**GCSE Chemistry Topic 10 - Using Resources Mark Scheme**

## Q1. Natural resources

- Example: wood / timber (1 mark)
- Example: fresh water / cotton / coal / oil / natural gas / wool / leather (1 mark)

**Total: 2 marks**

---

## Q2. Finite resources

- Resource that will **run out one day** (1 mark)
- Because it is **used faster than it is replaced / cannot be replaced quickly** (1 mark)

**Total: 2 marks**

---

## Q3. Potable water

- Water that is **safe to drink** (1 mark)
- Because it has **low levels of salts and microbes** (1 mark)

**Total: 2 marks**

---

## Q4. Water treatment in the UK

Any two:

- **Filtration (removes solids)** (1 mark)
- **Chlorination (kills microbes)** (1 mark)
- Accept **sterilisation (UV light / ozone)** as alternative

**Total: 2 marks**

---

## Q5. Distillation of salty water

- Distillation **separates water from dissolved salts** (1 mark)
- By **evaporation and condensation** (1 mark)

**Total: 2 marks**

---

## Q6. Wastewater treatment

- **Screening / sedimentation (removes large solids)** (1 mark)
- **Aerobic treatment (bacteria digest organic matter)** (1 mark)
- **Anaerobic digestion of sludge** OR **further chemical treatment** (1 mark)

**Total: 3 marks**

---

## Q7. Bioleaching

- Advantage: **uses low-grade ores / avoids mining / less energy than smelting** (1 mark)
- Disadvantage: **slow process / produces toxic substances / sulfuric acid** (1 mark)

**Total: 2 marks**

---

## Q8. Phytomining

- Plants **absorb copper compounds from soil** (1 mark)
- Plants are **burned and copper is extracted from the ash** (1 mark)

**Total: 2 marks**

---

## Q9. Recycling metals

- **Reduces need for mining / quarrying (less environmental damage)** (1 mark)

**Total: 1 mark**

---

## Q10. Life cycle assessments (LCA)

Any two:

- **Obtaining raw materials** (1 mark)
- **Manufacture and packaging** (1 mark)
- **Use / operation during lifetime** (alternative)
- **Disposal / recycling** (alternative)

**Total: 2 marks**

---

## Q11. Biased LCAs for plastic bags

- Some stages of LCA **cannot be measured exactly** (1 mark)
- **Value judgments / company may present data to favour product** (1 mark)

**Total: 2 marks**

---

## Q12. Rusting

(a) Iron needs **water** and **oxygen** (1 mark)
(b) Method: **painting / oiling / galvanising / sacrificial protection / coating with plastic** (1 mark)

**Total: 2 marks**

---

## Q13. Alloys harder than pure metals

- Different sized atoms **distort the layers** (1 mark)
- This makes it **more difficult for the layers to slide** (1 mark)

**Total: 2 marks**

---

## Q14. Glass uses

- Soda-lime glass: **windows / bottles / jars** (1 mark)
- Borosilicate glass: **cooking dishes / lab glassware** (1 mark)

**Total: 2 marks**

---

## Q15. Fertilisers (NPK)

- Provide **nitrogen, phosphorus, potassium** for plants (1 mark)
- To **increase growth / crop yield** (1 mark)

**Total: 2 marks**

## Q16. Potable vs pure water

- Potable water is **safe to drink** (1 mark)
- Pure water contains **only $H_2O$ molecules, no dissolved substances** (1 mark)

**Total: 2 marks**

---

## Q17. Desalination

Any one method described fully (2 marks total):

- **Distillation**: heat seawater to evaporate, then condense to collect pure water (1 mark for evaporation, 1 mark for condensation)

- **Reverse osmosis**: force water through a membrane that removes salts (1 mark for membrane, 1 mark for removing salts)

**Total: 2 marks**

---

## Q18. Wastewater treatment

- Wastewater contains **organic matter / harmful microbes / toxic chemicals** (1 mark)
- Must be treated to **prevent pollution and protect health / ecosystems** (1 mark)

**Total: 2 marks**

---

## Q19. Bioleaching vs phytomining

- Similarity: both **extract copper from low-grade ores** / reduce need for traditional mining (1 mark)
- Difference: **bioleaching uses bacteria**, phytomining uses **plants** (1 mark)

