Answers to examination-style questions

Answers	Marks	Examiner's tips
1 (a) (i) enthalpy to break a covalent bond varies between compounds so average value used	**1**	
	1	You could say dissociation energy.
(b) (i) $\frac{1}{2}N_2 + 1\frac{1}{2}H_2 \rightarrow NH_3$	**1**	
(ii) $\Delta H = \sum$(bonds broken) − $\sum$(bonds formed)	**1**	
$= \frac{1}{2} \times 944 + 1\frac{1}{2} \times 436 - 3 \times 388$	**1**	
$= -38$ kJ mol^{-1}	**1**	If you find these difficult, then always write down the general expression given above because it's worth a mark.
(c) 4(C–H) + (C=C) + (H–H) − (6(C–H) + (C–C)) = −136	**1**	
(C=C) + (H–H) − ((C–C) + 2(C–H)) = −136		
2(C–H) = 836	**1**	
(C–H) = 418 (kJ mol^{-1})	**1**	
2 (a) $\Delta H = \sum$(bonds broken) − $\sum$(bonds formed)	**1**	
= +146 − 496/2 (*or* 2 × 463 + 146 − (2 × 463 + 496/2))	**1**	
= −102 (kJ mol^{-1})	**1**	
(b) $C(s) + 2H_2(g) \rightarrow CH_4(g)$		
equation	**1**	
correct state symbols	**1**	
(c) (i) macromolecular, lots of energy needed to break covalent bonds	**1**	Can also accept giant molecule.
(ii) $\Delta H = \sum \Delta H_f$ (products) − $\sum \Delta H_f$ (reactants) (or correct cycle)	**1**	
= 715 + 4 × 218 − (−74.9)	**1**	
= 1662 (kJ mol^{-1})	**1**	
(iii) 1662/4 = 415.5	**1**	This mark is for realising that there are 4 bonds. Even if your answer is not correct you must carry on and divide by 4.
3 (a) enthalpy change when 1 mol of compound	**1**	
is formed from its elements	**1**	
all substances in their standard states	**1**	
(b) $\Delta H = \sum \Delta H^{\ominus}_c$(reactants) − $\sum \Delta H^{\ominus}_c$(products)	**1**	
= (7 × −394) + (4 × −286) − (−3909)	**1**	
= +7 kJ mol^{-1}	**1**	If you find these hard then always write the first line since it's worth a mark.
(c) heat change = $mc\Delta T$	**1**	Learn the heat change equation, $\Delta H = mc\Delta T$
= 250 × 4.18 × 60 = 62 700 J = 62.7 kJ	**1**	
moles C_7H_8 = 2.5 / 92 = 0.0272	**1**	
ΔH = 62.7 / 0.0272 = −2305 kJ mol^{-1}	**1**	
(d) mass of water heated = 25 + 50 = 75 g		
temp. rise = 26.5 − 18 = 8.5 °C	**1**	You need both here for 1 mark.

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heat change = 75 × 4.18 × 8.5 = 2665 J		
= 2.665 kJ	1	
moles HCl = 0.05	1	
ΔH = −2.665 / 0.05 = −53.3 kJ mol^{-1}	1	Don't forget that this is exothermic so put in the minus sign.
(e) less heat loss	1	
4 (a) enthalpy change / heat energy change when		
1 mol of a substance	1	
is completely burned in oxygen	1	
at 298 K and 100 kPa or standard conditions	1	This definition is definitely worth learning. It is worth 3 marks.
(b) $\Delta H = \sum$(bonds broken) − $\sum$(bonds formed)	1	
= (6 × 412) + 612 + 348 + (4.5 × 496) − [(6 × 743) + (6 × 463)]	1	
= −1572 kJ mol^{-1}	1	Always write down the general expression for bond energy calculations as shown here in the first line.
(c) by definition ΔH_f is formation from an element	1	
(d) $\Delta H_c = \sum \Delta H_f$(products) − $\sum \Delta H_f$(reactants or cycle)	1	
= (3 × −394) + (3 × −242) − (+20)	1	
= −1928 kJ mol^{-1}	1	Always write the first line as shown here for enthalpy calculations.
(e) bond enthalpies are mean / average values	1	
from a range of compounds	1	