Chemistry 1010

Explosions

Review

What compounds can be obtained when an organic material burns?

CO_2, H_2O, CO, C

What kind of compound do you get when the following elements burn?

phosphorus covalent (P_2O_5)

strontium ionic (SrO)

Where does the energy of fire come from?

breaking of high energy bonds, forming low energy bonds

In order to put out a fire, what do you need to remove?

fuel, oxygen, or heat

Which type of fire would result if the following things caught fire?

gasoline B

paper A

fireworks D

coffee pot C

What type of fire extinguisher should you have in your house?

ABC

Why shouldn't you use water on grease fires?

water turns to steam, creates a huge fireball

Why don't each of the following substances undergo combustion?

He doesn't form compounds, can't bond to oxygen

C_2Cl_6 oxygen-chlorine bonds are too high in energy

CO_2 already contains bonds to oxygen

Introduction

Have any of you personally witnessed an explosion?

What things can can you observe during an explosion?

there is a loud noise

there is often a bright flash of light
may be followed by a fireball

there is a shock wave

What is the difference between a fire and an explosion?

Can you have a fire without an explosion?

yes

Can you have an explosion without a fire?

yes

What is the main criteria to decide if an explosion has occurred?

sudden outward force

Do explosions happen by accident?

of course

What kinds of things can blow up?

gasoline, natural gas, gun powder, dynamite, etc

Can explosions be useful? What could they be used for?

excavation

mining

demolition

entertainment, special effects

war – blowing up enemy buildings, tanks, ships, planes, bunkers, etc

Types of explosions

There are three types of explosions.

1) popcorn

Heat turns water to steam inside the kernel and pressure builds to 135 psi, 180°C.

The pericarp bursts, steam carries the starch and proteins outward as a foam.

When it hits the cooler air, the foam sets, showing the shape of the explosion.

What kind of explosion is this? physical

caused by a build-up of a gas (often steam)
inside a durable container, then the container bursts

Popcorn video

http://www.youtube.com/watch?v=CXDstfD9eJ0

What other physical explosions can you think of?

potato in a microwave

dry ice bomb

water heater explosion

aerosol can in a fire

can of beans in a fire

volcanos

Dry ice bomb

http://www.youtube.com/watch?v=nZHGK37jBp8

Water heater explosion

http://www.youtube.com/watch?v=fUkjXGfCLIM

2) ANFO = ammonium nitrate, fuel oil

What kind of explosion is this? chemical

$$52\ NH_4NO_3 + C_{17}H_{36} \longrightarrow 52\ N_2 + 17\ CO_2 + 122\ H_2O$$

What makes this reaction explosive?

1) the reaction is very fast

takes place in a fraction of a second

$$52\ NH_4NO_3 + C_{17}H_{36} \longrightarrow 52\ N_2 + 17\ CO_2 + 122\ H_2O$$

2) the products of the reaction are gases

they expand rapidly as soon as they are formed

this creates the shock wave and outward force

it moves faster than the speed of sound, creating a boom

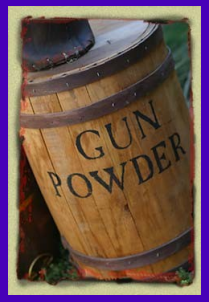
3) a lot of energy is released

this makes the gases expand even faster

Cement truck ANFO explosion

http://www.youtube.com/watch?v=Gxm_qpKh7Jw

What are some other examples of chemical explosives?



gunpowder

TNT

nitroglycerin

dynamite

C4

gasoline

C4 video http://www.youtube.com/watch?v=pLBmi4A92Wg

gasoline explosion http://www.youtube.com/watch?v=jFXw0cDC-A4

real car explosion

3) atomic bomb

How is a nuclear explosion different from a chemical explosion?

1) a huge amount of energy is released

25 million times more energy than in a chemical explosion

2) extremely bright flash of light

burns shadows onto walls

3) extreme heat produced

100,000,000 °C at the center
5000°C on the ground
people can be burned 3.5 km away

4) a huge shock wave is created by superheated air

1000 mph wind, flattens buildings

5) a huge fireball is created

anything close to the explosion is vaporized and burns

6) tons of dust are blown into the air

dust obscures the sun, causes rain

7) radioactive isotopes fall from the sky

clings to dust particles
settles with the dust or falls with the rain
called “fallout”

Underwater nuclear explosion

http://www.youtube.com/watch?v=_f2f6zb7Fe8

Underground nuclear explosion

http://www.youtube.com/watch?v=ssLZ4bUTDYM

Effects of nuclear explosion

http://www.youtube.com/watch?v=RqyBzXYZPoM

Largest ever nuclear explosion

http://www.youtube.com/watch?v=IGX8uq1e4Mo

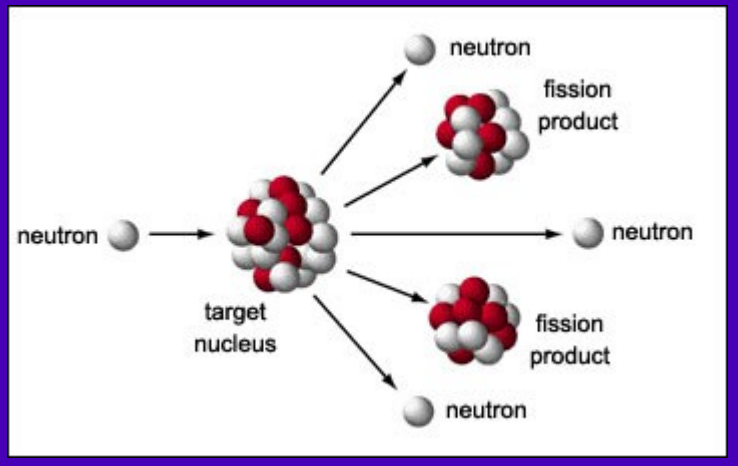
What reaction occurred in this explosion?

$$^{236}U \longrightarrow {}^{139}Ba + {}^{94}Kr + 3\ n^{o}$$

What kind of reaction is this?

nuclear fission reaction

a large, unstable nucleus is broken into pieces



Very few kinds of unstable atoms undergo this type of reaction.

The two used in nuclear explosions are ^{236}U and ^{240}Pu.

This reaction is only one of several ways that a ^{236}U atom can split up. Here is another reaction that can occur:

$$^{236}U \longrightarrow {}^{87}Br + {}^{146}La + 3\ n^{o}$$

Over 200 different isotopes can be formed, either from the fission reaction, or from radioactive decays of the original products.

Three of the radioactive isotopes are particularly harmful to humans.

iodine-131: concentrated in thyroid
half-life 8 days

strontium-90: takes the place of Ca in bones
half-life 28 years

cesium-137: takes the place of K in body tissues
half-life 30 years

How is a hydrogen bomb different from other kinds of nuclear explosions?

Hydrogen bombs use a fusion reaction.

$$^{3}H + ^{2}H \longrightarrow ^{4}He + n^{o}$$

Fusion requires enormous temperatures and pressures. This is created by using a fission explosion.

These are also called thermonuclear explosions. They are even more powerful than fission explosions alone.