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| **Ammonia (gas & solution)** |
| Substance | Hazard | Comment |
| Ammonia (gas) | toxic | It is irritating to the eyes and lungs; breathing it **can** lead to severe poisoning. However, the human nose can detect ammonia easily at well below danger levels.  |
| Concentrated ammonia solution*(If 6 M or more)* | corrosive | Concentrated (‘.880’) ammonia, causes burns; it is dangerous to the eyes (**goggles** should be worn). It causes severe internal damage if swallowed. Ammoniagas will be present in the container and the **pressure of gas builds up on hot days so be careful when opening it.** |
| Moderately-concen­trated ammonia solution*(If less than 6 M but 3 M or more)* | irritant | This includes ‘household’ ammonia.It is irritating to the eyes and skin. **Safety glasse**s are adequateIts odour can be very unpleasant |
| Dilute ammonia solution*(If less than 3 M)* | low hazard | It may still cause great discomfort in eyes or in a cut. |
| (It is also **dangerous for the environment** because it is very toxic to aquatic organisms.) |

### Control Measures

• Use the lowest concentration and smallest volume possible.

• **Wear suitable eye protection**, including when making or disposing of solutions. Goggles for concentrated solutions, safety glasses for moderately dilute)

• For small amounts, make sure you are working in a well-ventilated laboratory.

• For anything larger than test-tube amounts of the gas and more-concentrated solutions (including opening bottles) use a fume cupboard;

• If smelling the gas, follow the safe technique for sniffing gases: use your hand to waft the gas towards your nose.

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| **Think about the risks** | **Ask yourself** |
| ***What are the details of the activity to be undertaken?*** ***What are the hazards?******What is the chance of something going wrong?*** *Eg, Solution spurting out of test tubes when being heated; release of ammonia gas as a product of a chemical reaction; possibility of the ammonia gas concentration reaching dangerous levels.****How serious would it be if something did go wrong?*** *NB Alkali in the eye causes more damage than acid of equivalent concentration.****How can the risk(s) be controlled for this activity?*** *Eg, Can it be done safely? Does the procedure need to be altered? Should goggles or safety spectacles be worn?* | Can I do a safer experiment instead?Can I use a safer chemical for this experiment?Can I use a lower concentration?Can I use a smaller volume?Do I need to use a fume cupboard?What sort of eye or skin protection do I need? |
| **Spills** |  | **What to do if you have an accident** |
| - Make sure you don’t spill much. Decant as small an amount as you can and use that for your experiment – do not try to use a large reagent bottle.-if you do spill any, unless it is either dilute or a very small amount, call your teacher.- Wipe up small amounts with a damp cloth and rinse it well | **• In the eye** **• Vapour breathed in** **• Swallowed****• Spilt on skin or clothing****• Spilt on floor, bench, etc**  | Flood the eye with gently-running tap water for at least 20 minutes (for alkalis). See a doctor. If it is necessary to go to hospital, continue washing the eye during the journey in an ambulance.Remove the casualty to fresh air. Call a doctor if breathing is difficult. Do no more than wash out the mouth with water. Do not induce vomiting. Sips of water may help cool the throat and help keep the airway open. See a doctor. Remove contaminated clothing. Drench the skin with plenty of water. If a large area is affected or blistering occurs, see a doctor. Consider the need to evacuate the laboratory and open windows if large amounts are spilt and especially for (moderately) concentrated solutions. Cover with mineral absorbent (eg, cat litter) and scoop into a bucket. Neutralise with citric acid. Rinse with plenty of water. Wipe up small amounts with a damp cloth and rinse it well. |
| **Personal Protective Equipment (PPE)** |
| Only think about this once you have reduced all the other risks as low as possible – PPE is your last line of defence.**Eye protection** – If you are using anything corrosive or toxic or that is a health hazard (carcinogenic, mutagenic etc) then wear chemical resistant goggles, NOT safety specs.For anything of lower hazard, safety spectacles are fine.**Gloves** – if you are using anything corrosive, toxic in contact with skin or that is a skin sensitiser, you should wear gloves. Be careful not to spill anything – you might not be able to handle things as easily as without them.**Lab coa**t – These are a good idea – though their main use is to protect your clothing rather than you.**Respirators and masks** – not a good idea. These are much harder to fit and use properly than you might think. Dust masks for some activities might be acceptable but it is preferable to remove your exposure to dust and fumes by using, for instance, a fume cupboard. |

