



The products of burning do not follow any simple equation. One study's results showed it produced (in order of descending quantities): 55.91% solid products: Potassium carbonate, Potassium sulfate, Potassium sulfide, Sulfur, Potassium nitrate, Potassium thiocyanate, Carbon, Ammonium carbonate. 42.98% gaseous products: Carbon dioxide, Nitrogen, Carbon monoxide, Hydrogen sulfide, Hydrogen, Methane. 1.11% water

Compare your calculated quantities with those given overleaf.

### **Making Blackpowder**

The optimum proportions for gunpowder are: 74.64% [saltpetre](#), 13.51% [charcoal](#), and 11.85% [sulphur](#) (by weight). The current standard for black powder manufactured by [pyrotechnicians](#) today is 75% potassium nitrate, 15% softwood charcoal and 10% sulfur.

For the most powerful black powder "meal" a [wood](#) charcoal is used. The best wood for the purpose is [buckthorn](#), but others such as [balsa](#) or [willow](#) can be used. The ingredients are mixed as thoroughly as possible. This is achieved using a [ball mill](#) with non-sparking grinding apparatus ([lead](#)), or similar device.

Small quantities of black powder will not explode unless it is constricted in a container. It burns rapidly and the explosive effect is caused by the rapid production and expansion of the gaseous products. Without containment the gases escape and with small quantities there is no detonation.

### **EYE PROTECTION MUST BE WORN**

- Weigh 7.5g of potassium nitrate and use a mortar and pestle to grind it to a fine powder.
- **Separately** weigh out 1.5g of carbon, and 1.0g Of sulphur. Use a mortar and pestle to convert the sulphur into a fine powder.
- Gently **mix** the three components by repeatedly pouring from one piece of paper to another (or from one plastic bag to another). **Do not grind the mixture or use metal apparatus.**
- Place your powder on a heatproof mat or equivalent (you could make a gunpowder trail to your heap of powder) and ignite at **arms length** using a splint or wax tape attached to a meter rule or equivalent.
- Note the fumes - this explosive was used in much larger quantities in a mine!
- If you have time prepare a second batch, but halve the proportion of one of the components and compare the performance of this mixture with the first one.

## Tutor Demonstration

### Eye protection must be worn

- Seal one end of the cardboard tube by squeezing the end together and fixing in place using sticky tape (tube dimensions - approximately 5 cm in length and 1-2 cm diameter).
- Prepare 10g Of black powder using the quantities and procedure specified on the student sheet.
- Pour the black powder into the tube and insert a 5 cm length of the string fuse (previously prepared and dried before use).
- Ensure that the tube is stable and that students are at a safe distance (approximately 5 metres) before igniting the fuse.
- The moderate containment of the powder should produce a 'Roman candle' like effect with copious fumes which could be discussed with the students.