

## Worksheet 2.2

# Modifying metals

NAME:

CLASS:

### INTRODUCTION

Metals in their pure forms have many uses. For example, tungsten is used in light globe filaments, aluminium for cans and foil, and mercury in thermometers. More often than not, however, different metals are mixed together to produce an **alloy**, which is more useful than the pure metals. An alloy usually contains at least two different metals, and sometimes one or more non-metals. Alloys include:

Common name	Components (% by mass)	Uses
Rose gold (18 carat)	Gold 75% Copper 22.25% Silver 2.75%	Jewellery
Stainless steel	Iron 74% Nickel 8% Chromium 18% Carbon less than 1%	Sinks, cutlery
Brass	Copper 65% Zinc 35%	Musical instruments, sculptures
Solder	Tin 67% Lead 33%	Joining metal parts together

No.	Question	Answer
1	Ordinary steel is composed of iron, with less than 1% carbon added for strength. Why would ordinary steel be unsuitable for cutlery and sinks?	
2	Food tins are usually made of steel coated with tin. What properties must tin have?	
3	Pure gold is no longer used to make jewellery. What benefits do alloys offer in jewellery making?	
4	What are two properties that solder must have?	
5	What are three properties that make brass suitable for use in musical instruments?	

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Many metals undergo heat treatments during manufacturing. Sometimes this is done to make the metal softer, sometimes to make it harder. The heat treatment changes the metallic crystal structure. For example, pure aluminium is too weak and ductile for such purposes as aeroplane parts. However, when alloyed with 4% copper and appropriately heat-treated, it becomes very strong. This alloy is called duralumin. It is very light and strong. Many aluminium alloys are used in aeroplanes.

No.	Question	Answer
6	Explain why alloying aluminium would produce a less ductile product.	
7	Titanium alloys are even lighter and stronger than aluminium alloys. Why then are most aircraft made from aluminium alloys, and not titanium alloys?	
8	What are two advantages in a commercial aircraft being as light as possible?	
9	Some parts of aeroplanes need to be made from more flexible alloys. What is one part that would need some degree of flexibility?	
10	During the production of duralumin, the aluminium alloy is quenched. Consult books or the internet to find out what 'quenching' is. Explain why it makes the metal harder.	

## Worksheet 2.2: Solutions

### Modifying metals

No.	Answer
1	Ordinary steel corrodes too easily in damp conditions.
2	Tin must be non-toxic and unreactive.
3	Alloys in jewellery give the desirable appearance of the precious metal, but with added strength.
4	Solder must be soft and have a low melting point.
5	Brass is sonorous, relatively light and unreactive. It also has an attractive, shiny appearance.
6	The orderly lattice of positive ions in aluminium are disrupted by the presence of the copper ions. As a result, the layers of positive ions cannot move as easily over one another, making it more difficult to bend the alloyed metal.
7	Titanium is rarer and more expensive than aluminium.
8	Lighter aircraft have reduced fuel consumption, can carry a bigger load and can stay airborne more easily!
9	Wings need to be flexible.
10	During quenching, a metal is heated, then cooled very quickly. Metals are thought to be made up of many crystalline regions. In these regions the ions are neatly lined up, and the layers can easily move over one another. The larger these crystalline areas, the softer the metal. When the hot metal is cooled quickly in the quenching process, only small crystalline regions form, making the metal hard.

