Single Correct Answer Type:

1. The internal energy change when 5 kJ of work is done on the system and 15 kJ of heat is given out by the system

   (A) 20 kJ (B) 10 kJ (C) 0 kJ (D) 15 kJ

2. A 5 litre cylinder contained 10 moles of oxygen gas at $27°C$. Due to sudden leakage through the hole, all the gas escaped into the atmosphere and cylinder got empty. If the atmospheric pressure is 1.0 atmosphere, the work done by the gas is

   (A) -24443.7 J (B) -48886.1 J (C) -101.3 J (D) -2016.8 J

3. The heat of combustion of benzene in a bomb calorimeter was found to be $3263.9\ kJ.mol^{-1}$ at $25°C$. Then the heat of combustion of benzene at constant pressure is

   (A) 3267.6 kJ (B) -3263.9 kJ (C) -3267.6 kJ (D) -3260.2 kJ

4. One mole of an ideal gas at 300 K is expanded isothermally from an initial volume of 1 L to 10 L. The ΔE for this process is $\left(R = 2\ cal.mol^{-1}.k^{-1}\right)$

   (A) 163.7 cal (B) zero (C) 138.1 cal (D) 9 L.atm

5. When 1 mol of a gas is heated at constant volume, temperature is raised from 298 to 308 k. Heat supplied to the gas is 500 J. Then which statement is correct.

   (A) $q = w = 500\,J, \Delta U = 0$ (B) $q = \Delta U = 500\,J, w = 0$

   (C) $q = w = 500\,J, \Delta U = 0$ (D) $\Delta U = 0, q = w = -500\,J$

6. For the reaction $2H_2 + O_2 \longrightarrow 2H_2O,\ \Delta H = -571\,kJ$. Bond energy of H – H is 435 kJ and O = O is 498 kJ. Then the average bond energy of O – H bond will be

   (A) 484 kJ (B) – 484 kJ (C) 271 kJ (D) – 271 kJ

7. For the process $H_2O_{(\ell)}\left(1\,bar, 373k\right) \longrightarrow H_2O_{(s)}\left(1\,bar, 373k\right)$, the correct set of thermodynamic parameters is _____

   (A) $\Delta G = 0, \Delta S = +ve$ (B) $\Delta G = 0, \Delta S = -ve$ (C) $\Delta G = +ve, \Delta S = 0$ (D) $\Delta G = -ve, \Delta S = +ve$

8. The values of ΔH and ΔS for the reaction $C_{(gra)} + CO_{2(g)} \longrightarrow 2CO_{(g)}$ are 170 kJ and 170 JK^{-1} respectively. This reaction will be spontaneous at

   (A) 910 K (B) 1110 K (B) 510 K (D) 710 K

9. For the reaction $A \longrightarrow B,\ \Delta H = +24\ kJ/mole$

   For the reaction $B \longrightarrow C,\ \Delta H = -18\ kJ/mole$

   The decreasing order of enthalpy of A, B, C follows the order

   (A) A, B, C (B) B, C, A (C) C, B, A (D) C, A, B

10. For a gaseous reaction $A + 3B \rightleftharpoons 2C,\ \Delta H° = -90\ kJ,\ \Delta S° = -200\ Jk^{-1}$ at 400 K

    What is $\Delta G°$ for the reaction $\frac{1}{2}A + \frac{3}{2}B \rightleftharpoons C$ at 400 K?

    (A) -5 kJ (B) -10 kJ (C) -15 kJ (D) -20 kJ

11. The entropy change involved in conversion of one mole of solid ice at 273 K to liquid water at the same temperature (latent heat of fusion = 6025 $J.mol^{-1}$)

(A) 22.1 Jk^{-1} mol^{-1} (B) 23.8 Jk^{-1} mol^{-1} (C) 29.2 Jk^{-1} mol^{-1} (D) 30.7 Jk^{-1} mol^{-1}

12. Enthalpy of solution (ΔH) for $BaCl_2.2H_2O$ and $BaCl_2$ are 8.8 and -20.6 $kJ.mol^{-1}$ respectively. Calculate the heat of hydration of $BaCl_2.2H_2O$

(A) – 12.3 kJ (B) – 29.4 kJ (C) – 33 kJ (C) – 48 kJ

13. How many of the following are extensive properties. Mass, Volume, density, concentration, Free energy, entropy, specific heat, enthalpy, internal energy, temperature, pressure