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| Barium compounds |
| Substance | Hazard | Comment |
| **Barium chloride**Solid | toxic | Toxic if swallowed but only harmful if breathed in eg as dust. |
| Barium chlorideSolution*(If 1 M or more)* | toxic | Toxic if swallowed but only harmful if breathed in eg as aerosol. |
| Barium chlorideSolution*(If 0.1 M or more but less than 1 M)* | harmful | It is harmful if swallowed or inhaled. |
| Barium chlorideSolution*(If less than 0.1 M)* | low hazard | - |
| Barium hydroxide | **Corrosive** | The solid and solutions down to 0.03 mol/l-1 are currently classified as corrosive and will require **goggles** rather than safety spectacles. Below that it is of low hazard |
| Barium nitrate(V)*Solid* | oxidising /harmful | It is an oxidising agent and is harmful if swallowed or inhaled. |
| Barium nitrate(V)*Solution* | low hazard | - |
| Barium sulphate(VI)*Solid* | low hazard | Barium sulphate(VI) is low hazard because it does not dissolve in water or acids.  |
| (It is also **dangerous for the environment** because it is very toxic to aquatic organisms.) |

### Control Measures

• Use the lowest concentration possible.

• Use the smallest quantity possible.

• Wear suitable eye protection where required.

• Wash hands after handling barium compounds.

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| **Think about the risks** | **Ask yourself** |
| ***What are the details of the activity to be undertaken?*** ***What are the hazards?******What is the chance of something going wrong?*** *Eg, Solution spurting out of test tubes when being heated;* ***How serious would it be if something did go wrong?*** *NB Alkali in the eye causes more damage than acid of equivalent concentration.****How can the risk(s) be controlled for this activity?*** *Eg, Can it be done safely? Does the procedure need to be altered? Should goggles or safety spectacles be worn?* | Can I do a safer experiment instead?Can I use a safer chemical for this experiment?Can I use a lower concentration?Can I use a smaller volume?Do I need to use a fume cupboard?What sort of eye or skin protection do I need? |
| **Spills** |  | **What to do if you have an accident** |
| - Make sure you don’t spill much. Decant as small an amount as you can and use that for your experiment – do not try to use a large reagent bottle.-if you do spill any, unless it is either dilute or a very small amount, call your teacher.- Wipe up small amounts with a damp cloth and rinse it well | **• In the eye** **• Vapour breathed in** **• Swallowed****• Spilt on skin or clothing****• Spilt on floor, bench, etc**  | Flood the eye with gently-running tap water for at least 20 minutes (for alkalis). See a doctor. If it is necessary to go to hospital, continue washing the eye during the journey in an ambulance.Remove the casualty to fresh air. Call a doctor if breathing is difficult. Do no more than wash out the mouth with water. Do not induce vomiting. Sips of water may help cool the throat and help keep the airway open. See a doctor. Remove contaminated clothing. Drench the skin with plenty of water. If a large area is affected or blistering occurs, see a doctor. Consider the need to evacuate the laboratory and open windows if large amounts are spilt and especially for (moderately) concentrated solutions. Cover with mineral absorbent (eg, cat litter) and scoop into a bucket. Neutralise with citric acid. Rinse with plenty of water. Wipe up small amounts with a damp cloth and rinse it well. |
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| Calcium hydroxide & oxide*including* Slaked lime, Quick lime *&* Limewater |
| Substance | Hazard | Comment |
| Calcium oxide (Quicklime)Solid *(Old samples of calcium oxide are mostly calcium hydroxide.)* | corrosive | It causes burns. There is a risk of serious damage to the eyes. It is irritating to the skin, lungs, etc. Wear **goggles**.It reacts violently with water, becoming very hot - dust particles may shoot out. |
| Calcium hydroxide Solid*Slaked lime, garden lime* | (irritant) | Risk of serious damage to the eyes. It is irritating to the skin, lungs, etc. Wear **goggles**. |
| Calcium hydroxide SolutionLimewater*(Limewater is a saturated solution of calcium hydrox­ide, less than 0.02 M.)* | low hazard | Even a saturated solution of calcium hydroxide is so dilute that it is not classed as irritant. Limewater is usually made in schools by adding excess solid calcium hydroxide (or oxide) to water. Undissolved solid will remain: this is mainly calcium carbonate but some might be undissolved calcium hydroxide so care should be taken when using lime water to avoid splashing in the eyes. |

### Control Measures

• Wear suitable eye protection when handling solids.

