1. Question | 5070 May-June 2023 P1 V1 Q7

7 Three compounds are listed.

- calcium carbonate
- potassium sulfate
- zinc nitrate

Which row shows the element present in the greatest percentage by mass in each compound?

[A_r: Ca, 40; C, 12; O, 16; K, 39; S, 32; Zn, 65; N, 14]

	element present in the greatest percentage by mass in calcium carbonate	element present in the greatest percentage by mass in potassium sulfate	element present in the greatest percentage by mass in zinc nitrate
A	calcium	oxygen	oxygen
B	calcium	oxygen	zinc
C	oxygen	potassium	zinc
D	oxygen	potassium	oxygen

2. Question | 5070 May-June 2023 P1 V1 Q8

8 Two aqueous solutions, Q and R, have the same concentration in mol / dm^3.

Solution Q contains 4.0 g of NaOH in 500 cm^3 of solution.

Which solution could be solution R?

[A_r: Na, 23; O, 16; H, 1]

A 0.2 mol of $Ca(OH)_2$ in 250 cm^3 of solution

B 0.2 mol of HCl in 100 cm^3 of solution

C 0.05 mol of H_2SO_4 in 250 cm^3 of solution

D 0.1 mol of KOH in 1000 cm^3 of solution

3. Question | 5070 May-June 2023 P1 V1 Q9

9 Samples of two hydrated compounds are weighed and then dehydrated by heating.

The anhydrous compounds are weighed and the results are shown.

3.97 g $FeSO_4 \cdot xH_2O$ gives 2.17 g anhydrous $FeSO_4$.

2.88 g $CaSO_4 \cdot yH_2O$ gives 2.27 g anhydrous $CaSO_4$.

What are the values of *x* and *y*?

[M_r: $FeSO_4$, 152; $CaSO_4$, 136; H_2O, 18]

	x	*y*
A	5	2
B	5	5
C	7	5
D	7	2

4. Question | 5070 May-June 2023 P1 V1 Q10

10 What has a mass equal to the mass of one mole of water?

A 24 dm^3 of water at room temperature and pressure

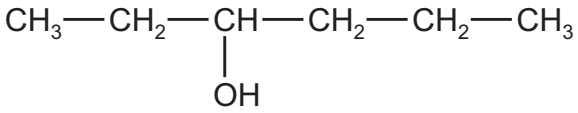
B one mole of steam at 200 °C and 100 kPa / 1 atm pressure

C one molecule of water at room temperature and pressure

D two moles of hydrogen molecules and one mole of oxygen molecules

5. Question | 5070 May-June 2023 P1 V1 Q37

37 Hexan-3-ol is an alcohol.



hexan-3-ol

How many molecules of oxygen are needed for the complete combustion of one molecule of hexan-3-ol?

A 9 **B** 10 **C** 18 **D** 19

6. Question | 5070 May-June 2023 P1 V2 Q8

8 Which statements about relative atomic mass and relative molecular mass are correct?

1 The mass of the different isotopes does **not** affect relative atomic masses.

2 Only covalent compounds have a relative molecular mass.

3 Relative atomic masses are compared to $\frac{1}{12}$ of the mass of one atom of ^{12}C.

A 1 and 2 only **B** 1 and 3 only **C** 2 and 3 only **D** 1, 2 and 3

7. Question | 5070 May-June 2023 P1 V2 Q9

9 Aqueous hydrogen peroxide, H_2O_2, decomposes slowly at 25 °C.

$$2H_2O_2(aq) \rightarrow 2H_2O(l) + O_2(g)$$

The decomposition reaction takes place faster when a catalyst is added.

A student adds a small amount of catalyst to 10 cm^3 of 1.0 mol/dm^3 $H_2O_2(aq)$ and collects the gas formed. The volume of gas collected is 90 cm^3.

All measurements are at room temperature and pressure.

