

GCSE Topic 9 Chemistry: Mark Scheme

Q1. Composition of atmosphere

(a) Nitrogen \approx **78%** (1 mark)

(b) Oxygen \approx **21%** (1 mark)

Total: 2 marks

Q2. Gases <1%

- Argon / carbon dioxide / water vapour / other noble gases (any one) (1 mark)

Total: 1 mark

Q3. Early atmosphere gas

- **Carbon dioxide** (1 mark)
Alternative: water vapour / methane / ammonia also acceptable.

Total: 1 mark

Q4. Volcanoes

- Volcanic activity **released gases** (e.g. CO₂, H₂O vapour, nitrogen) (1 mark)
- This **formed the early atmosphere** (1 mark)

Total: 2 marks

Q5. Oxygen first produced

- By **photosynthesis** (1 mark)
- In **algae and plants** (1 mark)

Total: 2 marks

Q6. Decrease in CO₂

- **Dissolved in oceans** (1 mark)
Alternative: locked up in rocks / taken in by photosynthesis.

Total: 1 mark

Q7. Greenhouse gases

(a) Any two: **carbon dioxide, methane, water vapour** (1 + 1 marks)

(b)

- Greenhouse gases let in **short-wave radiation from the Sun** (1 mark)
- But **trap infrared (long-wave) radiation reflected from Earth's surface** (1 mark)

Total: 4 marks

Q8. Effect of global warming

- Example: **rising sea levels / melting ice / extreme weather / habitat loss / drought / flooding** (1 mark)

Total: 1 mark

Q9. Climate change predictions

- Climate is a **complex system with many variables** (1 mark)
- Cannot predict exact outcomes → **different models give different predictions** (1 mark)

Total: 2 marks

Q10. Pollutants from fuels

- Any two: **carbon dioxide, carbon monoxide, sulfur dioxide, particulates/soot, nitrogen oxides** (1 + 1 marks)

Total: 2 marks

Q11. Carbon monoxide

(a)

- **Toxic / poisonous gas** (1 mark)
Alternative: prevents oxygen being carried in blood.

(b)

- Produced by **incomplete combustion** (1 mark)
- When fuels burn with **limited oxygen supply** (1 mark)

Total: 3 marks

Q12. Acid rain

(a) **Sulfur dioxide OR nitrogen oxides** (1 mark)

(b) **Kills plants / damages buildings / acidifies lakes / harms fish** (1 mark)

Total: 2 marks

Q13. Soot

(a) From **incomplete combustion of hydrocarbons** (1 mark)

(b)

- **Causes breathing problems / health issues** (1 mark)
- **Global dimming (reflects sunlight)** (1 mark)

Total: 3 marks

Q14. Carbon footprint

(a)

- The **total amount of carbon dioxide and other greenhouse gases** (1 mark)
- Released **over the full life cycle of a product/service/activity** (1 mark)

(b)

- Example: **using renewable energy, conserving energy, using public transport, carbon capture, planting trees** (1 mark)

Total: 3 marks

Q15. Early vs today's atmosphere

- Early atmosphere had **more CO₂ / less O₂** (1 mark)
- Today's atmosphere has **more O₂ / less CO₂ / presence of nitrogen** (1 mark)

Total: 2 marks

Q16. Composition of atmosphere

- (a) Nitrogen \approx **78%** (1 mark)
(b) Oxygen \approx **21%** (1 mark)

Total: 2 marks

Q17. Early vs today's atmosphere

- Early atmosphere had **more carbon dioxide** (1 mark)
- Early atmosphere had **little or no oxygen** (1 mark)
Alternative: early atmosphere had more water vapour / less nitrogen.