• Eye protection is advisable when using limewater, especially if blowing into it.

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| **Think about the risks** | **Ask yourself** |
| ***What are the details of the activity to be undertaken?*** ***What are the hazards?******What is the chance of something going wrong?*** *Eg, Solid particles spitting when adding water, dust blowing around or liquid splashing into the eye when blowing into limewater.****How serious would it be if something did go wrong?*** *NB Alkali in the eye causes more damage than acid of equivalent concentration.****How can the risk(s) be controlled for this activity?*** *Eg, Can it be done safely? Does the procedure need to be altered? Should goggles or safety spectacles be worn?* | Can I do a safer experiment instead?Can I use a safer chemical for this experiment?Can I use a lower concentration?Can I use a smaller volume?Do I need to use a fume cupboard?What sort of eye or skin protection do I need? |
| **Spills** |  | **What to do if you have an accident** |
| - Make sure you don’t spill much. Decant as small an amount as you can and use that for your experiment – do not try to use a large reagent bottle.-if you do spill any, unless it is either dilute or a very small amount, call your teacher.- Wipe up small amounts with a damp cloth and rinse it well | **• In the eye** **• Vapour breathed in** **• Swallowed****• Spilt on skin or clothing****• Spilt on floor, bench, etc**  | Flood the eye with gently-running tap water for at least 20 minutes (for alkalis). See a doctor. If it is necessary to go to hospital, continue washing the eye during the journey in an ambulance.Remove the casualty to fresh air. Call a doctor if breathing is difficult. Do no more than wash out the mouth with water. Do not induce vomiting. Sips of water may help cool the throat and help keep the airway open. See a doctor. Remove contaminated clothing. Drench the skin with plenty of water. If a large area is affected or blistering occurs, see a doctor. Consider the need to evacuate the laboratory and open windows if large amounts are spilt and especially for (moderately) concentrated solutions. Cover with mineral absorbent (eg, cat litter) and scoop into a bucket. Neutralise with citric acid. Rinse with plenty of water. Wipe up small amounts with a damp cloth and rinse it well. |
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| Chlorine *and* chlorates |
| Substance | Hazard | Comment |
| ChlorineGas | toxic | This is toxic if breathed in, causing severe lung damage. It irritates the eyes, skin and respiratory system. It may trigger an asthma attack and the effects of exposure may be delayed for some hours. Chlorine gas may be formed in the laboratory by electrolysis and the some reactions of chlorides/chlorates – beware inhaling the gas. |
| Chlorine waterSolution in water | low hazard(but beware of toxic gas given off) | It can be made in a fume cupboard by diluting a saturated solution with a little more than its own volume of water.Chlorine gas escapes easily from the solution, especially if it is warmed. |
| Concentrated sodium chlorate(I)Solution *more than 0.67 M*  | corrosive | It causes severe burns; it is especially dangerous to the eyes, similar to sodium hydroxide solution. Wear **goggles**.**It produces toxic chlorine gas, particularly with acids.**Pressure may build up in bottles during storage, due to slow decomposition.Domestic bleach is usually 5.25% so falls into this category |
| Moderately-dilute sodium chlorate(I)Solution *between 0.67 M and 0.13 M* | irritant | It is irritating to eyes and skin. Wear **eye protection**.**It produces toxic chlorine gas, particularly with acids.** |
| **Dilute sodium chlorate(I)**Solution *less than 0.13 M*  | low hazard | While not causing harm, it can be extremely uncomfortable in eyes or in a cut. |
| **Sodium and potassium chlorate(V)**Solids and solutions over 2M |  | The solids are powerful oxidisers but other than that are fairly low hazard, being harmful if swallowed. |
| **Sodium and potassium chlorate(V)** |  | The solids are extremely powerful oxidisers – avoid use if at all a possible. |

### Control Measures

• If preparing the gas in test-tube reactions, use the smallest possible amounts; where possible, absorb excess gas with a soda lime tube.

• Wear appropriate eye protection. Use a fume cupboard for anything larger than test-tube amounts; ensure good laboratory ventilation.

