

# Alloys

Answer all the questions below then check your answers.

1. What are alloys?
2. What advantage do alloys have over the metals and non-metals that make them up?
3. Alloy wheels are often made of an alloy of aluminium with up to 12% silicon and a small amount of magnesium. This alloy has excellent wear and corrosion resistance, is strong and is much lighter than traditional steel wheels.
  - a. If alloy wheels are better than steel wheels, then why are many cars, vans and lorries still fitted with steel wheels?
  - b. What are the advantages of alloy wheel over steel wheels?
  - c. Magnalium is an alloy of aluminium and magnesium, it is used in the aircraft industry. Magnalium is much stronger than both aluminium and magnesium but heavier than magnesium, although it is less dense than aluminium. It is also more resistant to corrosion than magnesium.



- d. Why not make wheels and aircraft out of aluminium metal instead of aluminium alloys?
- e. Draw a particle diagram to show how most alloys are stronger and harder than the metals that make them up.

3. Read the following then answer the questions.

Fine silver is stamped .999, this means it is 99.9% silver with a few trace impurities. It is a slightly greyish coloured metal that is soft and easily dented. However when polished it gives an attractive reflective finish.



Sterling silver bracelet

Sterling silver, stamped .925, is 92.5% silver with other metals added, mainly copper. Sterling silver is harder than fine silver and more resistant to scratches and dents and it polishes to give an attractive finish. However like fine silver is still prone to tarnishing if not polished regularly. Argentium silver is similar to sterling silver in the percentage of metallic silver present, 92.5%, but the element germanium is added to form this alloy of silver. Argentium silver is harder than sterling silver and very resistant to tarnishing. However it is expensive.

- a. Suggest 2 reasons why fine silver is not suitable for jewellery.
- b. What advantage does sterling silver have over fine silver for use in making silver wedding rings?
- c. Suggest 2 reason why sterling silver is more common than Argentium silver.

4. Steel is an alloy of iron and carbon. There are many different steels depending on the final use of the alloy.

a. **Carbon steels:** these steel contain iron with small amounts of carbon, between 0.03 – 2.5%. The higher the carbon content the stronger the steel but it can become more brittle. The lower the carbon content the more easily shaped the steel is. Carbon steel are the most common type of steel, they are the cheapest form of steel and are used for such items as: car bodies, cutlery, ships, fences, lamp posts.

**Low alloy steels:** These steels are harder, stronger and more corrosion resistant than carbon steel. These steels contain up to 5% of other metals including: chromium, nickel, manganese, vanadium and tungsten.

**High alloy steels:** These are similar to low alloy steel but contain a much higher proportion of other metals. These steels are often called stainless steels. They are very strong, hard and corrosion resistant steels but they are expensive and dense.

- a. Make a table or chart to summarise the differences between carbon, low and high alloy steels.
- b. For each of the item below suggest which type of steel to use and give a reason for your choice.

item	Type of steel to use	reason
Car body		
Spanner, hammers and other tools		
Cutlery		
Gates and fences		
bridges		

# Alloys

## Answers

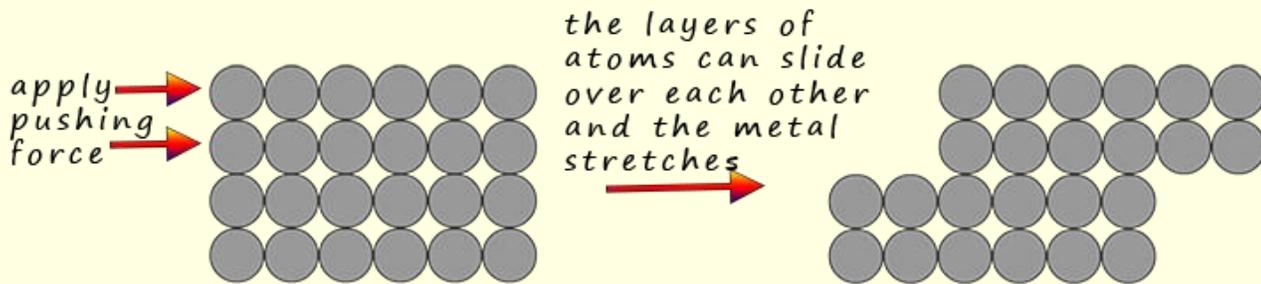
1. What are alloys? *Mixtures of metals and non-metals*
2. What advantage do alloys have over the metals and non-metals that make them up? *You can adjust the physical and chemical properties of an alloy by changing the composition of the metals/non-metals in the mixture. It is not possible to change the chemical or physical properties of a metal.*
3. Alloy wheels are often made of an alloy of aluminium with up to 12% silicon and a small amount of magnesium. This alloy has excellent wear and corrosion resistance, is strong and is much lighter than traditional steel wheels.
  - a. If alloy wheels are better than steel wheels, then why are many cars, vans and lorries still fitted with steel wheels?



