



INDIAN SCHOOL AL WADI AL KABIR



Class: XI	DEPARTMENT: SCIENCE (2023-24) SUBJECT: CHEMISTRY	Date of completion: I week of February, 2024
Worksheet No: 08 with answers	TOPIC: THERMODYNAMICS	Note: A4 FILE FORMAT
NAME OF THE STUDENT	CLASS & SEC:	ROLL NO.

MULTIPLE CHOICE QUESTIONS

- A system in which no exchange of matter, but exchange of energy possible between system and the surroundings is called

 - Open system
 - closed system
 - Isolated system
 - None of these

- Which of the following is a state variable?

 - temperature
 - pressure
 - volume
 - All of them are state variables

- Identify the correct statement from the following.

 - w_{ad} is negative when work is done on the system and the internal energy of system increases. Also, when work is done by the system, w_{ad} is positive and internal energy of the system decreases.
 - w_{ad} is negative when work is done on the system and the internal energy of system decreases. Also, when work is done by the system, w_{ad} is positive and internal energy of the system increases.
 - w_{ad} is positive when work is done on the system and the internal energy of system increases. Also, when work is done by the system, w_{ad} is negative and internal energy of the system decreases.
 - w_{ad} is positive when work is done on the system and the internal energy of system decreases. Also, when work is done by the system, w_{ad} is negative and internal energy of the system increases.

4. Which of the following is not an extensive property?
- density
 - mass
 - volume
 - internal energy
5. Identify the correct statement about free expansion.
- $p_{\text{ex}} = 0$
 - No work is done during free expansion of an ideal gas if the process is reversible.
 - No work is done during free expansion of an ideal gas if the process is irreversible.
 - All are correct.
6. The enthalpies of all elements in their standard states are:
- unity
 - zero
 - < 0
 - different for each element
7. For the reaction, $\text{Br}_{2(l)} \rightarrow 2\text{Br}_{(g)}$, what are the signs of ΔH and ΔS_{system} ?
- Both ΔH and ΔS_{system} are positive
 - Both ΔH and ΔS_{system} are negative
 - ΔH is negative and ΔS_{system} is positive
 - ΔH is positive and ΔS_{system} is negative
8. Which equation shows the standard enthalpy change of formation of sodium chloride?
- $\text{Na}(s) + \frac{1}{2}\text{Cl}_2(g) \rightarrow \text{NaCl}(s)$
 - $2\text{Na}(s) + \text{Cl}_2(g) \rightarrow 2\text{NaCl}(s)$
 - $\text{Na}(g) + \text{Cl}(g) \rightarrow \text{NaCl}(s)$
 - $\text{Na}^+(g) + \text{Cl}^-(g) \rightarrow \text{NaCl}(s)$

ASSERTION REASON TYPE

9. **Assertion (A):** If both ΔH and ΔS_{sys} are positive, then the reaction will be spontaneous at high temperature.

Reason (R): All processes with positive entropy change of system are spontaneous.

- a) Both Assertion and Reason are correct statements, and Reason is the correct explanation of the Assertion.
- b) Both Assertion and Reason are correct statements, but Reason is not the correct explanation of the Assertion.
- c) Assertion is correct but Reason is wrong statement.
- d) Assertion is wrong but Reason is correct statement.

10. **Assertion (A):** The process of atomization is always exothermic.

Reason (R): Energy is absorbed during atomisation.

- a) Both Assertion and Reason are correct statements, and Reason is the correct explanation of the Assertion.
- b) Both Assertion and Reason are correct statements, but Reason is not the correct explanation of the Assertion.
- c) Assertion is correct but Reason is wrong statement.
- d) Assertion is wrong but Reason is correct statement.

11. **Assertion (A):** For melting of ice, ΔS_{sys} is positive.

Reason (R): During the process of melting of ice, disorder of particles increases.

- a) Both Assertion and Reason are correct statements, and Reason is the correct explanation of the Assertion.
- b) Both Assertion and Reason are correct statements, but Reason is not the correct explanation of the Assertion.
- c) Assertion is correct but Reason is wrong statement.
- d) Assertion is wrong but Reason is correct statement.

Read the given passage and answer the questions that follow:

In a chemical reaction, reactants are converted into products. The enthalpy change accompanying a reaction is called the reaction enthalpy. Enthalpy change is a very useful quantity. Knowledge of this quantity is required when one needs to plan the heating or cooling required to maintain an industrial chemical reaction at constant temperature. Enthalpy of a reaction depends on the conditions under which a reaction is carried out.

12. Define Standard enthalpy of formation.
13. Write an equation for the Standard enthalpy of formation of water.
14. Calculate the standard enthalpy change of combustion of 2-Methylpropan-2-ol using the data given in the table.