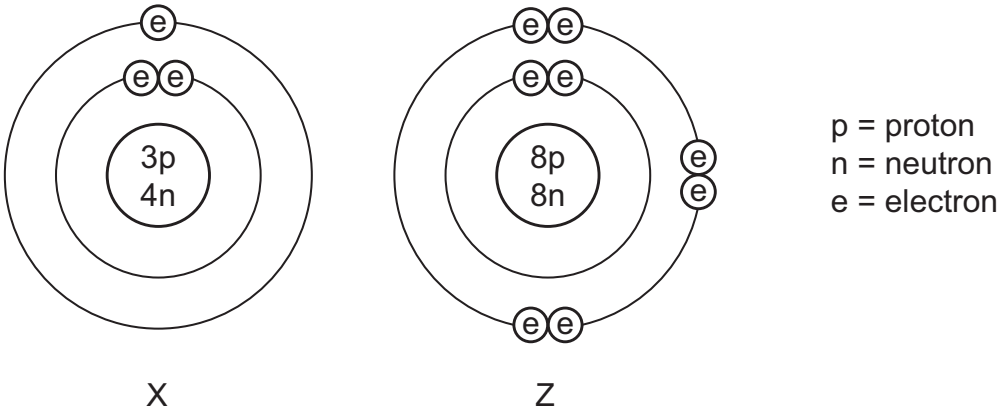
What is the percentage yield of $O_2(g)$?

A 28.1% **B** 37.5% **C** 56.3% **D** 75.0%

8. Question | 5070 May-June 2023 P1 V2 Q10

10 The diagram shows the structures of the atoms of two elements, X and Z.

X and Z are **not** the atomic symbols for these elements.



X Z

The elements combine to form a compound.

What is the mass of one mole of this compound?

A 11 g **B** 12 g **C** 23 g **D** 30 g

9. Question | 5070 May-June 2023 P1 V2 Q11

11 Which compound contains 45.2% nitrogen by mass?

[A_r: C, 12; H, 1; N, 14]

A ethane-1,2-diamine, $NH_2C_2H_4NH_2$

B hydroxylamine, NH_2OH

C methanamide, $HCONH_2$

D methylamine, CH_3NH_2

10. Question | 5070 May-June 2023 P1 V2 Q28

28 Which equation is correct?

A $Cu(s) + O_2(g) \rightarrow 2CuO(s)$

B $Mg(s) + H_2SO_4(aq) \rightarrow MgSO_4(aq) + H_2(g)$

C $Na(s) + H_2O(l) \rightarrow NaO(aq) + H_2(g)$

D $2Zn(s) + 2HNO_3(aq) \rightarrow 2ZnNO_3(aq) + H_2(g)$

11. Question | 5070 Oct-Nov 2023 P1 V1 Q7

7 Which row is correct?

	compound	molecular formula
A	ammonia	NH_4
B	ethene	C_2H_6
C	methanol	CH_4O
D	propanoic acid	$C_3H_8O_2$

12. Question | 5070 Oct-Nov 2023 P1 V1 Q8

8 Compound Y is the only substance formed when 500 cm^3 of ammonia reacts with 250 cm^3 of carbon dioxide. All measurements are at r.t.p.

What is the formula of Y?

A $(NH_4)_2CO_3$

B NH_2COONH_4

C $(NH_2)_2CO$

D NH_4COONH_4

13. Question | 5070 Oct-Nov 2023 P1 V1 Q9

9 How many sodium ions are there in 30 g of sodium sulfate?

A 1.52×10^{23} **B** 2.54×10^{23} **C** 6.02×10^{23} **D** 1.20×10^{24}

14. Question | 5070 Oct-Nov 2023 P1 V1 Q10

10 Three compounds are listed.

copper(II) nitrate, $Cu(NO_3)_2$

zinc sulfate, $ZnSO_4$

sodium thiosulfate, $Na_2S_2O_3$

Which row shows the element that is present in the greatest percentage by mass in each compound?

[relative formula masses, M_r: $Cu(NO_3)_2$, 188; $ZnSO_4$, 161; $Na_2S_2O_3$, 158]

	copper(II) nitrate	zinc sulfate	sodium thiosulfate
A	copper	oxygen	oxygen
B	copper	oxygen	sulfur
C	oxygen	zinc	sodium
D	oxygen	zinc	sulfur

15. Question | 5070 Oct-Nov 2023 P1 V2 Q6

6 When dilute hydrochloric acid is added to aqueous lead(II) nitrate, a white precipitate of lead(II) chloride is formed.

What is the ionic equation for this reaction?

