PHYSICAL CHEMISTRY

DPP

DAILY PRACTICE PROBLEMS

DPP No. 47

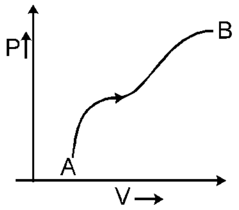
Total Marks : 30

Max. Time : 30 min.

Topic : Thermodynamics & Thermochemistry

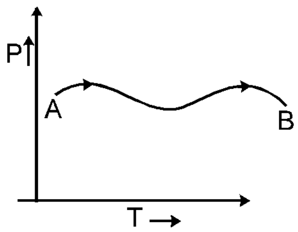
Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.7	(3 marks, 3 min.)	[21, 21]
Comprehension ('–1' negative marking) Q.8 to Q.10	(3 marks, 3 min.)	[9, 9]

1. The graph given below shows the P-V plot for a process on an ideal gas. Select the correct statement :



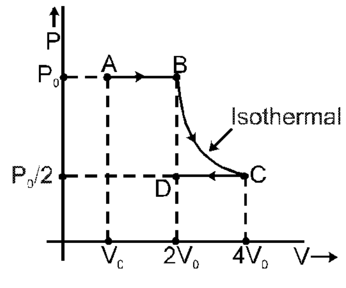
(A) Enthalpy content of the gas is constantly increasing and the process is carried out slowly.
(B) Enthalpy content of the gas first increases, then decreases and the process is carried out quasistaticly.
(C) Enthalpy content of the gas is constant and the process takes infinite time for completion.
(D) Enthalpy content first decreases, then increases and the process is reversible.

2. The P-T graph, as given below, was observed for a process on an ideal gas. Which of the following statement is true :



(A) W = +ve, ΔH = +ve	(B) W = –ve, ΔH = – ve
(C) W = –ve, ΔH = + ve	(D) W = +ve, ΔH = –ve

3. q, W, ΔE and ΔH for the following process ABCD on a monoatomic gas are :

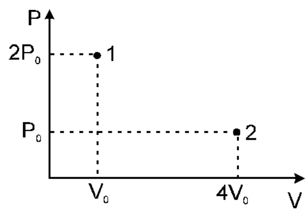


(A) $W = -2P_0V_0 \ln 2$,	$q = 2P_0V_0 \ln 2$,	$\Delta E = 0$,	$\Delta H = 0$
(B) $W = -2P_0V_0 \ln 2$,	$q = 2P_0V_0 \ln 2$,	$\Delta E = 0$,	$\Delta H = 2P_0V_0 \ln 2$
(C) $W = -P_0V_0(1+\ln 2)$,	$q = P_0V_0(1+\ln 2)$	$\Delta E = 0$,	$\Delta H = 0$
(D) $W = -P_0V_0 \ln 2$,	$q = P_0V_0 \ln 2$,	$\Delta E = 0$,	$\Delta H = 0$

4. A system containing a real gas changes it's state form state-1 to state-2.
State-1 (3 atm, 2L, 300 K)
State-2 (5 atm, 4L, 500 K)
If change in internal energy = 30 L atm, then calculate change in enthalpy :

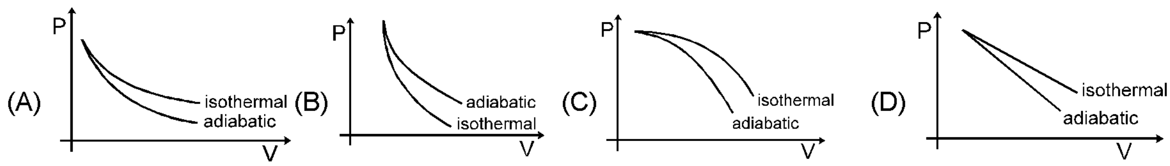
(A) 44 L atm	(B) 35 L atm	(C) 40 L atm	(D) None of these

5. A liquid which is confined inside an adiabatic piston is suddenly taken from state-1 to state-2 by a single stage irreversible process. If the piston comes to rest at point 2 as shown, then the enthalpy change for the process will be :

