Mark scheme

Chemical calculations

Chemistry 0620 · Questions from Paper 4 and Paper 6

Total marks

82

MARKS FOR EACH QUESTION

1	2	3	4	5	6	7	8	9	10	Total
4	6	7	8	9	11	6	6	12	13	**82**

Question 1 [4]

1	**M1** 5 moles of calcium nitrate (1) **M2** 10 moles ammonium nitrate (1) or ecf **M1** × 2 **M 3** M_r of ammonium nitrate = 80 **M4** 800 g or ecf **M2** × **M3**	4

Question 2 [6]

2(a)	0.025 **M1** 50 / 1000 (=0.05) **M2** (0.05 × 0.5) = 0.025	 1 1
2(b)	0.0125	1
2(c)	0.55 **M1** 44 **M2** 0.55	 1 1
2(d)	0.3	1

Question 3 [7]

3(a)	(thermal) decomposition	1
3(b)	84 (1) 12.6 / 84 = 0.15(00) (1) 0.15(00) / 2 = 0.075(00) (1) 0.075(0) × 24.0 = 1.8 (1)	4
3(c)	$Ca(OH)_2$ (1) $CaCO_3$ (1)	2

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Question 4 **[8]**

4 **(a)** **(i)** (the number of particles which is equal to the number of atoms in) 12 g of carbon 12
or
the mass in grams which contains the Avogadro's constant number of particles
or
Avogadro's constant **or** 6 to 6.023 × 10^{23} of atoms / ions / molecules / electrons / particles
or
(the amount of substance which has a mass equal to) its relative formula mass / relative atomic mass / relative molecular mass in grams
or
(the amount of substance which has a volume equal to) 24 dm^3 of a gas at RTP
[1]

(ii) (Avogadro's constant is the) number of particles / atoms / ions / molecules in one mole of a substance
or
the number of carbon atoms in 12 g of C(12).
or
the number of particles / molecules in 24 dm^3 of a gas at RTP
or
6 to 6.023 × 10^{23} (particles / atoms / ions / molecules / electrons) [1]

(b) CH_4 **and** SO_2 [1]

2/16 = 1/8 or 0.125 moles of CH_4 **AND** 8/64 = 1/8 or 0.125 moles of SO_2 [1]

(c) **(i)** 4.8/40 = 0.12 moles of Ca
3.6/18 = 0.2 moles of H_2O **both** correct [1]

(ii) Ca is in excess (**no mark**) (because 0.12 moles of Ca need) 0.24 moles / 4.32 g of H_2O to react [1]
there is not enough / there are 0.2 moles / 3.6 g of H_2O [1]
or
Ca is in excess **(no mark)** (because 0.2 moles / 3.6 g of water will react with) 0.1moles/4.0 g of Ca [1]
there is more than that / there are 0.12 moles / 4.8 g of Ca [1]
or
Ca is in excess **(no mark)** because the mole ratio Ca:H_2O is 3:5 / mass ratio 4:3 [1]
which is bigger than the required mole ratio of 1:2 / mass ratio 10:9 [1]
or
Ca is in excess **(no mark)** because the mole ratio H_2O:Ca is 5:3 / mass ratio 3:4 [1]
which is smaller than the required mole ratio of 2:1 / mass ratio 9:10 [1]

(iii) 0.02 × 40 = 0.8 (g) [1]

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Question 5 [9]

5(a)	carbon dioxide / a gas is made;	1
5(b)(i)	red;	1
5(b)(ii)	0.001;	1
5(b)(iii)	0.0005;	1
5(b)(iv)	0.031 (2 marks) **M1 (iii)** / 0.0162;	2
5(c)	0.48 (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 6 [11]

6(a)(i)	more particles (of acid) in a given volume / dm^3 / cm^3	1
	more collisions per second / unit time **OR** greater collision rate	1
6(a)(ii)	particles have more energy / particles move faster / more collisions per second / more collisions per unit time / greater collision rate	1
	more (of the) particles / collisions have energy greater than the activation energy / more particles have sufficient energy to react / more collisions have sufficient energy to react / a greater percentage of collisions are successful	1
6(b)(i)	0.075 If full credit is not awarded, allow 1 mark for M_r of CuO = 80	2
6(b)(ii)	0.05	1
6(b)(iii)	4 (g) **M1** moles copper(II) oxide that reacted = (0.05 / 2) = 0.025 mol **M2** mass copper(II) oxide = ((0.075 – 0.025) × 80) = 4 g	2
6(c)	$CCl_2CuH_4O_2$ **M1** 41.52 / 35.5; 37.43 / 64; 2.34 / 1; 18.71 / 16 **OR** 1.17 : 0.58 : 2.34 : 1.17 **M2** appropriate scaling to give whole number ratios	2

Question 7 [6]

7	• filter the water (1) **and any five from:** • specified volume of water / filtrate • placed in a suitable container and heated in this container (evaporating basin / beaker) • heat/warm (to evaporate water) • (heat) until all water gone / to dryness / to constant mass • find mass of solid left • concentration = mass × 1000 ÷ volume used	6

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Question 8 [6]

8	Any **six** from: **MP1** find mass of mixture **MP2** add water and stir **MP3** filter **MP4** add (excess) aqueous sodium hydroxide to residue and stir **MP5** filter and wash residue / calcium carbonate (with water) and dry **MP6** weigh residue / calcium carbonate **MP7** (mass calcium carbonate / initial mass) × 100 (%)	**6**

Question 9 [12]

9(a)	relative atomic mass	**1**
9(b)	C_4H_{10} is covalent	**1**
	KF is ionic	**1**
9(c)	mol of **Y** = 0.060 / 24.0 = 2.5×10^{-3} or 0.0025	**1**
	M_r = 0.095 / 2.5×10^{-3} = 38(.0)	**1**
	fluorine	**1**
9(d)	mass of O = 3.87 g – 1.68 g = 2.19 (g)	**1**
	mol of P and mol of O 1.68 / 31 OR 0.054.. 2.19 / 16 **OR** 0.13…	**1**
	ratio of P to O P = 0.054… / 0.054 O = 0.13… / 0.054… = 1 = 2.5	**1**
	whole number ratio and P_2O_5 = 2 = 5	**1**
9(e)	the formula is P_4O_6 or (one mole of) P_2O_3 = 110 (g)	**1**
	mass = 220 (g)	**1**

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Question 10 [13]

10(a)(i)	74	**1**
	0.12	**1**
10(a)(ii)	0.3	**1**
10(a)(iii)	0.02	**1**
10(a)(iv)	207	**1**
	4.14	**1**
10(a)(v)	75%	**1**
10(b)(i)	heat it	**1**
10(b)(ii)	$Ca(ClO_3)_2 \rightarrow CaCl_2 + 3O_2$ 1 mark for O_2 as product 1 mark for the rest correct and balanced	**2**
10(c)(i)	red	**1**
10(c)(ii)	proton donor	**1**
10(c)(iii)	$\rightarrow ClO_3^- + H_3O^+$	**1**

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