A $Pb^{2+}(aq) + 2HCl(aq) \rightarrow PbCl_2(s) + 2H^+(aq)$

B $Pb^{2+}(aq) + 2HCl(aq) + 2HNO_3(aq) \rightarrow PbCl_2(s) + 4H^+(aq) + 2NO_3^-(aq)$

C $Pb^{2+}(aq) + 2Cl^-(aq) \rightarrow PbCl_2(s)$

D $Pb(NO_3)_2(aq) + 2HCl(aq) \rightarrow Pb^{2+}(aq) + 2Cl^-(aq) + 2HNO_3(aq)$

16. Question | 5070 Oct-Nov 2023 P1 V2 Q7

7 Which row shows a pair of molecules where the M_r of compound X is exactly half that of compound Y?

[A_r: C, 12; Cl, 35.5; H, 1; O, 16]

	X	Y
A	$CH_3CH_2CH_3$	CO_2
B	CH_3CH_2Cl	CH_2ClCH_2Cl
C	CH_3CO_2H	$CH_3CH_2CH_3$
D	CO_2	$CH_3CO_2C_2H_5$

17. Question | 5070 Oct-Nov 2023 P1 V2 Q8

8 One volume of a gaseous element, X_2, combines with an equal volume of gaseous hydrogen to form two volumes of a gaseous hydride.

What is the formula for the hydride of X?

A H_2X **B** HX **C** HX_2 **D** H_2X_2

18. Question | 5070 Oct-Nov 2023 P1 V2 Q9

9 Which reaction would produce the greatest volume of carbon dioxide at room temperature and pressure?

[M_r: $CaCO_3$, 100; Na_2CO_3, 106; $CuCO_3$, 124]

A burning 1 g of carbon in excess oxygen

$$C(s) + O_2(g) \rightarrow CO_2(g)$$

B thermal decomposition of 10 g of calcium carbonate in the air

$$CaCO_3(s) \rightarrow CaO(s) + CO_2(g)$$

C adding 10 g of sodium carbonate to an excess of dilute hydrochloric acid

$$Na_2CO_3(s) + 2HCl(aq) \rightarrow 2NaCl(aq) + CO_2(g) + H_2O(l)$$

D adding 50 cm^3 of 1 mol / dm^3 sulfuric acid to an excess of copper carbonate

$$CuCO_3(s) + H_2SO_4(aq) \rightarrow CuSO_4(aq) + CO_2(g) + H_2O(l)$$

19. Question | 5070 Oct-Nov 2023 P1 V2 Q10

10 Chrome alum is the common name for a salt which has the formula $CrK(SO_4)_2$.

What is the percentage by mass of chromium in chrome alum?

A 17.3 **B** 18.4 **C** 20.7 **D** 21.3

20. Question | 5070 Oct-Nov 2023 P1 V2 Q11

11 The equation shows the production of iron by the reduction of iron(III) oxide.

$$Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$$

80 tonnes of iron(III) oxide produces 50 tonnes of iron.

What is the percentage yield?

A 45% **B** 63% **C** 68% **D** 89%

21. Question | 5070 Specimen 2023 P1 Q10

10 A compound contains 70% by mass of iron and 30% by mass of oxygen.

What is its empirical formula? [A_r: O, 16; Fe, 56]

A FeO **B** Fe_2O_3 **C** Fe_3O_2 **D** Fe_3O_4

22. Question | 5070 Specimen 2023 P1 Q11

11 The equation for the reaction between ethyne, C_2H_2, and oxygen is shown.

$$2C_2H_2(g) + xO_2(g) \rightarrow yCO_2(g) + zH_2O(g)$$

When the equation is balanced, what is *x*?

A 2 **B** 3 **C** 4 **D** 5

23. Question | 5070 Specimen 2023 P1 Q12

12 25.0 g of hydrated copper(II) sulfate crystals are heated to produce anhydrous copper(II) sulfate and water.

$$CuSO_4 \cdot 5H_2O(s) \rightarrow CuSO_4(s) + 5H_2O(g)$$

What is the mass of anhydrous copper(II) sulfate formed?

[M_r: $CuSO_4$, 160; H_2O, 18]

A 9.0 g **B** 16.0 g **C** 22.5 g **D** 25.0 g

24. Question | 5070 Specimen 2023 P1 Q13

13 The relative formula masses of four compounds are given.

A student has a 1.0 g sample of each compound.

Which sample contains the highest number of moles of oxygen atoms?

	compound	relative formula mass
A	Al_2O_3	102
B	CuO	80
C	H_2SO_4	98
D	HNO_3	63

25. Question | 5070 Specimen 2023 P1 Q14

14 $50.0\,cm^3$ of $0.10\,mol/dm^3$ silver nitrate, $AgNO_3$, is added to $150.0\,cm^3$ of $0.05\,mol/dm^3$ sodium iodide, NaI, in a beaker.

After the reaction, solid silver iodide is present in the beaker.
What else is present?

