surroundings. Choose the correct option for free expansion of an ideal gas under adiabatic conditions from the following :

A. $q = 0, \Delta T \neq 0, W = 0$

B. $q \neq 0$, $\Delta T = 0$, $W = 0$

C. $q = 0$, $\Delta T = 0$, $W = 0$

D. $q = 0$, $\Delta T < 0$, $W \neq 0$

Answer: C

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8. The pressure volume work for an ideal gas can be calculated by using the expression $w = -\int_{V_i}^{v_f} PexdV$. The work can also be calculated from the pV-plot by using the area under the curve within the specified limits. When an ideal gas is compressed (a) reversibly or (B) irreversibly from volume V_i to V_f choose the correct option.

A. W (reversible) = W (irreversible)

B. W (reversible) $<$ W (irreversible)

C. W (reversible) $=$ W (irreversible)

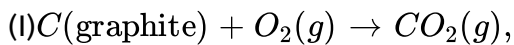D. W (reversible) $=$ W (irreversible) $+ p_{ex}. \Delta V$

Answer: B

9. The entropy change can be calculated by using the expression $\Delta S - \dfrac{q_{rev}}{T}$. When water freezes in a glass beaker, choose the correct statement amongst the following:

A. ΔS (system) decreases but ΔS (surroundings) remains the same

B. ΔS (system) increases but ΔS (surroundings) decreases

C. ΔS (system) decreases but ΔS (surroundings) increases

D. ΔS (system) decreases but ΔS (surroundings) also decreases

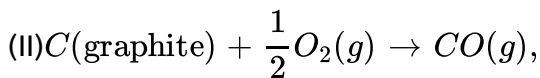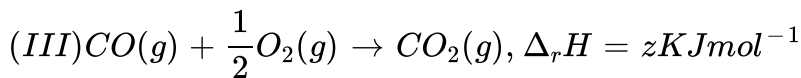**Answer: C**

10. On the basic of thermochemical equations (I),(II)and (III), Find out which of the algebraic relationships given in options (a)to (d) is correct ?

(I) $C(\text{graphite}) + O_2(g) \rightarrow CO_2(g)$,

$\Delta_r H = XKJmol^{-1}$

(II) $C(\text{graphite}) + \dfrac{1}{2}O_2(g) \rightarrow CO(g)$,

$\Delta_r H = yKJmol^{-1}$

$(III) CO(g) + \dfrac{1}{2}O_2(g) \rightarrow CO_2(g), \Delta_r H = zKJmol^{-1}$

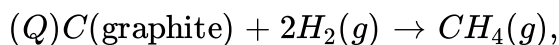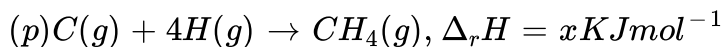A. $z = x + y$

B. $x = y - z$

C. $x = y + z$

D. $y = 2z - x$

Answer: C

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11. Consider the reactions given below .On the basis of these reactions ,Find out which of the algebraic relations given in options (a) to(d) is correct?

$(p)C(g) + 4H(g) \rightarrow CH_4(g), \Delta_r H = xKJmol^{-1}$

$(Q)C(\text{graphite}) + 2H_2(g) \rightarrow CH_4(g),$

$\Delta_r H = yKJmol^{-1}$

A. $x = y$

B. $x = 2y$

C. $x > y$

D. $x < y$

Answer: C

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12. The enthalpy of elements in their standard states are taken as zero .The enthalpy of formation of a compound:

A. is always negative

B. is always positive

C. may be positive or negative

D. is negative negative

Answer: C

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13. Enthalpy of sublimation of a substance is equal to :

A. enthalpy of fusion $+$ enthalpy of vaporisation

B. enthalpy of fusion

C. enthalpy of vaporisation

D. twice the enthalpy of vaporisation

Answer: B

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14. Which of the following is not correct ?

