Consolidation Answers D

Q5. ***a)*** It is reduced / receives electrons / gains electrons. **1**

b) $2\,Al_{(s)} + 6\,H^{+}_{(aq)} \rightarrow 2\,Al^{3+}_{(aq)} + \mathbf{3}\,H_{2(g)}$ **1**

Q6. ***a)*** Either of the following:

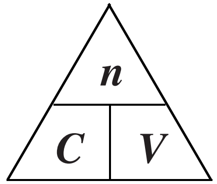
The error in reading the larger volume is a smaller portion of the total volume.

The error in reading the longer time is a smaller portion of the total time. **1**

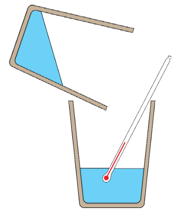
b) The volume occupied by a gas changes with temperature. **1**

Q7. ***a)*** The addition of ions (½) from the potassium iodide (½) **1**

b) All of the vitamin C has been oxidised / reacted (½)
so no more H^{+} or I^{-} ions are being produced. (½) **1**



Higher Chemistry



Topic 4:

Enthalpy, Moles & RedOx

Answer Book

4.1	A	B	C	D
1			■	
2				■
3			■	
4		■		
5			■	
6	■			
7	■			

4.2 4.3	A	B	C	D
1		■		
2			■	
3	■			
4	■			
5		■		
6				■
7				■
8	■			

4.4	A	B	C	D
1				■
2	■			
3				■
4		■		
5			■	
6	■			
7				■

4.5 4.6	A	B	C	D
1			■	
2	■			
3		■		
4				■
5			■	
6				■
7			■	
8		■		

4.7	A	B	C	D
1			■	
2				■
3			■	
4	■			
5		■		
6				■
7		■		

4.8	A	B	C	D
1	■			
2	■			
3				■
4				■
5		■		
6			■	
7		■		
8				■

4.9 4.10	A	B	C	D
1				■
2				■
3		■		
4	■			
5			■	
6			■	

Home Practice Answers 4.1

Q1. The standard enthalpy of combustion of propane is -2219 kJ mol^{-1}.

a) C_3H_8. **1**

b) $C_3H_{8(g)} + 5\ O_{2(g)} \rightarrow 3\ CO_{2(g)} + 4\ H_2O_{(l)}$ **1**

c) Molar mass of C_3H_8 = (3 x 12) + (8 x 1) = 44g (1)

-2219 / 44 = -50.4 kJ g^{-1} (1) **2**

d) -50.4 kJ x 1000 = 50,400 kJ kg^{-1} **1**

Q2. ***a)*** any ***two*** from***:***

(supports hypothesis) because when the fuel contains more carbon the temperature of the water went up more / faster (in 2 minutes)

(does not support hypothesis as) temperature change per gram decreases as the number of carbons increases

(does not support hypothesis) because the more carbon in the fuel the more smoke or the dirtier / sootier it is

2

b) The student only tested hydrocarbons / alkanes / fuels with between 5 and 12 carbon atoms so

- should have tested molecules from other familes **1**

Q3. Large amount of energy released / very exothermic (1)

High proportion (all) of products are gases - propulsion (1) **2**

Total ***(10)***

Consolidation Answers D

Q1. ***a)***

① $CH_{4(g)} + \cancel{2O_{2(g)}} \rightarrow \cancel{CO_{2(g)}} + \cancel{2H_2O_{(g)}}$ — ***b)*** ΔH = - 882 kJ

② x ½ rev $\cancel{CO_{2(g)}} \rightarrow CO_{(g)} + \cancel{\tfrac{1}{2}O_{2(g)}}$ — ΔH = + 283 kJ

③ x 3 rev $\cancel{3}H_2O_{(g)} \rightarrow 3\ H_{2(g)} + \cancel{\tfrac{3}{2}O_{2(g)}}$ — ΔH = + 858 kJ

Combined: $CH_{4(g)} + H_2O_{(g)} \rightarrow CO_{(g)} + 3\ H_{2(g)}$ **+ 259 kJ** **1**

[Correct equations (1), (½) if only one error] [Correct ΔH values (1), (½) if only one error]

Q2.