A aqueous silver nitrate and aqueous sodium nitrate

B aqueous sodium iodide and aqueous sodium nitrate

C aqueous sodium iodide only

D aqueous sodium nitrate only

26. Question | 5070 Specimen 2023 P1 Q15

15 When 0.1 mol of the hydrocarbon, C_5H_{12}, is completely combusted it produces carbon dioxide, CO_2, and water, H_2O.

$$C_5H_{12}(l) + 8O_2(g) \rightarrow 5CO_2(g) + 6H_2O(g)$$

What is the volume of carbon dioxide produced when measured at room temperature and pressure?

A $0.5\,dm^3$ **B** $2.4\,dm^3$ **C** $5.0\,dm^3$ D $12\,dm^3$

27. Question | 5070 Specimen 2023 P1 Q31

31 Which compound has the lowest percentage by mass of nitrogen?

A $(NH_2)_2CO$ [M_r: 60]

B $(NH_4)_2SO_4$ [M_r: 132]

C $(NH_4)_3PO_4$ [M_r: 149]

D NH_4NO_3 [M_r: 80]

28. Question | 5070 May-June 2024 P1 V1 Q6

6 Statements about empirical and molecular formulae are given.

Which statement is correct?

A The empirical and molecular formulae of a compound are always different.

B The empirical formulae of ethyne, C_2H_2, and of benzene, C_6H_6, are the same.

C The molecular formula always shows the simplest whole-number ratio of the different atoms or ions in a compound.

D The empirical formula always shows the numbers and types of different atoms in one molecule of a compound.

29. Question | 5070 May-June 2024 P1 V1 Q7

7 What is the relative formula mass, M_r, of aluminium oxide?

A 43 **B** 75 **C** 102 **D** 113

30. Question | 5070 May-June 2024 P1 V1 Q8

8 How many ions are there in 16.0 g of anhydrous copper sulfate?

A 1.20×10^{23}

B 3.61×10^{23}

C 1.20×10^{24}

D 3.61×10^{24}

31. Question | 5070 May-June 2024 P1 V1 Q9

9 Which sample contains the most atoms?

A 0.5 mol of water

B 1.0 mol of carbon dioxide

C 1.0 mol of methane

D 2.0 mol of hydrogen chloride

32. Question | 5070 May-June 2024 P1 V1 Q10

10 The reactions shown all produce hydrogen.

Which reaction produces the greatest volume of hydrogen, measured at room temperature and pressure?

A 1.4 g carbon reacts with excess steam.

$$C(s) + H_2O(g) \rightarrow H_2(g) + CO(g)$$

B 2.4 g calcium hydride, CaH_2, reacts with excess water.

$$CaH_2(s) + 2H_2O(l) \rightarrow Ca(OH)_2(aq) + 2H_2(g)$$

C 4.0 g calcium reacts with excess dilute hydrochloric acid.

$$Ca(s) + 2HCl(aq) \rightarrow CaCl_2(aq) + H_2(g)$$

D 50 cm^3 of 2.0 mol / dm^3 sulfuric acid reacts with excess zinc.

$$Zn(s) + H_2SO_4(aq) \rightarrow ZnSO_4(aq) + H_2(g)$$

33. Question | 5070 May-June 2024 P1 V1 Q11

11 Four solutions of NaOH are made by dissolving solid NaOH in distilled water.

Which method makes a solution with a concentration of 0.10 mol / dm^3?

[M_r: NaOH, 40]

A 1.6 g of NaOH(s) to make 400 cm^3 of solution

B 3.2 g of NaOH(s) to make 250 cm^3 of solution

C 4.0 g of NaOH(s) to make 100 cm^3 of solution

D 8.0 g of NaOH(s) to make 500 cm^3 of solution

34. Question | 5070 May-June 2024 P1 V2 Q7

7 What is the formula of zinc oxide?

A Zn_2O **B** ZnO **C** Zn_2O_3 **D** ZnO_2

35. Question | 5070 May-June 2024 P1 V2 Q8

8 Which statement is correct?

A If the relative formula mass of hydrated sodium carbonate, $Na_2CO_3 \cdot xH_2O$, is 286, then x is 10.

B Phosphoric(V) acid, H_3PO_4, has a relative molecular mass of 50.

C The relative atomic mass of a sample of an element with isotopes of masses 20 and 22 can only be equal to 21.

D The relative atomic mass of an element is the average mass of atoms of isotopes of the element compared with the mass of a hydrogen atom.