• If testing for the gas by its smell, follow the safe technique for sniffing gases; Prevent exposure to the gas by asthmatics. Even with chlorine water, take care not to breathe in chlorine.

• Keep chlorates (V & VII) away from combustible materials

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| **Think about the risks** | **Ask yourself** |
| ***What are the details of the activity to be undertaken?*** ***What are the hazards?******What is the chance of something going wrong?*** *NB There are occasional reports of pupils being taken to hospital as a result of breathing in chlorine.****How serious would it be if something did go wrong?******How can the risk(s) be controlled for this activity?*** *Eg, Can it be done safely? Does the procedure need to be altered? Should goggles or safety spectacles be worn?* | Can I do a safer experiment instead?Can I use a safer chemical for this experiment?Can I use a lower concentration?Can I use a smaller volume?Do I need to use a fume cupboard?What sort of eye or skin protection do I need? |
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| Chromium & its compounds*including* Chromium(III) salts, chrome alum, chromates and dichromates  |
| Substance | Hazard | Comment |
| **Chromium** (metal)Solid (not dust) | low hazard | It is used (as chromium plate) to give a shiny, protective surface on steel, eg, on cars and bicycles. |
| Chromium(III) saltsSolid and most solutions*(If 0.25 M or more)* | Health hazard, harmful | These include chromium potassium sulfate(VI) (chrome alum). They are harmful if swallowed and irritating to the eyes and skin. Many are also skin sensitisers. |
| **Chromium(III) salts**Dilute solutions*(If less than 0.25 M)* | low hazard | These include chromium potassium sulfate(VI) (chrome alum). |
| **Potassium**/**sodium chrom­ate(VI) /dichromate(VI)**SolidsAmmonium dichromate(VI)Chromium(VI) oxide | Health hazard, corrosive, toxic, oxidising | These are very toxic, especially by inhalation but inhalation is unlikely in most school uses. They may cause sensitisation and/or ulcers in contact with the skin. They also cause cancer and are mutagens. Wear **goggles and gloves**.Oxidation, eg, of alcohols, may be quite violent. (They are also dangerous for the environment because they are very toxic to aquatic organisms.)Ammonium dichromate, in addition to the above this decomposes if heated and will explode in confined spaces.Avoid using chromium(VI) oxide where possible |
| **All chromates(VI)**/**dichromates(VI)***Solutions* *of 0.003 M or more*. | The hazards above apart from oxidising) apply at various concentrations but they are carcinogenic down to 0.003 M. Wear **goggles and gloves**. |
| All chromates(VI)/ dichromates(VI)  | low hazard | This only applies to any solutions less than 0.003 M. |
| Other metal chromate(VI)Solid | Health hazard | There is evidence of carcinogenic effects and other health hazards. If made, eg as precipitates, they should not be dried out |

### Control measures

• Use the lowest possible concentration; wear eye protection; consider the use of gloves for chromates/dichromates.

• For the volcano experiment, prevent exposure to dust by the use of a fume cupboard or mineral-wool plug in the vessel.

• Avoid inhaling chromate/dichromate dust or spray (eg, during electrolysis).

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| **Think about the risks** | **Ask yourself** |
| ***What are the details of the activity to be undertaken?*** ***What are the hazards?******What is the chance of something going wrong?*** *Eg, Chromate or dichromate dust or solution are accidentally inhaled.****How serious would it be if something did go wrong?***  *Eg, Are there hazardous reactions, eg, violent oxidations or decompositions?****How can the risk(s) be controlled for this activity?*** *Eg, Can it be done safely? Does the procedure need to be altered? Should goggles or safety spectacles be worn?* | Can I do a safer experiment instead?Can I use a safer chemical for this experiment?Can I use a lower concentration?Can I use a smaller volume?Do I need to use a fume cupboard?What sort of eye or skin protection do I need? |
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| **Personal Protective Equipment (PPE)** |
| Only think about this once you have reduced all the other risks as low as possible – PPE is your last line of defence.**Eye protection** – If you are using anything corrosive or toxic or that is a health hazard (carcinogenic, mutagenic etc) then wear chemical resistant goggles, NOT safety specs.For anything of lower hazard, safety spectacles are fine.**Gloves** – if you are using anything corrosive, toxic in contact with skin or that is a skin sensitiser, you should wear gloves. Be careful not to spill anything – you might not be able to handle things as easily as without them.**Lab coa**t – These are a good idea – though their main use is to protect your clothing rather than you.**Respirators and masks** – not a good idea. These are much harder to fit and use properly than you might think. Dust masks for some activities might be acceptable but it is preferable to remove your exposure to dust and fumes by using, for instance, a fume cupboard. |

