GCSE Chemistry Topic 8 AQA: Chemical Analysis
Mark Scheme

Q1. Pure substance

- A substance made of **only one element or one compound** (1 mark)
  (Accept: not mixed with any other substance)

Total: 1 mark

Q2. Melting points

(a)

- A **pure substance has a single, sharp melting point** (1 mark)

(b)

- Impurities **lower the melting point** (1 mark)
- Impurities **broaden the melting range** (1 mark)

Total: 3 marks

Q3. Formulations

(a)

- A **mixture that has been designed for a specific purpose** (1 mark)

(b)

- Example: **paint, medicine, fuel, cleaning agent, food product** (1 mark)

Total: 2 marks

Q4. Chromatography

(a)

- To **separate mixtures / identify substances** (1 mark)

(b)

- Pencil is used because it is **insoluble in the solvent** (1 mark)
- Ink/pen would **dissolve and interfere with results** (1 mark)

Total: 3 marks

Q5. Chromatography phases

(a)

- **Mobile phase = solvent** (1 mark)
  (b)
- **Stationary phase = chromatography paper** (1 mark)

Total: 2 marks

Q6. Rf values

(a)

- Rf = **4.0 ÷ 8.0 = 0.5** (2 marks)
  - 1 mark for correct substitution,
  - 1 mark for correct final answer

(b)

- Formula: **distance moved by spot ÷ distance moved by solvent front** (1 mark)

Total: 3 marks

Q7. Gas tests

(a) Hydrogen: **lit splint gives a squeaky pop** (1 mark)
(b) Oxygen: **glowing splint relights** (1 mark)
(c) Carbon dioxide: **limewater turns cloudy** (1 mark)

Total: 3 marks

Q8. Chlorine test

(a) Test: **damp blue litmus paper** (1 mark)
(b) Result: **paper is bleached white** (1 mark)

Total: 2 marks

Q9. Flame tests

(a) Lithium: **crimson / red** (1 mark)
(b) Sodium: **yellow** (1 mark)
(c) Potassium: **lilac / light purple** (1 mark)

Total: 3 marks

Q10. More flame tests

(a) Calcium: **orange-red / brick red** (1 mark)
(b) Copper: **green / blue-green** (1 mark)

Total: 2 marks

Q11. Metal hydroxide precipitates

(a) Copper(II): **blue precipitate** (1 mark)
(b) Iron(II): **green precipitate** (1 mark)
(c) Iron(III): **brown precipitate** (1 mark)

Total: 3 marks

Q12. Halide ion tests

(a) Chloride: **white precipitate** (1 mark)
(b) Bromide: **cream precipitate** (1 mark)
(c) Iodide: **yellow precipitate** (1 mark)

Total: 3 marks

Q13. Sulfate test

- Add **barium chloride solution** (1 mark)
- **White precipitate of barium sulfate** forms (1 mark)

Total: 2 marks

Q14. Carbonate test

- Add **dilute acid** (1 mark)
- **Effervescence observed / carbon dioxide produced (limewater turns cloudy)** (1 mark)

Total: 2 marks

Q15. Flame emission spectroscopy

- More **accurate and sensitive** than flame tests (1 mark)
- Can **identify mixtures of metal ions** (1 mark)
- Can **measure concentrations of metal ions** (1 mark)

Total: 3 marks

Q16. Purity

(a)

- A pure substance is **made of only one element** (1 mark)
- OR **one compound** (1 mark)

(b)

- A pure substance has a **sharp, exact boiling point** (1 mark)
- Impurities **raise or lower the boiling point / broaden range** (1 mark)

Total: 4 marks

Q17. Formulations

(a)

- A mixture designed as a **useful product** (1 mark)

(b)

- Formulations have **precise amounts of each component** (1 mark)
- To ensure **product works correctly/consistently** (1 mark)

Total: 3 marks

Q18. Chromatography

- Substances travel at **different speeds** (1 mark)
- Due to **different solubilities in solvent** (1 mark)
- And **different attractions to the paper/stationary phase** (1 mark)

Total: 3 marks

Q19. Rf values

(a)

- Formula: **distance moved by spot ÷ distance moved by solvent** (1 mark)

(b)

- Substitution: 5.0 ÷ 10.0 (1 mark)
- Answer = **0.5** (1 mark)