$2\ CO_{(g)}$	+	$O_{2(g)}$	$\rightarrow$	$2\ CO_{2(g)}$	(½)
2 mol		1 mol			
2 vol		1 vol (½)			

So 80 cm^3 of CO would require 40 cm^3 of O_2 (½) - 150 cm^3 available so O_2 is in excess and CO is the ***limiting reagent***. (½)

$2\ CO_{(g)}$	+	$O_{2(g)}$	$\rightarrow$	$2\ CO_{2(g)}$
2 mol				2 mol
2 vol				2 vol (½)

80 cm^3 of CO would ***produce 80 cm^3 of CO_2*** (½) **3**

Q3. ***a)*** 1 *l* of water = 1 kg (½)

ΔH = - cm ΔT (½)
= -4.18 x 1 x (-2.5) (½)
= +10.5 kJ (½) [-½ if no, or incorrect unit] **2**

b) KBr, 1 mol = 119 g (½)

238 g $\longrightarrow$ +10.5 kJ (½)
119 g $\longrightarrow$ +10.5 x 119/238 (½) = +5.25 kJ mol^{-1} (½) **2**

Q4. ***a)*** L (*Data Booklet*) **1**

b) $Al(NO_3)_3$ so 3 mol of nitrate ions per mol of aluminium nitrate **1**

c) $MgSO_4$ $MgBr_2$ (½)

4 mol of SO_4 means 4 mol of $MgSO_4 \longrightarrow$ 4 mol Mg (½)

Therefore, Mg in $MgBr_2$ = 7 - 4 = 3 mol (½)

So Br in $MgBr_2$ = 3 x 2 = 6 mol (½) **2**

CONSOLIDATION ANSWERS C

Q6. $Zn_{(s)} + H_2SO_{4(aq)} \rightarrow ZnSO_{4(aq)} + H_{2(g)}$

Zn, 0.65 mol — mole ratio = 0.65/1 = 0.65 (½)

H_2SO_4, 2 x 0.250 = 0.5 mol (1) — mole ratio = 0.5/1 = 0.5 (½)

So H_2SO_4 is the limiting reagent and ***Zn is the chemical in excess***. **2**

An alternative method is to work out the amount of product produced by each chemical and whichever produces the least is the limiting reagent.

$Zn_{(s)} + H_2SO_{4(aq)} \rightarrow ZnSO_{4(aq)} + H_{2(g)}$
1 mol ⟶ 1 mol
0.65 mol ⟶ 0.65 mol = 0.65 x 2 = ***1.30 g***

$Zn_{(s)} + H_2SO_{4(aq)} \rightarrow ZnSO_{4(aq)} + H_{2(g)}$
1 mol ⟶ 1 mol
0.5 mol ⟶ 0.5 mol = 0.5 x 2 = ***1.0 g***

Q7. $C_2H_5OH_{(l)} + 3\,O_{2(g)} \rightarrow 2CO_{2(g)} + 3H_2O_{(l)}$ (state symbols ***are*** required) **1**

Q8. An electrochemical cell in which the following changes took place was set up.

$Cr_2O_7^{2-}{}_{(aq)} + 14\,H^+{}_{(aq)} + 6\,e^- \rightarrow 2\,Cr^{3+}{}_{(aq)} + 7\,H_2O_{(l)}$

$2\,Br^-{}_{(aq)} \rightarrow Br_{2(aq)} + 2\,e^-$

a) The second equation must be tripled / multiplied by 3.
or Both of the equations must have an equal number of electrons. **1**

b) $Cr_2O_7^{2-}{}_{(aq)} + 14\,H^+{}_{(aq)} + 6\,Br^-{}_{(aq)} \rightarrow 2\,Cr^{3+}{}_{(aq)} + 7\,H_2O_{(l)} + 3\,Br_{2(aq)}$ **1**

c) Br^- / $Br^-{}_{(aq)}$ / bromide (ion) / bromide solution **1**

Q9. ***a)*** $\mathbf{5}\,Fe^{2+}{}_{(aq)} + 8\,H^+{}_{(aq)} + \mathbf{1}\,MnO_4^-{}_{(aq)} \rightarrow 5\,Fe^{3+}{}_{(aq)} + Mn^{2+} + 4\,H_2O_{(l)}$

$\frac{V_x C_x}{n_x} = \frac{V_y C_y}{n_y}$ (½)

