1. 5070/21/M/J/16 QA4

A4(d)	Percentage of N in ammonium nitrate = 35% (1) Percentage of N in urea = 47% (1) **OR** Both formulae contain two nitrogen atoms (1) Urea has a lower relative formula mass (1)	**2**

2. 5070/21/M/J/16 QB8

B8(d)	Moles of C_6H_{14} = 3.0 (1) Mass of C_6H_{12} = 252 (g) (1)	**2**
B8(e)(i)	Mole ratio C : H = 7.14 : 14.3 **or** 85.7 / 12 and 14.3 / 1(1) Divide by 7.14 to get empirical formula (1)	**2**

3. 5070/22/M/J/16 QA2

A2(c)	Moles of HF = 0.01 (1) Moles of $Ca(OH)_2$ = 0.005 / moles of $Ca(OH)_2$ = 0.5 × moles of HF (1) Volume = 33.3 cm^3 (1)	**3**

4. 5070/22/M/J/16 QA4

A4(d)	Relative formula mass = 174 (1) Percentage of K = 44.8% (1)	**2**

5. 5070/22/M/J/16 QB8

B8(d)	Moles of C_6H_{14} = 3.0 (1) Mass of C_6H_{12} = 246 (1)	**2**
B8(e)(i)	Mole ratio C: H = 7.35 : 11.8 (1) Idea of dividing by smallest / simplest ratio is 1 : 1.6 **AND** × 5 (1)	**2**

6. 5070/22/M/J/16 QB9

B9(b)	Moles of methanol = 5 (1) Energy released = 455 kJ (1)	**2**

7. 5070/21/M/J/16 QB9

B9(b)	Moles of H_2 = 10 (1) Energy absorbed = 1310 (kJ) (1)	**2**

8. 5070/21/O/N/16 QA5

A5(a)	39% (2) If 2 marks not scored, molar mass of $KClO_3$ = 122.5 scores 1 mark	**2**
A5(b)	$KClO_3 = \frac{12.25}{122.5}$ OR 0.10 (mol) (1) moles O_2 = 1.5 × 0.01 = 0.15 moles / idea of multiplying moles by 1.5 (1) volume of O_2 = 3.6 dm^3 / 3600 cm^3, correct unit must be included (1)	**3**

9. 5070/21/O/N/16 QB9

B9(c)	mol Sn = $\frac{5.95}{119}$ mol Cl = $\frac{3.55}{35.5}$ dividing masses by correct atomic masses (1) (mol Sn = 0.05 and mol Cl = 0.1) formula is $SnCl_2$ (1)	**2**
B9(d)	mol tin(II) oxide = $\frac{13.5}{135}$ OR 0.10 mol (1) mass tin(IV) oxide expected = $0.10 \times 151 = 15.1$ g (1) % yield = $\frac{12.7}{15.1} \times 100$ = 84% (1)	**3**

10. 5070/21/O/N/16 QB10

B10(b)	mol LiOH = $0.500 \times \frac{20}{1000}$ OR 0.01 mol molar mass of hydrated lithium nitrate = 123 (1) mass = $123 \times 0.01 = 1.23$ g (1)	**3**

11. 5070/22/O/N/16 QA5

A5(a)	34.5% (2) If two marks not scored, 171 (for molar mass of nickel carbonyl) scores 1 mark	**2**
A5(b)	mol nickel carbonyl = $\frac{1.71}{171}$ OR 0.01 (mol) (1) mol gases = (0.01) × 5/idea of multiplying mol × 5 (1) volume of gases = 1.2 dm^3/1200 cm^3 (units must be correct) (1)	**3**

12. 5070/22/O/N/16 QB9

B9(e)	Cu_2O (2) If two marks not scored, mol Cu = $\frac{9.86}{64}$ AND mol O = $\frac{1.23}{16}$ scores 1 mark	**2**