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| Citric, Oxalic & Tartaric acids2-hydroxypropane-1,2,3-tricarboxylic acid, Ethanedioic acid & 2,3-dihydroxybutanedioic acid  |
| Substance | Hazard | Comment |
| **Citric acid**Solid and concentrated solutions*(If 1.0 M or more)* | irritant | It is irritating to eyes. Wear **eye protection.** |
| **Dilute citric acid***(If less than 1.0 M)* | low hazard | Dilute solutions, though not harmful, will cause discomfort in the eye. (Lemons contain citric acid up to about 0.25 M). |
| Oxalic acid (ethanedioic acid)Solid and most solutions *(If 0.5 M or more)* | harmful | It is harmful in contact with the skin and if swallowed. Soluble salts of oxalic acid (eg, sodium, potassium) are as hazardous as the acid.  |
| Dilute oxalic acid*(If less than 0.5 M)* | low hazard | Dilute solutions, though not harmful, will cause discomfort in the eye. |
| Tartaric acid(2,3-dihydroxy-butanedioic acid)Solid and concentrated solutions *(If 1.4 M or more)* | irritant | It is irritating to eyes. Wear **eye protection** |
| Dilute tartaric acid*(If less than 1.4 M)* | low hazard | Dilute solutions, though not harmful, will cause discomfort in the eye. |

### Control Measures

• Use the lowest concentration possible.

• Wear eye protection for all but dilute solutions.

• Avoid the possibility of swallowing oxalic acid or its salts, eg, by using a safety pipette filler.

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| **Think about the risks** | **Ask yourself** |
| ***What are the details of the activity to be undertaken?*** ***What are the hazards?******What is the chance of something going wrong?*** *Eg, Specks of solid acid transferred into the eye, by rubbing with a contaminated finger.****How serious would it be if something did go wrong?******How can the risk(s) be controlled for this activity?*** *Eg, Can it be done safely? Does the procedure need to be altered? Should goggles or safety spectacles be worn?* | Can I do a safer experiment instead?Can I use a safer chemical for this experiment?Can I use a lower concentration?Can I use a smaller volume?Do I need to use a fume cupboard?What sort of eye or skin protection do I need? |
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|  Copper & its compounds |
| Substance | Hazard | Comment |
| **Copper** (metal) | low hazard | - |
| Copper(II) oxidecupric oxide | low hazard | Dust irritates the lungs and eyes. |
| **Copper(II) sulphate(VI)** or **nitrate(V)**Solid *or* concentrated solutions *(If 0.1 M or more)* | Eye Dam harmful | They are harmful if swallowed (especially saturated solutions for crystal-growing); the solid is corrosive to the eyes and may irritate the skin. Wear **goggles.**Water added to anhydrous solid sulphate(VI) produces heat. |
| **Copper(II) sulphate(VI)** or **nitrate(V)**Dilute solutions*(If less than 0.1 M)* | low hazard | Benedict’s solution and Fehling’s solution both contain dilute copper(II) sulphate(VI) but Fehling’s solution has other hazards as well.  |
| Copper(II) carbonateSolid *(Malachite)* | harmful | It is harmful if swallowed and dust irritates the lungs and eyes. |
| Copper(II) chlorideSolid *or* concentrated solutions *(If 1.4 M or more)* | Eye Dam harmful | It is harmful if swallowed or in contact with the skin; solid and concentrated solutions are corrosive to the eyes and may irritate the skin. Wear **goggles.** |
| Copper(II) chlorideDilute solutions*(If less than 1.4 M)* | low hazard | - |
| (It is also **dangerous for the environment** because it is very toxic to aquatic organisms.) |

### Control Measures

• Use the lowest possible quantities and concentrations.

• Avoid the use of copper(II) chloride if possible (except for electrolysis of the solution).

• Avoid raising dust (eg, by dampening powders).