$\frac{25 \times C_x}{5} = \frac{22 \times 0.105}{1}$ (½) so 5 x C_x = 2.31 so C_x = 2.31/5 = 0.462 mol l^{-1} (1) **2**

[-½ if no, or incorrect unit]

b) None / no effect
or Reduce the margin of error 1 increase the accuracy. **1**

HOME PRACTICE ANSWERS 4.2/4.3

Q1. ***ΔH*** = ***(Energy of Bond Breaking) + (Energy of Bond Forming)*** (½)

Bond Breaking (*endothermic*) = (4 x ΔH(C—H) + ΔH(C=C) + ΔH(H—Cl)) (½)
= (4 x 467) + (612) + (432) = + 2912 kJ (½)

Bond Forming (*exothermic*) = (5 x ΔH(C—H) + ΔH(C—C) + ΔH(C—Cl)) (½)
= (5 x 467) + (347) + (346) = - 3028 (½)

overall ΔH = (+2912) + (-3028)
= - 116 kJ mol^{-1} (½)

3

Q2. ***a)*** no effect **1**

b) E = m c ΔT
= 0·1 (½) × 4·18 × 16 = 6.69 kJ (½)

1000 cm^3 of $H_2O_{2(aq)}$ ↔ 0.88 mol
50 cm^3 of $H_2O_{2(aq)}$ ↔ 50/1000 x 0.88 (½)
= 0.044 mol (½)

0.044 mol ↔ 6.69 kJ
1 mol ↔ 1/044 x 6.69 = 152 kJ (½)

include negative sign in final answer -152 kJ (½)
(units not required; deduct ½ mark for incorrect units) **3**

Q3. ***a)*** E = m c ΔT
= 2 × 4·18 × 75 (½) = 627 kJ (½)

Data Book, *Butane* 2878 kJ ↔ 1mol (½)
627 kJ ↔ 1 x 627 / 2878 = 0.218 mol (½) **2**

b) 80% ↔ 0.218 mol (½)
100% ↔ 100/80 x 0.218 = 0.2725 mol (½)

Butane, C_4H_{10}, 1 mol ↔ 58g (½)
0.2725 mol ↔ 0.2725/1 x 58 = 15.8 g (½) **2**

Total ***(11)***

HOME PRACTICE ANSWERS 4.4

Q1. ΔH_c carbon x 2 = -394 kJ x 2 = -788 kJ (½)

ΔHc hydrogen as is = -286 kJ (½)

reverse ΔHc ethyne = +1300 kJ (½)

addition = +226 kJ (½) **2**

(3 'sensible' numbers required for ½ mark for addition based on following through; no units required; deduct ½ for incorrect units)

Q2.

$C_6H_4(OH)_{2(aq)} \rightarrow C_6H_4O_{2(aq)} + H_{2(g)}$		+177.4 kJ mol^{-1} (½)	
$H_2O_{2(aq)} \rightarrow H_{2(g)} + O_{2(g)}$	reverse	+191.2 kJ mol-1 (½)	
$2H_{2(g)} + O_{2(g)} \rightarrow 2H_2O_{(g)}$	× 2	-438.6 kJ mol-1 (½)	
$2H_2O_{(g)} \rightarrow 2H_2O_{(\ell)}$	× 2	-87.6 kJ mol-1 (½)	

answer* = *-202.6 kJ mol^{-1} **2**

(deduct ½ mark for incorrect addition based on numbers used; no units required; deduct ½ mark for incorrect units)

Q3.

$SiO_{2(s)} + 2H_2O_{(\ell)} \rightarrow SiH_{4(g)} + 2O_{2(g)}$	+1517 kJ (½)
$Si_{(s)} + O_{2(g)} \rightarrow SiO_{2(s)}$	- 911 kJ (½)
$2H_{2(g)} + O_{2(g)} \rightarrow 2H_2O_{(l)}$	- 572 kJ (½)

addition = 34 kJ mol^{-1} (½) **2**

(3 'sensible' numbers required for ½ mark for addition based on following through; no units required; deduct ½ mark for incorrect units)

Q4.