    A. ΔG is zero for a reversible reaction

    B. ΔG is positive for a spontaneous reaction

    C. ΔG is negative for a spontaneous reaction

    D. ΔG is positive for a non-spontaneous reaction.

Answer: A::D

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15. Thermodynamics mainly deals with:

    A. interrelation of various forms of energy and their transformation from one form to another

B. energy changes in the processes which depends only on initial and

final states of the microscopic system containing a few molecules

C. how and at what rate these energy transformations are carried out

D. the system in equilibrium state or moving from one equilibrium

state to another equilibrium state

Answer: A::D

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16. In an exothermic reaction heat is evolved and system loses heat to the

surrounding. For such system

A. q_p will be negative

B. $\Delta_r H$ will be negative

C. q_p will be positive

D. $\Delta_r H$ will be positive

Answer: A::B

17. The spontaneity means having the potential to proceed without assistance of external agency. The processes which occur spontaneously are

    A. flow of heat from colder to warmer body

    B. gas in a container contracting into one corner

    C. gas expanding to fill the available volume

    D. burning carbon in oxygen to give carbon dioxide

Answer: C::D

18. For an ideal gas, the work of reversible expansion under isothermal condition can be calculated by using expression $= -nRT\ln.\dfrac{V_f}{V_i}$. A sample containing 1.0 mol of an ideal gas is expanded isothermally and reversible to ten times of its original volume, in two separate experiments. The expansion is carried out at 300 K and at 600 K respectively. Choose the correct option
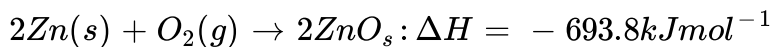
A. work done at 600 K is 20 times the work done at 300 K

B. work done at 300 K is twice the work done at 600 K

C. work done at 600 K is twice the work done at 300 K

D. $\Delta U = 0$ in both cases.

Answer: C::D

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19. Consider the following reaction between zinc and oxygen and choose the correct options out of the options given below

$$2Zn(s) + O_2(g) \rightarrow 2ZnO_s : \Delta H = -693.8 kJmol^{-1}$$

A. The enthalpy of two moles of ZnO is less than the total enthalpy of

two moles of Zn and one mole of oxygen by 693.8 kJ

B. The enthalpy of two moles of ZnO is more than the total enthalpy

of two moles of Zn and one mole of oxygen by $693.8 kJ$

C. $693.8 kJmol^{-1}$ energy is evolved in the reaction

D. $693.8 kJmol^{-1}$ energy is absorbed in the reaction

Answer: A::C

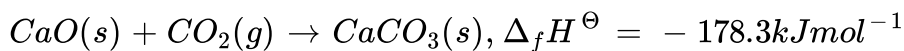> ▶ Watch Video Solution

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20. 18.0 g of water completely vaporises at $100°C$ and 1 bar pressure and

the enthalpy change in the process is $40.79 kJmol^{-1}$. What will be the

enthalpy change for vaporising two moles of water under the same

conditions ? What is the standard enthalpy of vaporisation for water ?

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21. One mole of acetone requires less heat to vaporise than 1 mole of water. Which of the two liquids has higher enthalpy of vaporisation ?
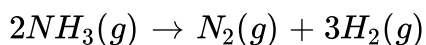
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22. Standard molar enthalpy of formation, $\Delta_f H^{\ominus}$ is just a special case of enthalpy of reaction, $\Delta_r H^{\ominus}$. Is the $\Delta_r H^{\ominus}$ same as standard molar enthalpy of formation ? Given reason for your answer.

$$CaO(s) + CO_2(g) \rightarrow CaCO_3(s), \Delta_f H^{\ominus} = -178.3 kJmol^{-1}$$

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23. The value of $\Delta_f H^{\ominus}$ for NH_3 is $-91.8 kJmol^{-1}$. Calculate enthalpy change for the following reaction.

$$2NH_3(g) \rightarrow N_2(g) + 3H_2(g)$$

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24. Enthalpy is an extensive property. In general, if enthalpy of an overall reaction $A \rightarrow B$ along one route is $\Delta_r H$ and $\Delta_r H_1, \Delta_r H_2, \Delta_r H_3.....$ Represent enthalpies of intermediate reactions leading to product B. What will be the relation between $\Delta_r H$ overall reaction and $\Delta_r H_1, \Delta_r H_2$ ... etc for intermediate reaction.

