Kinthalpy Assignment

[31 marks]

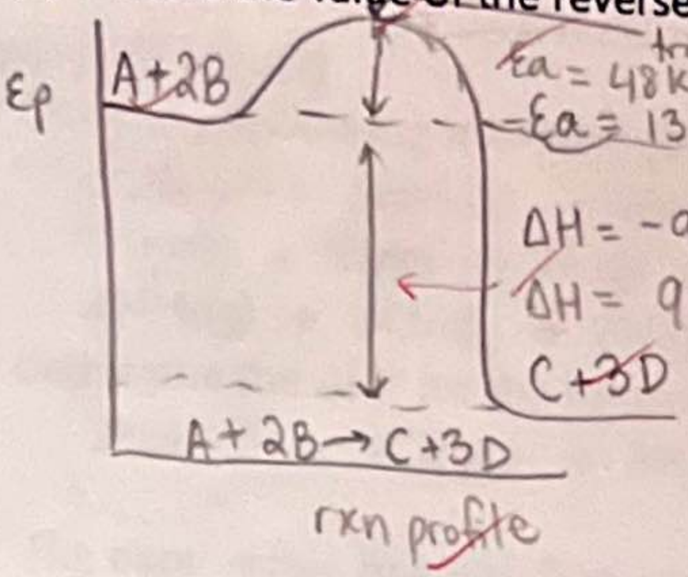
30.5/31 98%

Making Connections [9 marks]

9

1. For the reaction, A + 2B → C + 3D, the enthalpy of reaction is -90 kJ/mol and the forward activation energy is 48 kJ/mol.
   (a) Draw a completely labeled reaction profile for this reaction. [5 marks]
   (b) Label the Transition State. [1 mark]
   (c) Is this reaction exothermic or endothermic? [1 mark]
   (d) What is the value of the reverse activation energy? [2 marks]

a)



b) labelled on graph (top of the hill)

c) exothermic
↳ products have less Ea than reactants

d) 138kJ/mol
↓
48kJ/mol + 90kJ/mol

Inquiry [19 marks]

9.5

2. The exothermic reaction that occurs when a typical fat, glycerol trioleate, $C_{57}H_{104}O_6(s)$, is metabolized in the body is: $C_{57}H_{104}O_6(s) + 80\ O_2(g) \rightarrow 57\ CO_2(g) + 52\ H_2O(l)$. If 37.8 kJ is produced when 1.00 g of this fat is metabolized, calculate the molar enthalpy of formation of the fat in kJ/mol. Use your data tables. [10 marks]

$\Delta H = q/n$

$q = 37.8\,kJ$

$n = ?$

$m = 1.00\,g$

$M = 885.44916\,g/mol$

$n = \frac{m}{M} = \frac{1}{885.44916} = 0.00113\,mol$

$\Delta H = \frac{q}{n} = \frac{37.8\,kJ}{0.00113} = -33451.32\,kJ/mol$

$C_{57}H_{104}O_6 + 80\,O_2 \rightarrow 57\,CO_2 + 52\,H_2O$

$x\,kJ/mol$ | $0\,kJ/mol$ | $-393.5\,kJ/mol$ | $-285.8\,kJ/mol$

$\Sigma \Delta H°_f(P) - \Sigma \Delta H_f°(R) = -33451.32\,kJ/mol$

$[(-393.5)(57) + 152)(-285.8)] - [x + 80(0)] = -33451.32\,kJ/mol$

$[-37291.1] - x = -33451.32\,kJ/mol$

$x = -3839.78\,kJ/mol$

∴, the molar enthalpy of the fat is $-3839.78\,kJ/mol$

SD!

