PHYSICAL CHEMISTRY

DPP

DAILY PRACTICE PROBLEMS

DPP No. 46

Total Marks : 28

Max. Time : 30 min.

Topic : Thermodynamics & Thermochemistry

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.5	(3 marks, 3 min.)	[15, 15]
Subjective Questions ('–1' negative marking) Q.6 to Q.8	(4 marks, 5 min.)	[12, 15]
True or False (no negative marking) Q.9	(2 marks, 2 min.)	[2, 2]

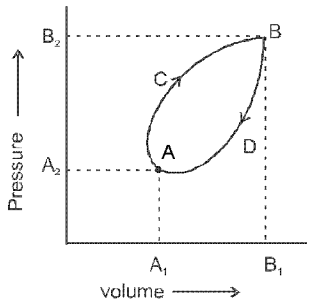
1. In a system, a piston caused an expansion against an external pressure of 1.2 atm giving a change in volume of 32 L for which $\Delta E = -51$ kJ. What was the value of heat involved : (Take 1 L atm = 100 J)
(A) –36 kJ (B) –13 kJ (C) –47 kJ (D) 24 kJ

2. The q value and work done in isothermal reversible expansion of one mole of an ideal gas from initial pressure of 1 bar to final pressure of 0.1 bar at constant temperature 273 K are :
(A) 5.22 kJ, –5.22 kJ (B) –5.22 kJ, 5.22 kJ (C) 5.22 kJ, 5.22 kJ (D) –5.22 kJ, –5.22 kJ

3. What is the difference between change in enthalpy and change in internal energy at constant volume :
(A) 0 (B) VdP (C) –VdP (D) +PdV

4. Calculate work done when 1 mole of an ideal gas is expanded from 10 L to 20 L against a constant 1 atm pressure at constant temperature of 300 K :
(A) 7.78 kJ (B) –1.013 kJ (C) 11.73 kJ (D) –4.78 kJ

5. A thermodynamic system goes in cyclic reversible process as represented in the following P–V diagram :
The net work done during the complete cycle is given by the area :
(A) cycle ACBDA (B) AA_1B_1BDA
(C) AA_2B_2B (D) AA_1B_1BCA



6. The valve on a cylinder containing initially 10 liters of an ideal gas at 25 atm and 25°C is opened to the atmosphere, where the pressure is 760 torr and the temperature is 25°C. Assuming that the process is isothermal, how much work in L atm is done on the atmosphere by the action of expanding gas ?

7. 20 g Ar gas is allowed to expand reversibly and isothermally at 300 K from 5 L to 10 L. Calculate the approximate value of work done. (Take R = 8.3 J/K/mole, at.wt of Ar = 40)

8. A horizontal piston-cylinder arrangement is placed in a constant temperature bath. The piston slides in the cylinder with negligible friction, and an external force holds it in place against an initial gas pressure of 14 bar. The initial gas volume is 0.03 m^3.
(a) The external force on the piston is reduced gradually, allowing the gas to expand until its volume doubles. Calculate the work done by the gas in moving the external force.
(b) How much work would be done if the same expansion is carried out by removing a part of the external force suddenly. Also calculate efficiency of this process as compared with the reversible process.

9. Which of the following statements are correct (T/F) :
(a) I^{st} law of thermodynamics can be applied on the individual particle enclosed in vessel.
(b) Many thermodynamic properties cannot be measured absolutely, so change in thermodynamic property is required for calculation.
(c) Feasibility of any chemical reaction cannot be explained by thermodynamics.
(d) When surroundings are always in equilibrium with the system, the process is called reversible.
(e) Between same initial and final states, work done by gas in isothermal irreversible expansion is less than the work in isothermal reversible expansion.

Answer Key

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1.	(C)	**2.**	(A)	**3.**	(B)	**4.**	(B)	**5.**	(A)
7.	– 859 J	**9.**	(a) F (b) T (c) F (d) T (e) T	**6.**	W = 240 L atm.				

Hints & Solutions

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1. $w = P_{ext}\,\Delta V$

$w = -1.2 \times 32 = -38.4$ lt atm.

$= -38.4 \times 100$ J $= -3840$ J $= -3.84$ kJ

$\Delta E = q + w$

so, $q = \Delta E - w = -51 + 3.84 = -47.16$.

6. W = 240 L atm.

7. $\Delta U = \Delta H = 0 \quad Q = -W$

$$W = -2.303\,nRT \log \frac{V_2}{V_1} \quad \Rightarrow \quad W = -2.3 \times \frac{20}{40} \times 8.3 \times 300 \log \frac{10}{5} = -859.05 \text{ J.}$$

8. (a) $W = -nRT \ln \dfrac{V_2}{V_1}$

$$W = -P_1V_1 \ln \frac{V_2}{V_1} = -14 \times 0.03 \ln \frac{0.06}{0.03} \text{ bar m}^3 = -14 \times 0.7 \times 0.03 = \textbf{– 0.294 bar m}^3 \textbf{ Ans.}$$

(b) $P_1V_1 = P_2V_2$

$$\therefore \quad P_2 = \frac{P_1V_1}{V_2} = \frac{14 \times 0.03}{0.06} = 7 \text{ bar}$$

$$\therefore \quad W = -P_{ext}(V_2 - V_1) = -7\,(0.06 - 0.03) = -7 \times 0.03 = -0.21 \text{ bar m}^3.$$

$$\text{Efficiency} = \frac{0.21}{0.294} = 71.43\% \textbf{ Ans.}$$

9. (a) F (b) T (c) F (d) T (e) T