

THE CHEMISTRY OF FIREWORKS

for red fireworks since strontium will glow red when burned. Pure magnesium powder, Mg, is used in stars to create an intense white light.

atom is different, the color produced by their electrons moving from the excited state to the ground state also varies.

(6) When metals are heated, the electrons of the metal atoms go from their lowest energy ground state to a higher energy level called the excited state. They do this by absorbing the energy of the heat around them produced by the exploding firework. However, the excited state is an unstable one so the electrons soon drop down to their ground state again. To do so they must get rid of the excess energy they absorbed. The electrons do this by emitting light energy which we see as the burst of light from the firework. Since each type of metal

(7) Not all fireworks are made equal. One way to tell the difference between cheap and good quality fireworks is to observe blue fireworks. Blue is a difficult color to produce because blue is produced by burning copper salts and copper compounds are usually unstable at high temperatures. They normally don't hold up well at the temperatures found in firework explosions. Only better made fireworks with better materials and quality construction will be able to produce a deep and convincing blue color.

Article Questions

- 1) What are the components of black powder and why are they needed to cause an explosion?

Black powder contains 15% charcoal and 10% sulfur, both of which act as fuels for combustion and the remaining 75% is made of potassium nitrate which is an oxidizing agent that provides the combustion reaction with a supply of oxygen. (3)

- 2) Why does an aerial firework require two explosions of black powder?

The first explosion is to launch the firework into the air and the second one is to ignite the stars and scatter them through the sky. (3&4)

- 3) What would happen if the secondary fuse in the aerial firework was made too short?

It would cause the secondary explosion to occur more quickly than intended, before the firework had reached its intended height. (4)

- 4) What are "stars"?

These are pellets of chemicals (metal powders and metal salts) in the firework that combust to form the colored firework spectacle. (4)

- 5) What metals and metal salts would produce the following colors when burned?

a) orange <u>calcium carbonate (5)</u>	c) white <u>magnesium powder (5)</u>
b) blue <u>copper salts / copper carbonate (7)</u>	d) green <u>barium nitrate (5)</u>

- 6) What causes the stars to give off light when ignited?

When the electrons of the metals in the stars are ignited, they absorb heat energy and go to an excited state which is unstable. When the electrons eventually return back to their lower energy ground state, they emit the energy they've absorbed as light. (6)

- 7) In poor quality fireworks, what will you notice and why?

Poor quality fireworks will have blue fireworks that aren't very vibrant and blue. This is because blue is created by burning copper salts which are unstable at high temperatures. Only high quality fireworks will be able to reproduce this blue color well. (7)