Question	Answer	Marks
1a)	car dioxide / a gas is made;	**1**
(b)(i)		**1**
(b)(ii)		**1**
(b)(iii)		**1**
(b)(iv)	0.031 (2 marks) **M1 (iii)** / 0.0162;	**2**
(c)	0 (dm^3) **M1** moles carbon dioxide = 0.02; **M2** volume carbon dioxide = 0.02 × 24; **M3** = 0.48 (dm^3);	**3** 1 1 1

Question	Answer	Marks
2(a)(i)	compound containing carbon and hydrogen only;	**1**
(a)(ii)	$_nH_{2n+2}$; C_nH_{2n};	**2**
b)(i)	mol C = 54.54 / 12 or 4.5(45) **and** mol H = 9.09 / 1 or 9.09 **and** mol O = 36.37 / 16 or 2.27; C_2H_4O;	**2**
(b)(ii)	M_r of C_2H_4O = 44; 88 / 44 = 2 therefore $C_4H_8O_2$;	**2**
(c)	methyl ethanoate; / CH_3COOCH_3; ethyl methanoate; / HCOO $_2H_5$;	**4**
(d)	met propanoate;	**1**
(e)(i)	condens	**1**
e)(ii)	/ H_2O;	**1**
(e)(iii)	dicarboxylic acid or diacyl chloride; diol;	**2**

Question	Answer	Marks
3(a)(i)	adds up to 100%;	**1**
3(a)(ii)	**M1** 55.85/12 **and** 6.97(/1) **and** 37.2/16; **or** evaluation 4.650 6.970 2.325; **M2** C_2H_3O; correct answer with no working = [2]	**1** **1**
3(a)(iii)	**M1** (86/)43; **M2** $C_4H_6O_2$; correct answer with no working = [2]	**1** **1**
(b)(i)	unsa / C=C double bond / alkene;	**1**
(b)(ii)	/ carboxylic) acid / contains or releases H^+ ions;	**1**
(b) (iii)	$_3$CH=CHCOOH / CH_2=CHCH_2COOH / CH_2=CH(CH_3)COOH;	**1**

Question	Answer	Marks
4(a)	*moles of KOH used* (= 0.025 × 2.53 =) 0.06325 / 0.063; *number of moles of H_2SO_4 needed to neutralise the KOH* = 0.031625 / 0.032; *concentration of dilute sulfuric acid* = 1.121/1.1 (mol / dm^3);	**3**
4(b)(i)	repeat experiment using same volume / amount of (same) H_2SO_4; and same volume / amount of (same) KOH; **or** (add activated) charcoal / carbon; filter out the charcoal; **or** mix volumes / amounts of H_2SO_4 and KOH in the ratio 1:2; of the same concentration;	**2**
4(b)(ii)	make solution of potassium sulfate as above; add same volume / amount of acid again; **or** same volume / amount of KOH; add double the volume / amount of H_2SO_4; 25 cm^3 KOH + 56.4 cm^3 H_2SO_4 = [2] **or** same volume / amount of H_2SO_4; add half the volume / amount of KOH; 12.5 cm^3 KOH + 28.2 cm^3 H_2SO_4 = [2] **or** mix equal volumes / amounts of H_2SO_4 and KOH ; of the same concentration; mix solutions containing equal numbers moles of KOH and H_2SO_4 = [2]	**2**

Question	Answer	Marks
4(c)	*test:* reactive metal / name or formula of suitable metal, e.g. Mg / Fe / Zn; *result:* bubbles or gas or hydrogen or H_2 evolved / dissolves; *test:* insoluble carbonate or name / formula of suitable insoluble carbonate, e.g. $CaCO_3$; *result:* bubbles or gas or carbon dioxide or CO_2 evolved / dissolves provided that carbonate is insoluble; *test:* alkali or name / formula of suitable alkali, e.g. NaOH / KOH; *result:* temperature change; *test:* alkali or name / formula of suitable alkali, e.g. NaOH / KOH and indicator; *result:* colour change; *test:* insoluble base or name / formula of suitable insoluble base; *result:* dissolves; *test:* indicator, e.g. blue litmus; *result:* colour change (colour need not be specified); *test:* measure pH / pH paper / UI paper / pH meter; *result:* pH 0–3 or indicator red / orange or pH lower than pH of K_2SO_4;	**2**