36. Question | 5070 May-June 2024 P1 V2 Q9

9 In a volumetric experiment, 25.0 cm^3 of 0.100 mol/dm^3 sodium hydroxide reacts exactly with 20.0 cm^3 of dilute sulfuric acid.

$$2NaOH + H_2SO_4 \rightarrow Na_2SO_4 + 2H_2O$$

What is the concentration of the dilute sulfuric acid?

A 0.0625 mol/dm^3

B 0.0800 mol/dm^3

C 0.125 mol/dm^3

D 0.250 mol/dm^3

37. Question | 5070 May-June 2024 P1 V2 Q10

10 The equation for the reaction between ammonium chloride and calcium hydroxide is shown.

$$2NH_4Cl + Ca(OH)_2 \rightarrow 2NH_3 + CaCl_2 + 2H_2O$$

10.7 g of ammonium chloride and 14.8 g of calcium hydroxide are mixed and warmed.

10.0 g of calcium chloride is obtained from the reaction.

What is the percentage yield of calcium chloride?

[M_r: NH_4Cl, 53.5; $Ca(OH)_2$, 74; $CaCl_2$, 111]

A 39.2% **B** 45.0% **C** 67.6% **D** 90.1%

38. Question | 5070 May-June 2024 P1 V2 Q31

31 Ammonium phosphate, $(NH_4)_3PO_4$, may be used as a fertiliser.

What is the percentage by mass of elements that improve plant growth in ammonium phosphate?

A 9 **B** 21 **C** 28 **D** 49

39. Question | 5070 Oct-Nov 2024 P1 V1 Q7

7 Chrome alum is a salt that contains two different cations and one anion.

The ions present in chrome alum are K^+, Cr^{3+} and SO_4^{2-}.

What is the formula of the salt?

A $KCrSO_4$ **B** $KCr(SO_4)_2$ **C** $KCr(SO_4)_3$ **D** $K_2Cr(SO_4)_3$

40. Question | 5070 Oct-Nov 2024 P1 V1 Q9

9 Which mass of carbon contains the same number of atoms as 16.0 g of sulfur?

A 0.5 g **B** 6.0 g **C** 8.0 g **D** 12.0 g

41. Question | 5070 Oct-Nov 2024 P1 V1 Q10

10 Compound X contains carbon, hydrogen and oxygen only.

It has an M_r of 90.

100 g of compound X contains 40.0 g of carbon and 6.7 g of hydrogen.

How many oxygen atoms are there in each molecule of compound X?

A 1 **B** 2 **C** 3 **D** 4

42. Question | 5070 Oct-Nov 2024 P1 V1 Q29

29 Sodium phosphate, Na_3PO_4, and ammonium nitrate, NH_4NO_3, are both used as fertilisers.

Which row shows the correct percentage by mass of the element in each compound that improves plant growth?

	% of the element in Na_3PO_4 that improves plant growth	% of the element in NH_4NO_3 that improves plant growth
A	19	18
B	19	35
C	42	18
D	42	35

43. Question | 5070 Oct-Nov 2024 P1 V1 Q34

34 How many moles of oxygen are required for the complete combustion of 2 moles of ethanol?

A 3 **B** 4 **C** 6 **D** 7

44. Question | 5070 Oct-Nov 2024 P1 V2 Q7

7 What is the relative molecular mass, M_r, of ethene?

A the average mass of the isotopes of C and H compared to $\frac{1}{12}$ of the mass of an atom of ^{12}C

B the atomic numbers of the isotopes of C and H compared to $\frac{1}{12}$ of the mass of an atom of ^{12}C

C twice the A_r of C plus four times the A_r of H

D twice the A_r of C plus six times the A_r of H

45. Question | 5070 Oct-Nov 2024 P1 V2 Q8

8 What is the relative molecular mass, M_r, of N_2O?

A 22 **B** 30 **C** 44 **D** 46

46. Question | 5070 Oct-Nov 2024 P1 V2 Q9

9 Which contains the greatest mass of oxygen?

A 0.2 mol of aluminium nitrate, $Al(NO_3)_3$

B 0.3 mol of potassium sulfate, K_2SO_4

C 0.4 mol of sodium nitrate, $NaNO_3$

D 0.5 mol of magnesium carbonate, $MgCO_3$

47. Question | 5070 Oct-Nov 2024 P1 V2 Q10

10 Compound Z contains carbon, hydrogen and oxygen only.

Compound Z contains 48.65% carbon and 8.11% hydrogen by mass.