$3C + 3O_2 \rightarrow 3CO_2$	−394 × 3 = −1182 kJ (½)
$4H_2 + 2O_2 \rightarrow 4H_2O$	−286 × 4 = −1144 kJ (½)
$3CO_2 + 4H_2O \rightarrow C_3H_8O_3 + {}^7/_2\,O_2$	= + 1654 kJ (½)

addition = −672 kJ mol −1 (½) **2**

(3 'sensible' numbers required for ½ mark for addition based on following through; no units required; accept kJ; deduct ½ mark for incorrect units)

Total ***(8)***

CONSOLIDATION ANSWERS C

Q1. ***a)***

ΔH = - cm ΔT (½)
= -4.18 x 0.2 x (-2) (½)
= +1.7 kJ (1) [-½ if no, or incorrect unit] **2**

b) Any ***one*** from:

no lid/cover to flask (to prevent convection)
not waiting to ensure minimum temperature reached
not ensuring that the vacuum flask was also at 24 °C **1**

Q2. ***a)***

$N_{2(g)} + 3H_{2(g)} \rightarrow 2NH_{3(g)}$
1 mol ⟶ 3 mol
1 vol ⟶ 3 vol (½)
25 cm^3 ⟶ 3 x 25 = **75 cm^3** (½) **1**

b)

$N_{2(g)} + 3H_{2(g)} \rightarrow 2NH_{3(g)}$
1 mol ⟵ 2 mol
1 vol ⟵ 2 vol (½)
½ x 150 = **75 cm^3** ⟵ 150 cm^3 (½) **1**

Q3. Twice (as many methane molecules) **1**

Q4. Magnesium reacts with 1 mol l^{-1} hydrochloric acid to form hydrogen.

$Mg_{(s)} + 2\,HCl_{(aq)} \rightarrow MgC1_{2(aq)} + H_{2(g)}$
1 mol ⟶ 1 mol (½)
(½) 24.3 g ⟶ 24 l (½)
4.86 g ⟶ 24 x 4.86/24.3 = **4.8 *l*** (½) **2**

Q5. ***a)*** Endothermic. **1**

b)

ΔH = - cm ΔT (½)
= -4.18 x 0.5 x (-8) (½)
= +16.72 kJ (1) [-½ if no, or incorrect unit] **2**

Consolidation Answers B

Q3. $H_{2(g)} + \frac{1}{2}O_{2(g)} \rightarrow H_2O_{(l)}$ (state symbols ***are*** required) **1**

Not $2\ H_{2(g)} + O_{2(g)} \rightarrow 2\ H_2O_{(l)}$

Q4. ***a)*** Initial temperature of water (½)
Final (or maximum) temperature of water (½)
Initial mass of ethanol (+ container) (½)
Final mass of ethanol (+ container) (½) **2**

b) ***i)*** -1367 kJ mol^{-1} (-½ if unit incorrect or missing) **1**

ii) Heat loss to air ***or*** Heat loss to beaker **1**
[***not*** inaccuracy in thermometer or balance]

Q5. $Fe_2O_3 + 3\ H_2 \rightarrow 2\ Fe + 3\ H_2O$ (½)
1 mol 3 mol (½)
1 mol of H_2 = 23.2 *l* (½)
3 mol of H_2 = 3 x 23.2 = ***69.6 l*** (½) **2**

Q6. ***a)*** The purple colour just remains / appears. **1**

b) (15.8 + 15.6) / 2 = 15.7 cm^3 **1**

Q7. ***a)*** Dissolve the tablet in a little deionised water (½)
and make up exactly to the mark in a graduated flask. (½) **1**

b) Add a little starch solution to the flask. (½)
The end point is when the mixture just turns a permanent blue/black colour. (½) **1**

Q8. ***a)*** $ClO^-_{4\ (aq)} + 8H^+_{(aq)} + 8e^- \rightarrow Cl^-_{(aq)} + 4H_2O_{(\ell)}$ **1**

b) $H^+_{(aq)}$ ions are involved/ used up. **1**

Home Practice Answers 4.5/4.6

Q1. 1 mol $Cu(NO_3)_2$ → 2 mol NO_2 (½)
187.5 g (½) → 48 l
2·0 g → 2·0/187.5 × 48 (½) = 0.51 litres (½) **2**

or 1 mol $Cu(NO_3)_2$ → 2 mol NO_2 (½)
no. of moles of $Cu(NO_3)_2$ = 2·0/187.5 = 0.107 mol (½)
0.107 mol → 0.107 × 2 = 0.314 mol (½)
0.314 x 24 l = 0.51 litres (½) **2**

