1 **(a** Avogadro's Number of particles
or formula mass in grams
or 6×10^{23} particles accept atoms, ions and molecules
or as many particles as there are carbon atoms in 12.00g of ^{12}Ca
ANY one **[1]**

(b) moles of Mg = 3/24 = 0.125
moles of CH_3COOH = 12/60 = 0.200
magnesium is in excess

OR 3.0g of magnesium react with 15g of acid
only 12.0 g of acid present
magnesium is in excess **[3]**

(ii) **Mark conseq to (i) but NOT to any simple integer**
moles of H_2 = 0.1 **[1]**

(iii) **Mark conseq to (ii) but NOT to any simple integer**
Volume of hydrogen = 0.1 x 24
= 2.4 dm^3 **[2]**

(c) moles of NaOH = 25/1000 x 0.4 = 0.01 **[1]**

(ii) **Mark conseq to (i) but NOT to any simple integer**
moles of acid = 0.01/2 = 0.005 **[1]**

(iii) **Mark conseq to (ii) max 10M**
concentration of acid = 0.005 x 1000/20 **[1]**
= 0.25 mol/dm^3 **[1]**

TOTAL = [10]

2 **(a** filter / centrifuge / decant; [1]
(partially) evaporate / heat / boil; [1]
allow to crystallise / cool / let crystals form; [1]
dry crystals / dry between filter paper / leave in a warm place to dry; [1]

(b) number of moles of HCl used = 0.04 × 2 = 0.08; [1]
number of moles CoCl_2 formed = 0.04; [1]
number of moles CoCl_2.6H_2O formed = 0.04; [1]
maximum yield of CoCl_2.6H_2O = 9.52; [1]
allow: 9.5
allow: ecf on number of moles of HCl

number of moles of HCl used = 0.08 note: must use their value
allow: ecf
number of moles of $CoCO_3$ in 5.95 g of cobalt(II) carbonate = 5.95/119 = 0.05; [1]

(ii) 0.05 > 0.04 or stated in words;
allow: ecf on number of moles of CoCl_2 formed [1]

Question	Answer	Marks
3(a)(i)	a reaction whose rate is influenced by light / reaction which occurs in presence of light;	**1**
(a)(ii)	$CH_3CHClCH_3$;	**1**
(a)(iii)	(both have) same molecular formula; different structural formula or structure;	**2**
(b)	**M1** bonds breaking = (8 × 412) + (2 × 348) + 242 = 4234; **M2** bonds forming = (7 × 412) + (2 × 348) + 338 + 431 = 4349; **M3** 4234 – 4349 = –115 **and** exothermic;	**3**
(c)(i)	$CH_3CH_2CH_2Cl + NaOH \rightarrow CH_3CH_2CH_2Cl + NaCl$ $NaCl$ as product; rest of equation;	**2**
(c)(ii)	p $CH_2=CHCH_3$;	**2**
c)(iii)	p acid;	**1**
(d)(i)		**1**
(d)(ii)		**1**
(d)(iii)	moles of $CH_3CH_2CH_2OH$ = 0.1; moles of HCOOH = 0.087 (0.09) **and** limiting reagent is methanoic acid;	**2**
(d)(iv)	88 × (mol of limiting reagent in **4(d)(iii)**); expected answer: 88 × 0.087 = 7.65 g;	**1**

4 **(a** making fertilisers or pickling metals or making fibres or making phosphoric acid/phosphates making dyes or making paints/pigments/dyes or making paper making plastics or making detergents or tanning leather or battery acid. [1]

(b) (i) add water (to yellow solid or to (anhydrous) iron(II) sulfate or to $FeSO_4$ or to products [1]

goes green [1]

(ii) M1 Sulfur trioxide reacts with water to make sulfuric acid or equation [1]

M2 sulfur dioxide reacts with oxygen to form sulfur trioxide or equation [1]

(iii) M1 = 2.07 Allow 2.1 or 2.0666…7

M2 = 62.8.g

M3 =(M2/152 =) 0.41(3)

M4 (=M1/M3) rounded to the nearest whole number × = 5 [4]

(c (i) nitric acid or nitric(V) acid or HNO_3 [1]

(ii) $2KNO_3 = 2KNO_2 + O_2$ [2]
Species (1)
Balance (1)

[Total: 12]

5 **(a) (i)** (X(s) ↔) X(l) [1]

(ii) melting point/freezing point (of X) [1]

(iii) gas/gaseous or vapour [1]

(iv) not horizontal **or** line slopes **or** line is lower [1]

(b) (i) 14.3 [1]

(ii) 85.7 ÷ 12 and 14.3 ÷ 1 **or** 7.14 and 14.3 [1]
ratio 1:2 [1]
CH_2 [1]
note: Award all 3 marks for correct answer
allow: alternative working e.g.
85.7 × 84 ÷ 100 and 14.3 × 84 ÷ 100 **or** 71.988/72 and 12/12.012 [1]
6:12 **or** ratio 1:2 [1]
CH_2 [1]

(iii) C_6H_{12} [1]

[Total: 9]