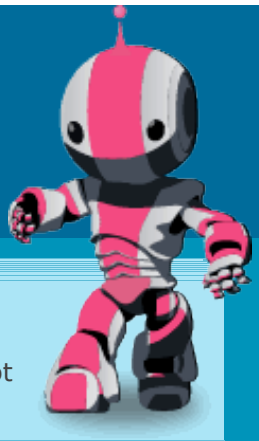
global science

Collapsing Can



Equipment

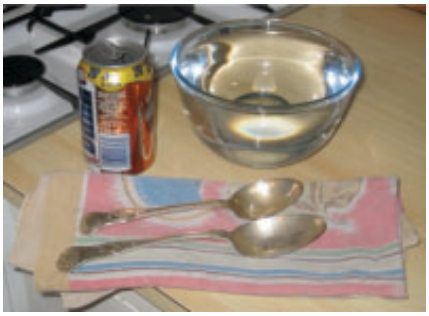
An empty drink can A bowl of water A gas burner Something to safely hold a hot can - cloth/tongs/spoons Oven gloves are useful

1

In this experiment you will boil a small amount of water in a drinks can, and then turn the can upside down and dip it into a bowl of water. You need to arrange a method of holding the can that will let you support it for several minutes over the gas flame and then move it and turn it upside down.

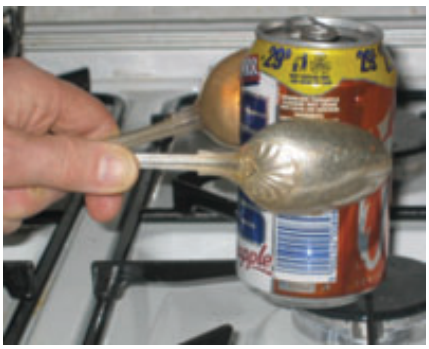
A pair of spoons used like tongs is a good way to hold the can. Kitchen tongs are usually too straight and the can slips out of the end.

Whatever you use, do a "cold run" first and rehearse the whole procedure without heating the water in the can. If all this seems a lot of bother, be assured that the result is worth the trouble!



2

Put about 1 centimetre depth of water (no more) into the can. Hold the can over the gas flame until the water starts to boil. You will feel the boiling and see wisps of steam coming out of the top of the can. Let the water boil for a minute or so.

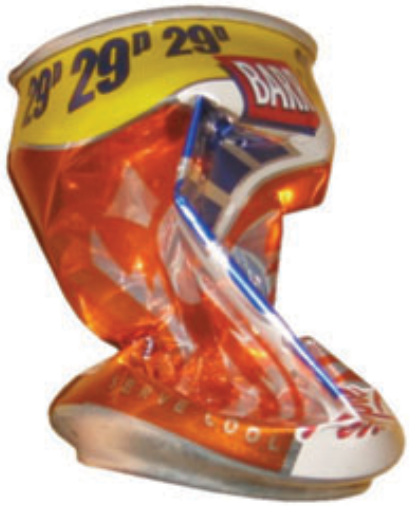


3

Remove the can from the flame and immediately turn it upside down and dip the open end into the bowl of water.

4

A fraction of a second later there will be a loud bang, and the can will collapse.



5

The air around us exerts a pressure on everything it touches. This pressure is amazingly large - about 10,000 kg force on every square metre. One reason we don't often notice it is that equal and opposite pressures usually balance. The air pressure inside the can is equal to the air pressure outside it, so the thin metal of the can has equal forces pressing on it from either side, and experiences no unbalanced force.

When you boil the water in the can, it evaporates to form steam. As it does so it gets a lot larger - the small amount of water in the bottom of the can could fill it many times over with steam. As the water boils, more and more steam is produced, which pushes the air out of the can, until it is completely full of steam. The steam exerts the same pressure inside the can as the air does outside, so the can remains unharmed - so far.

When you dip the can into the bowl of water, the steam is cooled and rapidly condenses into liquid water. As a liquid, it no longer exerts the same pressure as the air outside. In fact, when the steam has all condensed, the inside of the can is nearly a vacuum. There is now no pressure inside the can to resist the air pressure outside it, which instantly crushes the can.

6

You might wonder why the vacuum in the can doesn't simply suck water into the can rather than causing it to crush. Well it probably does, at first. But this cold water entering the can is highly effective in condensing the remaining steam in the can, which does so extremely fast. The can then crushes before much more water has time to enter it. You will notice that what space is left in the crushed can is practically full of water.