13. 5070/22/O/N/16 QB10

B10(b)	mol sulfuric acid = $2.0 \times \frac{15}{1000}$ OR 0.03 (1) molar mass of hydrated copper sulfate = 250 (1) mass of hydrated copper sulfate = 7.5 g (1)	**3**

14. 5070/21/M/J/17 QA3

A3(c)(i)	Moles = 0.020 × 0.550 **OR** 0.011 (1) Mass = 2.563 (1)	**2**
A3(c)(ii)	Percentage yield = 74.91	**1**

15. 5070/21/M/J/17 QB7

B7(c)	Moles of acid = 0.025 × 16 **OR** 0.4 (1) Moles of NO_2 = 0.2 (1) Volume of NO_2 = 4.8 dm^3 / 4800 cm^3 (1)	**3**

16. 5070/21/M/J/17 QB9

B9(d)(i)	element / xenon / oxygen / fluorine mass / 0.549 g / 0.134 g / 0.317 g moles / 0.00419 / 0.008375 / 0.0167 Mole ratio / 1 / 2 / 4 Correct moles (1) XeO_2F_4 (1)	**2**

17. 5070/22/M/J/17 QA3

A3(c)(i)	Moles of acid = 0.020 × 0.65 **OR** 0.013 (1) Mass = 2.26(2) (g) / 2.3 (g) (1)	**2**
A3(c)(ii)	Percentage yield = 76.(1) %	**1**

18. 5070/22/M/J/17 QB7

B7(c)	Moles of acid = 0.025 × 14.0 **OR** 0.35 (1) Moles of sulfur dioxide = 0.175 (1) Volume of gas = 4.2 dm^3 / 4 200 cm^3 (1)	**3**

19. 5070/22/M/J/17 QB9

B9(d)(i)	$\frac{H}{0.040/1}$ $\frac{C}{0.242/12}$ $\frac{Cl}{0.718/35.5}$ **OR** 0.040 mol 0.020 mol 0.020 mol (1) CH_2Cl (1)	**2**
B9(d)(ii)	$C_2H_4Cl_2$	**1**

20. 5070/21/O/N/17 QA3

A3(c)(i)	mol Fe_2O_3 = $\frac{14.4}{160}$ **OR** 0.090 (1) mol Fe = 2 × 0.090 **OR** 0.180 (1) mass = (0.180 × 56) = 10.1 (1)	**3**
A3(c)(ii)	mol CO_2 = $\frac{3}{2}$ × 0.18 **OR** 0.27 (1) volume = 0.27 × 24 = 6.48 (dm^3) (1)	**2**

21. 5070/21/O/N/17 QB7

B7(b)(i)	mass of germanium = 21.9 (g) (1) mol Ge = $\frac{21.9}{73}$ and mol Cl = $\frac{42.6}{35.5}$ **OR** mol ratio Ge : Cl is 0.3 to 1.2 (1) $GeCl_4$ (1)	**3**

22. 5070/21/O/N/17 QB8

B8(a)	$\frac{3\times14}{149} \times 100 = 28.2$ % (2 marks) If 2 marks not scored correct M_r = 149 (1)	**2**

B8(e)	mol $H_2SO_4 = 0.150 \times \frac{10.5}{1000}$ **OR** 1.575×10^{-3} (1) mol NH_3(aq) = $2 \times 1.575 \times 10^{-3}$ **OR** 3.15×10^{-3} (1) concentration of NH_3(aq) = 0.158 (mol dm^{-3}) (1)	**3**

23. 5070/22/O/N/17 QA3

A3(c)(i)	Mol Fe = $\frac{39.2}{56}$ **OR** 0.7(00) (1) Mol Fe_3O_4 = $\frac{0.7(00)}{3}$ **OR** 0.233 (1) Mass = $0.233 \times 232 = 54.1$ (1)	**3**
A3(c)(ii)	Moles $H_2 = 4 \times 0.233$ **OR** 0.933 (1) Volume = $0.933 \times 24 = 22.4$ dm^3 (1)	**2**

