**Q1 (20 July 2021 Shift 1)**

An average person needs about 10000 kJ energy per day. The amount of glucose (molar mass $= 180.0 \text{ g mol}^{-1}$ ) needed to meet this energy requirement is ___ $g$.
$\left(\text{ Use : } \Delta_C \text{H( glucose )} = -2700 \text{ kJ mol}^{-1}\right)$

**Q2 (20 July 2021 Shift 2)**

For a given chemical reaction $\text{A} \rightarrow \text{B}$ at 300 K the free energy change is $-49.4 \text{ kJ mol}^{-1}$ and the enthalpy of reaction is $51.4 \text{ kJ mol}^{-1}$. The entropy change of the reaction is ___ $\text{JK}^{-1} \text{ mol}^{-1}$

**Q3 (22 July 2021 Shift 1)**

If the standard molar enthalpy change for combustion of graphite powder is $-2.48 \times 10^2 \text{ kJ mol}^{-1}$, the amount of heat generated on combustion of 1 g
of graphite powder is _____ kJ. (Nearest integer)

**Q4 (25 July 2021 Shift 1)**

At 298.2 K the relationship between enthalpy of bond dissociation (in $\text{kJmol}^{-1}$ ) for hydrogen $(\text{E}_\text{H})$ and its isotope, deuterium $(\text{E}_\text{D})$, is best described by:

(1) $\text{E}_\text{H} = \frac{1}{2}\text{E}_\text{D}$

(2) $E_H = E_D$

(3) $\text{E}_\text{H} = \text{E}_\text{D} - 7.5$

(4) $\text{E}_\text{H} = 2\text{E}_\text{D}$

**Q5 (25 July 2021 Shift 1)**

At 298 K, the enthalpy of fusion of a solid $(\text{X})$ is $2.8 \text{ kJ mol}^{-1}$ and the enthalpy of vaporisation of the liquid $(\text{X})$ is $98.2 \text{ kJ mol}^{-1}$. The enthalpy of sublimation of the substance $(\text{X})$ in $\text{kJmol}^{-1}$ is
(in nearest integer)

**Q6 (25 July 2021 Shift 2)**

A system does 200 J of work and at the same time absorbs 150 J of heat. The magnitude of the change in internal energy is J. (Nearest integer)

**Q7 (27 July 2021 Shift 1)**

For water at $100^{\circ}\mathrm{C}$ and 1 bar,
$\Delta_{\mathrm{vap}} H-\Delta_{\mathrm{vap}} U=$
$\times 10^2 \mathrm{~J~mol}^{-1}$
(Round off to the Nearest Integer)
[Use: $\mathrm{R}=8.31 \mathrm{~J~mol}^{-1} \mathrm{~K}^{-1}$]
[Assume volume of $\mathrm{H_2O(l)}$ is much smaller than volume of $\mathrm{H_2O(g)}$. Assume $\mathrm{H_2O(g)}$ treated as an ideal gas]

**Q8 (27 July 2021 Shift 2)**

When 400 mL of $0.2 \mathrm{M} \mathrm{H_2SO_4}$ solution is mixed
with 600 mL of $0.1 \mathrm{M} \mathrm{NaOH}$ solution, the
increase in temperature of the final solution is $-10^{-2}$ K. (Round off to the nearest integer).
[ Use : $\mathrm{H}^{+}(\mathrm{aq})+\mathrm{OH}^{-}(\mathrm{aq}) \rightarrow \mathrm{H_2O}$ :

$$\Delta_{\gamma} \mathrm{H}=-57.1 \mathrm{~kJ~mol}^{-1}]$$

Specific heat of $\mathrm{H_2O}=4.18 \mathrm{~J~K}^{-1} \mathrm{~g}^{-1}$
density of $\mathrm{H_2O}=1.0 \mathrm{~g~cm}^{-3}$
Assume no change in volume of solution on mixing.

# Answer Key

**Q1** (667) **Q2** (360) **Q3** (21) **Q4** (3)

**Q5** (101) **Q6** (50) **Q7** (31) **Q8** (2)

**Q1**

1 mole glucose give 2700 kJ energy so mole of glucose needed for $10^5$ kJ energy $= \frac{10000}{2700} = 370$ moles

wt. of glucose $= 3.10 \times 180$

$= 666.666$

$\approx 667\text{gm}$

$\frac{Y_{\text{Benzene}}}{Y_{\text{M.B}}} = \frac{P_B^0 X_B}{P_{MB}^0 X_{MB}} = \frac{70 \times 1}{20 \times 1} = \frac{7}{2}$

$Y_{\text{Benzene}} = \frac{7}{9} = 77.77 \times 10^{-2}$

$= 78 \times 10^{-12}$

**Q2**

Given chemical reaction:

$A \underset{T300\,K}{\longrightarrow} B [\Delta G]_{P,T} = -49.4\,\text{kJ/mol}$

$\Delta H_{rxn} = 51.4\,\text{kJ/mol}$

$\Delta S_{rxn} = ?$

$\Rightarrow$ From the relation $[\Delta G]_{P,T} = \Delta H - T\Delta S$

$$\Rightarrow \Delta S_{rxn} = \frac{\Delta H_{rxn} - [\Delta G]_{P,T}}{T}$$

$$= \frac{[51.4 - (-49.4)] \times 1000}{300} \frac{J}{molK}$$

$$\Rightarrow \Delta S_{rxn} = 336 \frac{J}{molK}$$

**Q3**

1 mol graphite $= 12\text{gmC}$

Ans. $= \frac{248}{12} = 20.67\,\text{kJ/gm}$ heat evolved

**Q4**

Enthalpy of bond dissociation (kJ/mole) at 298.2 K For, hydrogen $= 435.88$ For, Deuterium $= 443.35$

$E_H \simeq E_D - 7.5$

**Q5**

$\Delta H_{ab} = \Delta H_{fis} + \Delta H_{vqp}$

$= 2.8 + 98.2$

$= 101\ kJ/mol$

**Q6**

$w = -200\ J, q = +150 : \Delta U = q + w$

$\Delta U = 150 - 200 = -50\ J : \text{magnitude} = 50\ J = |\Delta U|$

**Q7**

$H_2O_{(\theta)} \rightleftharpoons H_2O_{(v)}$

$\Delta H = \Delta U + \Delta n_g RT$

for 1 mole waters ;

$\Delta n_g = 1$

$\therefore \Delta n_g RT = 1\ mol \times 8.31\ J/mol - k \times 373\ K$

$= 3099.63\ J \cong 31 \times 10^2\ J$

**Q8**

$n_{H^+} = \frac{400 \times 0.2}{1000} \times 2 = 0.16$

$n_{OH^-} = \frac{600 \times 0.1}{1000} = 0.06$

Now, heat liberated from reaction

$=$ heat gained by solutions

or, $0.06 \times 57.1 \times 10^3$

$= (1000 \times 1.0) \times 4.18 \times \Delta T$

$\therefore \Delta T = 0.8196\ K$

$= 81.96 \times 10^{-2}\ K \approx 82 \times 10^{-2}\ K$