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25. The enthalpy of atomisation for the reaction $CH_4(g) \rightarrow C(g) + 4H(g)$ is $1665 kJmol^{-1}$. What is the bond energy of $C - H$ bond ?

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26. Use the following data to calculate $\Delta_{\text{lattice}} H^{\ominus}$ for $NaBr$. $\Delta_{\text{Sub}} H^{\ominus}$ for sodium metal $= 108.4 kJmol^{-1}$, ionisation enthalpy of sodium $= 496 kJmol^{-1}$, electron gain enthalpy of bromine $= -325 kJmol^{-1}$,

bond dissociation enthalpy of bromine
$= 192 kJmol^{-1}, \Delta_f H^{\ominus}$ for $NaBr(s) = -360.1 kJmol^{-1}$

27. Given that $\Delta H = 0$ for mixing of two gases. Explain whether the diffusion of these gases into each other in a closed container is a spontaneous process or not ?

28. Heat has randomising influence on a system and temperature is the measure of average chaotic motion of particles in the system. Write the mathematical relation which relates these three parameters.

29. Increase in enthalpy of the surroundings is equal to decrease in enthalpy of the system. Will the temperature of system and surroundings be the same when they are in thermal equilibrium ?
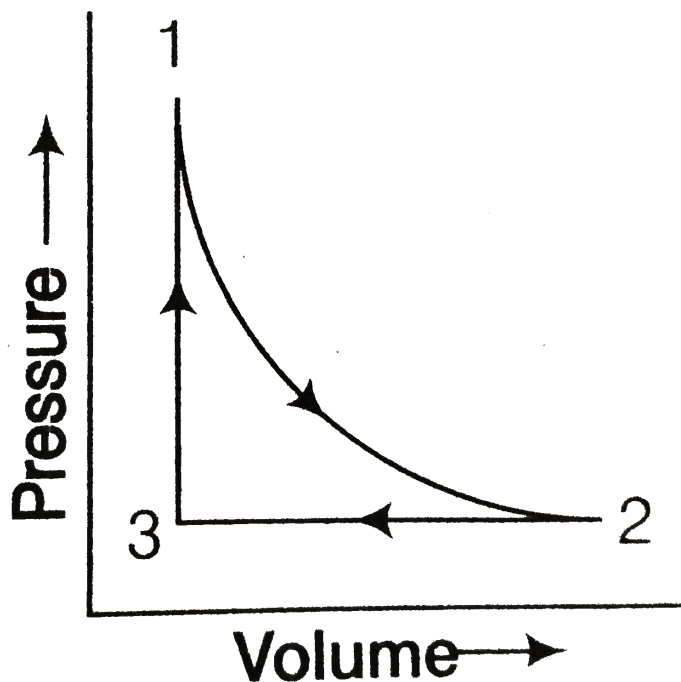
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30. At $298K$, K_p for reaction $N_2O_4(g) \Leftrightarrow 2NO_2(g)$ is 0.98. Predict whether the reaction is spontaneous or not.

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31. A sample of 1.0 mol of a monoatomic ideal gas is taken through a cyclic process of expansion and compression as shown in figure. What will

be the value of ΔH for the cycle as a whole ?

32. The standard molar entropy of $H_2O(l)$ is $70JK^{-1}mol^{-1}$. Will the standard molar entropy of $H_2O(s)$ be more, or less than $70JK^{-1}mol^{-1}$?

33. Identify the state functions and path functions out of the following enthalpy, entropy, heat, temperature, work, free energy

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34. The molar enthalpy of vaporisation of acetone is less than that of water. Why ?

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35. Which quantity out of $\Delta_r G$ and $\Delta_r G^{\ominus}$ will be zero at equilibrium ?

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36. Predict the change in internal energy for an isolated system at constant volume.

