

# Procedures to make explosives

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## Quick Links

- 1) [Trinitrophenol](#)
- 2) [H.M.T.D.](#)
- 3) [Lead Picrate](#)
- 4) [Ammonium Picrate](#)
- 5) [M.M.A.N.](#)
- 6) [Hexamethylenetetramine Dinitrate](#)
- 7) [C.T.A.P.](#)
- 8) [P.E.T.N.](#)
- 9) [R.D.X.](#)

- 12) [Nitrourea](#)
- 13) [Sucrose Nitrate](#)
- 14) [Sorbitol Hexanitrate](#)
- 15) [Mannitol Hexanitrate](#)
- 16) [Cellulose Nitrate \(c. 13.5% N\)](#)
- 17) [Amylose Nitrate \(?% N\)](#)
- 18) [Tetranitronaphthalene](#)

[Home page.](#)

[The Other page.](#)

- 10) [T.M.D.D.](#)
- 19) [NG / EGDN](#)
- 20) [Aminodinitrophenol  
\(Picramic Acid\)](#)
- 21) [Diazodinitrophenol  
\(D.D.N.P.\)](#)
- 22) [Silver Acetylide  
Nitrate \(Double Salts\)](#)
- 11) [C.T.M.T.N.A.](#)

All briscancies are relative to T.N.T., which on this scale has a value of 1.

### 1) Trinitrophenol (from aspirin, acetylsalicylic acid)

Also called Picric Acid, TNP, Lyddite and Shimose. This explosive is slightly more powerful than TNT, and has a VoD of 7480 m/s at 1.76 g/cm<sup>3</sup>. Relative briscancy = 1.21 It can be used as-is, or to make the following explosives: Ammonium Picrate (Explosive D), DDNP and Lead Picrate.

It is relatively storage stable, but will form dangerously sensitive metal Picrates. To store it in absolute safety, make a saturated solution out of it in alcohol and store it in sealed glass containers. It can be stored indefinitely like this.

You will need:

96 aspirin tablets, each containing 300mg of aspirin,  
120mL of 95% sulphuric acid,  
60g of potassium nitrate,  
Acetone,  
Distilled water,  
Some ice cubes (c. 10),  
A pestle and mortar,  
A gas or alcohol burner,  
A 250mL conical flask,  
A 1L container,  
Two 250mL beakers,  
A 500ml beaker,  
A filter funnel,  
A thermometer,  
Filter papers,  
A glass rod.

1) Place the aspirins in the pestle and mortar, and crush them. They don't have to be fine, but the finer they are the better.

2) Heat 150mL of acetone (methylated spirits will work) in a 250mL beaker until it's nearly boiling. Add the aspirin powder, and stir it with a glass rod until the grains have all disintegrated, leaving a small amount of white

powder at the bottom of the alcohol.

- 3) Filter this liquid into the other 250mL beaker. Throw away the solid left on the filter paper.
- 4) Gently heat the filtrate to reduce it's volume, until crystals begin to appear. Then let it cool and evaporate over night in a warm place.
- 5) Scrape up the crystals, and store them.
- 6) Heat the sulphuric acid to 65°C in a 250ml flask, and while it's heating up gradually stir in the purified aspirin using the thermometer.
- 7) When all of the aspirin has been added, let the solution cool to 50°C.
- 8) Add the potassium nitrate constantly, at a rate of about 1 to 2 grams every minute, while stirring rapidly. The temperature should be kept between about 60°C and 70°C. When I do this, I get very little nitrogen dioxide formed, just nitric acid vapours and CO<sub>2</sub>, formed by decarboxylation. Others claim to have clouds of nitrogen dioxide formed. This is because they add the potassium nitrate too fast, and it wastes the potassium nitrate.
- 9) When all of the potassium nitrate has been added, let the solution cool to room temperature, and dump it into 300mL of distilled water, with the ice cubes, in a 1L container. This will precipitate out the Trinitrophenol as light canary yellow crystals.
- 10) Filter the liquid once most of the ice has melted, or remove the ice when the temperature is below 5°C, and discard of the liquid carefully as it is toxic and corrosive. You can concentrate it and extract slightly more Trinitrophenol, but it isn't really worth it..
- 11) Take the crystals formed, and add them to 100mL of boiling water in a 500mL beaker. Stir, and add more water until all the crystals have dissolved.
- 12) Cool the solution in the fridge, and filter out the purified crystals.
- 13) Leave them spread out to dry.

1)a) Trinitrophenol (from phenol. Many other methods exist since it was, at one time, an important explosive.)

You will need:

25g of phenol,

14mL of 95% sulphuric acid,  
45mL of 75% sulphuric acid,  
175mL of 70% nitric acid,  
Two 500mL beakers,  
A 1500mL beaker,  
A hot water bath,  
An ice bath,  
A dropping pipette,  
A thermometer,  
A filter funnel,  
Filter papers.

- 1) Mix the phenol and 95% sulphuric acid in a 500mL beaker.
- 2) Heat it at 100°C on the water bath for five hours.
- 3) Let it cool to room temperature, and add the 75% sulphuric acid.
- 4) Add the nitric acid a few mL at a time, while stirring vigorously. Do not allow the temperature to rise above 50°C during the addition.
- 5) After the nitric acid has been added, heat the mixture on a water bath at 100°C for two hours.
- 6) Let the mixture cool to room temperature, and dump it into 150mL of cold distilled water in the other 500mL beaker.
- 7) Cool the solution to around 0°C in the ice bath.
- 8) Filter off the crystals of Trinitrophenol.
- 9) Add the crystals to 1 litre of water in the 1500mL beaker, and heat it until it boils. Discard any oily substances found.
- 10) Let the solution cool, and filter out the pure Trinitrophenol.

1) Yield, based on the amount of aspirin used:

Amount of aspirin used: 26.1 grams.

Theoretical yield: 36.4 grams.

Experimental yield: 29.5 grams..

Percentage yield: 81.0%.

Cost for the amount of explosive made in my experiment:

Aspirins: £1.14

Sulphuric acid: £0.48

Acetone: c. £0.25

Potassium nitrate: £0.08

Total: £1.95

Cost for 100 grams: £6.61

Possible improvements:

I did a few calculations to work out the proportions needed for the reactants, and it seems to have worked a lot! Also, using larger quantities improves yields by reducing the percentage lost on filter papers etc.

Substituting pure phenol for the aspirin should improve the reaction, because there will be fewer impurities.

I believe that with cheap aspirins, like the Wilkinson's brand that I used which were £0.19 for 16, purification will be unnecessary.

1)a) Yield, based on the amount of phenol used:

Amount of phenol used: 25.0 grams.

Theoretical yield: 60.9 grams.

Experimental yield: 51.2 grams.

Percentage yield: 84.1%

Cost for the amount of explosive made in my experiment:

Phenol: £0.25

Sulphuric acid: £0.14

Nitric acid: £1.15

Total: £1.54

Cost for 100 grams: £3.01

Possible improvements:

??