24. 5070/22/O/N/17 QB7

B7(c)(i)	Mass of sulfur = 19.2 g (1) mol S = $\frac{19.2}{32}$ mol Cl = $\frac{21.3}{35.5}$ **OR** ratio = 0.6 to 0.6 (1) SCl(1)	**3**
B7(c)(ii)	S_2Cl_2 (1)	**1**

25. 5070/22/O/N/17 QB8

B8(a)	$\frac{2\times39}{174} \times 100 = 44.8\%$ / 45% (2 marks) If 2 marks not scored correct M_r = 174 (1)	**2**
B8(e)	Mol KOH = $0.200 \times \frac{12.5}{1000}$ **OR** 2.5×10^{-3} (1) Mol phosphoric acid = $\frac{2.5\times10^{-3}}{3}$ **OR** 8.33×10^{-4} (1) Concentration of phosphoric acid = 0.0333 (mol / dm^3) (1) ($8.33 \times 10^{-4} \times 1000 / 25$)	**3**

26. 5070/21/M/J/18 Q3

3(b)	moles of hydrochloric acid = $6 \times 10^{-2} / 0.06$ (1) (moles of barium chloride = moles of HCl ÷ 2) = $3 \times 10^{-2} / 0.03$ (1) (mass of barium chloride = moles × 208 × 0.75) = 4.68 (1)	**3**

27. 5070/21/M/J/18 Q4

4(d)	(moles of CO_2 = 0.01 so) moles of C_2H_5OH = 0.005 (1) energy released = (moles of C_2H_5OH × 1350) = 6.75 (1)	**2**

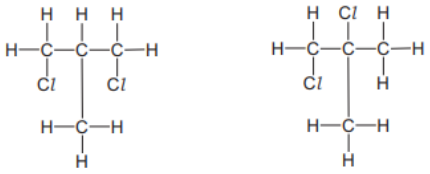
28. 5070/21/M/J/18 Q6

6(a)	M_r = 184 (1) (% copper = 34.8 so mass of copper = % × 20) = 6.96 (1)	**2**

29. 5070/21/M/J/18 Q8

8(a)	CH_4SO_3 (1)	**1**
8(b)	methanesulfonic acid is more dissociated (1)	**1**
8(c)	acids contain H^+ (1) alkalis contain OH^- (1)	**2**
8(d)	moles of acid = 0.0225 / 0.15 × 0.150 (1) M_r of acid = 96 (1) mass of acid (= moles of acid × M_r) = 2.16 (1)	**3**
8(e)	8.57 (cm^3) (1)	**1**

30. 5070/21/M/J/18 Q9

9(a)(i)	$C_4H_8Cl_2$ (1) Structure showing all atoms and all of the bonds of a compound having two chlorine atoms substituted and based on methylpropane skeleton e.g.  (1)	**2**
9(a)(ii)	molecular formula is $C_4H_7Cl_3$ (2) If two marks not scored: 1 mark for mole ratio C : H : Cl is 2.475 : 4.30 : 1.856 **OR** 1 mark for C = 29.7 / 12, H = 4.3 / 1 and Cl = 65.9 / 35.5	**2**
9(a)(iii)	$C_4H_5Cl_5$ (1)	**1**

31. 5070/22/M/J/18 Q3

3(c)	(moles of nitric acid) = 4.5×10^{-3} (1) **EITHER** moles from first marking point × 170 **OR** 0.765 g (silver nitrate) (1) $(0.765 \times 0.8) = 0.612$ g (silver nitrate) (1) **OR** moles from first marking point × 0.8 **OR** 3.6×10^{-3} moles (silver nitrate) (1) $(3.6 \times 10^{-3} \times 170) = 0.612$ g silver nitrate (1)	**3**