Total: 3 marks

Q20. Gas tests

(a) Hydrogen: **squeaky pop with lit splint** (1 mark)
(b) Oxygen: **relights a glowing splint** (1 mark)
(c) Carbon dioxide: **turns limewater cloudy** (1 mark)
(d) Chlorine: **bleaches damp blue litmus paper white** (1 mark)

Total: 4 marks

Q21. Flame tests

(a) Lithium: **crimson/red** (1 mark)
(b) Sodium: **yellow** (1 mark)
(c) Potassium: **lilac** (1 mark)

(d) Calcium: **orange-red / brick red** (1 mark)
(e) Copper: **green / blue-green** (1 mark)

Total: 5 marks

Q22. Metal hydroxides

(a) Copper(II): **blue precipitate** (1 mark)
(b) Iron(II): **green precipitate** (1 mark)
(c) Iron(III): **brown precipitate** (1 mark)
(d) Aluminium: **white precipitate dissolves in excess NaOH** (1 mark)

Total: 4 marks

Q23. Halides

(a) Chloride: **white precipitate** (1 mark)
(b) Bromide: **cream precipitate** (1 mark)
(c) Iodide: **yellow precipitate** (1 mark)

Total: 3 marks

Q24. Sulfates

- Add **barium chloride solution (with HCl)** (1 mark)
- **White precipitate** shows sulfate ions present (1 mark)

Total: 2 marks

Q25. Carbonates

- Add **dilute acid** (1 mark)
- **Fizzing / effervescence** → **carbon dioxide produced** (limewater cloudy) (1 mark)

Total: 2 marks

Q26. Flame tests vs spectroscopy

(a)

- **Only works for some metals / colours can be hard to distinguish** (1 mark)

(b)

- Spectroscopy is **more accurate / sensitive** (1 mark)
- Can **identify mixtures / measure concentrations** (1 mark)

Total: 3 marks

Q27. Flame emission spectrum

(a)

- Spectrum shows **more than one set of lines** (1 mark)
- Each set corresponds to a **different metal ion** (1 mark)

(b)

- Computers are **faster / more accurate / avoid human error** (1 mark)

Total: 3 marks

Q28. Mixtures & formulations

(a)

- Pure = **one element/compound only** (1 mark)

- Mixture = **two or more not chemically bonded**

(b)

- Medicines are formulated for **correct dosage** (1 mark)
- And to ensure **stability/effectiveness/controlled release** (1 mark)

Total: 3 marks

Q29. Rf calculation

- Substitution: 9.0 ÷ 12.0 (1 mark)
- Answer = **0.75** (1 mark)

Total: 2 marks

Q30. Chlorine test

- Paper must be **damp** so chlorine can **dissolve** (1 mark)
- Blue litmus is **bleached white** (1 mark)

Total: 2 marks

Q31. Aluminium vs calcium

- Al^{3+} forms **white precipitate** with NaOH (1 mark)
- Which **dissolves in excess NaOH** (1 mark)
- Ca^{2+} also forms **white precipitate but does not dissolve** (1 mark)

Total: 3 marks

Q32. Flame emission spectroscopy sample

- Must be in solution so it can be **passed into flame / excite electrons** (1 mark)

Total: 1 mark

Q33. Instrumental methods

- More **accurate** (1 mark)
- More **sensitive / faster / detect smaller amounts** (1 mark)

Total: 2 marks

Q34. Sulfate vs carbonate

- Add acid: carbonates **fizz (CO_2)**, sulfates do not (1 mark)
- Add barium chloride: sulfates give **white precipitate** (1 mark)
- Carbonates would only fizz with acid (1 mark)

Total: 3 marks

Q35. Hard water

(a)

- Contains **calcium ions (Ca^{2+})** (1 mark)
- And/or **magnesium ions (Mg^{2+})** (1 mark)

(b)

- Causes **limescale in kettles/pipes** (1 mark)
- Reduces **soap effectiveness / scum forms** (1 mark)

Total: 4 marks

Q36. Pure water tests

- **Boiling point test** → pure water boils at 100 °C (1 mark)
- **Freezing point test** → pure water freezes at 0 °C (1 mark)
- **Evaporation test** → leaves no residue (1 mark)
- Conductivity → pure water has **very low conductivity** (1 mark)

Total: 4 marks

Q37. Concentration

(a)