What is the empirical formula of Z?

A C_2H_4O **B** $C_3H_6O_2$ **C** $C_4H_8O_3$ **D** $C_8H_{16}O_5$

48. Question | 5070 Oct-Nov 2024 P1 V2 Q11

11 Which fertiliser contains the highest percentage by mass of nitrogen?

[M_r: NH_4NO_3, 80; $(NH_4)_3PO_4$, 149; $(NH_4)_2SO_4$, 132; $(NH_2)_2CO$, 60]

A NH_4NO_3 **B** $(NH_4)_3PO_4$ **C** $(NH_4)_2SO_4$ **D** $(NH_2)_2CO$

49. Question | 5070 Oct-Nov 2024 P1 V2 Q31

31 Iron can be extracted from the ore hematite.

What is the maximum mass of iron that is produced from 500 kg of hematite?

[A_r: O, 16; Fe, 56]

A 160 kg **B** 240 kg **C** 350 kg **D** 420 kg

50. Question | 5070 Oct-Nov 2024 P1 V2 Q38

38 In a titration, a 25.0 cm^3 sample of 0.100 mol/dm^3 sodium hydroxide is exactly neutralised by 16.2 cm^3 of dilute sulfuric acid.

The equation for the reaction is shown.

$$H_2SO_4 + 2NaOH \rightarrow Na_2SO_4 + 2H_2O$$

What is the concentration of the dilute sulfuric acid?

A 0.0648 mol/dm^3

B 0.0772 mol/dm^3

C 0.154 mol/dm^3

D 0.309 mol/dm^3

51. Question | 5070 May-June 2025 P1 V1 Q9

9 The ions Ca^{2+} and PO_4^{3-} combine to form an ionic compound.

What is the formula of the compound?

A Ca_2PO_4 **B** $Ca(PO_4)_3$ **C** $Ca_2(PO_4)_3$ **D** $Ca_3(PO_4)_2$

52. Question | 5070 May-June 2025 P1 V1 Q10

10 Magnesium reacts with aqueous copper(II) sulfate to form copper and aqueous magnesium sulfate.

What is the correct equation for this reaction?

A $Mg + CuSO_4 \rightarrow Cu + MgSO_4$

B $Mg + Cu_2SO_4 \rightarrow 2Cu + MgSO_4$

C $2Mg + CuSO_4 \rightarrow Cu + Mg_2SO_4$

D $2Mg + Cu_2SO_4 \rightarrow 2Cu + Mg_2SO_4$

53. Question | 5070 May-June 2025 P1 V1 Q11

11 An organic compound has an M_r of 88.

What is the molecular formula of this compound?

A $C_{10}H_{20}O$ **B** $C_5H_{10}O$ **C** $C_4H_8O_2$ **D** C_2H_4O

54. Question | 5070 May-June 2025 P1 V1 Q12

12 $10\,cm^3$ of hydrogen gas is mixed with $x\,cm^3$ of chlorine gas. The equation for the reaction that takes place is shown.

$$H_2(g) + Cl_2(g) \rightarrow 2HCl(g)$$

All the hydrogen reacts. The total volume of gas at the end of the reaction is $40\,cm^3$.

All measurements are at room temperature and pressure.

What is the value of x?

A $10\,cm^3$ **B** $20\,cm^3$ **C** $30\,cm^3$ **D** $40\,cm^3$

55. Question | 5070 May-June 2025 P1 V1 Q13

13 $100\,cm^3$ of aqueous potassium hydroxide with a concentration of $1.00\,mol/dm^3$ reacts with excess dilute sulfuric acid.

$$2KOH(aq) + H_2SO_4(aq) \rightarrow K_2SO_4(aq) + 2H_2O(l)$$

3.48 g of pure anhydrous potassium sulfate is produced.

What is the percentage yield of potassium sulfate?

A 5% **B** 10% **C** 20% **D** 40%

56. Question | 5070 May-June 2025 P1 V2 Q9

9 Which compound has the highest relative formula mass, M_r?

[A_r: K, 39; N, 14; O, 16; Ca, 40; C, 12; Li, 7; S, 32; Mg, 24; Cl, 35.5]

A calcium carbonate

B lithium sulfate

C magnesium chloride

D potassium nitrate

57. Question | 5070 May-June 2025 P1 V2 Q10

10 100 cm^3 of ethene is completely combusted in 400 cm^3 of oxygen. The volumes of both gases are measured at r.t.p.