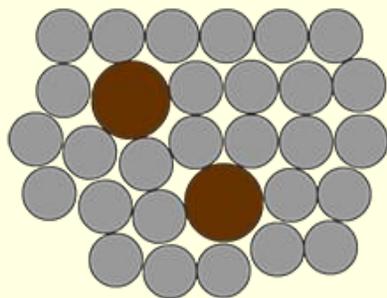
*Alloys are expensive and more difficult to produce.*

- b. What are the advantages of alloy wheel over steel wheels? *Lighter so saves fuel which is good for the environment. More attractive to look at, better resistance to corrosion.*
- c. Magnalium, alloys of aluminium and magnesium are also used in the aircraft industry. Magnalium is much stronger than both aluminium and magnesium but heavier than magnesium, although it is less dense than aluminium. It is also more resistant to corrosion than magnesium.

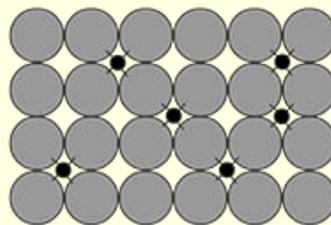
- d. Why not make wheels and aircraft out of aluminium metal instead of aluminium alloys? *Aluminium is not a very strong metal and is brittle and prone to metal fatigue, the aluminium alloys with 5% magnesium added can be 4 times stronger than aluminium metal.*
- e. Draw a particle diagram to show how most alloys are stronger and harder than the metals that make them up.



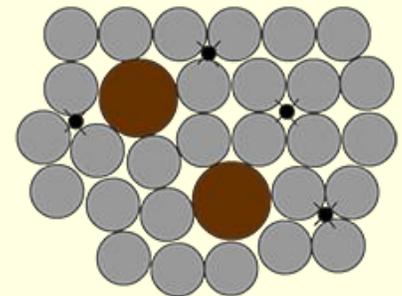
When other metals or non-metals are added the layers of metal atoms are not able to move or slide so freely. This means the alloy will be harder and stronger. Depending on the size of the atoms mixed through the metal we can end up with an alloys of different structures, as shown below.



substitutional alloy



interstitial alloy



substitutional/interstitial alloy

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a. Suggest 2 reasons why fine silver is not suitable for jewellery.

*Soft, easily dented and tarnishes*

b. What advantage does sterling silver have over fine silver for use in making silver wedding rings? What are the disadvantages of using sterling as alloy for wedding rings *advantages: harder, less prone to scratch, disadvantages: tarnishes.*

c. Suggest 2 reason why sterling silver is more common than Argentium silver.

*Less expensive, Argentium is still stamped .925 so still has the same % of silver present.*

4. Steel is an alloy of iron and carbon. There are many different steels depending on the final use of the alloy.

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a. Make a table or chart to summarise the differences between carbon, low and high alloy steels.

Type of steel	composition	properties
Carbon steel	0.03 – 2.5% carbon	Strong but brittle as % of carbon increases. Corrodes. Easily shaped.
Low alloy steel	Up to 5% of metals such as Ti, Cr, Ni, V, Mn, W added.	Very strong and hard Improved corrosion resistance
High alloy steels	Up to 25% of metals such as Ti, Cr, Ni, V, Mn, W added.	Very strong, corrosion resistant, very hard. Very expensive

b. For each of the item below suggest which type of steel to use and give a reason for your choice.

<i>item</i>	<i>Type of steel to use</i>	<i>reason</i>
<i>Car body</i>	<i>Carbon steel</i>	<i>Strong, easily shaped</i>
<i>Spanner, hammers and other tools</i>	<i>Low alloy steel</i>	<i>Very strong and hard</i>
<i>Cutlery</i>	<i>Low alloy steel but cheaper items will use carbon steel</i>	<i>Corrosion resistant</i>
<i>Gates and fences</i>	<i>Carbon steel</i>	<i>Strong and easily shaped.</i>
<i>bridges</i>	<i>Carbon steel</i>	<i>Strong and easily shaped.</i>