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37. Although heat is a path function but heat absorbed by the system under certain specific conditions is independent of path. What are those conditions ? Explain.

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38. Expansion of a gas in vacuum is called free expansion. Calculte the work done and the change in internal energy when 1 L of ideal gas expands isothermally into vacuum until its total volume is 5L ?

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39. Heat capacity (C_p) is an extensive property but specific heat (c) is intensive property. What will be the relation between C_p and c for 1 mole of water ?

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40. The difference between C_p and C_v can be derived using the empirical relation $H = U + pV$. Calculate the difference between C_p and C_v for 10 moles of an ideal gas.

41. If the combustion of 1 g of graphite produces -20.7 kJ of heat, what will be molar enthalpy change ? Give the significance of sign also.

42. The net enthalpy change of a reaction is the amount of energy required to break all the bonds in reactant molecules minus amount of energy required to form all the bonds in the product molecules. What will be the enthalpy change for the following reaction ? $H_2(g) + Br_2(g) \rightarrow 2HBr(g)$. Given that, bond energy of H_2, Br_2 and HBr is $435kJmol^{-1}$, $192kJmol^{-1}$ and $368kJmol^{-1}$ respectively
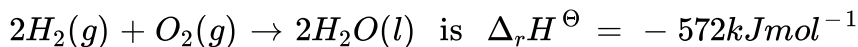
43. The enthalpy of vaporisation of CCl_4 is $30.5 kJmol^{-1}$. Calculate the heat required for the vaporisation of $284g$ of CCl_4 at constant pressure.

(Molar mass of $CCl_4 = 154 gmol^{-1}$)

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44. The enthalpy of reaction for the reaction

$2H_2(g) + O_2(g) \rightarrow 2H_2O(l)$ is $\Delta_r H^{\ominus} = -572 kJmol^{-1}$
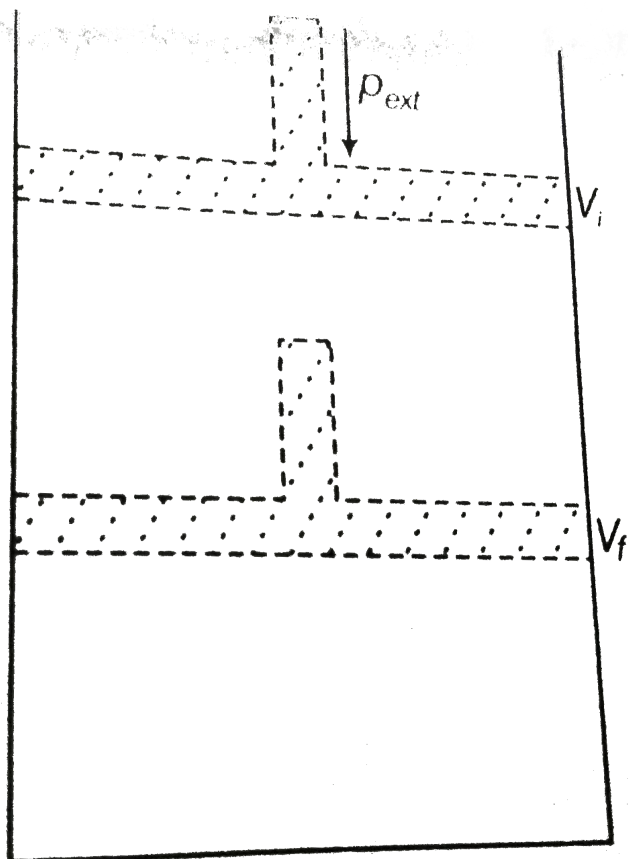
What will be standard enthalpy of formation of $H_2O(l)$?

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45. What will be the work done on an ideal gas enclosed in a cyliner, when it is compressed by a constant external pressure, p_{ext} in a single step as
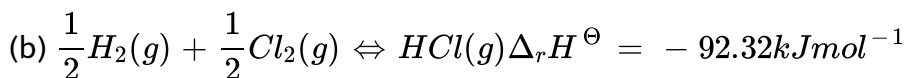
shown in figure ? Explain graphically.

