1.What will be the entropy change for the reaction, $2H_{2(g)} + O_{2(g)} \rightarrow 2H_2O_{(l)}$ at 300 K?
(Standard entropies of $H_{2(g)}$, $O_{2(g)}$ and $H_2O_{(l)}$ are 126.6, 201.20 and 68.0 J $K^{-1}$ $mol^{-1}$ respectively.)
1. –318.4 $JK^{-1}mol^{-1}$ 2. 318.4 $JK^{-1}mol^{-1}$ 3. 31.84 $JK^{-1}mol^{-1}$ 4. 21.84 $JK^{-1}mol^{-1}$ 5. None of these

**2.** For a given reaction, $\Delta H$ = 35.5kJ $mol^{-1}$ and $\Delta S$ = 83.6$JK^{-1}mol^{-1}$. The reaction is spontaneous at (Assume that $\Delta H$ and $\Delta S$ do not vary with temperature.)
1. $T > 425$ K 2. all temperatures 3. $T > 298$ K 4. $T < 425$ K 5. $T < 298$ K

3. 4 g of graphite is burnt in a bomb calorimeter of heat capacity of 30 kJ $K^{-1}$ in excess of oxygen at 1 atmospheric pressure. _e temperature rises from 300 K to 304 K. What is the enthalpy of combustion of graphite (in kJ $mol^{-1}$)?
1. 360 2. 1440 3. –360 4. –1440 5. 260

**4.** The following data are available for the melting of KCl : $\Delta H_{fus}$ = 7.25 kJ $mol^{-1}$ and $\Delta S_{fus}$ = 0.007 kJ $K^{-1}$ $mol^{-1}$. Calculate the melting point of KCl.
1. 1035.7 K 2. 762.7 K 3. 897.5 K 4. 1308.7 K 5.OK

**5.** In which reaction, $\Delta S$ is positive?
(a) $H_2O_{(l)} \rightarrow H_2O_{(s)}$
(b) $3O_{2(g)} \rightarrow 2O_{3(g)}$
(c) $H_2O_{(l)} \rightarrow H_2O_{(g)}$
(d) $N_{2(g)} + 3H_{2(g)} \rightarrow 2NH_{3(g)}$

**6.** A reaction, $A + B \rightarrow C + D + q$ is found to have a positive entropy change. The reaction will be
(a) possible at high temperature
(b) possible only at low temperature
(c) not possible at any temperature
(d) possible at any temperature.

**7.** If an endothermic reaction occurs spontaneously at constant temperature $T$ and pressure $P$, then which of the following is true?
(a) $\Delta G > 0$ (b) $\Delta H < 0$ (c) $\Delta S > 0$ (d) $\Delta S < 0$

**8.** Given : $C + 2S \rightarrow CS_2$ ; $\Delta H$ = 117 kJ $mol^{-1}$
$C + O_2 \rightarrow CO_2$ ; $\Delta H$ = – 393 kJ $mol^{-1}$
$S + O_2 \rightarrow SO_2$ $\Delta H$ = –297 kJ $mol^{-1}$
The heat of combustion of $CS_2$ to form $CO_2$ and $SO_2$ is
1. –1104 kJ $mol^{-1}$ 2. 1104 kJ $mol^{-1}$ 3. + 807 kJ $mol^{-1}$ 4. –807 kJ $mol^{-1}$ 5. –297 kJ $mol^{-1}$

9.Calculate $\Delta_f H°$ for the reaction $Ag^+(aq) + Cl^-(aq) \rightarrow AgCl$ (s) at 25°C.
Given :
$\Delta_f H°$ ($Ag^+$, aq) = 105.58 kJ $mol^{-1}$,
$\Delta_f H°$ ($Cl^-$, aq) = –167.16 kJ $mol^{-1}$ and $\Delta_f H°$ (AgCl, s) = –127.07 kJ $mol^{-1}$

10. Enthalpy of neutralization of HCl by NaOH is –57.32 kJ $mol^{-1}$ and by $NH_4OH$ is –51.34 kJ $mol^{-1}$. Calculate the enthalpy of dissociation of $NH_4OH$.
1. 5.98 kJ/$mol^{-1}$ 2. 5.98 kJ/$mol^{-1}$ 3. 5.98 kJ/$mol^{-1}$ 4. 5.98 kJ/$mol^{-1}$ 5. 5.98 kJ/$mol^{-1}$

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PART II

I.A.Consider the following thermochemical data .

The standard enthalpy of formation of C2H6= -85kjmol-1
The standard enthalpy change for the reaction. 2H(g) → H2 (g)= -436kjmol-1
The standard enthalpy change for the reaction 2C(g) → C-C (g)= -348kjmol-1
The standard enthalpy of atomisation of C(graphite) is= +715kjmol-1
using the above data, calculate the standard mean bond dissociation enthalpy of C H pertaining to C2H6

B.The following data are provided

Table-1

| Substance | Standard enthalpy of Combustion(KJ mol-1) |
|---|---|
| $C_{(Graphite)}$ | -394 |
| $H_2$ | -286 |

Table-2

| Heat source | Standard enthalpy of formation(KJ mol-1) |
|---|---|
| $C_3H_{8(g)}$ | -104 |
| $C_8H_{18(l)}$ | -237 |

i. Calculate the standard enthalpies of combustion of C3H8(g) and $C_8H_{18(l)}$
ii. Calculate the amount of heat needed to increase the temperature of 500g of water from $25^0$C to $70^0$C(Heat capacity of water is 4.2 $Jg^{-1}c^{-1}$)
iii. Assuming complete combustion would take place, calculate the mass of $CO_2$ emitted in each when the above process (iii) is carried out using
    i. $C_3H_{8(g)}$ as the fuel
    ii. $C_8H_{18(l)}$ as the fuel
iv. Based on your calculations in (ii) above deduce, which of the two compounds would be more advantageous as a heat source

c)Write down chemical equation for the reaction appropriate to each of the following statement at standard state

i. The standard enthalpy of 1st electron affinity of $F_{(g)}$
ii. The standard enthalpy of laltice of $KBr_{(s)}$
iii. The standard enthalpy of formation of trinitrotoluene,$C_7H_5N_3O_{6(l)}$
iv. The standard enthalpy of combustion of $C_6H_{12}O_{6(s)}$
v. The standard enthalpy of 3rd ionization of Al
vi. The standard enthalpy of hydration of $Mg^{2+}$ ion.

d)Explain how you would determine in laboratory standard neutratization enthalpy of strong acid and strong base.

E. (*a*) Consider the following reaction at a temperature of 25 °C.

**AB**(s) ⟶ **C**(s) + **D**(g)

The following data are given for $\Delta H_f^\circ$ and $S^\circ$ at 25 °C.

| | $\Delta H_f^\circ$ /kJ mol$^{-1}$ | $S^\circ$ /J K$^{-1}$ mol$^{-1}$ |
|---|---|---|
| **AB**(s) | −1208 | 100 |
| **C**(s) | −600 | 50 |
| **D**(g) | −500 | 170 |

(i) Show that the reaction is **non-spontaneous** at 25 °C.

(ii) This reaction is spontaneous when the temperature is greater than T °C. This reaction is non-spontaneous when the temperature is less than T °C. Calculate T.

(iii) State the assumptions you made in the calculation in (ii) above.



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