## 2) H.M.T.D.

Hexamethylenetriperoxidediamine, or H.M.T.D., is a primary explosive, very good for a home manufacturer due to the ingredients, which in the UK are very easy to find. It is a better initiator, and less sensitive, than Mercury Fulminate, and more storage stable

than C.T.A.P. VoD is 5100 m/s at 1.10 g/cm<sup>3</sup>.  
Relative briscancy = 0.35.

Like all explosives, in particular organic peroxides, this should not be stored for extended periods of time. It gradually decomposes (although I have a very old sample which is still fine), and there have been some cases of spontaneous detonation. I think this is due to insufficient washing, however.

You will need:

225mL of 6% hydrogen peroxide solution,  
150mL of 15% hydrochloric acid acid,  
20g of hexamethylenetetramine,  
Distilled water,  
Sodium bicarbonate,  
Two 500mL beakers,  
A glass rod,  
A fridge,  
A filter funnel,  
Filter papers.

- 1) Pour the hydrogen peroxide into a 500mL beaker, and put it in the fridge to cool down to about 5°C to 10°C.
- 2) Add the hexamine to the hydrogen peroxide, and stir it with the glass rod until it has dissolved.
- 3) Add the hydrochloric acid, and place the solution in the fridge for 24-36 hours.
- 4) After this time, filter out the white crystals.
- 5) Place them in the other 500mL beaker, add 15g of sodium bicarbonate and 400mL of distilled water. Stir it around very well, and filter it.
- 6) Wash out the beaker, and put the crystals back in. Add 400mL of distilled water, stir it and filter it.
- 7) Repeat steps 5) and 6) twice each, and then wash twice more 400mL of with distilled water.
- 8) Filter out the crystals, and leave them to dry in a thin layer.

Yield, based on the amount of hexamethylenetetramine used:

Amount of hexamethylenetetramine used: 20.0 grams.

Theoretical yield: 29.7 grams.

Experimental yield: 13.0 grams.  
Percentage yield: 43.8%

Cost for the amount of explosive made in my experiment:

Hexamethylenetetramine: £0.28  
Hydrochloric acid: £0.24  
Hydrogen peroxide: £0.79  
Sodium bicarbonate: Negligable

Total: £1.31  
Cost for 100 grams: £10.08

Possible improvements:

Use more concentrated acid and hydrogen peroxide to speed up the reaction. Also keep it very cold (just above its freezing point) and let it react longer to increase yields.

### 3) Lead Picrate

This and other Picrates, such as Ammonium Picrate, are extremely simple to make once you have made Trinitrophenol (Picric Acid). This is a very sensitive primary explosive, although it appears storage stable. Quite similar to Mercury Fulminate in most respects. VoD is 4400 m/s at 2.83g/cm<sup>3</sup>. Relative briscancy = 0.67. Despite it's extreme sensitivity to physical stimuli such as heat and friction, it might be a better choice than C.T.A.P., for example, because it doesn't decompose as fast - i.e., it's more storage stable.

You will need:

2g of Trinitrophenol,  
1.2g of lead monoxide (I always have this in slight excess),  
20mL of alcohol,  
A 50mL beaker,  
A glass rod,  
An evaporating dish.

- 1) Put the alcohol into the beaker.
- 2) Add the Trinitrophenol, and stir it with the glass rod until it has all dissolved.

3) Add the lead monoxide a bit at a time to avoid clumping, and stir it VERY GENTLY for a few minutes. If any dry crystals form on the side of the beaker, wash them into the main liquid with more alcohol.

4) Pour the liquid into an evaporating dish, and heat it over a steam bath until dry. You can just leave it to dry by itself, but it's not as good.

CAUTION: The dry crystals are sensitive to everything, including shock, friction, heat, bad language and dirty looks. They may just explode because they don't like you. If you're going to store this before use, do so under alcohol. I've heard that when dry they can also explode from their own weight if piled up.

Yield, based on the amount of Trinitrophenol used:

Amount of Trinitrophenol used: 2.0 grams.

Theoretical yield: 2.9 grams.

Experimental yield: 2.3 grams.

Percentage yield: 79.3%.

Cost for the amount of explosive made in my experiment:

Trinitrophenol: £0.14

Lead monoxide: £0.03

Alcohol: £0.05

Total: £0.22

Cost for 100 grams: £9.57.

Possible improvements:

This reaction is very efficient. The only way in which the yield was reduced was by some of the explosive sticking to the equipment used, and therefore not being weighed.

#### 4) Ammonium Picrate (Explosive D)

This is an insensitive explosive, considerably less sensitive than Trinitrophenol. Its main advantage over Trinitrophenol is that it doesn't form sensitive Picrate salts, and is compatible



with most chemicals (when dry. When in solution it can form other Picrates with metal salts). VoD is 7040 m/s at 1.60 g/cm<sup>3</sup>.  
Relative briscancy = 0.97.

You will need:

1g of Trinitrophenol,  
Lots of ammonia solution (any concentration),  
Some universal litmus papers,  
A 250mL beaker (or bigger, if your ammonia solution is very weak),  
An evaporating dish,  
A gas or alcohol burner,  
The ever-present glass rod.

- 1) Put your Trinitrophenol into the beaker.
- 2) Add about 50mL of ammonia solution.
- 3) Stir it with the glass rod. If it doesn't all dissolve, add more ammonia solution and stir until it does.
- 4) Check it with the litmus paper. If the pH is below 8, keep adding ammonia solution, about 10mL at a time, until the pH is above 8.
- 5) Pour the solution into an evaporating dish, and warm it over a low heat until nearly all the water has evaporated off.
- 6) Take it off the heat, and leave it to evaporate the water totally.

Yield, based on the amount of Trinitrophenol used:

Amount of Trinitrophenol used: 10.0 gram.  
Theoretical yield: 10.7 grams.  
Experimental yield: 8.9 grams  
Percentage yield: 83.2%

Cost for the amount of explosive made in my experiment:

Trinitrophenol: £0.66  
Ammonia solution: £1.40

Total: £2.06  
Cost for 100 grams: £23.15

Possible improvements:

The main reason this is so expensive is due to

the fact that I can only buy weak ammonia solution, so a lot must be used, and it's expensive when buying it OTC in small quantities. If ammonia was obtained from a different source it could be made cheaper.

#### 5) M.M.A.N.

Full name: Monomethylamine Nitrate. It requires a large charge to set it off (2g of H.M.T.D. should be plenty in a detonator), and is very hygroscopic so it must be stored in airtight containers. The main attraction of this explosive is that any concentration of nitric acid can be used to make it.

VoD is 6100 m/s at 1.20 g/cm<sup>3</sup>. Relative briscancy = 0.55.

Step #1: The production of methylamine hydrochloride.