3. The initial rate of a reaction A + B → C was measured for several different starting concentrations of A and B, with the results given below:

[A] (M)	[B] (M)	Initial Rate (M/s)
0.100	0.100	4.0×10^{-5}
0.200	0.100	4.0×10^{-5}
0.100	0.200	16.0×10^{-5}

(a) Determine the rate law for the reaction. Show your work. [3 marks] 3

$r = K[A]^x[B]^y$

$r = K[A]^0[B]^2$

$r = K[B]^2$

$A \rightarrow 2^x = 1$

$A \rightarrow 0^{th}$ order

$B \rightarrow 2^x = 4$

$B \rightarrow 2nd$ order

(b) Determine the rate constant. [3 marks] 3

$4.0 \times 10^{-5} = K[0.100]^2$ ← use any trial

$K = 0.004 = 4.0 \times 10^{-3} M^{-1} s^{-1}$

$B \rightarrow 2$

$A \rightarrow 1$

(c) Determine the rate of the reaction when [A] =0.075 M and [B] =0.050 M. [3 marks] 3

$r = k[A]^0[B]^2$

$r = 4.0 \times 10^{-3}(0.075)^0(0.050)^2$

$r = 0.00001 = 1.0 \times 10^{-5} Ms^{-1}$

Knowledge & Understanding [3 marks]

4. Write the rate law for this reaction. Assume it involves a single elementary step. [3 marks]

$2H_2(g) + O_2(g) \rightarrow 2H_2O(g)$ 3

$r = K[A]^x[B]^y$

$r = K[H_2]^2[O_2]^1$

$r = K[H_2]^2[O_2]$ ← don't have to write 1, it's assumed

Unit 3 Assignment

[39 marks]

92%

Making Connections [9 marks]

1. For the reaction, $A + 2B \rightarrow C + 3D$, the enthalpy of reaction is -90 kJ/mol and the forward activation energy is 48 kJ/mol.

ΔH = -90 (forward) → forward reverseEa = 90 + 48 kJ/mol

(a) Draw a completely labeled reaction profile for this reaction. [5 marks]
(b) Label the Transition State. [1 mark]
(c) Is this reaction exothermic or endothermic? [1 mark]
(d) What is the value of the reverse activation energy? [2 marks]

Inquiry [27 marks]

2. Given the following information,

$2ClF_3(g) + 2NH_3(g) \rightarrow N_2(g) + 6HF(g) + 2Cl_2(g)$ $\quad \Delta H° = -1196$ kJ

$N_2H_4(l) + O_2(g) \rightarrow N_2(g) + 2H_2O(l)$ $\quad \Delta H° = -622$ kJ

Flip $4NH_3(g) + 3O_2(g) \rightarrow 2N_2(g) + 6H_2O(l)$ $\quad \Delta H° = -1530$ kJ

determine the $\Delta H°$ for the following reaction

$3N_2H_4(l) + 4ClF_3(g) \rightarrow 3N_2(g) + 12HF(g) + 2Cl_2(g)$ [8 marks]

3. The exothermic reaction that occurs when a typical fat, glycerol trioleate, $C_{57}H_{104}O_6(s)$, is metabolized in the body is: $C_{57}H_{104}O_6(s) + 80\ O_2(g) \rightarrow 57\ CO_2(g) + 52\ H_2O(l)$. If 37.8 kJ is produced when 1.00 g of this fat is metabolized, calculate the molar enthalpy of formation of the fat in kJ/mol. Use your data tables. [10 marks]

4. The initial rate of a reaction $A + B \rightarrow C$ was measured for several different starting concentrations of A and B, with the results given below:

[A] (M)	[B] (M)	Initial Rate (M/s)
0.100	0.100	4.0×10^{-5}
0.200	0.100	4.0×10^{-5}
0.100	0.200	16.0×10^{-5}

(a) Determine the rate law for the reaction. Show your work. [3 marks]
(b) Determine the rate constant. [3 marks]
(c) Determine the rate of the reaction when [A] = 0.075 M and [B] = 0.050 M. [3 marks]

Knowledge & Understanding [3 marks]

5. Write the rate law for this reaction. Assume it involves a single elementary step. [3 marks]

$2H_2(g) + O_2(g) \rightarrow 2H_2O(g)$