• Take care if evaporating solutions to dryness.

• Wear eye protection.

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| **Think about the risks** | **Ask yourself** |
| ***What are the details of the activity to be undertaken?*** ***What are the hazards?******What is the chance of something going wrong?*** *Eg, Solutions spurting out of test tubes when heated or solutions heated to dryness and decomposing.****How serious would it be if something did go wrong?*** *Eg, Are there hazardous reaction products (such as chlorine from the electrolysis of copper chloride)?****How can the risk(s) be controlled for this activity?*** *Eg, Can it be done safely? Does the procedure need to be altered? Should goggles or safety spectacles be worn?* | Can I do a safer experiment instead?Can I use a safer chemical for this experiment?Can I use a lower concentration?Can I use a smaller volume?Do I need to use a fume cupboard?What sort of eye or skin protection do I need? |
| **Spills** |  | **What to do if you have an accident** |
| - Make sure you don’t spill much. Decant as small an amount as you can and use that for your experiment – do not try to use a large reagent bottle.-if you do spill any, unless it is either dilute or a very small amount, call your teacher.- Wipe up small amounts with a damp cloth and rinse it well | **• In the eye** **• Vapour breathed in** **• Swallowed****• Spilt on skin or clothing****• Spilt on floor, bench, etc**  | Flood the eye with gently-running tap water for at least 20 minutes (for alkalis). See a doctor. If it is necessary to go to hospital, continue washing the eye during the journey in an ambulance.Remove the casualty to fresh air. Call a doctor if breathing is difficult. Do no more than wash out the mouth with water. Do not induce vomiting. Sips of water may help cool the throat and help keep the airway open. See a doctor. Remove contaminated clothing. Drench the skin with plenty of water. If a large area is affected or blistering occurs, see a doctor. Consider the need to evacuate the laboratory and open windows if large amounts are spilt and especially for (moderately) concentrated solutions. Cover with mineral absorbent (eg, cat litter) and scoop into a bucket. Neutralise with citric acid. Rinse with plenty of water. Wipe up small amounts with a damp cloth and rinse it well. |
| **Personal Protective Equipment (PPE)** |
| Only think about this once you have reduced all the other risks as low as possible – PPE is your last line of defence.**Eye protection** – If you are using anything corrosive or toxic or that is a health hazard (carcinogenic, mutagenic etc) then wear chemical resistant goggles, NOT safety specs.For anything of lower hazard, safety spectacles are fine.**Gloves** – if you are using anything corrosive, toxic in contact with skin or that is a skin sensitiser, you should wear gloves. Be careful not to spill anything – you might not be able to handle things as easily as without them.**Lab coa**t – These are a good idea – though their main use is to protect your clothing rather than you.**Respirators and masks** – not a good idea. These are much harder to fit and use properly than you might think. Dust masks for some activities might be acceptable but it is preferable to remove your exposure to dust and fumes by using, for instance, a fume cupboard. |

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| Ethanoic acid & Methanoic acid |
| Substance | Hazard | Comment |
| Ethanoic acid (acetic acid)Pure liquid, known as ‘glacial’Also methanoic (formic) acid. | corrosive, flammable | It causes severe burns and the vapour irritates the lungs. Wear **goggles and gloves** and if using more than a small amount work in a fume cupboard.Ethanoic acid is flammable but methanoic acid is not |
| **Concentrated ethanoic (acetic) acid**Solution in water*(If 4 M or more)* | corrosive | It causes burns. Wear **goggles** and possibly glovesAlso methanoic (formic) acid. |
| Moderately-concen­trated ethanoic (acetic) acid*(If less than 4 M but 1.7 M or more)* | irritant | It is irritating to the eyes and skin. Wear **eye protection.**Also methanoic (formic) acid. |
| Dilute ethanoic (acetic) acid*(If less than 1.7 M)* | low hazard | Though not damaging, it can still cause extreme discomfort in the eyes or in a cut. This includes vinegar. |

### Control Measures

• Use the lowest concentration possible.

• Use the smallest volume possible.

• Wear eye protection for all but the most-dilute solutions.

• Wear protective gloves if anything more than tiny amounts of concentrated acid are handled.

• Avoid breathing gas or fumes from concentrated solutions, eg, by use of a fume cupboard.

