Exercise walk-through

10.3

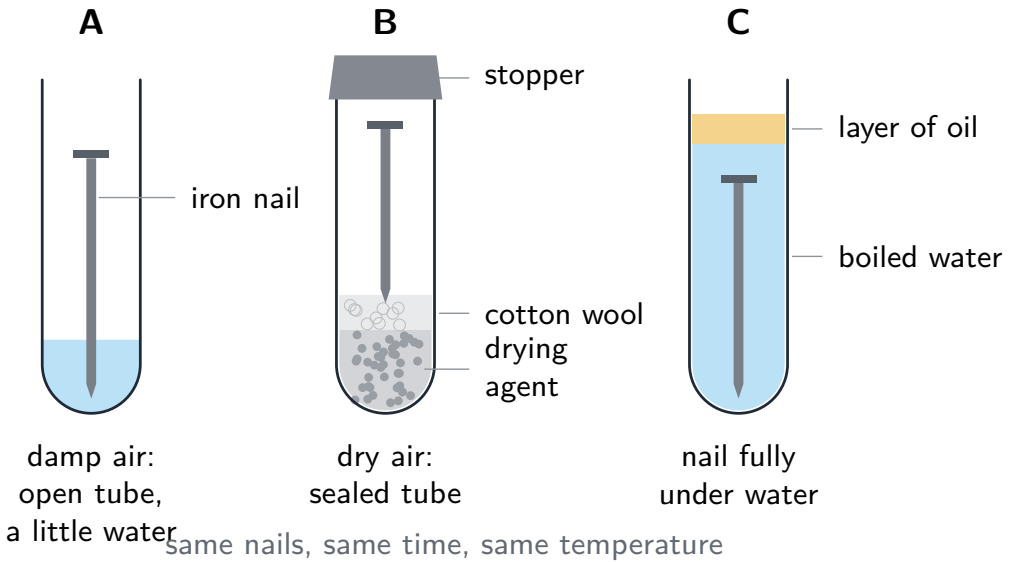
Using materials – corrosion and alloys, chemistry only (4.10.3.1–4.10.3.2)

AQA · GCSE · Chemistry

Corrosion and its prevention (chemistry only)

- A barrier stops air and water reaching the metal: paint, oil or grease, or electroplating with another metal.
- **Sacrificial protection** uses a more reactive metal. Galvanised iron is coated with zinc. Zinc reacts in place of the iron, so even if the coating is scratched, the iron does not rust. Ships' hulls have blocks of zinc or magnesium fixed to them for the same reason.

Figure: Corrosion and its prevention (chemistry only)

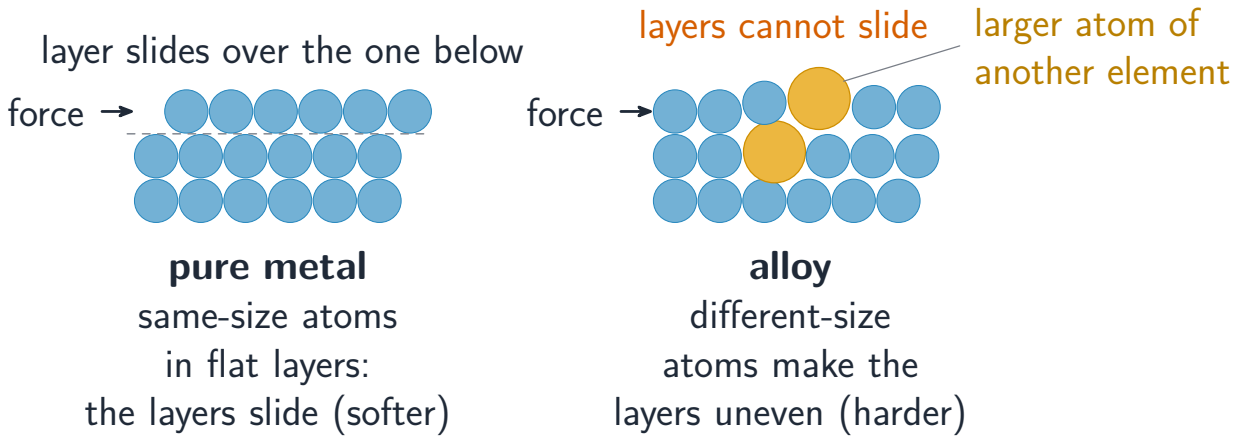


- Rusting needs both water and oxygen.
- Only tube A, with both, rusts.

Alloys (chemistry only)

- Most metals we use are alloys.
- In an **alloy** , atoms of different sizes distort the layers of metal atoms, so they slide over each other less easily.
- This makes alloys harder than pure metals.
- The purity of gold is measured in carats. 24 **carat** gold is pure gold, so 18 **carat** gold is $18/24 = 75\%$ gold. **Worked example 4.** A 12 g ring of 18 carat gold contains $12 \times 18/24 = 9$ g of gold.