32. 5070/22/M/J/18 Q4

4(a)	moles of $SiO_2 = 5$ **OR** $\frac{300}{60}$ **OR** moles of $P_4 = \frac{300}{360}$ **OR** 0.83 (1) mass of P_4 (= moles of $SiO_2 \times 124 \div 6$ OR = moles of $P_4 \times 124$) = 103.3 (1)	**2**

33. 5070/22/M/J/18 Q7

7(a)	$M_r = 97$ **OR** % zinc = 67 % (1) (% zinc = 67 so mass of zinc = % × 30) = 20.1 (1)	**2**

34. 5070/22/M/J/18 Q9

9(a)	SO_3NH_3 (1)	**1**
9(b)(i)	(a substance that) donates hydrogen ions / (a substance that) produces hydrogen ions (in solution) (1)	**1**
9(b)(ii)	weak acids partially ionise / weak acids do not completely dissociate / weak acids do not fully ionise (1) strong acids completely ionise / strong acids completely dissociate (1)	**2**
9(c)	moles of acid = $0.25 \times 0.15 / 0.0375$ (1) M_r of acid = 97 (1) mass of acid (= moles of acid × M_r) = 3.6(4) (1)	**3**
9(d)	16.7 (cm^3) (1)	**1**

35. 5070/21/O/N/18 Q3

3(d)	moles succinic acid = 1.25×10^{-3} (1) moles sodium hydroxide = 2.50×10^{-3} (1) 125 (cm^3) (1)	**3**

36. 5070/21/O/N/18 Q4

4(f)(i)	mole ratio C = 90 / 12 **AND** mole ratio H = 10 / 1 **OR** C = 7.5 **AND** H = 10 (1) empirical formula = C_3H_4 (1)	**2**
4(f)(ii)	(relative) molecular mass	**1**

37. 5070/21/O/N/18 Q9

9(d)	mol Ce = 0.09 (1) mol H_2 = 0.135 (1) volume of H_2 = 3.24 (dm^3) (1)	**3**
9(e)	relative formula mass = 460 (1) percentage = 60.9% / 61% (1)	**2**

38. 5070/22/O/N/18 Q3

3(c)(i)	$H^+ + OH^- \rightarrow H_2O$	**1**
3(c)(ii)	moles fumaric acid = 4.00×10^{-4} (1) moles sodium hydroxide = 8.00×10^{-4} (1) 16.0 (cm^3) (1)	**3**

39. 5070/22/O/N/18 Q4

4(e)(i)	mole ratio C = 85.7 / 12 AND mole ratio H = 14.3 / 1 **OR** C = 7.14 AND H = 14.3 (1) empirical formula = CH_2 (1)	**2**
4(e)(ii)	(relative) molecular mass	**1**

40. 5070/22/O/N/18 Q9

9(d)	mol Zn = 0.07(0) (1) (= mol H_2) volume of H_2 = 1.68 (dm^3) (1)	**2**
9(e)	50.6% / 51% (2) If two marks not obtained, award one mark for: (relative formula mass of zinc phosphate) = 385	**2**

41. 5070/21/M/J/19 Q3

3(d)	process 1 – correct use of 20% in calculation e.g. need to make 200 g of molybdenum (1) process 2 – moles of molybdenum needed = 200 / 96 **OR** 2.083 process 3 – mass of MoO_3 = (moles of Mo × 144) = 300 (g)	**3**

42. 5070/21/M/J/19 Q5

5(a)	<table><tr><td>element</td><td>C</td><td>H</td><td>O</td></tr><tr><td>mass in g</td><td>1.68</td><td>0.14</td><td>**4.48**</td></tr><tr><td>moles</td><td>**0.14**</td><td>**0.14**</td><td>**0.28**</td></tr><tr><td>simplest mole ratio</td><td>**1**</td><td>**1**</td><td>**2**</td></tr></table> mass of oxygen / 4.48 (1) moles / mole ratio (1) empirical formula CHO_2 (1)	**3**
5(b)	moles of KOH = 0.0127 x 0.150 **OR** 0.001905 (1) mole of **U** = 0.5 × moles of KOH **OR** 0.001905 × 0.5 **OR** 0.0009525 (1) M_r = (0.086 / 0.0009525) =90.3 / 90 (1)	**3**
5(c)	$C_2H_2O_4$ (1)	**1**

