



CHEMISTRY

BOOKS - VGS PUBLICATION-BRILLIANT

THERMODYNAMICS

Very Short Answer Questions

1. What is the information given by the terms

thermodynamics?



5. The system loses 'q' amount of heat though no work is done on the system. What type of wall does the system have?

Watch Video Solution

6. Work is done by the system and 'q' amount of beat is

supplied the system. What type of system would it be?

Watch Video Solution

7. What is the work done in the free expansion of an ideal

gas in reversible and irreversible processes?

8. From the equation $\Delta Uq - p_{ex}\Delta V$, if the volume is

constant what is the value of ΔU ?

Watch Video Solution

9. In isothermal free expansion of an ideal gas find the value of q and ΔU .

Watch Video Solution

10. In isothermal irreversible change of ideal gas what is

the value of q?



11. In isothermal reversible change of an ideal gas, what is

the value of q?

Watch Video Solution

12. For an adiabatic change of in an ideal gas what is the

relationship between its ΔU and W(adiabatic)?

Watch Video Solution

13. State the first law of thermodynamics.

14. What are the sign conventions of the work done on

the system and work done by the system?



15. Volume (V), Pressure (P) and Temperature (T) are state

functions. Is the statement true?



16. What are the heat (q) sign conventions when heat is transferred from the surroundings to the system and that transferred from system to the surrounding?



17. No heat is absorbed by the system from the surroundings, but work (w) is done on the system. What type of wall does the system have?



18. No work is done on the system, but heat (q) is taken

out from the system by the surroundings. What type of

wall does the system have?



19. Work is done by the system and heat (q) is supplied to

the system. What type of system would it be?

20. If the boundary of system moves by an infinitesimal
amount, the work involved is given by
$$dw = -P_{ext}dV$$

for irreversible process
 $w = -P_{ext}\Delta V$ (where $\Delta V = V_f - V_i$)
for reversible process $P_{ext} = P_{int} \pm dP \cong P_{int}$
so for reversible isothermal process $w = -nRT \ln \cdot \frac{V_f}{V_i}$
2mole of an ideal gas undergoes isothermal compression
along three different plaths :

(i) reversible compression from $P_i=2$ bar and $V_i=8L$

to $P_f=20$ bar

(ii) a single stage compression against a constant external pressure of 20 bar, and

(iii) a two stage compression consisting initially of compression against a constant external pressure of 10 bar until $P_{\rm gas}=P_{\rm ext}$, followed by compression against a constant pressure of 20 bar until $P_{\rm gas}=P_{\rm ext}$

Work done on the gas in single stage compression is :

Watch Video Solution

21.
$$q=-w=nRT1nig(v_f-v_iig)$$
 is for isothermal

change.

22. What are the $\Delta H'$ sign conventions for exothermic

and endothermic reactions?



25. Give the equation that gives the relationship between

 ΔU and ΔH .



27. 1 g of graphite is burnt in a bomb calorimeter in excess of O_2 at 298 K and 1 atm. Pressure according to the equations.

$$C_{ ext{graphite}} + O_{2(g)}
ightarrow CO_{2(g)}$$

During the reaction the temperature rises from 298 K to

200K. Heat capacity of the bomb calorimeter is $20.7KJK^{-1}$. What is the enthalpy change for the above reaction at 298 K 1 atm?



28. For the above reaction what is the internal energy change, ΔU ?



molar enthaples of the respective reaction and products?



30. Enthalpy decreases is not the criterion for spontaneity. Why?

Watch Video Solution

31. Is increase of entropy the criterion for spontaneity ? Why ?

Watch Video Solution

32. Explain the relationship between Gibbs energy change

and equilibrium constant.





33. If we measure ΔH^{θ} and ΔS^{θ} it is possible to estimate ΔG^{θ} . Is it true? Why?

Watch Video Solution

34. Equilibrium constant 'K' is measured accurately in the laboratory at given temperature. Is it possible to calculate ΔG^{θ} at any other temperature ? How?



35. Comment on the thermodynamics stability of $NO_{\left(g
ight)}$

given that

$$egin{aligned} &rac{1}{2} N_{2\,(\,g\,)} \,+ rac{1}{2} O_{2\,(\,g\,)} \, o NO_g, \Delta_r H^{ heta} = 90 k Jmol^{-1} \ & NO_{\,(\,g\,)} \,+ rac{1}{2} O_{2\,(\,g\,)} \, o NO_{2\,(\,g\,)}, \Delta_r H^{ heta} d = \,-\,74 K jmol^{-1} \end{aligned}$$



36. Calculate the entropy change in surroundings when 1.00 mole of $H_2O_{(l)}$ is formed under standard conditions $\Delta_f H^{\theta} = -286 k Jmol^{-1}$.

37. The equilibrium constant for a reaction is 10. What will

be the value of ΔG^{θ} ?

 $R = 8.314 J K^{-1} mol^{-1}, T = 300 K.$

Watch Video Solution

38. State the third law of thermodynamics.



Short Answer Questions

1. What are open, closed and isolated systems ? Give one

example for each.