What is the final volume of gas in the mixture measured at r.t.p.?

A 200 cm^3 **B** 250 cm^3 **C** 300 cm^3 **D** 500 cm^3

58. Question | 5070 May-June 2025 P1 V2 Q11

11 The formula of hydrated sodium carbonate is $Na_2CO_3 \cdot 10H_2O$.

What is the percentage composition by mass of oxygen in hydrated sodium carbonate?

A 16.8 **B** 22.4 **C** 55.9 **D** 72.7

59. Question | 5070 Oct-Nov 2025 P1 V1 Q8

8 Aluminium ions, Al^{3+}, react with sulfate ions, SO_4^{2-}, to form aluminium sulfate.

Which row shows the correct empirical formula and ionic formula of aluminium sulfate?

	empirical formula	ionic formula
A	$AlSO_4$	$Al^{3+}SO_4^{2-}$
B	$Al_2S_2O_8$	$Al^{3+}(SO_4^{2-})_2$
C	$Al_2S_3O_{12}$	$Al^{3+}{}_2(SO_4)^{2-}{}_3$
D	$Al_3S_2O_8$	$Al^{2+}{}_3(SO_4^{3-})_2$

60. Question | 5070 Oct-Nov 2025 P1 V1 Q9

9 Which statement is correct?

A The concentration of a solution is expressed in dm^3 / mol.

B The empirical formula of a compound always gives the actual numbers of each type of atom in one molecule.

C The molecular formula of a compound always contains more atoms than the empirical formula.

D The relative atomic mass of an element is $\frac{\text{the average mass of one atom of the element}}{\frac{1}{12}\text{ the mass of one atom of carbon-12}}$.

61. Question | 5070 Oct-Nov 2025 P1 V1 Q10

10 How many atoms are there in 27.0 g of water, H_2O?

A 9.030×10^{23} **B** 1.806×10^{24} **C** 2.709×10^{24} **D** 3.612×10^{24}

62. Question | 5070 Oct-Nov 2025 P1 V1 Q11

11 A mixture of sodium hydrogencarbonate and sodium chloride is heated.

The equation for the reaction that takes place when sodium hydrogencarbonate is heated is shown.

$$2NaHCO_3(s) \rightarrow Na_2CO_3(s) + CO_2(g) + H_2O(g)$$

Sodium chloride is unchanged on heating.

When 6.0 g of the mixture is heated, the loss in mass is 1.5 g.

What is the percentage by mass of sodium hydrogencarbonate in the mixture?

[relative molecular mass, M_r: $NaHCO_3$, 84; Na_2CO_3, 106; CO_2, 44; H_2O, 18]

A 34% **B** 48% **C** 68% **D** 95%

63. Question | 5070 Oct-Nov 2025 P1 V2 Q7

7 Powdered calcium carbonate reacts with dilute hydrochloric acid to produce calcium chloride, water and carbon dioxide.

What is the correct ionic equation, including state symbols, for this reaction?

A $CaCO_3(s) + 2HCl(aq) \rightarrow CaCl_2(aq) + H_2O(l) + CO_2(g)$

B $CaCO_3(s) + 2H^+(aq) \rightarrow Ca^{2+}(aq) + H_2O(l) + CO_2(g)$

C $Ca^{2+}(aq) + CO_3^{2-}(aq) + 2H^+(aq) \rightarrow Ca^{2+}(aq) + H_2O(l) + CO_2(g)$

D $CO_3^{2-}(aq) + 2H^+(aq) \rightarrow H_2O(l) + CO_2(g)$

64. Question | 5070 Oct-Nov 2025 P1 V2 Q9

9 A mixture of 2 g of hydrogen and 32 g of oxygen occupies a volume, *V*, measured at r.t.p.

The gases react until there is no further change.

$$2H_2(g) + O_2(g) \rightarrow 2H_2O(l)$$

Which reactant is in excess and what is the final volume of the mixture measured at r.t.p.?

	reactant in excess	final volume
A	hydrogen	$\frac{V}{4}$
B	hydrogen	$\frac{V}{2}$
C	oxygen	$\frac{V}{4}$
D	oxygen	$\frac{V}{2}$

65. Question | 5070 Oct-Nov 2025 P1 V2 Q10

10 A chemist prepares calcium nitrate. They start with 8.00 g of pure calcium oxide and an excess of dilute nitric acid. They produce 12.65 g of pure, dry anhydrous calcium nitrate crystals.

What is the percentage yield of calcium nitrate?