43. 5070/21/M/J/19 Q7

7(b)	moles of ammonium carbonate = 4.80 / 96 **OR** 0.05(00) (1) moles of gas = 3 × 0.05 **OR** 0.15 (1) volume of gas = (0.15 × 24) = 3.6 dm^3 **OR** 3600 cm^3 (1)	**3**

44. 5070/22/M/J/19 Q3

3(c)	**Process 1:** mol $TiCl_4$ = $\frac{1000}{190}$ **OR** 5.263 (1) **Process 2:** mass Ti = $\frac{1000}{190} \times 48$ **OR** 252.63 (1) **Process 3:** % = $\frac{1000}{190} \times 48 \times 0.9$ **OR** 227.36 / 230g **OR** **Process 1:** mol $TiCl_4$ = $\frac{1000}{90}$ **OR** 5.263 (1) **Process 2:** % = $\frac{90}{100} \times 5.263$ **OR** 4.736 (1) **Process 3:** mass = 4.736 × 48 **OR** 227.36 / 230 g	**3**

45. 5070/22/M/J/19 Q5

5(a) — **3**

element	C	H	O
%	57.1	4.8	**38.1**
moles	**4.76**	**4.8**	**2.38**
simplest mole ratio	**2**	**2**	**1**

% of oxygen (1)

moles / mole ratio (1)

empirical formula C_2H_2O (1)

5(b) — **3**

moles of KOH = 0.0185 × 0.250 **OR** 0.004625 (1)

moles of W = moles of KOH ÷ 3 **OR** 0.004625 ÷ 3 **OR** 0.00154 (1)

M_r = (0.194 / 0.00154) = 125.97 / 126 (1)

5(c) — **1**

$C_6H_6O_3$ (1)

46. 5070/22/M/J/19 Q7

7(b) — **3**

moles of ammonium iodide $\frac{2.9}{145}$ **OR** 0.02(00) (1)

moles of gas = 2 × 0.02 **OR** 0.04(0) (1)

volume of gas = (0.04 × 24) = 0.96 dm^3 **OR** 960 cm^3 (1)

47. 5070/21/O/N/19 Q2

2(c) — **3**

mol $H_2 = \frac{300}{24000}$ **OR** 0.0125 (1)

moles sodium 2 × 0.0125 **OR** 0.025 (1)

mass of sodium = 0.575 g (1)

48. 5070/21/O/N/19 Q3

3(c) — **2**

$\frac{Cu}{\frac{21.09}{64}}$ $\frac{Cs}{\frac{43.82}{133}}$ $\frac{Cl}{\frac{35.09}{35.5}}$

OR

Cu = 0.33 Cs = 0.33 Cl = 0.99 (1)

$CuCsCl_3$ (1)

49. 5070/21/O/N/19 Q5

5(d) — **2**

molar mass of $NiCl_2$ = 130 (1)

x = 6 (1)

50. 5070/21/O/N/19 Q6

6(d)	mol sodium carbonate $= \frac{3.18}{106}$ **OR** 0.03 mol (1) mol ethanoic acid $= \frac{224}{1000} \times 0.250$ **OR** 0.056 (1) sodium carbonate in excess because $0.03 \times 2 = 0.06$ **OR** sodium carbonate in excess because $0.056 \div 2 = 0.028$ (1)	**3**

51. 5070/22/O/N/19 Q4

4(d)	mol $CO_2 = \frac{16.8}{24\,000}$ **OR** 7×10^{-4} **OR** 0.0007 (1) mass of $CaCO_3 = 7 \times 10^{-4} \times 100 = 0.0700$ (g) (1)	**2**