**Total: 2 marks**

---

## Q20. Replacing mining

- Traditional mining causes **large environmental damage / uses lots of energy** (1 mark)
- Bioleaching and phytomining can **use low-grade ores / are more sustainable** (1 mark)

**Total: 2 marks**

---

## Q21. Recycling metals

- Recycling **uses less energy than extracting new metals** (1 mark)

- Reduces **waste / environmental damage from mining / conserves resources** (1 mark)

**Total: 2 marks**

---

## Q22. LCA – production stage

Any three:

- **Energy used in manufacturing** (1 mark)
- **Raw materials used** (1 mark)
- **Pollution / waste produced** (1 mark)
- **Packaging** (alternative acceptable)

**Total: 3 marks**

---

## Q23. Subjectivity in LCAs

- Some stages require **value judgments (e.g. weighting environmental impacts)** (1 mark)
- Data may be **incomplete or biased to favour a product** (1 mark)

**Total: 2 marks**

---

## Q24. Alloys

(a) Alloy = a **mixture of metals / metal + another element** (1 mark)
(b) Different sized atoms **distort layers** (1 mark), making it harder for **layers to slide** (1 mark)

**Total: 3 marks**

---

## Q25. Steels

(a) Low-carbon steel: **car bodies / easily shaped objects** (1 mark)
(b) High-carbon steel: **cutting tools / blades** (1 mark)
(c) Stainless steel: **cutlery / sinks / pipes** (1 mark)

**Total: 3 marks**

---

## Q26. Glass

- Soda-lime: **made from sand, sodium carbonate, limestone** (1 mark)
- Borosilicate: **made from sand and boron trioxide** (1 mark)
- Borosilicate has **higher melting point / more heat resistant** (1 mark)

**Total: 3 marks**

---

## Q27. Ceramics

- Property: **hard / brittle / heat-resistant / good insulator** (1 mark)
- Use: **bricks / tiles / pottery / sinks** (1 mark)

**Total: 2 marks**

---

## Q28. Composites

- Made of **two or more materials combined** (1 mark)
- Gives **useful properties of both materials** (e.g. strong + lightweight) (1 mark)

**Total: 2 marks**

---

## Q29. Thermosoftening polymers

(a) Soften when heated and **can be reshaped** (1 mark)
(b) Have **no cross-links between chains** (1 mark) so chains can **slide over each other** (1 mark)

**Total: 3 marks**

---

## Q30. Thermosetting polymers

- Have **strong covalent cross-links between chains** (1 mark)
- This makes them **rigid, hard, heat-resistant** (1 mark)

**Total: 2 marks**

---

## Q31. Corrosion

- Iron corrodes to form **hydrated iron(III) oxide (rust) that flakes away** (1 mark)
- Aluminium forms an **oxide layer that protects metal underneath** (1 mark)

**Total: 2 marks**

---

## Q32. Rust prevention

(a) Any one: **painting, oiling, greasing, galvanising, sacrificial protection** (1 mark)
(b) Sacrificial protection: a **more reactive metal corrodes instead of iron** (1 mark) because it **provides electrons / corrodes preferentially** (1 mark)

**Total: 3 marks**

---

## Q33. Haber process raw materials

- **Nitrogen (from air)** (1 mark)
- **Hydrogen (from natural gas / methane)** (1 mark)

**Total: 2 marks**

---

## Q34. Haber process conditions

- **450 °C** (1 mark)
- **200 atmospheres** (1 mark)
- **Iron catalyst** (1 mark)

**Total: 3 marks**

---

## Q35. NPK fertilisers

- Supply **nitrogen, phosphorus, potassium** (1 mark)
- To ensure **healthy growth / high crop yield** (1 mark)

**Total: 2 marks**

---

## Q36. Ammonium nitrate

- Contains **nitrogen from ammonia and nitrate ions** (1 mark)
- Provides a **high nitrogen content for plant growth** (1 mark)

**Total: 2 marks**

---

## Q37. Haber process compromises

- High temperature = faster reaction but **reduces yield** (1 mark)
- Low temperature = higher yield but **too slow** (1 mark)
- Pressure chosen as **compromise between yield, cost, and safety** (1 mark)

**Total: 3 marks**

---

## Q38. Potable water from seawater

- **Distillation** OR **reverse osmosis** (1 mark)

**Total: 1 mark**

---

## Q39. Recycling glass

- Saves **raw materials (sand)** (1 mark)
- Uses **less energy than making new glass** (1 mark)