46. How will you calculate work done on an ideal gas in a compression, when change in pressure is carried out in infinite steps ?

47. Represent the potential energy/enthalpy change in the following processes graphically.

(a) Throwing a stone from the ground to roof.

(b) $\frac{1}{2}H_2(g) + \frac{1}{2}Cl_2(g) \Leftrightarrow HCl(g)\Delta_r H^{\ominus} = -92.32 kJmol^{-1}$

In which of the processes potential energy/enthalpy change is contributing factor to the spontaneity ?

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48. Enthalpy diagram for a particular reaction is given in figure. Is it possible to decide spontaneity of a reaction from given diagram. Explain.

Products

H_p ----------

$\uparrow$

$\Delta_r H$, Net heat
absorbed from
surroundings

H

H_r -------

Reactants

Reaction coordinate $\longrightarrow$
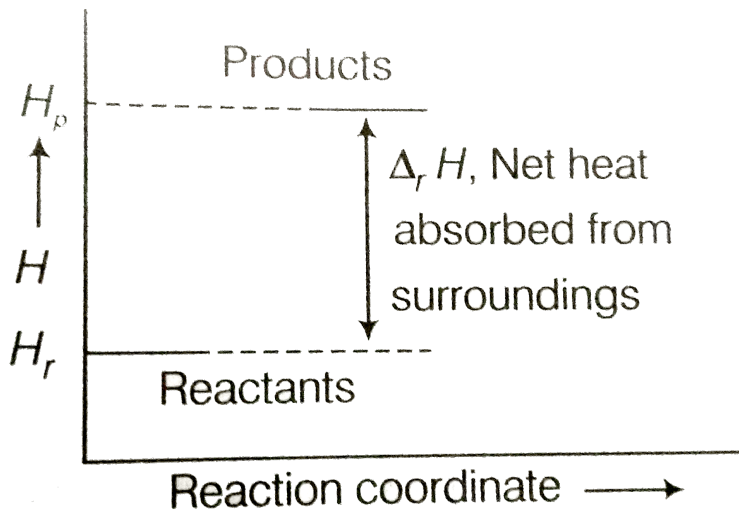
49. 1.0 mol of a monoatomic ideal gas is expanded from state (1) to state

(2) as shown in figure. Calculate the work done for the expansion of gas

from state (1) to state (2) at 298 K.

State (1)

2.0

State (2)

1.0

22.7

p(bar) →

V(L) →
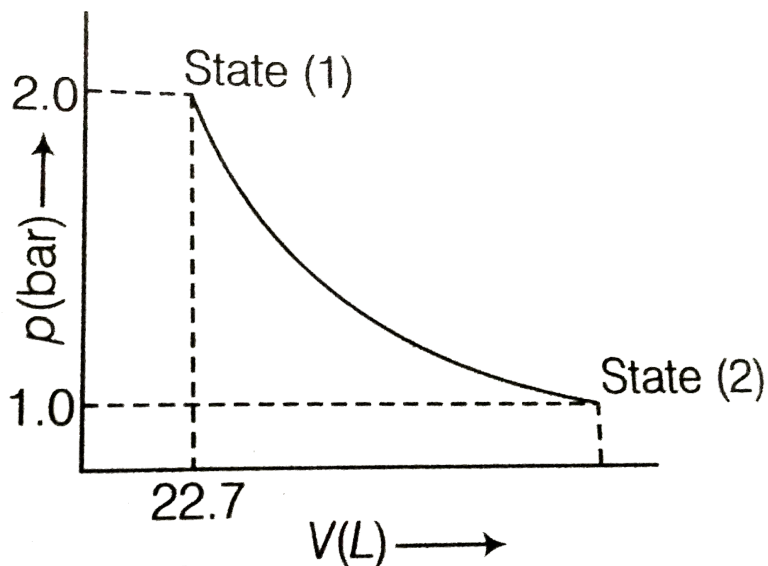
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50. An ideal gas is allowed to expand against a constant pressure of 2 bar from 10L to 50 L in one step. Calculate the amount of work done by the gas. If the same expansion were carried out reversibly, will the work done be higher or lower than the earlier case ?