Total: 2 marks

Q18. Volcanoes

- Volcanoes **released carbon dioxide** (1 mark)
- Volcanoes **released water vapour** (1 mark)
- Volcanoes **released nitrogen and small amounts of other gases** (1 mark)

Total: 3 marks

Q19. Oxygen production

- **Produced by photosynthesis** (1 mark)
- **In algae and later plants** (1 mark)

Total: 2 marks

Q20. Carbon dioxide

(a)

- **Dissolved in oceans** (1 mark)
- **Locked into rocks / fossil fuels / taken in by photosynthesis** (1 mark)

(b) Word equation:

- **Carbon dioxide + water → glucose + oxygen** (1 mark each)

Total: 4 marks

Q21. Greenhouse gases

(a)

- **Carbon dioxide** (1 mark)
- **Methane** (1 mark)
- **Water vapour** (1 mark)

(b)

- Greenhouse gases allow **short-wave radiation from the Sun to enter the atmosphere** (1 mark)
- But **absorb and re-emit long-wave infrared radiation from Earth's surface** (1 mark)

Total: 5 marks

Q22. Global warming

(a) Any two:

- **Rising sea levels** (1 mark)
- **Extreme weather / droughts / floods / melting ice / habitat loss** (1 mark)

(b)

- The climate system is **very complex** (1 mark)
- With **many variables** (e.g. oceans, atmosphere, biosphere) (1 mark)
- Makes **models give different predictions / uncertainty** (1 mark)

Total: 5 marks

Q23. Incomplete combustion

(a) **Carbon monoxide OR soot (particulates)** (1 mark)

(b)

- Produces **toxic gases** (1 mark)

- Can cause **suffocation or respiratory problems** (1 mark)

Total: 3 marks

Q24. Carbon monoxide

- **Binds to haemoglobin in red blood cells** (1 mark)
- Prevents **oxygen transport in the blood** (1 mark)

Total: 2 marks

Q25. Particulates

(a) From **incomplete combustion of hydrocarbons** (1 mark)

(b)

- Cause **health problems (e.g. lung damage)** (1 mark)
- Cause **global dimming by reflecting sunlight** (1 mark)

Total: 3 marks

Q26. Sulfur dioxide

(a) From **sulfur impurities in fossil fuels** (1 mark)

(b)

- **Dissolves in water** (1 mark)
- Forms **sulfuric acid** → **acid rain** (1 mark)

Total: 3 marks

Q27. Nitrogen oxides

(a) Formed when **nitrogen and oxygen from the air react in hot engines** (1 mark)

(b) Causes **acid rain OR respiratory problems** (1 mark)

Total: 2 marks

Q28. Reducing vehicle pollution

Any two:

- **Catalytic converters** (1 mark)
- **Use of electric / hybrid vehicles** (1 mark)
- *Alternative: use public transport / biofuels.*

Total: 2 marks

Q29. Carbon footprint

(a)

- The **total amount of greenhouse gases (mainly CO₂)** (1 mark)
- Released **over the life cycle of a product, service, or activity** (1 mark)

(b) Example: **carbon capture, renewable energy, taxation, regulations** (1 mark)

Total: 3 marks

Q30. Climate model predictions

- Climate is a **complex system** (1 mark)
- Contains **many interacting variables** (1 mark)
- Models may be **based on assumptions / incomplete data** → **uncertainty** (1 mark)

Total: 3 marks

Q31. Renewable energy

- Renewable energy **reduces burning of fossil fuels** (1 mark)
- So **reduces carbon dioxide emissions** → **less global warming** (1 mark)

Total: 2 marks

Q32. Sedimentary rocks

- Carbon dioxide **dissolved in oceans** (1 mark)
- Formed **sedimentary carbonate rocks (e.g. limestone)** (1 mark)

Total: 2 marks

Q33. Methane

- Methane is a **greenhouse gas** (1 mark)
- Increasing methane → **more heat trapped** (1 mark)
- Leads to **global warming** (1 mark)
- Causes **environmental effects (e.g. sea level rise, climate change)** (1 mark)

Total: 4 marks

Q34. Carbon capture

- **Captures CO₂ from power stations** (1 mark)
- Stores it **underground in rock formations** (1 mark)

Total: 2 marks

Q35. Peer review

- Ensures **data is checked by other scientists** (1 mark)
- Prevents **false claims / ensures reliability** (1 mark)

Total: 2 marks

Q36. Fossil fuels

- Burning **releases carbon locked in fuels** (1 mark)
- Produces **carbon dioxide gas** (1 mark)

Total: 2 marks

Q37. Methane combustion

Balanced equation:

- $\text{CH}_4 + 2\text{O}_2 \rightarrow \text{CO}_2 + 2\text{H}_2\text{O}$ (correct formulae = 1 mark, balanced = 1 mark)