**Total: 2 marks**

---

## Q40. Potable vs pure water (again)

- Potable water contains **dissolved substances / minerals** (1 mark)
- Chemically pure water is **only $H_2O$** (1 mark)

**Total: 2 marks**

## Q41. Alloys stronger than pure metals

- Pure metals: atoms are the **same size, so layers can slide easily** (1 mark)
- In alloys: different atoms are **different sizes, disrupting the regular layers** (1 mark)
- This makes it **harder for layers to slide, so the alloy is stronger** (1 mark)

**Total: 3 marks**

---

## Q42. Composites

Any two, with use:

- **Carbon fibre** → used in **aerospace / sports equipment / car bodies** (1 mark)
- **Fibreglass** → used in **boats / surfboards / car panels** (1 mark)

- Alternatives: **concrete** → construction / buildings; **wood** → furniture

**Total: 2 marks**

---

## Q43. Thermosoftening vs thermosetting polymers

- Thermosoftening: **no cross-links between polymer chains** (1 mark)
- Chains can **slide over each other when heated** → **soften + remould** (1 mark)
- Thermosetting: **strong covalent cross-links between chains** → rigid and **don't melt when heated** (1 mark)

**Total: 3 marks**

---

## Q44. Rusting

(a) Word equation:
**Iron + oxygen + water** → **hydrated iron(III) oxide (rust)** (1 mark)

(b) Aluminium: forms a **protective aluminium oxide layer** (1 mark) that **stops further corrosion** (1 mark)

**Total: 3 marks**

---

## Q45. Haber process temperature

- Lower temperature = **higher yield but slower rate** (1 mark)
- 450 °C = **compromise for reasonable yield and faster reaction** (1 mark)

**Total: 2 marks**

---

## Q46. Dynamic equilibrium

(a) **Forward and reverse reactions occur at the same rate** (1 mark)

(b) Haber process:

- Increasing pressure = equilibrium shifts to side with **fewer gas molecules** (1 mark)
- This favours **ammonia production (2 moles vs 4 moles)** (1 mark)

**Total: 3 marks**

---

## Q47. Fertilisers

- Excess fertiliser **washes into rivers/lakes (leaching)** (1 mark)
- Causes **eutrophication / algal blooms → kills aquatic life** (1 mark)

**Total: 2 marks**

---

## Q48. Potable water

- Groundwater: **filtered to remove solids, sterilised with chlorine/UV/ozone** (1 mark)
- Seawater: **desalinated (distillation or reverse osmosis)** (1 mark)
- Wastewater: **treatment to remove organic matter + harmful microbes** (1 mark)

**Total: 3 marks**

---

## Q49. Borosilicate vs soda-lime glass

- Borosilicate has a **higher melting point / more heat resistant** (1 mark)
- Useful for **laboratory glassware / cooking equipment** (1 mark)

**Total: 2 marks**

---

## Q50. Life cycle assessments

- LCAs allow **comparison of environmental impacts at each stage** (1 mark)

- Important to **choose material with lowest overall impact** (1 mark)

**Total: 2 marks**

---

## Q51. Finite resources

- Finite resources will **eventually run out** (1 mark)
- Reducing use = more **sustainable for future generations / reduces environmental impact** (1 mark)

**Total: 2 marks**

---

## Q52. Reverse osmosis vs distillation

- **Reverse osmosis**: uses **less energy than distillation** (1 mark)
- But requires **expensive membranes that can be damaged** (1 mark)
- **Distillation**: very **energy intensive (heating water)** (1 mark)

**Total: 3 marks**

---

## Q53. Haber process equation

**$N_2$ + 3$H_2$ ⇌ 2$NH_3$** (1 mark)

**Total: 1 mark**

---

## Q54. Phytomining vs traditional mining

- Phytomining: less **environmental damage / less energy-intensive** (1 mark)
- But **slower process, lower yield** (1 mark)
- Traditional mining: faster, higher yield but **destroys habitats / uses lots of energy** (1 mark)

**Total: 3 marks**

---

## Q55. Sustainable industries

Any two, explained:

- **Recycle materials** → reduces need for new raw materials (1 mark)
- **Use renewable energy** → reduces carbon emissions (1 mark)
- **Develop more efficient processes** → reduces waste + pollution (1 mark)

**Total: 3 marks**