Question	Expected Answers	Marks
1 (a) (i)	the enthalpy change when 1 mole of compound/species/substance is formed [mention of 1 mole of *elements* negates this mark]	✓
	from its elements [NOT atoms/ions] (under standard conditions)	✓ [2]
(ii)	25°C/298K **and** 1 atmos/1 x 10^5 Pa	✓ [1]
(b)	$Pb(s) + \frac{1}{2}O_2(g) \longrightarrow PbO(s)$ *(balancing for 1 mol of PbO)*	✓
	(state symbols)	✓u/c [2]
(c) (i)	$\Delta H^e = -718 - 3(-217)$	
	= **-67** (kJ mol^{-1}) *(use of correct data & multiplier*	✓)
	(correct signs	✓)
	(correct calculation of value	✓) [3]
	some possible ecf values: +67 [2]	
	-501 [2]	
	+501 [1]	
	-1369 [2]	
	+1369 [1]	
(ii)	$\Delta H^e_f = -718 + 10 + 2(217)$	
	= **-274** (kJ mol^{-1}) *(use of correct data & multiplier*	✓)
	(correct signs	✓)
	(correct calculation of value	✓) [3]
	some possible ecf values: -57 [2]	
	-284 [2] -294 [2]	
	+424 [1] +444 [2] -491 [2]	
	-511 [1] -708 [1] -1142 [2]	

for others, work through the calc: -[1] for each error.

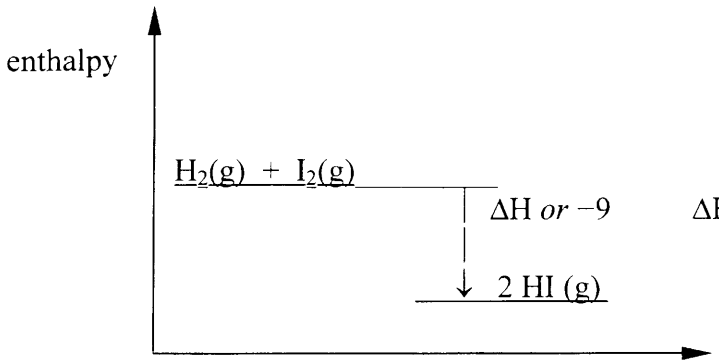
Total: 11

2 (a) $I\text{-}I(g) \longrightarrow 2I(g)$ *(state symbols ✓)*
(1 mole I_2 ✓)

(b) $\Delta H_r^{\ominus} = 151 + 436 - 2(298)$
$= -9$ kJ mol^{-1} *(all the right numbers & x2)*
(use of the – sign)
(L – R: using - sign the right way round)

some ecf values: +9 [2]
+289 [2]
+1183 [1]

(c)



ΔH **and** direction (ecf from (b))

2 HI(g)✓

(d) (i) fizzing/gas/hydrogen evolved *or* Mg dissolves/disappears
[an incorrect observation negates this mark]

(ii) $2HCl + Mg \longrightarrow MgCl_2 + H_2$
[correct formula for $MgCl_2$. Allow equation with HI/MgI_2 instead of HCl]
[balancing: e.g. $2HCl + 2Mg \rightarrow 2MgCl + H_2$ will get this mark but not the 1st]

(iii) $2H^+ + Mg \longrightarrow Mg^{2+} + H_2$ ✓ (ecf if M
[NO spectator ions allowed]

(e) strong acids are completely ionised/dissociated (in solution)

weak acids are incompletely ionised/dissociated (in solution)

[the comparative statement that *strong acids are more ionised than weak acids* is worth [1] mark]

To

3 (a) *(When a system in dynamic equilibrium is subjected to a change in conditions....)*
the (position of) equilibrium will shift ✓
in the direction that minimises the effect of /opposes the change ✓ [2]
[NOT negates, nullifies or cancels]

(b) Any two of the following bullet points ✓✓ [2]
- forward rate = reverse rate [NOT just "forward reaction = reverse reaction"]
- can be approached from either direction
["*forward rate of reaction = reverse rate of reaction*" is worth both the above bullet points]
- no change in overall macroscopic properties *or* a specific one (e.g. colour)
- takes place in a closed system
[N.B. every wrong point negates a correct one]

(c) (from yellow) to orange ✓
increasing $[H^+]$ *or* more acid/HCl
moves equilibrium/reaction to the left *or* produces more $Cr_2O_7^{2-}$ ✓ [2]

(d) (i) turns lighter brown/colourless ✓
(equilibrium/reaction moves to the right):
fewer molecules/particles/moles on right *or* 2 moles → 1 mole ✓ [2]

(ii) turns darker (brown) ✓
(equilibrium/reaction moves to the left): L→R/forward rxn is exothermic. ✓ [2]

[in (i) and (ii) mark the observation first, and then the reason. Each mark is unconditional on the other.]
[in (ii), if neither mark is scored and you are convinced that the only error is mixing up endo/exo-thermic, you may award [1] mark]

Total: 10

4 (a) (adding a catalyst):

- speeds up a reaction
- provides an alternative route *or* forms an intermediate of some sort
- of lower E_{act} (can be read into a label on a Boltzmann distribution)
- so more molecules have $E > E_{act}$ *or* more collisions are successful
- weakens bonds in the reactants

[any 4 points. Look for these in part (b) if not all stated in (a)] ✓✓✓

(b) General scheme for each example:

- identity of all reactants and all products (by names or the **correct** formu in an (unbalanced) equation [if words given, ignore incorrect formulae]
- identity of catalyst
- whether the catalyst is hetero or homo-geneous.

example A: converting nitrogen and hydrogen into ammonia (in the Haber process)
iron/Fe [NOT Fe^{2+} etc]
heterogeneous ✓✓

example B: converting unsaturated oils into fats for margarine with hydrogen
nickel/Ni
heterogeneous
✓✓

communicating the correct sense of the terms heterogeneous *or* homogeneous QwC

[N.B. allow other examples, as long as they are of economic or environmental import

other possibilities: catalytic converter: platinum
$CO + NO \longrightarrow CO_2 + N_2$
heterogeneous

fermentation: (yeast) <u>enzymes</u> , or <u>zymase</u>
starch/sugar $\longrightarrow$ ethanol + CO_2
homogeneous

esterification: H_2SO_4 *or* HCl (***conc.*** not needed, but ***dil*** or ***aq*** is in
acid + alcohol $\longrightarrow$ ester + water
homogeneous

Tota