5. What is heat? Explain.

Watch Video Solution
6. Derive the equation for $ 'W_{ m rev} '$ in isothermal reversible
process.
•
Watch Video Solution
7. Two litres of an ideal gas at a pressure of 10 atm
expands isothermally into a vacuum until its total volume
is 20 litres. How much heat is absorbed and how much

work is done in the expansion?

8. If the ideal gas given in the problem 45 expands against constant external pressure of 1 atm what is the q value?

Watch Video Solution

9. If the ideal gas given in the problem 45 expands to a final volume of 10L conducted reversibly what is g value?

Watch Video Solution

10. Explain the state function 'enthalpy, H'. What is the relationship between ΔU and ΔH ?



11. Show that $\Delta H = \Delta U + \Delta n_{\,(\,g\,)}\,, RT$

Watch Video Solution

12. If water vapour is assumed to be a perfect gas, molar enthalpy change for vapouration of 1 mole of water at 1 bar and $100^{\circ}C$ is 41 kJ mol^{-1} . Calculate the internal energy change when

a) 1 mol of water is vapourised at 1 bar and $100\,^\circ\,C$

b) 1 mol of water liquid is converted into ice.

13. Explain extensive and intensive properties.



16. Explain the determination of ΔH of a reaction calorimetrically:



17. What is enthalpy of a reaction? Explain the standard

enthalpy of a reaction.

Watch Video Solution

18. What is the standard enthalpy of formation? Explain it

with example.



19. Define and explain enthalpy of phase transformation.

Watch Video Solution
20. Define the explain the standard enthalpy of fusion (Molar enthalpy of fusion).
Watch Video Solution
21. Define and explain the standard enthalpy of
vapourisation (Molar enthalpy of vapourisation).

22. Define and explain the standard enthalpy of

vapourisation of sublimation.



24. State and explain the Hess's law of constant heat summation.



25. Define and explain the enthalpy of combustion $\left(\Delta_c H^{\theta}\right)$.



28. What is the bond enthalpy of C-H bond of CH_4 ?



- - - - -



32. Is decrease in enthalpy a criterion for spontaneity?

Explain.

Watch Video Solution

33. What is entropy? Explain with examples.

Watch Video Solution

34. Is increases in entropy a criterion for spontaneity? Explain.



35. Can ΔU and ΔS discriminate between irreversible and reversible process? Explain.

Watch Video Solution

36. In which of the following process entropy increases?

a) A liquid evaporates to vapour.

b) Temperature of a crystalline solid lowered from 115 K to

0 K.

c) $CaCO_{3\,(\,s\,)}\,
ightarrow\,CaO_{\,(\,s\,)}\,+\,CO_{2\,(\,g\,)}$

d) $Cl_{2\,(\,g\,)}\,
ightarrow\,2Cl_{\,(\,g\,)}$

37. For the oxidation of iron

 $4Fc_{(s)} + 3O_{2(g)} \rightarrow 2Fe_{(2)}O_{3(s)},$

the entropy change is $-549.45 J K^{-1} mol^{-1}$ at 298 K. Though it has negative entropy change the reaction is spontaneous. Why?

$$\left(\Delta_r H^ heta = \ -164 imes 10^3 Jm l^{-1}
ight)$$

Watch Video Solution

38. Which formulate in the following are correct?

a)
$$G=H-TS$$

b) $\Delta G_{
m sys}=\Delta H_{
m sys}-T\Delta S_{
m sys}$
c) $\Delta S_{
m surr}=rac{\Delta H_{
m surr}}{T}=rac{-\Delta H_{
m sys}}{T}$

d)
$$\Delta S_{
m total} = \Delta S_{
m sys} + rac{ig(- \Delta H_{
m sys} ig)}{T}$$

e)
$$\Delta S_{
m total} = T \Delta S_{
m sys} - \Delta H_{sys}$$

Watch Video Solution

39. Calculate
$$\Delta_r G^{ heta}$$
 for conversion of oxygen to ozone $rac{3}{2}O_{2(g)} o O_{3(g)}$ at 298 K. K_p for the reaction is $2.43 imes10^{-29}.$

Watch Video Solution

40. State the second law of thermodynamics and explain

it.



41. State the third law of thermodynamics.

Vatch Video Solution
12 What is antrony? Evalain with avamples
Watch Video Solution

43. Explain spontaneity of a process in terms of Gibbs

energy.

44. The sign and magnitude of Gibbs energy change of a chemical process tells about its spontaneity and useful work that could be extracted from it. Explain.

Watch Video Solution

45. In a process 701 J of heat is absorbed by a system and

394 J of work is done by the system. What is the change in

internal energy for the process?



46. The reaction of cyanamide (s), with dioxygen was carried out in a bomb calorimeter and ΔU was found to

be -742.7 kJ mol^{-1} at 298 K. Calculate the enthalpy change for the reaction at 298 K.

$$NH_2CN_{(\,g\,)}\,+\,rac{3}{2}O_2(g)
ightarrow N_{2\,(\,g\,)}\,+\,CO_{2\,(\,g\,)}\,+H_2O_l$$



47. Calculate the number of kJ of heat necessary to rise the temperature of 60.0 g of aluminum from $35^{\circ}C \rightarrow 55^{\circ}C$. Molar heat capacity of aluminum is 24 J $mol^{-1}K^{-1}$.