Question	Answer	Marks	Guidance
5(a)(i)	(Haber process makes) ammonia / NH_3 ; (ammonia converted into) fertilisers / nitrates / ammonium salts or names or formulae of examples e.g. ammonium nitrate / NH_4NO_3 / ammonium sulfate / $(NH_4)_2SO_4$ / calcium nitrate / $Ca(NO_3)_2$ / urea / $CO(NH_2)_2$;	**2**	**A** 2 marks for 'ammonia is a fertiliser' **A** ammonia is used to make sodium nitrate Haber process used to make fertilisers gets second mark only
5(a)(ii)	it (refers to sodium nitrate) / sodium nitrate would dissolve (in rain) / soluble (in water) / wash away / leach / drain off;	**1**	**A** reacts with water **I** reference to fertiliser **R** sodium reacts / dissolves **A** because they are not dissolved by rainfall (implication is in desert)
5(a)(iii)	potassium (is required by plants as well as nitrogen) / NP**K**;	**1**	comments about pH / better for soil / %N higher / reactivity of potassium **I** comments about what K does for plants e.g. combat disease
5(b)(i)	$_3 \rightarrow 2NaNO_2 + O_2$ species; balancing;	**2**	**A** multiples **I** state symbols / word equation

Question	Answer	Marks	Guidance
6(b)(ii)	(colour changes) from pink / purple; to colourless / decolourised;	**2**	**I** clear / discoloured / effervescence **I** brown fumes / brown gas **NOTE:** stays pink or purple gets first mark but turns purple or pink is 0
6(b)(iii)	the more reactive the metal the lower rate of decomposition / more difficult the decomposition / more stable the nitrate / more energy needed to decompose / decomposes at higher temperature ora;	**1**	**A** less (extent the) decomposition **A** reactive metals produce nitrates difficult to decompose ora i.e. comparatives not essential **A** the more reactive the metal the less it decomposes is acceptable because we can assume that *it* refers to the nitrate BOD **A** inverse relationship with further qualification **A** group 1 / reactive metals produce nitrite (and oxygen) **and** less reactive metals produce oxide (+ NO_2 + O_2) (both required for mark) **I** less products (unqualified) **R** less products / metals decompose
6(c)(i)	(changes from) blue solid / blue crystals; black solid formed; brown gas / brown vapour / (pungent) smell;	**3**	**R** precipitate **A** one mark out of the first two for changes from blue to black (without solid or crystals) **I** red / melt **I** water / steam / condensation given off **I** reference to glowing / burning splints / colourless gas / effervescence **I** names / formulae

Question	Answer	Marks	Guidance
6(c)(ii)	Avogadro('s) number / constant / 6.02×10^{23}; **COND** particles; **OR** (the number of particles which is equal to the number of atoms in) 12 g of carbon 12; **COND** atoms; **OR** the mass **in grams** which contains Avogadro('s) Number; **COND** particles; **OR** (the amount of substance which has a mass equal to) its relative formula mass / RFM / relative atomic mass / Ar / relative molecular mass / Mr / molar mass; **COND** in grams; **OR** (the amount of substance which has a volume equal to) 24 dm^3; **COND** of a gas **at** RTP;	**2**	**A** any values from 6 to 6.023×10^{23} **A** atoms / ions / molecules / electrons **A** one mark for reference to C12 **A** equivalent statement for any element **or** compound e.g. 32 grams of oxygen(1) **COND** molecules / O_2 (1) e.g. 16 grams of oxygen (1) **COND** atoms / O(1) **A** different volumes under different conditions e.g. 22.4 dm^3 at STP or volumes in different units e.g. 24 000 cm^3 at RTP
6(c)(iii)	M1 (number of moles of CuO formed =) **0.03**; M2 (number of moles of $Cu(NO_3)_2.xH_2O$ in 7.26 g =) **0.03**; M3 (mass of 1 mole of $Cu(NO_3)_2.xH_2O$ 7.26 ÷ 0.03 =) **242** (g); (mass of 1 mole of $Cu(NO_3)_2$ is 188 g) M4 the value of x = **3**;	**4**	ecf same as M1 ecf 7.26 ÷ M2 ecf M3 – 188 ÷ 18

Question	Answer	Marks	Guidance
7(a)(i)	$_3$;	**1**	
(a)(ii)	$_2O_3$;	**1**	As_2O_5
(a)(iii)	$_4$;	**1**	
(b)(i)	^{3} ;	**1**	
(b)(ii)	$^{2+}$;	**1**	
b)(iii)	$^+$;	**1**	
(c)	M1 2 double bonds, one between each O and the C atom; M2 each O has 8 outer electrons; M3 each C has 8 outer electrons;	**3**	**R** wrong symbols for O for M2 **R** wrong symbols for C for M3 **I** missing symbols **A** any combination of x and o