[relative atomic masses, A_r: Ca, 40; N, 14; H, 1; O, 16]

A 54.0 **B** 63.2 **C** 67.1 **D** 86.8

66. Question | 5070 May-June 2026 P1 V1 Q8

8 Which definition of the empirical formula of a compound is correct?

A the number and type of different atoms or ions in one mole of the compound

B the number of different atoms or ions in one mole of the compound

C the relative number of bonds between the different atoms or ions in the compound

D the simplest whole number ratio of the different atoms or ions in the compound

67. Question | 5070 May-June 2026 P1 V1 Q9

9 Hydrated magnesium sulfate has the formula $MgSO_4 \cdot 7H_2O$.

[A_r: Mg, 24; S, 32; O, 16; H, 1]

Which mass of hydrated magnesium sulfate is needed to make 250 cm^3 of a solution containing 0.50 moles per litre of magnesium ions, Mg^{2+}?

A 15.00 **B** 30.75 **C** 61.50 **D** 123.0

68. Question | 5070 May-June 2026 P1 V1 Q10

10 A 3.00 g sample of copper ore containing copper(II) carbonate, $CuCO_3$, and inert rock is heated until there is no change in mass. When cool, the residue weighs 2.20 g.

The equation shows the decomposition of the carbonate.

$$CuCO_3 \rightarrow CuO + CO_2$$

What is the percentage purity of the ore?

A 48.5% **B** 71.5% **C** 75.2% **D** 77.4%

69. Question | 5070 May-June 2026 P1 V1 Q11

11 A compound contains 40.0% carbon, 6.7% hydrogen and 53.3% oxygen by mass.

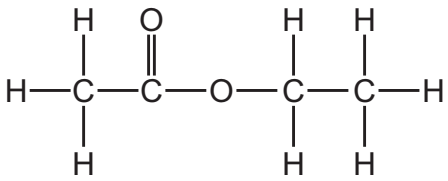
The relative molecular mass of the compound is between 55 and 65.

What is the molecular formula of the compound?

A CH_2O **B** C_2H_4O **C** $C_2H_4O_2$ **D** $C_2H_6O_2$

70. Question | 5070 May-June 2026 P1 V2 Q6

6 The displayed formula of a compound is shown.



What is the empirical formula of the compound?

A CHO

B C_2H_4O

C $C_4H_8O_2$

D $CH_3COOCH_2CH_3$

71. Question | 5070 May-June 2026 P1 V2 Q7

7 An ionic compound contains only three elements, X, Y and Z.

The compound has a ratio of one atom of X to one atom of Y to three atoms of Z.

The average mass of the isotopes of element X is twice the mass of an atom of $^{12}_{6}C$.

The average mass of the isotopes of element Y is equal to the mass of an atom of $^{12}_{6}C$.

The relative atomic mass of Z is $\frac{4}{3}$ times the relative atomic mass of Y.

What is the relative formula mass of the compound?

A 26 **B** 42 **C** 52 **D** 84

72. Question | 5070 May-June 2026 P1 V2 Q8

8 Nitrogen monoxide and oxygen react to form nitrogen dioxide.

$$2NO(g) + O_2(g) \rightarrow 2NO_2(g)$$

What is the maximum volume of nitrogen dioxide that may be obtained when 1 dm^3 of nitrogen monoxide reacts with 2 dm^3 of oxygen when all volumes are measured at room temperature and pressure?

A 1 dm^3 **B** 2 dm^3 **C** 3 dm^3 **D** 4 dm^3

73. Question | 5070 May-June 2026 P1 V2 Q9

9 During a titration, 25.0 cm^3 of 0.050 mol / dm^3 aqueous sodium hydroxide, NaOH, reacts exactly with 20.0 cm^3 of dilute phosphoric acid, H_3PO_4.

$$3NaOH + H_3PO_4 \rightarrow Na_3PO_4 + 3H_2O$$

What is the concentration of the dilute phosphoric acid?

A 0.0208 mol / dm^3

B 0.0313 mol / dm^3

C 0.0625 mol / dm^3

D 0.1875 mol / dm^3

74. Question | 5070 May-June 2026 P1 V2 Q34

34 X mol of ethanol and X mol of propan-1-ol separately undergo complete combustion at the same temperature and pressure.

The complete combustion of X mol of propan-1-ol requires 0.15 mol of oxygen more than the complete combustion of X mol of ethanol.

What is the value of X?

A 0.10 **B** 0.15 **C** 1.00 **D** 1.50