52. 5070/22/O/N/19 Q5

5(d)	$x = 5$ (2) if 2 marks not scored 1 mark for: molar mass of $NaIO_3 = 198$ (1)	**2**

53. 5070/22/O/N/19 Q6

6(d)	mol butanoic acid $= \frac{5.28}{88}$ **OR** 0.06 mol (1) mol sodium carbonate $= \frac{56}{1000} \times 0.500$ **OR** 0.028 (1) (butanoic acid in excess because sodium carbonate $\times 2$) = 0.056 mol **OR** (butanoic acid in excess because butanoic acid $\div 2$) = 0.03 mol (1)	**3**

54. 5070/21/M/J/20 Q3

3(a)	(moles of H_2O_2) $= \frac{680}{34}$ **OR** 20 (1) (energy $= 20 \times 98$) = 1960 (kJ) (1)	**2**

55. 5070/21/M/J/20 Q8

8(c)(i)	mole ratio Al to Cl is $\frac{20.2}{27}$ to $\frac{79.8}{35.5}$ **OR** 0.748 to 2.25 (1) divide by smallest $\frac{0.748}{0.748}$ to $\frac{2.25}{0.748}$ (1)	**2**
8(c)(ii)	267 (1) Al_2Cl_6 (1)	**2**

56. 5070/21/M/J/20 Q9

9(c)(ii)	moles of $FeSO_4 = \frac{6.08}{152}$ **OR** 0.04 (1) moles of SO_2 ($= 0.5 \times 0.04$) = 0.02 (1) volume of SO_2 ($= 24 \times 0.02$) = 0.48 (dm^3) (1)	**3**

57. 5070/22/M/J/20 Q2

2(a)	(moles of H_2) = $\frac{25}{2}$ **OR** 12.5 (1) (energy = 12.5 × 286) = 3575 / 3580 (kJ) (1)	**2**

58. 5070/22/M/J/20 Q3

3(d)(i)	moles of propanoic acid = $\frac{11.0}{74}$ **OR** 0.149 (1) (mass = 88 × 0.149) = 13.1 (g) (1)	**2**

59. 5070/22/M/J/20 Q7

7(c)(i)	mole ratio P to O is $\frac{43.7}{31}$ to $\frac{56.3}{16}$ **OR** 1.41 to 3.52 (1) divide by smallest $\frac{1.41}{1.41}$ to $\frac{3.52}{1.41}$ = 1 to 2.5 and evidence of multiplying by 2 (1)	**2**
7(c)(ii)	284 (1) P_4O_{10} (1)	**2**

60. 5070/22/M/J/20 Q8

8(c)	M_r of $CuSO_4$ = 160 (1) moles of $CuSO_4$ or moles of SO_3 = 0.04 (1) volume of SO_3 (= 24 × 0.04) = 0.96 (dm^3) (1)	**3**

61. 5070/21/O/N/20 Q3

3(e)	mass of copper = 2.00 g (1) mol copper = $\frac{2.00}{64}$ **and** mol oxygen = $\frac{0.25}{16}$ **OR** mol copper = 0.0313 **and** mol oxygen = 0.0156 (1) empirical formula is Cu_2O (1)	**3**

62. 5070/21/O/N/20 Q4

4(d)	mol oxygen = $\frac{0.037}{4}$ **OR** 9.25×10^{-3} (1) volume of oxygen = 0.22 (dm^3) (1)	**2**

63. 5070/21/O/N/20 Q7

7(b)(ii)	mol aluminium oxide = $\frac{25.5}{102}$ **OR** 0.25 mol (1) mass of aluminium = 13.5 g (1)	**2**

64. 5070/21/O/N/20 Q8

8(a)(i)	mol barium hydroxide = $0.045 \times \frac{34.0}{1000}$ **OR** 1.53×10^{-3} (1) mol nitric acid = 3.06×10^{-3} (1) concentration nitric acid = 0.122(4) mol / dm^3 (1)	**3**