You will need:

14g of hexamethylenetetramine,  
100mL of 15% hydrochloric acid,  
100mL of acetone,  
A filter funnel,  
A filter paper,  
Two 150mL beaker,  
An alcohol or gas burner,  
An evaporating dish,  
A 500mL beaker,  
A tripod,  
Yes, and a glass rod.

1) Pour the hydrochloric acid into the 150mL beaker.

2) Add the hexamethylenetetramine. I was expecting something to happen when I did this - some bubbling or SOMETHING, but nothing happened except a slight temperature rise, so I'd say it'd be safe to add all the hexamethylenetetramine at once.

3) Stir it with the glass rod until all the hex. has dissolved.

4) Fill the 500mL beaker with water, put it on the tripod over the burner, and put the 150mL beaker into the hot water. Leave it there to evaporate off as much of the water as

possible. Some NASTY fumes come off this. I think they're formaldehyde. They don't really smell, they just HURT. Carbon dioxide will also bubble off.

5) Quickly scrape the crystals out of the beaker, and put them into the other 150mL beaker.

6) Pour on the acetone, and crush up the crystals with the glass rod. Stir them around lots.

7) Filter out the crystals and put them onto the evaporating dish.

8) Put the evaporating dish over the 500mL beaker of boiling water, until the crystals are dry.

9) Scrape them into an AIRTIGHT container.

Step #2: The production of M.M.A.N.

You will need:

10g of methylamine hydrochloride,

24g of lead nitrate,

100mL of distilled water,

Two 150mL beakers,

A gas or alcohol burner,

A glass rod,

A filter funnel,

Two filter papers.

1) Pour the water into a beaker, and add the methylamine hydrochloride and the lead nitrate.

2) Stir them with the glass rod until they dissolve, leaving an opaque white precipitate of lead chloride.

3) Filter the solution into the other beaker. Throw away the solid.

4) Boil down the filtrate until crystals begin to appear.

5) Let the liquid cool and filter out these crystals, and save the filtrate in the other 150mL beaker.

6) Boil it down until crystals begin to appear, and cool it to 5°C or colder.

7) Filter out the crystals, and add them to the crystals filtered out before.

8) Put the crystals in an evaporating basin, and dry them over an oil bath at 100°C, or in a warm, very dry place.

Step #1: The production of methylamine hydrochloride.

Yield, based on the amount of hexamethylenetetramine used:

Amount of hexamethylenetetramine used: 14.0 grams.

Theoretical yield: 27.0 grams.

Experimental yield: 25.9 grams.

Percentage yield: 95.9%! Not bad!

Cost for the amount of methylamine hydrochloride made in my experiment:

Hexamethylenetetramine: £0.19

Hydrochloric acid: £0.16

The acetone can be used many times due to the obviously small amount of unreacted hexamethylenetetramine, and is therefore not included.

Total: £0.35

Total for enough methylamine hydrochloride to make 100 grams of M.M.A.N.: £0.97. This is definitely going to be the best explosive for those with a limited budget!!

Possible improvements:

Use more concentrated hydrochloric acid to reduce the volume of water which must be boiled off, use more hydrochloric acid to convert all of the hexamethylenetetramine if you want 100% yields, OR omit the purification in acetone. This step removes any unreacted hexamethylenetetramine, and leaves the crystals VERY hygroscopic, and frustrating to work with. Leaving in a small hexamethylenetetramine impurity reduces the tendency to absorb water, making it easier to work with, and the only impurity in the M.M.A.N. caused by this would be Hexamethylenetetramine Dinitrate which won't spoil performance.

As you may have read, my retort has broken. This means no nitric acid! I have therefore done a reaction with lead nitrate and methylamine hydrochloride to make lead

chloride and M.M.A.N.

Step #2: The conversion of methylamine hydrochloride to M.M.A.N.

Yield, based on the amount of methylamine hydrochloride used:

Amount of methylamine hydrochloride used:  
10.0 grams.

Theoretical yield: 13.9 grams.

Experimental yield: 10.1 grams.

Percentage yield of this stage is therefore  
72.7%.

Overall yield for the reaction is therefore  
 $72.7 \times 0.959 = 69.7\%$

Cost for the amount of M.M.A.N. made in my experiment:

methylamine hydrochloride: £0.14

lead nitrate: £0.24 (I think - the container no longer has a price label, but I think it was roughly £5 for 500 grams)

Total: £0.38

Cost per 100 grams: £3.76

Possible improvements:

Use nitric acid and sodium hydroxide! You'll get a greater yield of a purer product.

The ratio would be 10 grams of methylamine hydrochloride : 5.9 grams of sodium hydroxide : 9.3 grams of 100% nitric acid. However, this concentration is unnecessary, and possibly dangerous to use (lots of heat would be made!). Adjust it accordingly. Don't use very weak acid though, it'll give you a lot of water to get rid of!

You need to dissolve the methylamine hydrochloride in water, and add the sodium hydroxide SLOWLY. This will effectively make a solution of sodium chloride and methylamine. Heat the solution, and use a glass tube to bubble the methylamine gas given off through the cold nitric acid. Only use about 7 or 8 grams of nitric acid in your solution, because not all of the methylamine

will be reacted. Then boil off the water, and voila!

Alternatively, you could add the nitric acid slowly to the methylamine/sodium chloride solution, and then purify the product with fractional crystallisation. This would be much simpler, but it would give lower yields due to the need for recrystallisation. When using lead nitrate, the practically insoluble lead chloride can be filtered out, and recrystallisation isn't necessary.

When using home-made nitric acid, the cost to get the same theoretical yield would drop to about £0.20, a percentage decrease of around 47% (£1.99 for 100 grams)! This makes it a very cheap explosive compared to many of the others.

One method to precipitate some of the M.M.A.N. or M.A.\*HCl from a solution is to dump it into cold acetone and quickly filter it. A strange thing happens if you shake it up and leave it: it forms two immiscible liquids! The acetone floats on top, and below is a solution of the salt in water and a bit of acetone. This is strange, because acetone and water are normally totally miscible.

#### 6) Hexamethylenetetramine Dinitrate (no HNO<sub>3</sub> needed)

I don't have much information on this explosive at the moment, but I'll keep looking... I think I heard that VoD was around 6000-7000 m/s, with a lead block expansion of 220 cm<sup>3</sup>, but I can't remember. I will find out. It is a similar sort of explosive to Urea Nitrate and M.M.A.N., i.e. it is a nitrate salt.

You will need:

- 5g of hexamethylenetetramine,
- 65mL of 15% hydrochloric acid,
- 10g of ammonium nitrate,
- A 150mL beaker,
- A filter funnel,
- A filter paper,
- A glass rod,
- A fridge.

- 1) Pour the hydrochloric acid into the beaker and add the ammonium nitrate.
- 2) Stir the solution with the glass rod until all the ammonium nitrate has dissolved.
- 3) Cool the solution to 5°C in the fridge.
- 4) Add the hexamethylenetetramine. Stir it with the glass rod until it has all dissolved. A white crystalline precipitate should form.
- 5) Quickly filter out the precipitate.
- 6) Leave it in a warm, dry place to dry fully.