- Convert 500 cm^3 → 0.5 dm^3 (1 mark)
- 20 ÷ 0.5 = **40 g/dm^3** (1 mark)

(b)

- Equation: **concentration = mass ÷ volume** (1 mark)

Total: 3 marks

Q38. Chromatographic comparison

- Compare **Rf values** (1 mark)

- With those of **known reference substances** (1 mark)

Total: 2 marks

Q39. Errors in chromatography

- Spot **below solvent line / dissolved in solvent** (1 mark)

Total: 1 mark

Q40. Flame emission spectroscopy

- Each metal ion produces a **unique line spectrum** (1 mark)
- Spectrum **identifies the metal** (1 mark)
- Intensity of lines shows **concentration** (1 mark)

Total: 3 marks

Q41. Instrumental methods

- More **accurate / reliable results** (1 mark)
- More **sensitive – can detect very small amounts** (1 mark)
- Faster and can **analyse many samples automatically** (1 mark)
  Alternative: less sample required / produces permanent record / can detect mixtures.

Total: 3 marks

Q42. Emission spectra and electrons

- Electrons are **excited to higher energy levels** when heated (1 mark)
- They **drop back down to lower levels**, releasing energy (1 mark)
- Energy released as **specific wavelengths of light** → **unique line spectrum** (1 mark)

Total: 3 marks

Q43. Unknown sample spectrum

- Three different sets of lines mean **three different elements are present** (1 mark)
- Shows the sample is a **mixture of elements/ions** (1 mark)

Total: 2 marks

Q44. Flame emission vs flame tests

- Flame emission spectroscopy: **more accurate/sensitive** (1 mark)
- Can **detect mixtures** (1 mark)
- Flame tests: **simple/cheap/easy to do in lab** (1 mark)
- But flame tests are **less precise / difficult to distinguish colours** (1 mark)

Total: 4 marks

Q45. Water

(a)

- **Boil and check at 100 °C** OR **freeze at 0 °C** (1 mark)

(b)

- Desalination uses **distillation / reverse osmosis** (1 mark)
- Removes **dissolved salts/ions** to make water potable (1 mark)

Total: 3 marks

Q46. Chromatography

(a)

- Different substances have **different solubilities in solvent** (1 mark)
- And **different attractions to paper/stationary phase** (1 mark)

(b)

- Spray with **ninhydrin / locating agent** (1 mark)
- Produces **coloured spots** (1 mark)

Total: 4 marks

Q47. Computers in spectroscopy

(a)

- Computers are **more accurate, avoid human error** (1 mark)
- Compare spectra with **databases quickly** (1 mark)

(b)

- Example: **mass spectrometry / infrared spectroscopy / gas chromatography** (1 mark)

Total: 3 marks

Q48. Bright line at 589 nm

- Wavelength corresponds to **sodium ions** (1 mark)
- Bright line shows **sodium present in the sample** (1 mark)

Total: 2 marks

Q49. Sodium + potassium ions

- Each ion produces a **unique spectrum** (1 mark)
- Sodium gives line at **589 nm**, potassium gives **different lines** (1 mark)
- Both sets of lines appear, showing **mixture present** (1 mark)

Total: 3 marks

Q50. Carbonate + sulfate tests

- Carbonates produce **carbon dioxide with acid** (1 mark)
- But carbonates also form **white precipitate with barium chloride**, giving false positive for sulfate (1 mark)

Total: 2 marks

Q51. Uses of spectroscopy

- Used by **astronomers to identify elements in stars/planets** (1 mark)
- Used by **environmental monitoring / forensic science / detecting metal ions in water** (1 mark)

Total: 2 marks

Q52. Dissolved salts in water

- Other ions could give **additional lines** in spectrum (1 mark)
- Could **interfere with / mask the result** for the ion being tested (1 mark)

Total: 2 marks

Q53. Resolution

- Resolution = ability to **distinguish between different wavelengths/lines** (1 mark)
- High resolution = **lines seen separately not blurred together** (1 mark)

Total: 2 marks

Q54. Concentration from spectrum

- Spectrum matches calcium → **calcium ions present** (1 mark)
- Less intense lines → solution has **lower concentration of calcium ions** (1 mark)

Total: 2 marks

Q55. Distilled vs tap water

- Tap water contains **dissolved ions** (1 mark)
- These could give **extra lines in spectrum** → **false results** (1 mark)

Total: 2 marks