Q2. 1 mol CaF_2 → 2 mol HF (½)
78 g (½) → 48 l
1000 g → 1000/78 × 48 l (½) = 615 litres (½) **2**

or 1 mol CaF_2 → 2 mol HF (½)
no. of moles of CaF_2 = 1000/78 = 12.82 mol
12.82 mol → 12.82 x 2 =25.6 mol(½)
25.6 mol × 24 = 615 litres (½) **2**

(deduct ½ mark for no or incorrect units)

Q3. $3O_2 \rightarrow 2O_3$ 1 mol → 2/3 mol (½)
32 g (½) → 2/3 x 6 x 10^{23} = 4 x 10^{23} molecules (½)
6 g → 6/32 x 4 x 10^{23} = 7.5 x 10^{22} molecules(½) **2**

Q4. moles of LiOH = 0.1 × 0.4 = 0.04 mol (½)

moles of CO_2 = 0.24/24 = 0.01 mol (½)

0.02 mol of LiOH needed to react with 0.01 mol of CO_2 (½)
excess LiOH = 0.02 (½) **2**

Q5. 1 mole $Ca(OCl)_2$ → 2 moles Cl_2
143 g (½) → 48 litres (½)
0·096 litres → 143 x 0.096/143 (½) = 0·286 g or 0·29 g (½)

(deduct half mark for missing or incorrect unit) **2**

Total ***(10)***

HOME PRACTICE ANSWERS 4.7

Q1. ***a)*** NH_3, 17g → 1mol (½) CO_2, 25 *l* → 1mol
7.5g → 7.5/17 = 0.44 mol (½) 4.5 *l* → 4.5/25 = 0.18 mol (½)

$2NH_3 \rightarrow CO_2$ 0.44/2 and 0.18/1 = 0.22 and ***0.18*** so CO_2 limiting reagent (½) **2**

b) CO_2 → $(NH_2)_2CO$
0.18 mol → 0.18 mol 0.18 x 60 (½) = 10.8 g (½) **1**

Q2. ***a)*** Na_3PO_4, 0.2 x 0.05 → 0.01mol (½) $Ba(NO_3)_2$, 0.15 x 0.075 → 0.01125mol (½)

$2Na_3PO_4 \rightarrow 3Ba(NO_3)_2$ 0.01/2 → 0.01125 /3 = 0.005 and **0.00375** so $Ba(NO_3)_2$ is limiting reagent (½) **2**

b) $3Ba(NO_3)_2$ → $Ba_3(PO_4)_{2(s)}$
0.01125 mol → 0.01125/3 = 0.00375 mol (½) 0.00375 x 601 = 2.25 g (½) **1**

Q3. ***a)*** TiO_2, 80 g → 1mol (½)
4.15 g → 4.15/80 = 0.052 mol (½) 0.052/3 = 0.017

C, 12 g → 1mol (½)
5.67 g → 5.67/12 = 0.473 mol (½) 0.473/4 = 0.118

Cl_2, 71 g → 1mol (½)
6.78 g → 6.78/71 = 0.096 mol (½) 0.096/6 = **0.016**

so Cl_2 is limiting reagent . **3**

b) $6Cl_2$ → $3TiCl_4$
0.016 mol → 0.008 mol (½) 0.008 x 190 = 1.52 g (½) **1**

Total ***(10)***

CONSOLIDATION ANSWERS B

Q1. ***a)*** The overall enthalpy change in a reaction (or sequence of reactions) depends only on the reactants and the products and not on the route taken. **1**

b) Combustion of magnesium sulphide

or $MgS + {}^3/_2O_2 \rightarrow MgO + SO_2$

or $2\,MgS + 3\,O_2 \rightarrow 2\,MgO + 2\,SO_2$ **1**

b) (ΔH for the) combustion of magnesium sulphide. **1**

Q2. Ammonium sulphate fertiliser can be manufactured by neutralising sulphuric acid with ammonia.