6a) Hexamethylenetetramine Dinitrate (with HNO<sub>3</sub>, much better yield)

You will need:

14g of hexamethylenetetramine,  
20mL of 70% nitric acid,  
Distilled water,  
Three 150mL beakers,  
A thermometer,  
A filter funnel,  
Filter papers,  
An ice bath,  
A fridge,  
Acetone.

- 1) Dissolve the hexamethylenetetramine in 100mL of water in one of the beakers (it will help if you heat it up, to around 80°C). Put it into the fridge after it's all dissolved, and cool it to around 5°C.
- 2) Measure out the nitric acid into another 150mL beaker.
- 3) Slowly, while stirring with the thermometer and keeping the temperature below 5°C (with the ice bath), add the nitric acid to the hexamethylenetetramine solution.
- 4) After the nitric acid has been added, cool the solution to 0°C.
- 5) Filter out the precipitate, and add it to 100mL of acetone in the third 150mL beaker.
- 6) Use the thermometer to crush it up and stir it around under the acetone.
- 7) Filter out the solid, and leave it to dry. Protect it from moisture.

6) Yield, based on the amount of hexamethylenetetramine used:

Amount of hexamethylenetetramine used: 5 grams.

Theoretical yield: 9.5 grams.

Experimental yield: 3.1 grams.

Percentage yield: 32.6%

Cost for the amount of explosive made in my experiment:

Hexamethylenetetramine: £0.07

Hydrochloric acid: £0.10

Ammonium nitrate: £0.01

Total: £0.18

Cost for 100 grams of explosive: £5.81

6)a) Yield, based on the amount of hexamethylenetetramine used:

Amount of hexamethylenetetramine used: 14 grams.

Theoretical yield: 26.6 grams.

Experimental yield: 23.4 grams.

Percentage yield: 88.0%

Cost for the amount of explosive made in my experiment:

Hexamethylenetetramine: £0.20

Nitric acid: £0.13

Acetone: negligible since it can be re-used many times.

Total: £0.33

Cost for 100 grams of explosive: £1.41

Possible improvements:

This is much better! One way it could be improved is by using the liquid left over from one batch to dissolve the

hexamethylenetetramine in the next batch.

This will improve yields since this liquid already contains significant amounts of the product, so not as much will dissolve in it the next time.

7) C.T.A.P.



This is an unstable primary explosive peroxide. Some say more powerful than H.M.T.D., some say less. I haven't bothered to find out, since the difference won't be noticeably large, or large enough to worry about. It is less storage stable than H.M.T.D., and if stored in a sealed container can form a layer of sensitive crystals on the inside of the container, and IN SCREW THREADS!!! These can detonate if the container is opened. Overall, this is an OK primary explosive, if not stored for more than a week or so. It is easy to make, and a good alternative to H.M.T.D. when hexamethylenetetramine is unavailable. VoD is 5300 m/s at 1.18 g/cm<sup>3</sup>. Relative briscancy = 0.41.

You will need:

50 mL of acetone,  
90 mL of 17.5% hydrogen peroxide,  
5 mL of 50% sulphuric acid,  
A 250mL beaker,  
A fridge,  
A filter funnel,  
Four filter papers,  
Some 10% sodium carbonate solution,  
400mL of distilled water,  
A salt/ice bath,  
A thermometer,  
A glass rod.

- 1) Pour the hydrogen peroxide and the acetone into the beaker.
- 2) Place the beaker into the salt/ice bath until it's below 5°C.
- 3) While stirring and maintaining the temperature below 10°C, add the sulphuric acid one drop at a time.
- 4) Stir the mixture for 5 minutes, and put it into the fridge.
- 5) After 36 hours, filter out the white precipitate.
- 6) Add it to 200mL of distilled water, and stir it around.
- 7) Filter it out, and add it to 200mL of sodium carbonate solution. Stir.
- 8) Filter it out and add it to 200mL more of distilled water. Stir.
- 9) Filter it and leave to dry at room

temperature.

Yields of C.T.A.P. seem to be very poor (using the common H<sub>2</sub>O<sub>2</sub>, yields may be better with 20%+), and I don't like this explosive anyway so I'm not going to bother with it. If for some reason you want a primary peroxide, make H.M.T.D.

#### 8) P.E.T.N. (Sulphuric acid + potassium nitrate method)

This is an excellent explosive. It is a stable, solid nitrate ester, that is sensitive to initiation (0.01g of lead azide!). Used in Semtex, detonators, boosters, det cord and countless other things by both the military and the civilian population. VoD is around 8350 m/s at 1.74 g/cm<sup>3</sup>. With 20% glycerine, VoD is 7825 m/s at 1.40 g/cm<sup>3</sup>. Relative briscancy when pure = 1.48, with glycerine = 1.05.

You will need:

5g of pentaerythritol,  
60mL of 98% sulphuric acid,  
50g of potassium nitrate,  
75mL of acetone,  
1g of sodium bicarbonate,  
600mL of distilled water,  
300mL of ice/water,  
A thermometer,  
A hot water bath,  
An ice bath,  
A filter funnel,  
Two filter paper,  
Three 150mL beakers,  
A 500mL beaker,

- 1) Put 30mL of sulphuric acid into a 150mL beaker.
- 2) Add 5g of pentaerythritol, and warm it to about 40°C while stirring until it all dissolves.
- 3) In another 150mL beaker, mix 30mL of sulphuric acid and 50g of potassium nitrate slowly, while keeping it cool in an ice bath.
- 4) When it is below 20°C, take the acid/nitrate mixture out of the ice bath.
- 5) In four portions, over a period of 10

minutes, add the PE/sulphuric acid solution to the acid/nitrate mixture, while stirring vigorously. Use the hot water bath and the ice bath to keep the temperature at around 35°C.

6) When the addition is complete, stir it occasionally for 90 minutes, at 30°C to 40°C.

7) Dump the reaction into 300mL of ice/water in the 500mL beaker.

8) Filter out the crystals, and add them to 75mL of acetone in the other 150mL beaker. Put this in the hot water bath, and while stirring allow it to heat up to 50°C.

9) Add 1g of sodium bicarbonate, and stir for 5 minutes.

10) Filter the solution while hot, and add the filtrate to 300mL of cold water.

11) Filter out the crystals, and allow them to dry in a warm place, or over a water bath.

#### 8)a) P.E.T.N. (95% white nitric acid method, better yields and better product)

You will need:

5g of pentaerythritol,  
20mL of 95% nitric acid, free of nitrogen dioxide,  
75mL of acetone,  
1g of sodium bicarbonate,  
Distilled water,  
Ice,  
A thermometer,  
An ice bath,  
A hot water bath,  
A filter funnel,  
Filter papers,  
Two 150mL beakers,  
A 500mL beaker.