(A) 4 (B) 3 (C) 7 (D) 6

14. The enthalpies of combustion of $C_{(graphite)}$ and $C_{(diamond)}$ are – 393.5 and – 395.4 kJ/mol respectively. The enthalpy of conversion of $C_{(graphite)}$ to $C_{(diamond)}$ in kJ/mol is

(A) 1.9 (B) 1.5 (C) 2.7 (D) 4.5

15. ΔH_f^0 298 K of methanol is given by the chemical equation:

(A) $CH_4(g)+\frac{1}{2}O_2(g)\longrightarrow CH_3OH(g)$

(B) $C(\text{graphite})+\frac{1}{2}O_2(g)+2H_2(g)\longrightarrow CH_3OH(\iota)$

(C) $C(\text{diamond})+\frac{1}{2}O_2(g)+2H_2(g)\longrightarrow CH_3OH(\iota)$

(D) $CO(g)+2H_2(g)\longrightarrow CH_3OH(\iota)$

16. The standard molar heat of formation of ethane, CO_2 and H_2O (ι) are respectively – 21 .1, – 94.1 and – 68.3 kcal. The standard molar heat of combustion of ethane will be

(A) – 372 kcal (B) – 240 kcal (C) 162 kcal (D) 183.5 kcal

17. When ethyne is passed through a red hot tube, then formation of benzene takes place:

$\Delta H^0_{f\,(C_2H_2)(g)} = 230\ kJmol^{-1}$

$\Delta H^0_{f\,(C_2H_6)(g)} = 85\ kJmol^{-1}$

Calculate the standard heat of trimerisation of ethyne to benzene

$3C_2H_2(g)\longrightarrow C_6H_6(g)$

(A) 205 $kJmol^{-1}$ (B) 605 $kJmol^{-1}$ (C) -605 $kJmol^{-1}$ (D) -205 $kJmol^{-1}$

18. $F_2(g)+2HCl(g)\longrightarrow 2HF(g)+Cl_2(g)$;

$\Delta H^\circ = -352.18$ kJ

$\Delta H^\circ_{f\,(HF)} = -268.3$ kJ

The heat of formation of HCl will be:

(A) -22 kJ mol^{-1} (B) 88 kJ mol^{-1} (C) -92.21 kJ mol^{-1} (D) -183.8 kJ mol^{-1}

19. Equal volumes of 1 M HCl and 1 M H_2SO_4 are neutralised by 1 M NaOH solution and x and y kJ/equivalent of heat are liberated respectively. Which of the following relations is correct?

(A) x = 2y (B) x = 3y (C) x = 4y (D) x = 1/2 y

20. Use the bond energies in the table to estimate ΔH for this reaction:

$CH_2 = CH_2 + Cl_2 \longrightarrow ClCH_2 - CH_2Cl$

Bond	C – C	C = C	C – Cl	C – H	Cl – Cl
Bond energy (kJ/mol)	347	612	331	414	243

(A) $\Delta H = -684$ kJ (B) $\Delta H = -154$ kJ (C) $\Delta H = +89$ kJ (D) $\Delta H = +177$ kJ

Numerical Based:

21. Calculate the theoretical maximum efficiency of a heat engine operating between 373 K and 173 K

22. The following data is known about the melting of KCl: $\Delta H = 7.25$ kJ mol^{-1} and $\Delta S = +0.007$ J K^{-1} mol^{-1}. Calculate its melting point. (in Kelvin)

23. Calculate the internal energy (in kcal) change for the process in which 1.0 kcal of heat is added to 1.2 litre of O_2 gas in a cylinder at constant pressure of 1.0 atm and the volume changes to 1.5 litre.

24. A sample of a gas in a cylinder contracts by 7.5 litres at a constant pressure of 5.0 atmosphere. How much work (in lit.atm) is done on the gas by the surroundings?

25. Calculate the standard heat of formation (in kcal) of $C_{10}H_8$ (naphthalene) if standard heat of combustion of naphthalene is – 1231.0 kcal at 298 K and standard heat of formation of $CO_2(g)$ and $H_2O(\iota)$ are – 94.0 kcal and – 68.4 kcal respectively.

KEY

1.	B	2.	A	3.	C	4.	B	5.	B
6.	A	7.	A	8.	B	9.	B	10.	A
11.	A	12.	B	13.	D	14.	A	15.	B
16.	A	17.	C	18.	C	19.	D	20.	B
21.	0.54	22.	1035.7	23.	0.993	24.	37.5	25.	17.4