$2\,NH_{3(g)} + H_2SO_{4(l)} \rightarrow (NH_4)_2SO_{4(s)}$
(GFM = 17 g) *(GFM = 98 g)* *(GFM = 132 g)*

a) 132 g → 1 mol $(NH_4)_2SO_{4(s)}$ → 2 mol NH_4^+ ions (½)
1 mol → 6.02×10^{23} ions 2 mol → 1.204×10^{24} ions (½) **1**

b) *though 20 tonnes (20,000,000 g) and 49 tonnes (49,000,000 g) could be converted into grammes and actual numbers of moles calculated, it is the ratio that counts and both calculations can be done with original numbers retained.*

NH_3, 17g → 1mol (½)
20g → 20/17 = 1.18 mol (½) mole ratio = 1.18/2 = 0.59

H_2SO_4, 98g → 1mol (½)
49g → 49/98 = 0.5 mol (½) mole ratio = 0.5/1 = 0.5

Since H_2SO_4 has the lower mole ratio it is the limiting reagent and will run out first. **2**

An alternative method is to work out the amount of product produced by each chemical and whichever produces the least is the limiting reagent.

$2\,NH_{3(g)} + H_2SO_{4(l)} \rightarrow (NH_4)_2SO_{4(s)}$
2 mol → 1 mol
34 g → 132 g
34 tonnes → 132 tonnes
20 tonnes → 132 x 20/34 = **77.75 tonnes**

$2\,NH_{3(g)} + H_2SO_{4(l)} \rightarrow (NH_4)_2SO_{4(s)}$
1 mol → 1 mol
98 g → 132 g
98 tonnes → 132 tonnes
49 tonnes → 132 x 49/98 = **66 tonnes**

Consolidation Answers A

Q6. a) $I_{2(aq)} + 2e^- \rightarrow 2I^-_{(aq)}$ **1**

b) $C_6H_8O_{6(aq)} + I_{2(aq)} \rightarrow 2\,H^+I^-_{(aq)} + C_6H_6O_{6(aq)}$

or

$C_6H_8O_{6(aq)} + I_{2(aq)} \rightarrow 2\,H^+_{(aq)} + 2I^-_{(aq)} + C_6H_6O_{6(aq)}$ **1**

c) Reducing agent **1**

Q7. a) None ***or*** no effect **1**

b) Any purple colour would disappear. **1**

Home Practice Answers 4.8

Q1. a) i) $Mg_{(s)} \rightarrow Mg^{2+}_{(aq)} + \mathbf{2e^-}$ (½)

ii) $Sn^{4+}_{(aq)} + \mathbf{2e^-} \rightarrow Sn^{2+}_{(aq)}$ (½)

iii) $ClO^-_{(aq)} + \mathbf{2H^+_{(aq)}} + \mathbf{2e^-} \rightarrow Cl^-_{(aq)} + \mathbf{H_2O_{(l)}}$ (½)

iv) $FeO_4{}^{2-}{}_{(aq)} + \mathbf{8H^+_{(aq)}} + \mathbf{3e^-} \rightarrow Fe^{3+}_{(aq)} + 4\mathbf{H_2O_{(l)}}$ (½) **2**

b) i) Oxidation$^-$ (½)

ii) Reduction (½)

iii) Reduction (½)

iv) Reduction (½) **2**

Q2. a)

i) $Zn_{(s)} \rightarrow Zn^{2+}_{(aq)} + \mathbf{2e^-}$ (½)

ii) $\mathbf{2}Al_{(s)} \rightarrow 2Al^{3+}_{(aq)} + \mathbf{6e^-}$ (½)

iii) $2I^-_{(aq)} \rightarrow I_{2(s)} + \mathbf{2e^-}$ (½)

iv) $Zn_{(s)} \rightarrow Zn^{2+}_{(aq)} + \mathbf{2e^-}$ (½) **2**

b) i) $Pb^{2+}_{(aq)} + \mathbf{2e^-} \rightarrow Pb_{(s)}$ (½)

ii) $6H^+_{(aq)} + \mathbf{6e^-} \rightarrow 3H_{2(g)}$ (½)

iii) $Cl_{2(g)} + \mathbf{2e^-} \rightarrow 2Cl^-_{(aq)}$ (½)

iv) $S_{(s)} + \mathbf{2e^-} \rightarrow S^{2-}_{(s)}$ (½) 2

Q3.