1) Put the nitric acid in the 150mL beaker, and cool it to 0°C in the ice bath.

2) Slowly add, while stirring, the pentaerythritol. This must be done so that the temperature does not rise above 5°C.

3) After the addition, stir it for a further 30 minutes at 0°C to 5°C.

4) Dump the mixture into 300mL of ice/water in the 500mL beaker.

5) Filter out the crystals, and purify them using steps 8) to 11) in the method above.

8) Yield, based on the amount of pentaerythritol used:

Amount of pentaerythritol used: 5.0 grams.  
Theoretical yield: 11.6 grams.  
Experimental yield: 4.1 grams ( :o( a very crappy result!)  
Percentage yield: 35.3%

Cost for the amount of explosive made in my experiment:

Pentaerythritol: £0.20  
Potassium nitrate: £0.06  
Sulphuric acid: £0.28

Total: £0.54  
Cost for 100 grams: £13.17

Possible improvements:

Well, I am certainly not happy with that yield! I'm not too sure how I can improve it though. Perhaps by letting it react for longer, or using the method with only pentaerythritol and 95% white nitric acid. I think the low yield is at least partially due to the small amount being made. As with the Ammonium Picrate, the small amount that is lost during filtration etc. represents a large percentage...

8)a) Yield, based on the amount of pentaerythritol used:

Amount of pentaerythritol used: 5.0 grams.  
Theoretical yield: 11.6 grams.  
Experimental yield: 9.8 grams.  
Percentage yield: 84.5%

Cost for the amount of explosive made in my experiment:

Pentaerythritol: £0.20  
c. 95% nitric acid: c. £0.20

Total: £0.40  
Cost for 100 grams: £4.08

Possible improvements:

Use phosphorous pentoxide to dehydrate the nitric acid further??

### 9) R.D.X.

Another excellent explosive, with the same potential as P.E.T.N. This is the base of the A, B and C compositions, and is used for everything that P.E.T.N. is used for. It is slightly less sensitive, and perhaps very slightly less powerful than P.E.T.N., but it too is storage stable for years, sensitive to initiation, powerful and brisant. VoD is 8500 m/s at 1.82 g/cm<sup>3</sup>. Relative briscancy = 1.61.

You will need:

50mL of 95% or better white nitric acid, as free from nitrogen dioxide as possible,  
25g of Hexamethylenetetramine Dinitrate,  
100mL of acetone,  
A 150mL beaker,  
A 250mL beaker,  
A 500mL beaker,  
A hot water bath,  
A cold water/ice bath,  
A glass rod,  
A thermometer,  
1000mL of distilled water,  
100mL of 10% sodium carbonate solution,  
A filter funnel,  
Two filter papers.

- 1) Pour the nitric acid into the 250mL beaker, and put it into the cold water bath.
- 3) While keeping the temperature at around 25°C (between 20°C and 30°C), stir in the Hexamethylenetetramine Dinitrate, in portions of roughly 1g.
- 4) When it has all been added, stir it for 10 minutes while warming it up to 50°C to 55°C in the hot water bath.
- 5) Hold it at 50°C to 55°C for 5 minutes, and then let it cool back down to 20°C.
- 6) Pour 300mL of distilled water into the 500mL beaker, and add the reaction to it.
- 7) Leave it to precipitate the R.D.X., and filter it out.

- 8) Wash the solid in the filter with 150mL of water, then the sodium carbonate solution, then with the remaining 150mL of water.
- 9) Scoop the crystals out into the 150mL beaker, and add the acetone.
- 10) Warm it to 50°C in the hot water bath, and filter it.
- 11) Dump the filtrate into 400mL of cold, distilled water, and filter out the crystals.
- 12) Leave the crystals spread out to dry.

Yield, based on the amount of x used:

Amount of x used: grams.  
Theoretical yield: grams.  
Experimental yield: grams.  
Percentage yield: %

Cost for the amount of explosive made in my experiment:

X: £  
Y: £  
Z: £

Total: £  
Cost for 100 grams: £

Possible improvements:

#### 10) Tetramethylenediperoxidedicarbamide (T.M.D.D.)

This is a similar explosive peroxide to Hexamethylenetriperoxidodiamine (H.M.T.D.). This procedure came from a Swedish text which I had to translate. Before I saw the text, I had never seen another Swedish word, so I can't guarantee 100% accuracy of this translation. I have not yet tried it as I have no formaldehyde right now. I think that the molecule will be less stressed than that of H.M.T.D., resulting in a more stable product, but I'm not sure...

You will need:

16mL of 35% formaldehyde solution,  
22mL of 35% hydrogen peroxide (or

equivalent),  
6g of urea,  
10mL of 50% sulphuric acid,  
An ice bath,  
A fridge,  
500mL of distilled water,  
250mL of 10% sodium carbonate solution,  
(Acetone?),  
A thermometer,  
A 150mL beaker,  
A pipette,  
A filter funnel,  
A filter paper.

- 1) Mix the formaldehyde and the hydrogen peroxide in the 150mL beaker, and dissolve the urea in it.
- 2) Cool it to 5°C in the ice bath, and add the sulphuric acid drop by drop, while stirring with the thermometer and no letting the temperature go above 20°C.
- 3) After the addition of the acid, put the 150mL beaker of reactants into the fridge for 48 hours.
- 4) After this time, filter out the crystals of T.M.D.D.
- 5) While they're in the filter paper, wash the crystals with 100mL of water, then with the 250mL of sodium carbonate solution, then with the remaining 400mL of water.
- 6) I think the Swedish text said to recrystallise from acetone. So try this, but if it doesn't work then just dry the crystals in a cool, dry place!

Apparently this explosive is really bad, and can even be easily dead-pressed! That's unusual for an organic peroxide explosive, eh? So unless anyone actually wants me to, I'm not going to bother making this.

#### 11) C.T.M.T.N.A. (Cyclotrimethylenetrinitrosamine, R-salt)

This is R.D.X., but missing three oxygen atoms (one from each NO<sub>2</sub> group). It uses no concentrated nitric acid. The only acid used is hydrochloric, and it doesn't even have to be very concentrated. This explosive is carcinogenic and toxic, contact should be

avoided. However, this is perhaps the best explosive to make at home since it is easy to produce and powerful. The reason it's not used militarily is the low yield of 30% (I have seen 50% stated, but this means that the weight yielded is 50% of the weight of hexamethylenetetramine used, e.g. 3.5 grams of C.T.M.T.N.A. from 7 grams of hexamethylenetetramine.)

VoD is 7800 m/s at 1.57 g/cm<sup>3</sup>. Relative briscancy is 1.17. Lead block expansion is 370 cm<sup>3</sup>. At this density 2.5 grams of Mercury Fulminate will cause detonation, at 0.85 g/cm<sup>3</sup> a mere 0.3 grams of Mercury Fulmiate will suffice!