Total: 2 marks

Q38. Sulfur dioxide & nitrogen oxides

- Sulfur dioxide → **acid rain** (1 mark)
- Nitrogen oxides → **respiratory problems / acid rain / smog** (1 mark)

Total: 2 marks

Q39. Algae & plants

- **Produced oxygen by photosynthesis** (1 mark)
- **Removed carbon dioxide** from atmosphere (1 mark)

- Oxygen **allowed animals to evolve** (1 mark)

Total: 3 marks

Q40. Global warming consequences

- **Humans:** risk of flooding / food shortages / migration / health problems (1–2 marks)
- **Environment:** habitat loss / species extinction / melting ice / sea level rise (1–2 marks)

Total: 4 marks

Q41. Greenhouse gases & infrared

- Greenhouse gases **absorb infrared radiation** (1 mark)
- Radiation makes their **bonds vibrate** (1 mark)
- They **re-emit energy as infrared in all directions**, warming the Earth (1 mark)

Total: 3 marks

Q42. Long-term data

- **Shows patterns and trends over time** (1 mark)
- **Removes effects of short-term fluctuations** (1 mark)

Total: 2 marks

Q43. Uncertainties in models

Any two:

- Climate involves **many complex variables** (1 mark)
- Models rely on **assumptions about human activity** (1 mark)

- **Limitations in data collection / computing power** (alternative acceptable)

Total: 2 marks

Q44. Ice cores

- Contain **trapped air bubbles with past atmospheric gases** (1 mark)
- Allow **measurement of CO₂ and temperature over thousands of years** (1 mark)

Total: 2 marks

Q45. Deforestation

- **Fewer trees for photosynthesis → less CO₂ removed** (1 mark)
- **Burning trees releases CO₂** (1 mark)

Total: 2 marks

Q46. Ocean chemistry

- **CO₂ dissolves in oceans** (1 mark)
- Causes **ocean acidification, harming marine life/coral** (1 mark)

Total: 2 marks

Q47. Positive feedback

Example:

- **Melting ice reduces reflection of sunlight (albedo effect)** (1 mark)
- **More heat absorbed → faster warming** (1 mark)

EveryTuition Revision- etrevision.co.uk

Connect With A Tutor: everytuition.org

Alternative: warming releases methane from permafrost.

Total: 2 marks

Q48. Water vapour

- Water vapour is a **greenhouse gas (absorbs infrared radiation)** (1 mark)
- But it is a **feedback, not a cause — its level depends on temperature not emissions** (1 mark)

Total: 2 marks

Q49. Uncertainties in predictions

- Climate is a **complex system with many interactions** (1 mark)
- Models are based on **incomplete or limited data** (1 mark)
- **Assumptions about future emissions/technology use** (1 mark)
- Predictions may **vary depending on model design/computer power** (1 mark)

Total: 4 marks

Q50. Anthropogenic

- Means **human-caused** (1 mark)
- E.g. from **burning fossil fuels, industry, deforestation** (1 mark)

Total: 2 marks

Q51. Geoengineering

Example:

- **Reflecting sunlight with mirrors/aerosols OR carbon capture and storage** (1 mark)
- Explanation of how it **reduces heat absorbed OR reduces CO₂ in atmosphere** (1 mark)

Total: 2 marks

Q52. Particulates

- Cause **global dimming by reflecting sunlight** (1 mark)
- Cause **health problems by damaging lungs** (1 mark)

Total: 2 marks

Q53. CO₂ vs methane

- CO₂ is **released in much larger amounts** (1 mark)
- Methane is a **more powerful greenhouse gas molecule-for-molecule** (1 mark)
- Both contribute to **global warming, but CO₂ is more significant overall** (1 mark)

Total: 3 marks

Q54. Renewable energy

- Renewables are **not always reliable (e.g. wind/solar depends on weather)** (1 mark)
- Require **high costs / new infrastructure / storage technology** (1 mark)

Total: 2 marks

Q55. Political, social & economic factors

EveryTuition Revision- etrevision.co.uk

Connect With A Tutor: everytuition.org

- Climate change involves **international agreements / cooperation** (1 mark)
- Must consider **costs and impacts on jobs/industry** (1 mark)
- Also influenced by **public attitudes and lifestyle choices** (1 mark)

Total: 3 marks