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| **Think about the risks** | **Ask yourself** |
| ***What are the details of the activity to be undertaken?*** ***What are the hazards?******What is the chance of something going wrong?*** *Eg, Choking fumes if concentrated acid is over-heated.****How serious would it be if something did go wrong?***  *Eg, Skin and eyes can be seriously burned if not treated quickly.****How can the risk(s) be controlled for this activity?*** *Eg, Can it be done safely? Does the procedure need to be altered? Should goggles or safety spectacles be worn?* | Can I do a safer experiment instead?Can I use a safer chemical for this experiment?Can I use a lower concentration?Can I use a smaller volume?Do I need to use a fume cupboard?What sort of eye or skin protection do I need? |
| **Spills** |  | **What to do if you have an accident** |
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| Ethanol*and* Denatured alcohol and Methylated spirit |
| Substance | Hazard | Comment |
| EthanolPure | highly flammable | There is a serious risk of liquid catching fire; its vapour may catch fire above 13 °C. The vapour / air mixture can be explosive.Breathing vapour may result in sleepiness. |
| **Industrial denatured alcohol (IDA)** [**Industrial methylated spirit (IMS)**] | highly flammable, harmful | It is more hazardous than pure ethanol because of the presence of 5% (v/v) methanol which is toxic. |
| Completely denatured alcohol (CDA)*Methylated spirits* | It contains methanol, pyridine and a purple dye. CDA smells unpleasant and is not suitable for use indoors in more than small quantities. |
| Surgical spirit*(It contains small amounts of castor oil, methyl salicyl­ate and diethyl phthalate)* | highly flammable | It is suitable for demonstrating the cooling effect of evaporation. It can be applied to the skin on the back of the hand. It must not be swallowed. |
| EthanolDilute solution in water | low hazard | Alcoholic drinks contain ethanol, typically 3 to 50%. Chemical hazards are low but can cause intoxication.Below 50% solutions are not flammable |

### Control Measures

• Use the smallest volume possible; wear eye protection.

• Make sure the room is well ventilated.

• Check that equipment for extinguishing fires is nearby, eg, damp cloth, bench mat, fire blanket.

• **Do *not* use near naked flames; if heating is necessary, use an electrically-heated water bath or hot water from a kettle.**

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| **Think about the risks** | **Ask yourself** |
| ***What are the details of the activity to be undertaken?*** ***What are the hazards?******What is the chance of something going wrong?*** *Eg, Does ethanol need to be heated? Could quantities of the vapour be breathed in? Might there be practical jokes or fooling around? Are any reaction products hazardous?****How serious would it be if something did go wrong?*** *NB Some of the most serious accidents in school science have involved ethanol fires, including clothing fires, and badly-burnt skin needing grafts.****How can the risk(s) be controlled for this activity?*** *Eg, Can it be done safely? Does the procedure need to be altered? Should goggles or safety spectacles be worn?* | Can I do a safer experiment instead?Can I use a safer chemical for this experiment?Can I use a lower concentration?Can I use a smaller volume?Do I need to use a fume cupboard?What sort of eye or skin protection do I need? |
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| **Hydrocarbons** |
| Substance | Hazard | Comment |
| **Methane** (natural gas);**ethane;****propane** (Calor gas, some camping gas(orange cans);**butane** (lighter fuel, camping gas(orange cans) | **extremely flammable** | These gases form explosive mixtures with air and oxygen. Mixtures with air between 5% and 15% methane by volume are explosive. Butane is easily liquefied under pressure (it normally boils at 0 °C) and the vapour is denser than air so be cautious of its spread.. |
| **Pentane**, **hexane**, **heptane**, etc; **cyclohexane**, **petrol** (**gasoline**) (see also benzene, below);**methylbenzene (toluene)**;**dimethylbenzene (xylene)**. | highly flammable,**harmful / Irritant** | Hexane and mixtures containing hexane are harmful to health on prolonged exposure. The others are less hazardous but still harmful, irritating and flammable.  |
| **Benzene,****Petroleum Ethers** | **toxic,****highly Flammable** | Benzene (which is found in petrol) should not be used in schools. PET ethers are all flammable in varying degrees and are carcinogens and mutagens. Use in a fume cupboard or small quantities in a well-ventilated area |
| **Paraffin** (**kerosine**);**diesel fuel**;**engine oil** | **Flammable harmful** | Some oils may contain substances which cause cancer. Used engine oil contains more hazardous substance and should not be used. |
| **Naphthalene** | **harmful** | Harmful if breathed in, swallowed or in contact with skin. Used in moth balls. If heated, the concentration of vapour in the air increases considerably. |
| **Waxes** including paraffin wax**;** **medicinal paraffin (‘liquid paraffin’), oil for oil baths** | **low hazard** | For example, candle wax. |

### Control Measures

• Use smallest amount possible; wear eye protection; avoid skin contact; make sure room is well ventilated.