Figure: Alloys (chemistry only)



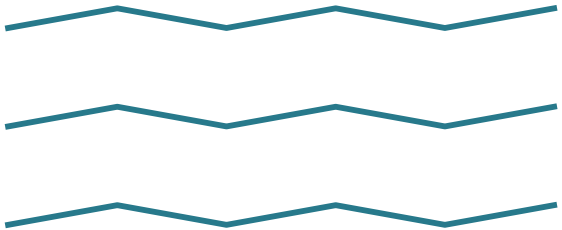
- Different-sized atoms disrupt the layers, so they slide less easily: one reason many alloys are harder than the pure metal
- Match each part of the diagram to the text.

Ceramics, polymers and composites (chemistry only)

- **Ceramics.** Most glass is soda-lime glass, made by heating sand, sodium carbonate and limestone.
- Borosilicate glass, made from sand and boron trioxide, melts at a higher temperature, so it is used for oven dishes and laboratory glassware.
- Clay ceramics, such as pottery and bricks, are made by shaping wet clay and heating it in a furnace.
- **Polymers.** The properties of a polymer depend on its monomer and on the conditions used to make it.

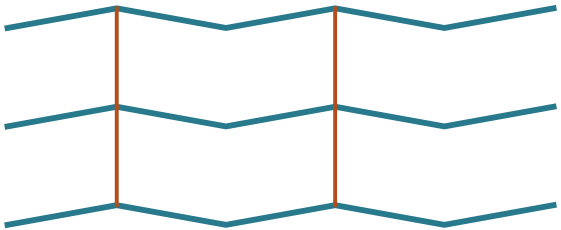
Figure: Ceramics, polymers and composites (chemistry only)

Separate chains



Heating: chains can move past one another; polymer softens

Covalent cross-linked network



Network does not melt; strong heating can decompose it

Lines represent chain backbones; orange links are covalent bonds. Schematic.

- Separate polymer chains and a covalent cross-linked network.
- Match each part of the diagram to the text.

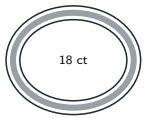
Exercises 2.1·2.2

2.1 Iron nails are left in three tubes for a week. Which nail rusts? Explain your answer. [2]



A: air, water B: boiled water, oil C: dry air

2.2 A gold ring is 18 carat. Calculate the percentage of gold in the ring. [2]



Exercises 2.1·2.2

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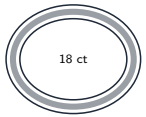


A: air, water B: boiled water, oil C: dry air

2.1

- nail **A**; only tube A has both air and water

2.2 A gold ring is 18 carat. Calculate the percentage of gold in the ring. [2]

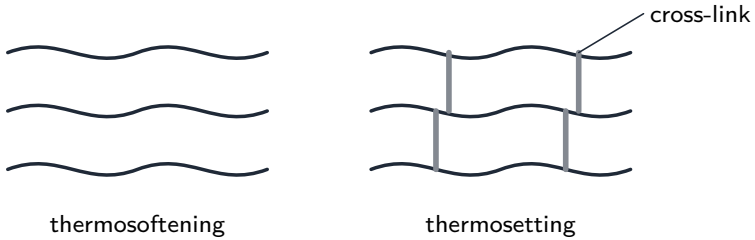


2.2

- $18 \div 24 \times 100 = \mathbf{75}\%$

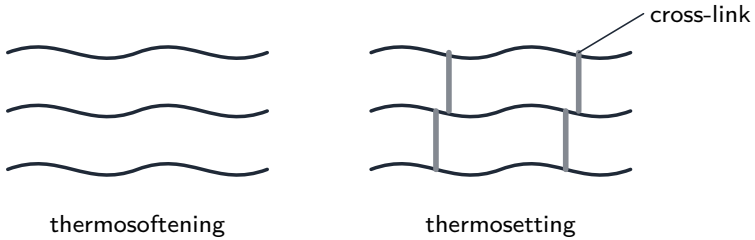
Exercise 3.1

3.1 Explain why a thermosetting polymer does not melt when heated, but a thermosoftening polymer does. [3]



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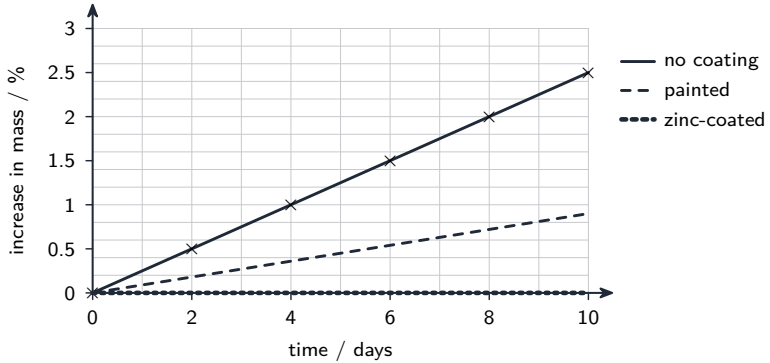
3.1

