Thermochemistry

DPP-7 [Bond Enthalpy]

"No one said it'd be easy. But doing it anyway? That's powerful."

Q1. Bond energy of a molecule :

(1) Is always negative

(2) Is always positive

(3) Either positive or negative

(4) Depends upon the physical state of the system

Q2. Among the following for which reaction heat of reaction represents bond energy of HCl?

(1) $HCl(g) \rightarrow H^+(g) + Cl^-(g)$

(2) $HCl(g) \rightarrow H(g) + Cl(g)$

(3) $2HCl(g) \rightarrow H_2(g) + Cl_2(g)$

(4) $H_2(g) + Cl_2(g) \rightarrow 2HCl(g)$

Q3. The bond energies of F_2, Cl_2, Br_2, and I_2 are 155.4, 243.6, 193.2, and 151.2 kJ mol^{-1} respectively. The strongest bond is :

(1) F–F

(2) Br–Br

(3) I–I

(4) Cl–Cl

Q4. Which of the following methods for calculation of heat of reaction is not correct?

(1) $\Delta H_{\text{reaction}} = \sum \Delta H_{\text{f(products)}} - \sum \Delta H_{\text{f(reactants)}}$

(2) $\Delta H_{\text{reaction}} = \sum B.E._{\text{(reactants)}} - \sum B.E._{\text{(products)}}$

(3) $\Delta H_{\text{reaction}} = \sum \Delta H_{\text{comb(reactants)}} - \sum \Delta H_{\text{comb(products)}}$

(4) $\Delta H_{\text{reaction}} = \sum \Delta H_{\text{solution(reactants)}} + \sum \Delta H_{\text{solution(products)}}$

Q5. The standard enthalpy of formation ($H_f°$) at 298 K for methane, $CH_4(g)$, is –74.8 kJ mol^{-1}. The additional information required to determine the average energy for C–H bond formation would be :

(1) Latent heat of vaporization of methane

(2) The first four ionization energies of carbon and electron gain enthalpy of hydrogen

(3) The dissociation energy of hydrogen molecule H_2

(4) The dissociation energy of H_2 and enthalpy of sublimation of carbon

Q6. **The enthalpy changes at 298 K in successive breaking of O–H bonds of water are :**

$$\mathbf{H_2O(g) \rightarrow H(g) + OH(g)} \quad \Delta H = 498 \ \mathbf{kJ\ mol^{-1}}$$
$$\mathbf{OH(g) \rightarrow H(g) + O(g)} \quad \Delta H = 428 \ \mathbf{kJ\ mol^{-1}}$$

The bond enthalpy of O–H bond is :

(1) 498 kJ mol^{-1}

(2) 428 kJ mol^{-1}

(3) 70 kJ mol^{-1}

(4) 463 kJ mol^{-1}

Q7. **From the reactions :**

$$\mathbf{C(s)} + 2\mathbf{H_2}(g) \rightarrow \mathbf{CH_4}(g) \quad \Delta H = -X \ \mathbf{kcal}$$
$$\mathbf{C(g)} + 4\mathbf{H(g)} \rightarrow \mathbf{CH_4}(g) \quad \Delta H = -X_1 \ \mathbf{kcal}$$
$$\mathbf{CH_4}(g) \rightarrow \mathbf{CH_3}(g) + \mathbf{H(g)} \quad \Delta H = +Y \ \mathbf{kcal}$$

Bond energy of C–H bond is –

(1) $\frac{X}{4}$ kcal mol^{-1}

(2) Y kcal mol^{-1}

(3) $\frac{X_1}{4}$ kcal mol^{-1}

(4) X_1 kcal mol^{-1}

Q8. **Energy required to dissociate 4g of gaseous hydrogen into free gaseous atoms is 208 kCal at 25°C. The bond energy of H–H bond will be :**

(1) 1.04 kCal

(2) 104 kCal

(3) 10.4 kCal

(4) 1040 kCal

Q9. **If energy required to dissociate 16 g of gaseous hydrogen into free atoms is 3488 kJ at 25°C, then the bond energy of H–H bond will be : [NCERT Pg. 177]**

(1) 384 kJ mol^{-1}

(2) 436 kJ mol^{-1}

(3) 384 J mol^{-1}

(4) 436 J mol^{-1}

Q10. **Heat evolved in the reaction, H_2 (g) + Cl_2 (g) → 2HCl (g) is 182 kJ. Bond energies of H–H and Cl–Cl are 430 and 242 kJ mol^{-1} respectively. The H–Cl bond energy is :**