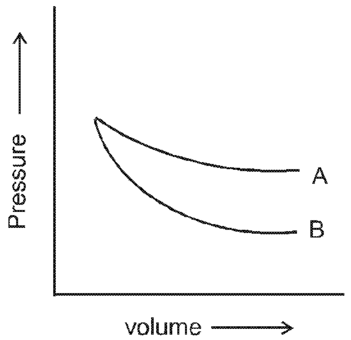


(A) $\Delta H = \frac{2\gamma P_0V_0}{\gamma - 1}$ (B) $\Delta H = \frac{3\gamma P_0V_0}{\gamma - 1}$ (C) $\Delta H = -P_0V_0$ (D) None of these

6. The correct figure representing isothermal and adiabatic expansions of an ideal gas from a particular initial state is :



7. P–V plots for two gases during an adiabatic process are given in the figure :

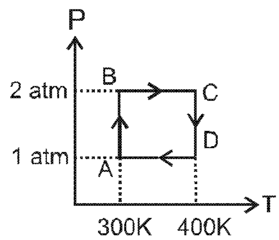


Plot A and plot B should correspond to :

(A) He and O_2 (B) He and Ar (C) O_2 and He (D) O_2 and F_2

Comprehension # (Q. Nos. 8 to 10)

One mole of Helium gas undergoes a reversible cyclic process ABCDA as shown in the figure. Assuming gas to be ideal, answer the following questions:



8. What is the value of ΔH for the overall cyclic process :

(A) $-100\ R\ell n2$ (B) $+100R\ell n2$ (C) $+200R\ell n2$ (D) Zero

9. What is the value of 'q' for the overall cyclic process :

(A) $-100\ R\ell n2$ (B) $+100R\ell n2$ (C) $+200R\ell n2$ (D) $-200R\ell n2$

10. What is the net work involved in the cyclic process :

(A) $-100\ R\ell n2$ (B) $+100R\ell n2$ (C) $+200R\ell n2$ (D) $-200R\ell n2$

Answer Key

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1.	(A)	**2.**	(C)	**3.**	(A)	**4.**	(A)	**5.**	(C)
6.	(A)	**7.**	(C)	**8.**	(D)	**9.**	(B)	**10.**	(A)

Hints & Solutions

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1. The product PV is increasing so temperature will keep or increasing in the process, hence
$\Delta H = \Delta E + \Delta(PV)$ will increase constantly.

2. From graph we know that $V_B > V_A$, so expansion has taken place so w will be with –ve sign and ΔH will be +ve as both ΔE and $\Delta(PV)$ have increased.

3. At A and D the temperatures of the gas will be equal, so
$\Delta E = 0, \quad \Delta H = 0$
Now $w = W_{AB} + W_{BC} + W_{CD} = -P_0V_0 - 2P_0V_0 \ln 2 + P_0V_0 = -2P_0V_0 \ln 2$
and $q = -W = 2P_0V_0 \ln 2$

5. Since liquid is expanding against external pressure P_0 hence work done
$w = -P_0(4V_0 - V_0) = -3P_0V_0$
$\Delta U = w = -3P_0V_0$
$\Rightarrow \quad \Delta H = \Delta U + P_2V_2 - P_1V_1 = -3P_0V_0 + 4P_0V_0 - 2P_0V_0$.

7. γ for O_2 = 1.44 γ for He = 1.66.

8. Since, ΔH is a state function, and the final state attained by the gas is same as its initial state, so value of $\Delta H = 0$.

9. $q = q_{AB} + q_{BC} + q_{CD} + q_{DA}$

$$= -1R \times 300\ell n2 + 1 \times \frac{5R}{2} \times (400 - 300) + 1R \times 400\ell n2 + 1 \times \frac{5R}{2} \times (300 - 400)$$

($\because q_{AB} = -W_{AB} = -1R \times 300\ell n2$ since process is reversible isothermal for which $\Delta U = 0$).

($\because q_{BC} = \Delta H_{BC} = 1 \times \frac{5R}{2} \times (400 - 300)$ since process is reversible isobaric).

($\because q_{CD} = -W_{CD} = 1R \times 300\ell n2$ since process is reversible isothermal for which $\Delta U = 0$).

($\because q_{DA} = \Delta H_{AB} = 1 \times \frac{5R}{2} \times (300 - 400)$ since process is reversible isobaric).

So, $q = 100 R\ell n2$.

10. Since, for a cyclic process, $\Delta U = 0$.
So, $W = -q = -100 R\ell n2$.