Question	Marking guidance	Mark	AO	Comments
03.1	$C(s) + 2F_2(g) \longrightarrow CF_4(g)$	1	AO1a	State symbols essential
03.2	Around carbon there are 4 bonding pairs of electrons (and no lone pairs) Therefore, these repel equally and spread as far apart as possible	1 1	AO1a AO1a	
03.3	ΔH = Σ $\Delta_f H$ products – Σ $\Delta_f H$ reactants or a correct cycle Hence = (2 × –680) + (6 × –269) – (x) = –2889 x = 2889 – 1360 – 1614 = –85 (kJ mol^{-1})	1 1 1	AO1b AO1b AO1b	 Score 1 mark only for +85 (kJ mol^{-1})
03.4	Bonds broken = 4(C–H) + 4(F–F) = 4 × 412 + 4 × F–F Bonds formed = 4(C–F) + 4(H–F) = 4 × 484 + 4 × 562 –1904 = [4 × 412 + 4(F–F)] – [4 × 484 + 4 × 562] 4(F–F) = –1904 – 4 × 412 + [4 × 484 + 4 × 562] = 632 F–F = 632 / 4 = 158 (kJ mol^{-1}) The student is correct because the F–F bond energy is much less than the C–H or other covalent bonds, therefore the F–F bond is weak / easily broken	 1 1 1 1	 AO3 1a AO3 1a AO3 1a AO3 1b	 Both required Relevant comment comparing to other bonds (Low activation energy needed to break the F–F bond)