(1) 245 kJ mol^{-1}

(2) 427 kJ mol^{-1}

(3) 336 kJ mol^{-1}

(4) 154 kJ mol^{-1}

Q11. **Given that bond energies of H–H and Cl–Cl are 430 kJ mol^{-1} and 240 kJ mol^{-1} respectively, and ΔH for HCl formation is –90 kJ mol^{-1}. Find the bond enthalpy of HCl.**

(1) 245 kJ mol^{-1}

(2) 290 kJ mol^{-1}

(3) 380 kJ mol^{-1}

(4) 425 kJ mol^{-1}

Q12. **Bond dissociation enthalpy of H_2, Cl_2 and HCl are 434, 242 and 431 kJ mol^{-1} respectively. Enthalpy of formation of HCl is :**

(1) –93 kJ mol^{-1}

(2) 245 kJ mol^{-1}

(3) 93 kJ mol^{-1}

(4) –245 kJ mol^{-1}

Q13. **The bond dissociation energies of X_2, Y_2 and XY are in the ratio of 1 : 0.5 : 1. H for the formation of XY is –200 kJ mol^{-1}. The bond dissociation energy of X_2 will be :**

(1) 200 kJ mol^{-1}

(2) 100 kJ mol^{-1}

(3) 800 kJ mol^{-1}

(4) 400 kJ mol^{-1}

Q14. **If the bond dissociation energies of XY, X_2 and Y_2 (all diatomic molecules) are in the ratio of 1 : 1 : 0.5 and H for the formation of XY is –200 kJ mol^{-1}, the bond dissociation energy of X_2 will be :**

(1) 200 kJ mol^{-1}

(2) 100 kJ mol^{-1}

(3) 800 kJ mol^{-1}

(4) 300 kJ mol^{-1}

– Q32 ——————

Q15. **If the bond dissociation energies of XY, X_2 and Y_2 (all diatomic molecules) are in the ratio of 1 : 0.5 : 0.25 and H for formation of XY is –200 kJ mol^{-1}, then the bond dissociation energy of X_2 will be : [AIEEE–2005]**

(1) 200 kJ mol^{-1}

(2) 100 kJ mol^{-1}

(3) 800 kJ mol^{-1}

(4) 30 kJ mol^{-1}

Q16. **The enthalpy change for the reaction $H_2(g) + C_2H_4(g) \rightarrow C_2H_6(g)$ for the bond energies are : H–H = 103 kJ , C–H = 99 kJ , C–C = 80 C=C =145 kcal mol^{-1}.**

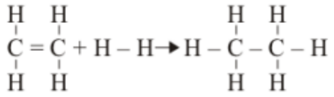
(1) –10 kJ mol^{-1}

(2) +10 kJ mol^{-1}

(3) -30 kJ mol^{-1}

(4) +30 kJ mol^{-1}

Q17. **From the following bond energies : H–H bond energy = 431.37 kJ mol^{-1} C=C bond energy = 606.10 kJ mol^{-1} C–C bond energy = 336.49 kJ mol^{-1} C–H bond energy = 410.50 kJ mol^{-1} Enthalpy for the reaction,**



will be :

(1) 553.0 kJ mol^{-1}

(2) 1523.6 kJ mol^{-1}

(3) –243.6 kJ mol^{-1}

(4) –120.0 kJ mol^{-1}

Q18. **If at 298 K the bond energies of C–H, C-C, C=C and H–H bonds are respectively 414, 347, 615 and 435 kJ mol^{-1}, the value of enthalpy change for the reaction:**

$$\mathbf{H_2C = CH_2}(g) + \mathbf{H_2}(g) \rightarrow \mathbf{H_3C–CH_3}(g)$$

will be : [AIEEE–2003]

(1) +125 kJ mol^{-1}

(2) –125 kJ mol^{-1}

(3) +250 kJ mol^{-1}

(4) –250 kJ mol^{-1}

Q19. **The heat of combustion of ethene from the given data is :**

$$\mathbf{CH_2 = CH_2}(g) + \mathbf{3O_2}(g) \rightarrow \mathbf{2CO_2}(g) + \mathbf{2H_2O}(l)$$

Bond energies :

C=C	:	x kJ mol^{-1}
C–H	:	y kJ mol^{-1}
O=O	:	z kJ mol^{-1}
C=O	:	a kJ mol^{-1}
O–H	:	b kJ mol^{-1}