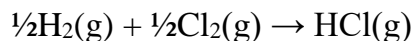
Compound	$\Delta_f H^\circ$ (kJmol ⁻¹)
2-Methylpropan-2-ol	-359
carbon dioxide	-394
water	-286

Question – Answer Type:

15. In a process 700 J of heat is absorbed by a system and 390 J of work is done by the system. Find ΔU . 1
16. Barium carbonate decomposes in an endothermic reaction as follows: 1
$$\text{BaCO}_3(\text{s}) \rightarrow \text{BaO}(\text{s}) + \text{CO}_2(\text{g})$$

What are the signs of entropy of system and entropy of surroundings?
17. State first law of thermodynamics. Write the mathematical expression. 1
18. Calculate the Enthalpy of solution of NaCl using the following data: 1
(Lattice enthalpy of NaCl = + 788 kJ mol⁻¹, Enthalpy of hydration for sodium and chloride ions are -406 and -378 kJ mol⁻¹ respectively).
19. Define the following terms. 2
a) Enthalpy
b) Extensive properties
20. The enthalpy change for a reaction $\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \rightarrow 2\text{NH}_3(\text{g})$ is -4.0 kJ mol⁻¹ at 300K. Calculate the value of ΔU . ($R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$) 2
21. The equilibrium constant for a reaction is 100. What will be the value of ΔG° ? 2
 $R = 8.314 \text{ JK}^{-1} \text{ mol}^{-1}$, $T = 300 \text{ K}$.

22. The enthalpy change of reaction for the equation shown can be calculated using bond enthalpy data. 2



Bond	Bond enthalpy (kJmol ⁻¹)
H - H	436
Cl - Cl	242
H - Cl	431

23. Complete the following table to express the relationship between spontaneity and temperature. 3

		ΔH_{sys}	
		Positive	Negative
ΔS_{sys}	Positive	Spontaneous only at high temperature	
	Negative		

24. Predict in which of the following, entropy increases/decreases: 3

- a) Sublimation of dry ice into CO₂ gas.
 b) Temperature of a crystalline solid is raised from 10 K to 115 K.
 c) $4\text{Fe}(\text{s}) + 3\text{O}_2(\text{g}) \rightarrow 2\text{Fe}_2\text{O}_3(\text{s})$

25. For a reaction at 298 K, $\Delta H = 600 \text{ kJ mol}^{-1}$ and $\Delta S = 1200 \text{ J K}^{-1} \text{ mol}^{-1}$. At what temperature will the reaction become spontaneous? 3

ANSWERS

1.	b) closed system
2.	d) All of them are state variables

3.	c) w_{ad} is positive when work is done on the system and the internal energy of system increases. Also, when work is done by the system, w_{ad} is negative and internal energy of the system decreases.
4.	a) density
5.	d) All are correct.
6.	b) zero
7.	a) Both ΔH and ΔS_{system} are positive.
8.	a) $Na(s) + \frac{1}{2}Cl_2(g) \rightarrow NaCl(s)$
9.	c) Assertion is correct but Reason is wrong statement
10.	d) Assertion is wrong but Reason is correct statement.
11.	a) Both Assertion and Reason are correct statements, and Reason is the correct explanation of the Assertion.
12.	The standard enthalpy change for the formation of one mole of a compound from its elements in their most stable states of aggregation is called standard molar enthalpy of formation.
13.	$H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(l)$
14.	$\Delta H = -(-359) + (4 \times -394) + (5 \times -286)$ $= -2647 \text{ kJ mol}^{-1}$
15.	$\Delta U = q + w$ $q = +700 \text{ J} \quad w = -390 \text{ J}$ $\Delta U = 700 - 390$ $= \mathbf{310 \text{ J}}$
16.	Entropy of system is +ve Entropy of surroundings is -ve
17.	The energy of an isolated system is constant. $\Delta U = q + w$
18.	$\Delta_{sol}H^\theta = \Delta_{lattice}H^\theta + \Delta_{hyd}H^\theta$ $= (788) + (-406 + -378 \text{ kJ})$ $= +4 \text{ kJ mol}^{-1}$
19.	a) Total heat content of a system. It is equal to the internal energy of the system plus the product of pressure and volume.

	$H = U + PV$ <p>b) An extensive property is a property whose value depends on the quantity or size of matter present in the system.</p>													
20.	$\Delta H = \Delta U + \Delta n_g R T$ $\Delta U = \Delta H - \Delta n_g R T$ $= (-4000) - (-2 \times 8.314 \times 300)$ $= + 988.4 \text{ J mol}^{-1}$													
21.	$\Delta_r G^\theta = -2.303 RT \log K$ $= -2.303 \times 8.314 \times 300 \times \log 100$ $= -11488.28 \text{ J mol}^{-1}$													
22.	$\Delta_r H = (0.5 \times 436 + 0.5 \times 242) - 431$ $= -92 \text{ kJ mol}^{-1}$													
23.	<table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td colspan="2" rowspan="2"></td> <th colspan="2">ΔH_{sys}</th> </tr> <tr> <th>Positive</th> <th>Negative</th> </tr> <tr> <th rowspan="2">ΔS_{sys}</th> <th>Positive</th> <td>Spontaneous only at high temperature</td> <td>Always spontaneous</td> </tr> <tr> <th>Negative</th> <td>Never spontaneous</td> <td>Spontaneous only at low temperature</td> </tr> </table>			ΔH_{sys}		Positive	Negative	ΔS_{sys}	Positive	Spontaneous only at high temperature	Always spontaneous	Negative	Never spontaneous	Spontaneous only at low temperature
				ΔH_{sys}										
		Positive	Negative											
ΔS_{sys}	Positive	Spontaneous only at high temperature	Always spontaneous											
	Negative	Never spontaneous	Spontaneous only at low temperature											
24.	<p>a) Entropy increases.</p> <p>b) Entropy increases.</p> <p>c) Entropy decreases.</p>													
25.	$\Delta G = \Delta H - T\Delta S$ $\Delta G = 0, \Delta H = T\Delta S$ $T = 500 \text{ K}$ <p>Above 500 K, reaction is spontaneous.</p>													

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