48. Calculate the enthalpy change on freezing of 1.0 mol

of water at $10.0^{\circ}C$ to ice at $-10.0^{\circ}C$.

$$\Delta_{
m fus} H = 6.03 k Jmol^{-1} at0^{\circ} C$$

 $C_p[H_2O(l)] = 75.3 Jmol^{-1} K^{-1}$
 $C_p[H_2O(s)] = 36.8 Jmol^{-1} K^{-1}$
Watch Video Solution

49. Enthalpy of combustion of carbon to CO_2 is $-393.5kJmol^{-1}$. Calculate the heat released upon formation of 35.2 g of CO_2 from carbon and dioxygen gas.



50. Enthalpies of formation of CO(g), $CO_2(g), N_2O(g)$ and $N_2O_4(g)$ are -110, -393.81 and 9.7 kJ mol^{-1} respectively. Find the value of D_rH for the reaction:

$$N_2O_4(g)+3CO(g)
ightarrow N_2O(g)+3CO_2(g)$$



 $N_2(g) + 3H_2(g) o 2NH_3(g), \Delta_r H^ heta = -92.4 k Jmol^{-1}$

What is the standard enthalpy of formation of NH_3 gas ?

52. From the following data
$$CH_3OH(l)+rac{3}{2}O_2(g) o CO_2(g)+2H_2O(l)$$
 $\Delta_r H^\circ\,=\,-\,726kJmol^{-1}$

 $egin{aligned} &H_2(g)+rac{1}{2}O_2(g) o H_2O(l), \Delta_r H^\circ = &-286 k Jmol^{-1}\ &C(ext{graphite})+O_2(g) o CO_2(g), \Delta_r H^\circ = &-393 k Jmol^{-1}\ & ext{The standard enthalpy of formation of}\ &CH_3OH(l) & ext{ in } k Jmol^{-1} & ext{ is} \end{aligned}$

Watch Video Solution

53. Calculate the enthalpy change for the process $CCl_4(g) \rightarrow C(g) + 4CI(g)$ and calculate bond enthalpy of $C - Cl \in CCl_4(g)$. $\Delta_{vap}H^{\theta}(C Cl_4) = 30.5kJmol^{-1}$. $\Delta_f H^{\theta}(Cl_4) = -135.5kJmol^{-1}$. $\Delta_0 H^{\theta}(C) = 715.0kJmol^{-1}$, where $\Delta_a H^{\theta}$ is enthalpy of atomisation.

 $\Delta_a H^ heta(Cl_2) = 242 k J mol^{-1}.$

54. For an isolated system , $\Delta U = 0$ what will be ΔS ?

Watch Video Solution

55. For the reaction at 298 K,

2A + B
ightarrow C

 $\Delta H = 400 k J mol^{-1}$ and $\Delta S = 0.2 k J K^{-1} mol^{-1}$.

At what temperature will the reaction becomes spontaneous considering ΔH and ΔS to be constant over the temperature range?

56. For the reaction,

 $2Cl(g)
ightarrow Cl_2(g), ext{ what are the signs of } \Delta H ext{ and } \Delta S?$



58. The equilibrium constant for a reaction is 10. What will

be the value of ΔG ?

 $R = 8.314 J K^{-1} mol^{-1}, T = 300 K.$

Watch Video Solution

59. State the first law of thermodynamics. Explain its

mathematical notation.

Watch Video Solution

60. State the second law of thermodynamics in any two

ways.

61. Explain spontaneity of a process in terms of Gibbs energy.

Watch Video Solution

62. Explain spontaneity of a process in terms of Gibbs

energy.

Watch Video Solution

Long Answer Questions

1. State and explain the Hess's law of constant heat summation.

Watch Video Solution
2. Explain the experiment to determine the internal
energy change of a chemical reaction.
Vatch Video Solution

3. Explain the experiment to determine the enthalpy change of a chemical reaction.



4. Explain the spontaneity of a reaction in terms of enthalpy change, entropy change and Gibbs energy change.

Watch Video Solution

Additional Questions Answers

1. When no heat is absorbed by the system them from the surroundings, but work (w) is done on the system, the

change in internal energy of the system is given as

2. No work is done on the system, but heat (q) is taken out from the system by the surroundings. What type of wall does the system have?

Watch Video Solution

3. Express the change in internal energy of a system when iii) w amount of work is done by the system and q amount of heat is supplied to the system. What type of system would it be?

4. Two litres of an ideal gas at a pressure of 10 atm expands isothermally into a vacuum until its total volume is 20 litres. How much heat is absorbed and how much work is done in the expansion?

Watch Video Solution

5. If the ideal gas given in the problem 45 expands against

constant external pressure of 1 atm what is the q value?



6. Consider the same expansion, to a final volume of 10

litres conducted reversibly.