[**NCERT Pg. 177**] The enthalpy change (H) will be :

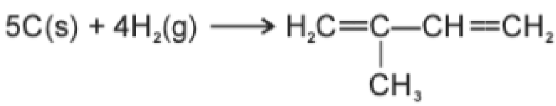
(1) $x - a + b + 4y - 3z$

(2) $x + b - 3z + a + 4y$

(3) $x + 4y + 3z - 4(a + b)$

(4) $a + b - (x + 4y + 3z)$

Q20. **Using bond energy data, calculate heat of formation of isoprene as per equation:**



Given: BE for C-H, H–H, C-C, C=C and C(s) $\rightarrow C(g)$ bonds are respectively 98.8, 104, 83, 147 and 171 kcal mol^{-1}.

(1) -20.6 kcalmol^{-1}

(2) 20.6 kcal mol^{-1}

(3) 40 kcal mol^{-1}

(4) 50 kcal mol^{-1}

Q21. **If $\Delta H_{\text{C–H}} = 300$ kJ mol^{-1}, $\Delta H_{\text{atom}}(\text{C}) = 500$ kJ mol^{-1} and $\Delta H_{\text{H–H}} = 200$ kJ mol^{-1}, then $\Delta H_f(CH_4)$ will be:**

(1) −500 kJ

(2) −300 kJ

(3) −200 kJ

(4) −100 kJ

Q22. **Heat of atomisation of CH_4 is 360 kJ mol^{-1} and of C_2H_6 is 620 kJ mol^{-1}. Then the bond dissociation energy of C–C bond is :**

(1) 170 kJ mol^{-1}

(2) 50 kJ mol^{-1}

(3) 80 kJ mol^{-1}

(4) 220 kJ mol^{-1}

Q23. **Heat of formation of ethane = –20.2 kcal mol^{-1} and heat of atomisation of C and H_2 are 179.2 kcal mol^{-1} and 52.1 kcal mol^{-1} respectively. If bond energy of C–H bond is 73.3 kcal mol^{-1}, calculate the approximate bond energy of C–C.**

(1) 96 kcal mol^{-1}

(2) 230 kcal mol^{-1}

(3) 88 kcal mol^{-1}

(4) 540 kcal mol^{-1}

Q24. **Heat of formation of benzene; assuming no resonance. Given that :**

$$\text{BE (C–C)} = 83 \text{ kcal}, \quad \text{BE (C=C)} = 140 \text{ kcal}, \quad \text{BE (C–H)} = 99 \text{ kcal}$$

$$\text{Heat of atomisation of C} = 170.9 \text{ kcal}, \quad \text{Heat of atomisation of H} = 104.2 \text{ kcal}$$

will ne :

(1) 39 kcal

(2) 75 kcal

(3) 1263 kcal

(4) 421 kcal

Q25. **If ΔH_f° of ICl(g), Cl(g), and I(g) is 17.57, 121.34 and 106.96 J mol^{-1} respectively, then bond dissociation energy of ICl bond is :**

(1) 35.15 J mol^{-1}

(2) 106.69 J mol^{-1}

(3) 210.73 J mol^{-1}

(4) 420.9 J mol^{-1}

Q26. **Bond dissociation enthalpies of H_2(g) and N_2(g) are 436 and 941.8 kJ mol^{-1} respectively and enthalpy of formation of NH_3(g) is -46 kJ mol^{-1} What is the enthalpy of atomisation of NH_3 (g)?**

(1) 390.3 kJ mol^{-1}

(2) 590 kJ mol^{-1}

(3) 1170.9 kJ mol^{-1}

(4) 720 kJ mol^{-1}

Q27. **The standard enthalpy of formation of NH_3(g) is –46.0 kJ mol^{-1}. If the enthalpy of formation of H_2 from its atoms is -436 kJ mol^{-1} and that of N_2 is -712 kJ mol^{-1}, the average bond enthalpy of N–H bond in NH_3 is :**

(1) –1102 kJ mol^{-1}

(2) –964 kJ mol^{-1}

(3) +352 kJ mol^{-1}

(4) +1056 kJ mol^{-1}

Q28. **Enthalpy of formation of NH_3 is –X kJ and H_{H-H}, H_{N-H} are respectively Y kJ mol^{-1} and Z kJ mol^{-1}. The value of $H_{N=N}$ is :**

(1) $Y - 6Z + \frac{X}{3}$

(2) $-3Y + 6Z - 2X$

(3) $3Y + 6Z + X$

(4) $Y + 6X + Z$