65. 5070/22/O/N/20 Q2

2(e)(i)	mol C = $\frac{14.4}{12}$ mol C*l* = $\frac{21.3}{35.5}$ mol H= $\frac{0.600}{1}$ **OR** mol C = 1.20 mol C*l* = 0.60 mol H = 0.60 (1) empirical formula is C_2HCl (1)	**2**
2(e)(ii)	$C_6H_3Cl_3$	**1**

66. 5070/22/O/N/20 Q4

4(d)	mol hydrogen peroxide = $\frac{16}{34}$ **OR** 0.471 mol oxygen = $\frac{0.471}{2}$ **OR** 0.235 (1) volume of oxygen = 5.65 (dm^3) (1)	**3**

67. 5070/22/O/N/20 Q7

7(c)(ii)	mol iron oxide = $\frac{12.5}{160}$ **OR** 0.078 mol (1) mass of iron = 8.75 g(1)	**2**

68. 5070/22/O/N/20 Q8

8(a)(i)	mol sodium hydroxide = $0.0150 \times \frac{24.0}{1000}$ **OR** 3.60×10^{-4} (1) mol sulfuric acid = 1.80×10^{-4} (1) concentration sulfuric acid = 7.2×10^{-3} / 0.0072 mol / dm^3 (1)	**3**

69. 5070/21/M/J/21 Q2

2(e)	percentage of xenon = 60.4 (1) mole ratio Xe : O : F is 60.4 / 130 : 22.1 / 16 : 17.5 / 19 **OR** 0.46 : 1.38 : 0.92 (1) empirical formula XeO_3F_2 (1)	**3**
2(f)(iii)	moles = 21 / 24 **OR** 0.875 (1) mass = 18 (g) (1)	**2**

70. 5070/21/M/J/21 Q7

7(a)	moles of NH_4NO_2 = 0.00375 (1) volume = 0.09 (dm^3) (1)	**2**

71. 5070/21/M/J/21 Q9

9(d)(i)	relative formula mass of alcohol is 58 (1) mol of alcohol = 0.2 **OR** 11.6/58 (1) mass of ester = 0.2 × M_r **AND** 0.2 × 100 **OR** M_r × 11.6 / 58 **AND** 100 ×.6 / 58 (1)	**3**
9(d)(ii)	33.6 (%)	**1**

72. 5070/22/M/J/21 Q2

2(d)	percentage of selenium = 47.6 (1) mole ratio Se : O : C*l* is 47.6 / 79 : 9.6 / 16 : 42.8 / 35.5 **OR** 0.60 : 0.60 : 1.21 (1) empirical formula $SeOCl_2$ (1)	**3**
2(e)(iii)	mol = 11.5 / 24 **OR** 0.479(117) (1) mass = 15 (g) (1)	**2**

73. 5070/22/M/J/21 Q7

7(a)	moles of $NaNO_2$ = 0.00300 (1) volume = 0.072 (dm^3) (1)	**2**

74. 5070/22/M/J/21 Q9

9(d)(i)	mol of carboxylic acid = 10.8 / 72 **OR** 0.15 mol (1) relative molecular mass of ester = 100 (1) mass of ester = 0.15 × 100 (1)	**3**
9(d)(ii)	63 (%)	**1**

75. 5070/21/O/N/21 Q3

3(c)	mol iron = $\frac{3.36}{56}$ **OR** 0.060 mol (1) volume of hydrogen = 1.44 (dm^3) (1)	**2**

76. 5070/21/O/N/21 Q4

4(d)	$\frac{\text{C}}{54.5/12}$ $\frac{\text{H}}{9.10/1}$ $\frac{\text{O}}{36.4/16}$ **OR** 4.54 9.10 2.275 (1) C_2H_4O (1)	**2**