(Give that, 1 L bar = 100 J)

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51. Match the following

following.

List i		List 11
A.	...	
B.	...	
...	...	
D.	Path fun...	...t...n
E.	State fun...	
F.	$\Delta U = q$	...perature
G.	Law of conservation of energy	...a energy
H.	Reversible process	8. ...
I.	Free expansion	9. At constant pressure
J.	$\Delta H = q$	10. infinitely slow process which proceeds through a series of equilibrium states
K.	Intensive property	11. Entropy
L.	Extensive property	12. Pressure
		13. Specific heat

... E → (7, 11, 12) F → (2) G → (3) H

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52. Match the following processes with entropy change

Reaction		Entropy change	
A.	A liquid vaporises	1.	$\Delta S = 0$
B.	Reaction is non-spontaneous at all temperatures and ΔH is positive	2.	$\Delta S =$ positive
C.	Reversible expansion of an ideal gas	3.	$\Delta S =$ negative

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53. Match the following parameters with description for spontaneity

Δ (Parameters) $\Delta_r H^\ominus$ $\Delta_r S^\ominus$ $\Delta_r G^\ominus$			Description
A.	+	− +	1. Non-spontaneous at high temperature
B.	−	− + at high T	2. Spontaneous at all temperatures
C.	−	+ −	3. Non-spontaneous at all temperatures

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54. Match the following

A.	Entropy of vaporisation	1.	decreases
B.	K for spontaneous process	2.	is always positive
C.	Crystalline solid state	3.	lowest entropy
D.	ΔU in adiabatic expansion of ideal gas	4.	$\dfrac{\Delta H_{vap}}{T_b}$

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55. Assertion (A). Combustion of all organic compounds is an exothermic reaction.

Reason (R). The enthalpies of all elements in their standard state are zero

    A. Both A and R are true and R is the correct explanation of A

    B. Both A and R are true but R is not the correct explanation of A

    C. A is true but R is false

    D. A is false but R is true

Answer: B

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56. Assertion (A). Spontaneous process is an irreversible process and may be reversed by some external agency.

Reason (R). Decrease in enthalpy is a contributory factor for spontaneity

    A. Both A and R are true and R is the correct explanation of A

    B. Both A and R are true but R is not the correct explanation of A

    C. A is true but R is false

D. A is false but R is true

Answer: B

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57. Assertion (A). A liquid crystallises into a solid and is accompanied by decrease in entropy.

Reason (R). In crystals, molecules organise in an ordered manner.

    A. Both A and R are true and R is the correct explanation of A

    B. Both A and R are true but R is not the correct explanation of A

    C. A is true but R is false

    D. A is false but R is true

Answer: A

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58. Derive the relationship between ΔH and ΔU for an ideal gas. Explain each term involved in the equation.

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59. Extensive properties depends on the quantity of matter but intensive properties do not. Explain whether the following properties are extensive or intensive.

Mass internal energy, pressure, heat capacity, molar heat capacity, density, mole fraction, specific heat, temperature and molarity

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60. The lattice enthalpy of an ionic compound is the enthalpy when one mole of an ionic compoud present in its gaseous state, dissociates into its ions. It is impossible to determine it directly by experiment. Suggest and explain in indirect method to measure lattice enthalpy of NaCl(s).

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61. ΔG is energy availabe to do useful work and is thus a meaure of "Free energy". Show mathemactically that ΔG is a measure of free energy. Find the unit of ΔG. IF a reaction has positive enthalpy change and positive entropy change, under what condition will the reaction be spontaneous ?

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62. Graphically show the total work done in an expansion when the state of an ideal gas is changed reversibly and isothermally from (p_i, V_i) to (p_f, V_f). With the help of a pV plot compare the work done in the above case with that carried out against a constant pressure p_f.

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