You will need:

7g of hexamethylenetetramine,  
60mL of 15% hydrochloric acid,  
10.5g of sodium nitrite,  
Distilled water,  
50mL of 10% sodium carbonate solution,  
20mL of acetone,  
1g of sodium carbonate,  
An ice bath,  
A 150mL beaker,  
A thermometer,  
A filter funnel,  
Three filter papers.

- 1) Dissolve the hexamine in 25mL of water and add the hydrochloric acid in the 150mL beaker.
- 2) Cool this to 0°C in the ice bath, and add a solution of the sodium nitrite in 50mL of water, while stirring.
- 3) Leave the solution to react overnight at 5°C, and then filter out the crystals.
- 4) Wash them with 200mL of water, then the sodium carbonate solution, then another 200mL of water.
- 5) Dissolve them in the acetone at around 40°C, add the 1 gram of sodium carbonate, and stir for 5 minutes.
- 6) Filter the solution
- 7) Dump the filtrate into 100mL of cold water in the other 150mL beaker to precipitate the crystals.
- 7) Filter them out, and leave them to dry in a



warm, dry place in a thin layer.

Yield, based on the amount of hexamethylenetetramine used:

Amount of hexamethylenetetramine used: 7.0 grams.

Theoretical yield: 11.6 grams.

Experimental yield: 3.3 grams.

Percentage yield: 28.4%

Cost for the amount of explosive made in my experiment:

Hexamethylenetetramine: £0.10

Hydrochloric acid: £0.15

Sodium nitrite: £0.07

Total: £0.32

Cost for 100 grams: £9.70

Possible improvements:

I have no idea! I know yields for this explosive are normally rather low. Perhaps a longer reaction time could help, although I doubt it since it had been reacting for a long time. Maybe a shorter reaction time could help!

## 12) Nitrourea

This is a simple ketonitramine which is very easy to make. Its main (only?) drawback is the fact that it is easily decomposed in the presence of moisture, and therefore must be kept absolutely anhydrous for increased storage stability. This is a two stage synthesis, first forming Urea Nitrate, which is also an explosive.

I can't find density values for either of them at the moment, but Urea Nitrate has a max. VoD of around 4500 m/s and Nitrourea can get up to about 7000 m/s.

I have not found the zinc salt of Nitrourea to be very useful, so I will not include it unless people actually want me to.

Step #1: The production of Urea Nitrate.

You will need:

30g of urea (cheaper lawn fertilisers, such as Wilkinson's own brand, are pure urea.),  
35mL of 70% nitric acid,  
Distilled water,  
Acetone,  
Three 150mL beakers,  
A thermometer,  
A filter funnel,  
A fridge,  
Filter papers.

- 1) Put the urea in a 150mL beaker, and add 40mL of distilled water. Stir it with the thermometer until it has dissolved - it gets quite cold, so you'll need to warm it, or have a bit of patience.
- 2) Measure out the nitric acid into the other 150mL beaker.
- 3) Cool the nitric acid, and the urea solution, to 5°C in the fridge, or in an ice bath.
- 4) Slowly, while stirring with the thermometer, mix the two liquids, while keeping the temperature below 20°C.
- 5) Filter out the precipitate, and discard the solution.
- 6) Add the precipitate to 100mL of acetone in the third 150mL beaker, and stir it around with the thermometer.
- 7) Filter the Urea Nitrate out, and let it dry in a warm place.

Step #2: The production of Nitrourea.

You will need:

60g of Urea Nitrate,  
90mL of conc. sulphuric acid,  
Distilled water,  
Alcohol,  
Ice,  
A salt/ice bath,  
A hot water bath,  
A thermometer,  
A filter funnel,  
Filter papers,  
Two 250mL beakers,  
A 500mL beaker.

- 1) Measure the sulphuric acid into a 250mL beaker, and cool it to  $-5^{\circ}\text{C}$  in the salt/ice bath.
- 2) Slowly, while stirring and keeping the temperature below  $0^{\circ}\text{C}$ , add the Urea Nitrate.
- 3) 5 minutes after all the Urea Nitrate has been added, dump the mixture into 300mL of ice/water in the 500mL beaker.
- 4) Filter out the precipitate, and put it into the second 250mL beaker, containing 50mL of alcohol.
- 5) Heat this to the boiling point of the alcohol using the hot water bath, and while stirring add more alcohol, slowly, until all the Nitrourea has dissolved.
- 6) Chill this solution to  $0^{\circ}\text{C}$  in the salt/ice bath, filter out the precipitate and rinse it with cold alcohol.
- 7) Dry it in warm, dry air to prevent condensation of water on the precipitate.
- 8) The Nitrourea will now be pure, and can be stored for years in hard glass bottles if kept dry.
- 9) It's a good idea to keep it SLIGHTLY acidic, since alkalis accelerate it's decomposition when moist.

Step #1: The production of Urea Nitrate:

Yield, based on the amount of urea used:

Amount of urea used: 30.0 grams.

Theoretical yield: 61.5 grams.

Experimental yield: 55.5 grams.

Percentage yield: 90.2%

Cost for the amount of explosive made in my experiment:

Urea: £0.09

Nitric acid: £0.23

Total: £0.32

Cost for 100 grams: £0.58

Step #2: The conversion of Urea Nitrate to Nitrourea:

Yield, based on the amount of Urea Nitrate used:

Amount of Urea Nitrate used: 60.0 grams.  
Theoretical Yield: 51.2 grams.  
Experimental Yield: 30.4 grams.  
Percentage yield: 59.4%

Cost for the amount of explosive made in my experiment:

Urea Nitrate: £0.35  
Sulphuric acid: £0.36

Total: £0.71  
Cost for 100 grams: £2.34

Possible improvements:

Not much really. As with Hexamethylenetetramine Dinitrate, the liquid left after making one batch of Urea Nitrate can be used to dissolve the urea for the next batch, so that less Urea Nitrate is lost in the solution.

### 13) Sucrose Nitrate

I'm still looking for information on this. I don't even know for certain how many nitrate groups there are in this product, but I think it will be mostly between six and eight. It is/was used in "nitrohydrene", a mixture of Glyceryl Trinitrate and Sucrose Nitrate, used because sucrose is cheaper than glycerol.

You will need:

3g of sucrose,  
15mL of 70% nitric acid,  
30mL of 90% sulphuric acid,  
An ice bath,  
A hot water bath,  
Two 150mL beakers,  
A 250mL beaker,  
A dropping pipette,  
A thermometer,  
Distilled water,  
Sodium bicarbonate (or other alkali),  
Urea.

1) Put the sucrose and nitric acid into a 150mL

beaker.

2) Cool it to around 15°C in the ice bath, and stir it with the thermometer until all the sucrose has dissolved.

3) Add sulphuric acid slowly, a few mL at a time (using the dropping pipette), to the nitric acid/sucrose solution, while stirring and keeping the temperature below 15°C. The solution will eventually go cloudy.