77. 5070/21/O/N/21 Q9

9(b)	$NaOH = \frac{4.5}{40}$ **OR** 0.1125 (mol) (1) $(NH_4)_2SO_4 = \frac{50}{1000} \times 1.25$ **OR** 0.0625 (mol) (1) ($(NH_4)_2SO_4$ because $0.0625 \times 2) = 0.125$ **OR** ($(NH_4)_2SO_4$ because $0.1125 \div 2) = 0.056$ (1)	**3**

78. 5070/22/O/N/21 Q3

3(c)	mol magnesium = $\frac{1.68}{24}$ **OR** 0.070 mol (1) volume of oxygen = 1.68 (dm^3) (1)	**2**

79. 5070/22/O/N/21 Q4

4(d)	C_2H_3 (2) if 2 marks not scored 1 mark for: C H $\frac{88.9}{12}$ $\frac{11.1}{1}$ **OR** 7.4 11.1 (1)	**2**

80. 5070/22/O/N/21 Q9

9(c)	mol $H_2SO_4 = \frac{45}{1000} \times 0.20$ **OR** 0.009 (1) mol sodium hydroxide = $\frac{0.76}{40}$ **OR** 0.019 mol (1) (sodium hydroxide because 0.019 is greater than) 2×0.009 **OR** (sodium hydroxide because 0.009 is less than) 0.019 / 2 (1)	**3**

81. 5070/21/M/J/22 Q2

2(f)	moles of nitrogen = 0.6857 **OR** 19.2 / 28 (1) volume = 0.6857×24 **OR** 16.457 (1) volume = 16 (dm^3) (1)	**3**

82. 5070/21/M/J/22 Q5

5(b)(iii)	278	**1**
5(b)(iv)	13.9	**1**

83. 5070/21/M/J/22 Q7

7(e)	moles of aluminium = 0.0866666667 (1) moles of H_2SO_4 = 0.100 (1) 0.1 mole of acid would react with 0.067 mol of aluminium / 0.0867 mole of aluminium would need 0.13 moles of H_2SO_4 (1)	**3**

84. 5070/22/M/J/22 Q2

2(f)	moles of oxygen = 0.94375 **OR** 30.2 / 32 (1) volume = 0.94375 × 24 **OR** 22.65 (1) volume = 23 (dm^3) (1)	**3**

85. 5070/22/M/J/22 Q6

6(c)	M_r for aluminium sulfate is 342 (1) x = 18 (1)	**2**

86. 5070/22/M/J/22 Q8

8(d)	moles of zinc = 0.036 (1) moles of HC*l* = 0.100 (1) 0.1 mole of acid would react with 0.05 mol of zinc / 0.036 mole of zinc would need 0.072 moles of HC*l* (1)	**3**

87. 5070/21/O/N/22 Q3

3(e)(i)	division by correct relative atomic mass e.g. C = $\frac{22.2}{12}$ H = $\frac{3.7}{1}$ Br = $\frac{74.1}{80}$ **OR** 1.85 3.7 0.93 (1) division by lowest value to get correct answer $\frac{1.85}{0.93}$ $\frac{3.7}{0.93}$ $\frac{0.93}{0.93}$ C_2H_4Br (1)	**2**
3(e)(ii)	$C_6H_4Br_2$	**1**

88. 5070/21/O/N/22 Q4

4(b)	relative molecular mass of ammonium phosphate = 149 (1) $\frac{42}{149}$ × 100 **OR** 28% / 28.18(791946)% (1) 28.2% (1)	**3**

89. 5070/21/O/N/22 Q9

9(a)(i)	mol H_2 = 60/24 000 **OR** 2.5 × 10^{-3} mol (1) mol HC*l* = M1 × 2 **OR** 5 × 10^{-3} mol (1) concentration of HC*l* = 0.25 mol / dm^3 (1)	**3**

90. 5070/22/O/N/22 Q9

9(a)(i)	mol CO_2 = 120 / 24000 **OR** 5 × 10^{-3} (1) mol HC*l* = M1 × 2 **OR** 1 × 10^{-2} (1) concentration of HC*l* = 0.4 (mol / dm^3) (1)	**3**