$Cd_{(s)} + 2OH^-_{(aq)} \rightarrow Cd(OH)_{2(s)} + 2e^-$

$Ni(OH)_{3(s)} + e^- \rightarrow Ni(OH)_{2s)} + OH^-_{(aq)}$ ***multiply by 2***

a) $Cd_{(s)} + 2Ni(OH)_{3(s)} \rightarrow Cd(OH)_{2(s)} + 2Ni(OH)_{2s)}$ **1**

b) $Ni(OH)_{3(s)}$ **1**

Total (10)

HOME PRACTICE ANSWERS 4.9/4.10

Q1. ***a)*** $H_2O_{2(aq)} + 2H^+_{(aq)} + 2I^-_{(aq)} \rightarrow 2H_2O_{(\ell)} + I_{2(aq)}$ **1**

(State symbols not required; accept $I_{2(s)}$ on right hand side of equation; deduct ½ if $2e^-$ shown on each side).

b) no. of moles of thiosulphate = 0.0050 x 0.0149 = 7.45×10^{-5} (½)

2 mol thiosulphate : 1 mol I_2 (1)

no. of moles of I_2 = ½ x 7.45×10^{-5} = 3.725×10^{-5} (½)

1 mol I_2 = 2 x 126.9 = 253.8 g (½)

mass of I_2 = 3.725×10^{-5} x 253.8 = 0.00945 g (9.45×10^{-3} g) (½)

(Deduct ½ for no or incorrect units) **3**

Q2. ***a)*** $MnO^-_{4\,(aq)} + 8H^+_{(aq)} + 5e^- \rightarrow Mn^{2+}_{(aq)} + 4H_2O_{(\ell)}$ **1**

(state symbols not required)

b) there is a colour change from colourless to purple (or purple to colourless)

or the reaction is self-indicating (or a colour change shows the end of the reaction) **1**

c) ***i)*** first titre is a rough (or approximate) result
or not accurate
or an estimate
or too far away from the others **1**

ii) no. of moles of $MnO^-_{4\,(aq)}$ = 0.040 × 0.0269 = 0.001 (½)

ratio of $(COOH)_{2(aq)}$: $MnO^-_{4\,(aq)}$ = 5 : 2 (½)

no. of moles of $(COOH)_{2(aq)}$ in 25 cm3 = 5/2 × 0.001 = 0.0025 (½)

no. of moles of $(COOH)_{2(aq)}$ in 500 cm^3 = 0.0025 × 500/25 = 0.05 (½) **2**

(no units required; deduct ½ mark for incorrect units)

Total ***(9)***

CONSOLIDATION ANSWERS A

Q1. ***a)*** 1130 kJ **1**

b) - 640 kJ **1**

c) Exothermic (½)

Because ΔH is negative.
or Products have less energy than reactants (½) **1**

Q2. ***a)*** Loss of heat (½) to beaker/ thermometer/ air/ surroundings (½) **1**

b) Any ***one*** from:
Use plastic / better insulated beaker.
Use a vacuum flask for reaction.
Have a lid on top (to reduce heat loss).
Use a more accurate thermometer. **1**

Q3. NH_3, 1mole = 17g 3.4g = 3.4/17 = 0.2 mol of NH_3 (½)

1 mol NH_3 → 3 mol of N atoms
0.2 mol of NH_3 → 0.6 mol of N atoms C

1 mol → 6.02×10^{23} N atoms (½)
0.6 mol → 0.6 x 6.02×10^{23} = ***3.612 x 10²³ N atoms*** (½) **2**

Q4. ***a)*** $C_3H_{8(g)}$ → 3 $CO_{2(g)}$
1 mol → 3 mol (½)
0.2 mol → **0.6 mol** (½) **1**

b) 1 mol → 23 *l* (½)
0.6 mol → 0.6 x 23 = **13.8 *l*** (½) **1**

Q5. ***a)*** $N_{2(g)}$ + 2 $O_{2(g)}$ → 2 $NO_{2(g)}$
1 mol 2 mol
1 vol 2 vol (½)

So 80 *l* of N_2 would require 160 *l* of O_2 (½)- only 20 *l* available so O_2 is limiting reagent

20 *l* of O_2 would react with 10 *l* of N_2 (½) so 80 -10 = **70 *l* of N_2 in excess.** (½) **2**

b) $N_{2(g)}$ + 2 $O_{2(g)}$ → 2 $NO_{2(g)}$
2 mol 2 mol
2 vol 2 vol (½)

20 *l* 20 *l* (½)

plus 70 *l* of unreacted N_2 (½), so total volume = 70 + 20 = 90 *l* of gas. (½) **2**