4) Put 150mL of distilled water into the 250mL beaker, and add the reaction mixture to it.

5) Warm this to 40°C in the water bath, and keep it around this temperature (40°C-45°C) for ten minutes. The Sucrose Nitrate will settle.

6) Cool the liquid in the 250mL beaker to 25°C in the ice bath, and fish the Sucrose Nitrate out with the thermometer.

7) Add the Sucrose Nitrate to the other 150mL beaker, containing 100mL of water and 10g of sodium bicarbonate.

8) Warm this to 40°C to melt the Sucrose Nitrate, and stir it around thoroughly for 15 minutes.

9) Add 5g of urea, and continue stirring for 15 minutes.

10) Repeat steps 5) and 6)

11) Allow the Sucrose Nitrate to dry at room temperature. This can be done very quickly if it is softened at 30°C and rolled into a ball, so that it has a low surface area : volume ratio to speed up drying.

Yield, based on the amount of x used:

Amount of x used: grams.

Theoretical yield: grams.

Experimental yield: grams.

Percentage yield: %

Cost for the amount of explosive made in my experiment:

X: £

Y: £

Z: £

Total: £

Cost for 100 grams: £

Possible improvements:

#### 14) Sorbitol Hexanitrate

This is very similar to Mannitol Hexanitrate (see below). Shock sensitive, small quantities burn rapidly if ignited. This procedure will produce a sticky liquid product, which is actually a mixture of nitrates. A solid product can be obtained by dissolving it in ethanol, and adding an equal volume of cold water to precipitate it. This will be pure Sorbitol Hexanitrate.

You will need:

5g of sorbitol,  
35mL of 70% nitric acid,  
70mL of 90% sulphuric acid,  
Distilled water,  
Sodium bicarbonate,  
Urea,  
Two 250mL beakers,  
A 500mL beaker,  
A thermometer,  
A hot water bath,  
A dropping pipette,  
An ice bath.

- 1) Put the sorbitol and nitric acid in a 250mL beaker, and cool it to 5°C in the ice bath.
- 2) Stir it until all the sorbitol has dissolved.
- 3) Slowly add the sulphuric acid, while stirring, making sure that the temperature does not rise above 10°C.
- 4) After all the sulphuric acid has been added, dump the reaction into the 500mL beaker, containing 200mL of distilled water.
- 5) Warm the water/acid/product mixture to 40°C to melt the Sorbitol Hexanitrate. It will settle to the bottom.
- 6) Using the pipette, suck up the product while still warm, and add it to the other 250mL beaker, containing 100mL of water and 10g of sodium bicarbonate.
- 7) Warm it to 40°C, and stir it for 10 minutes.
- 8) Add 5g of urea and stir it for a further 10 minutes.
- 9) Suck up the Sorbitol Hexanitrate with the pipette, and let it dry in a warm place

overnight.

Yield, based on the amount of x used:

Amount of x used: grams.  
Theoretical yield: grams.  
Experimental yield: grams.  
Percentage yield: %

Cost for the amount of explosive made in my experiment:

X: £  
Y: £  
Z: £

Total: £  
Cost for 100 grams: £

Possible improvements:

### 15) Mannitol Hexanitrate

This is a different isomer of Sorbitol Hexanitrate, but this one is more widely used, as a base charge in blasting caps. This procedure produces a white powder, and yields seem to be higher. Lead block expansion for this explosive is a whopping 560 cm<sup>3</sup>, almost as high as Glyceryl Trinitrate! VoD is 7000 m/s, density is 1.60 g/cm<sup>3</sup>, relative brisance is 0.96 under these conditions.

To make it, use the procedure for Sorbitol Hexanitrate above, but use mannitol instead of sorbitol (duh...), use a mixture of 6mL of 70% nitric acid, 27g of potassium nitrate and 14mL of 98% sulphuric acid instead of the nitric acid, and use 30mL of 98% sulphuric acid. Omit the step in which the Sorbitol Hexanitrate is melted. Simply filter off the Mannitol Hexanitrate and recrystallise it from ethanol after washing and drying the crude product.

Yield, based on the amount of x used:

Amount of x used: grams.  
Theoretical yield: grams.

Experimental yield: grams.

Percentage yield: %

Cost for the amount of explosive made in my experiment:

X: £

Y: £

Z: £

Total: £

Cost for 100 grams: £

Possible improvements:

### 16) Cellulose Nitrate

This explosive has been used in torpedoes, grenades, rocket propellants, gunpowders and many other things, sometimes in conjunction with other substances such as Glyceryl Trinitrate or Ethylene Glycol Dinitrate. Today, it's main use is in propellants, because its power, sensitivity and stability are not as good as more modern explosives such as R.D.X. or P.E.T.N. When dry, this explosive is incredibly flammable, and will burn extremely quickly, producing a characteristic "WHOOMPH!!" It burns so fast that it can be used as a low explosive, in firecrackers etc. When used as a high explosive, VoD is 7300 m/s at 1.20 g/cm<sup>3</sup>, therefore its relative brisance is 0.78. Check out [Powerlab's video](#) of Cellulose Nitrate burning...

You will need:

30mL of 70% nitric acid,  
70mL of 98% sulphuric acid,  
10g of cellulose (cotton wool),  
5g of sodium bicarbonate,  
5g Urea,  
Distilled water,  
Two 150 beakers,  
A thermometer,  
An ice bath,  
A hot water bath.

1) Mix the two acids in a 150mL beaker.



- 2) Cool them to 10°C, and add the cellulose.
- 3) Stir it with the thermometer, and keep it between 10°C and 30°C, for 45 minutes.
- 4) Using the thermometer, fish the nitrated cellulose out of the acid, and squeeze out excess acid back into the beaker. This can be recycled.
- 5) Put the Cellulose Nitrate into the other 150mL beaker, add 100mL of distilled water.
- 6) Stir it around, and drain off the water.
- 7) Repeat steps 5) and 6).
- 8) Pour 100mL of water into the 150mL beaker with the Cellulose Nitrate, and add the sodium bicarbonate. Stir it for 10 minutes, heating it at around 60°C using the hot water bath.
- 9) Repeat step 8), with urea instead of sodium bicarbonate.
- 10) Let the Cellulose Nitrate dry in a warm place.

Yield, based on the amount of x used:

Amount of x used: grams.

Theoretical yield: grams.

Experimental yield: grams.

Percentage yield: %

Cost for the amount of explosive made in my experiment:

X: £

Y: £

Z: £

Total: £

Cost for 100 grams: £

Possible improvements:

### 17) Amylose Nitrate

This is practically the same as Cellulose Nitrate, but seems slightly less flammable. This is at least partially due to the fact that it's in the form of a fine powder, rather than a low-density ball of fluff in which flames can spread very quickly.