- a thermosetting polymer has cross-links between its chains
- the cross-links are strong covalent bonds that hold the chains in place, so they cannot move apart
- a thermosoftening polymer has only weak forces between chains, which are overcome by heating

Exercise 3.2 (a)

3.2 Three iron nails are left in salty water: one with no coating, one painted and then scratched, and one coated with zinc and then scratched. The graph shows the increase in mass of each nail.

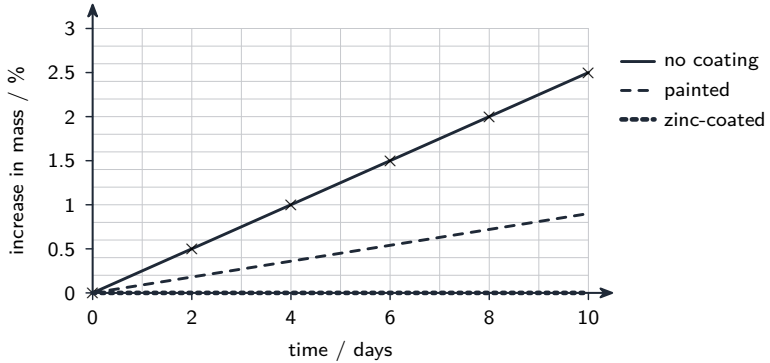
(a) Describe what happens to the nail with no coating, and explain why its mass increases. [2]



Exercise 3.2 (a)

3.2 Three iron nails are left in salty water: one with no coating, one painted and then scratched, and one coated with zinc and then scratched. The graph shows the increase in mass of each nail.

(a) Describe what happens to the nail with no coating, and explain why its mass increases. [2]



(a) its mass increases steadily; iron reacts with oxygen and water to form rust, which adds mass

Exercise 3.2 (b)

3.2 Three iron nails are left in salty water: one with no coating, one painted and then scratched, and one coated with zinc and then scratched. The graph shows the increase in mass of each nail.

(b) Explain why the zinc-coated nail does not rust, even though it is scratched. [3]

Exercise 3.2 (b)

3.2 Three iron nails are left in salty water: one with no coating, one painted and then scratched, and one coated with zinc and then scratched. The graph shows the increase in mass of each nail.

(b) Explain why the zinc-coated nail does not rust, even though it is scratched. [3]

(b) zinc is more reactive than iron; so zinc reacts with the air and water instead of the iron; this is sacrificial protection

Exercise 3.2 (c)

3.2 Three iron nails are left in salty water: one with no coating, one painted and then scratched, and one coated with zinc and then scratched. The graph shows the increase in mass of each nail.

(c) Explain why the painted nail rusts, but more slowly than the nail with no coating. [2]

Exercise 3.2 (c)

3.2 Three iron nails are left in salty water: one with no coating, one painted and then scratched, and one coated with zinc and then scratched. The graph shows the increase in mass of each nail.

(c) Explain why the painted nail rusts, but more slowly than the nail with no coating. [2]

(c) the paint is a barrier that keeps air and water away from most of the nail; at the scratch the iron meets air and water, so it rusts there

Exercise 3.2 (d)

3.2 Three iron nails are left in salty water: one with no coating, one painted and then scratched, and one coated with zinc and then scratched. The graph shows the increase in mass of each nail.

(d) Explain why alloys are used instead of pure metals. Give examples of alloys and their uses. [6]

Exercise 3.2 (d)

3.2 Three iron nails are left in salty water: one with no coating, one painted and then scratched, and one coated with zinc and then scratched. The graph shows the increase in mass of each nail.

(d) Explain why alloys are used instead of pure metals. Give examples of alloys and their uses. [6]

(d) points to include:

- pure metals are often too soft, because their layers of atoms slide easily
- in an alloy, atoms of different sizes distort the layers, so they slide less and the alloy is harder
- steel (iron and carbon) is strong, for bridges and buildings; stainless steel does not rust, for cutlery
- bronze (copper and tin) is hard, for statues and medals
- brass (copper and zinc) is hard, for musical instruments and fittings
- gold alloys are harder than pure gold, for jewellery; aluminium alloys are light, for aircraft

Levels: **5–6** a full, logical answer with correct chemistry and correct terms; **3–4** several correct points, partly linked; **1–2** one or two relevant points.