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AP WORKED ANSWERS

1996, 3

Points 2, 3, 2, 2

(a) $\Delta S° = \Sigma S^{ø}_{(products)} - \Sigma S^{ø}_{(reactants)}$

$-232.7 = \Sigma S^{ø}_{(products)} - [(200.9) + 2(130.7)]$

$\Sigma S^{ø}_{(products)} =$ **$+ 229.6\ JK^{-1}mol^{-1}$**

(b) First calculate ΔH using either Hess's Cycle or $\Delta H° = \Sigma H^{ø}_{(products)} - \Sigma H^{ø}_{(reactants)}$ or algebraic manipulation of equations.

$\Delta H = (-84.7) - (226.7) = -311.4\ kJ\ mol^{-1}$

Then apply;

$\Delta G = \Delta H - T\Delta S$

$\Delta G = (-311.4) - ((298)(-0.2327))$

$\Delta G =$ **-242.1 kJ (negative so feasible)**

Note: ΔG is quoted at a specific temperature. Any stated temperature is OK. Using T = 273 K rather than 298 K gives $\Delta G = -247.9$ kJ.

(c) $\ln K = -\frac{\Delta G}{RT} = \frac{242.1}{(8.31)(298)} = 97.7$

$K =$ **3×10^{42}**

(d)

Bonds Broken (Endothermic +ve)		Bonds made (Exothermic -ve)	
C≡C	X	C-C	-347
2 H-H	(2) (+436)	6 C-H	(6) (-414)
2 C-H	(2) (+414)		
TOTAL	**+1700 + X**	**TOTAL**	**- 2831**

ΔH from part (b) =

-311.4 kJ = (Total broken) + (Total formed)

- 311.4 kJ = (+1700 + X) + (-2831)

X = **820 kJ**