Use the procedure for Cellulose Nitrate, but

whenever you have to get the Amylose Nitrate out of a liquid, you'll have to filter it instead of fishing it out with a thermometer or simply draining off the liquid. For the starch, cornflour/cornstarch (I believe these are English/American names for the same thing) can be used, or any form of pure starch.

Yield, based on the amount of x used:

Amount of x used: grams.  
Theoretical yield: grams.  
Experimental yield: grams.  
Percentage yield: %

Cost for the amount of explosive made in my experiment:

X: £  
Y: £  
Z: £

Total: £  
Cost for 100 grams: £

Possible improvements:

### 18) Tetranitronaphthalene

This was once considered as a high explosive for use in artillery shells; as far as I know, the only reasons why it was not used are the facts that it was more expensive than Trinitrotoluene, and it didn't have the advantage of being safely castable. It is as stable as Trinitrotoluene and has the same oxygen balance.

VoD is 7013 m/s at 1.60 g/cm<sup>3</sup>, therefore its relative brisquancy under these conditions is 0.96.

You will need:

105g of naphthalene,  
320mL of 98% sulphuric acid,  
140mL of 70% nitric acid,  
60mL of 95% nitric acid,  
5% sodium bicarbonate solution,  
Ethanol,

A 250mL beaker,  
A 1.5L beaker,  
A 3L container,  
A hot water bath,  
An ice bath,  
A thermometer,  
A filter funnel,  
Filter papers.

Step #1: The production of mononitronaphthalene.

- 1) Add 30g of powdered naphthalene to 50mL of water in a 250mL beaker. Stir it around, and mix it together as good as you can (water and naphthalene do not like mixing!)
- 2) Slowly add 80mL of the sulphuric acid, while stirring with the thermometer, and then add 60mL of the 70% nitric acid. Do not let the temperature rise above 30°C during either of the additions.
- 3) Slowly stir in a further 75g of naphthalene, keeping the temperature at around 50°C using the ice bath and hot water bath. Hold it at this temperature, while stirring, for half an hour.
- 4) Heat the mixture to 60°C for 3 minutes, then let it cool to room temperature.
- 5) Remove the solidified mononitronaphthalene from the surface of the liquid. This can be used in the next steps to make Tetranitronaphthalene, or purified by stirring it around under 75°C 5% sodium bicarbonate solution, then several washes under hot water, if it is going to be used to make Cheddites.

Step #2: The production of 1,8-Dinitronaphthalene.

- 1) In a 1.5L beaker surrounded by an ice bath, cool 160mL of sulphuric acid to around 15°C.
- 2) Slowly stir in 80mL of 70% nitric acid, keeping the temperature below 30°C.
- 3) Crush the mononitronaphthalene from the previous step as finely as you can, and slowly stir it into the sulphuric acid/nitric acid mixture, keeping the temperature below 40°C.
- 4) After all the mononitronaphthalene has been added, stir it occasionally for half an hour, keeping the temperature at 20°C - 30°C.
- 5) After this time, slowly warm the mixture to

- 70°C, while stirring vigorously. This warming should last about half an hour.
- 6) Hold the temperature between 65°C and 75°C for half an hour, while stirring.
  - 7) Let the mixture cool to room temperature, and dump it into 1L of cold water in a 3L container. Let the product settle.
  - 8) Decant off most of the liquid from the product, and slowly add 2L of distilled water at about 40°C, while stirring. Let the product settle and repeat the washing..
  - 9) Filter the product out of the liquid, and let it dry.
  - 10) Dissolve as much of the product as possible in near-boiling acetone, and filter the solution while hot. Cooling the filtrate in the freezer will precipitate 1,8-Dinitronaphthalene (and unreacted Mononitronaphthalene, if any) for the next step. The undissolved solid will be 1,5-Dinitronaphthalene, which can be used in mixtures with Ammonium Nitrate or Chlorates.

Step #3: The production of 1,3,6,8-Tetranitronaphthalene.

- 1) Chill 60mL of 95% nitric acid in a 500mL beaker, using a salt/icbath.
- 2) Once the acid is below 0°C, begin the addition of 80mL of 98% sulphuric acid, while stirring, keeping the temperature below 30°C.
- 3) After the acids have been mixed, add 20g of the powdered 1,8-Dinitronaphthalene, as obtained above. Add it slowly, with rapid stirring, keeping the temperature between 25°C and 30°C.
- 4) After the addition, leave the mixture at room temperature for one hour, with occasional stirring.]
- 5) After this time, slowly heat the mixture, while stirring rapidly, to 70°C to 80°C. This heating should be done over the period of about one hour, and the final temperature should be maintained, with stirring, for at least one further hour.
- 6) Cool the mixture and dump it into roughly three times its volume of cold distilled water.
- 7) Filter out the solids, wash them a few times with distilled water, and dry them.
- 8) Recrystallise them from ethanol.

Yield, based on the amount of x used:

Amount of x used: grams.  
Theoretical yield: grams.  
Experimental yield: grams.  
Percentage yield: %

Cost for the amount of explosive made in my experiment:

X: £  
Y: £  
Z: £

Total: £  
Cost for 100 grams: £

Possible improvements:

### 19) NG / EGDN

"Nitroglycerine" (Glyceryl Trinitrate, Propan-1,2,3-triol Trinitrate) and Ethylene Glycol Dinitrate (Ethan-1,2-diol Dinitrate) are two similar liquid nitrate esters. Glyceryl Trinitrate was the first high explosive to be mass produced and was used extensively for mining, building etc in the form of Dynamite. This was Glyceryl Trinitrate absorbed into sawdust or kieselghur, a diatomaceous, clay-like earth, to make it less sensitive to impact and friction. It was also employed in Blasting Gelatine (Glyceryl Trinitrate gelled with Cellulose Nitrate, a similar mixture is now used in double-base smokeless powder), and a few other compositions. Ethylene Glycol Dinitrate has replaced Glyceryl Trinitrate in almost all applications now, due to its lower sensitivity and higher stability (this is due, in general terms, to the fact that the molecule is smaller). This is used in the modern equivalents of ghur dynamite, for example in ammonia dynamites (Ethylene Glycol Dinitrate absorbed into finely powdered Ammonium Nitrate). Ethylene Glycol Dinitrate's main drawback, from our point of view, is its higher volatility compared to Glyceryl Trinitrate. This means the dreaded "Nitro-headache", caused by dilation of the arteries (leading to a reduced blood pressure),

is much more likely to be encountered when working with Ethylene Glycol Dinitrate. Both are sensitive explosives, but if the proper care is exercised when using them, as with all high explosives, you should have no problems. They can be desensitised by dissolving them in acetone, perhaps 1 mL of acetone for every 2 mL of explosive.

Both are fairly powerful explosives, Glycerol Trinitrate has a VoD of around 7700 m/s at 1.59 g/cm<sup>3</sup>, and Ethylene Glycol Dinitrate is similar, although slightly less powerful.

(to be continued.....)