• Use fume cupboard or prevent escape of vapour, eg with mineral wool plug in test tube.

• Check gas supplies for leaks; store bottled gas in a cool place; use “spirit burners” with care.

• Check equipment to put out fires, eg damp cloth, bench mat, fire blanket.

• **Do not use the highly flammable liquids near naked flames;** if heating is necessary, use an electrically-heated water bath or hot water from a kettle.

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| **Think about the risks** | **Ask yourself** |
| ***What are the details of the activity to be undertaken?*** ***What are the hazards?******What is the chance of something going wrong?*** *Eg, Does hydrocarbon need to be heated? Could quantities of the vapour be breathed in?* ***How serious would it be if something did go wrong?******How can the risk(s) be controlled for this activity?*** *Eg, Can it be done safely? Does the procedure need to be altered? Should goggles or safety spectacles be worn?* | Can I do a safer experiment instead?Can I use a safer chemical for this experiment?Can I use a lower concentration?Can I use a smaller volume?Do I need to use a fume cupboard?What sort of eye or skin protection do I need? |
| **Spills** |  | **What to do if you have an accident** |
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| **Personal Protective Equipment (PPE)** |
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| Hydrochloric acid*also applies to* Hydrogen chloride gas |
| Substance | Hazard | Comment |
| Hydrogen chlorideGas | corrosive | If breathed in. It causes severe burns and irritates the lungs. All but very small amounts should be handled in a fume cupboard |
| Concentrated hydrochloric acid*(If 6.5 M or more)* | corrosive | It causes burns to skin and eyes. The vapour irritates the lungs. Wear **goggles and gloves.** |
| Moderately-concen­trated hydrochloric acid*(If less than 6.5 M but 2 M or more)* | irritant | It may irritate the eyes and skin. Wear **eye protection.** |
| Dilute hydrochloric acid*(If less than 2 M)* | low hazard | Even though it is of low hazard, it may still cause great discomfort in the eyes or in a cut. |

### Control Measures

• Use the lowest concentration possible.

• Use the smallest volume possible.

• Wear eye protection for all but the most-dilute solutions.

• Wear protective gloves if anything more than tiny amounts of concentrated acid are handled.

• **Avoid breathing the gas or fumes from concentrated solutions, eg, by use of a fume cupboard.**

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| **Think about the risks** | **Ask yourself** |
| ***What are the details of the activity to be undertaken?*** ***What are the hazards?******What is the chance of something going wrong?*** *Eg, Hazardous products (such as chlorine) produced as a result of a reaction with the acid or choking fumes produced if concentrated acid is over-heated.****How serious would it be if something did go wrong?*** *NB There are occasional reports of pupils being taken to hospital as a result of breathing in chlorine.****How can the risk(s) be controlled for this activity?*** *Eg, Can it be done safely? Does the procedure need to be altered? Should goggles or safety spectacles be worn?* | Can I do a safer experiment instead?Can I use a safer chemical for this experiment?Can I use a lower concentration?Can I use a smaller volume?Do I need to use a fume cupboard?What sort of eye or skin protection do I need? |
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| Hydrogen peroxide |
| *Concentrations**Hydrogen peroxide concentration is usually referred to as ‘volume’, rather than percentage (and molarity is used very rarely)**The most concentrated solution likely to be found in schools is 100 vol, which is 30%.**Anything more concentrated than this is likely to be a powerful oxidiser as well as being corrosive and should be handled with extreme caution.* |
| Substance | Hazard | Comment |
| Concentrated hydrogen peroxide solution*over ‘28 vol strength’ (8%)* | harmful | It is harmful if swallowed. There is a risk of serious damage to the eyes. Wear **goggles**. It decomposes slowly to produce oxygen gas; pressure may build up and care needs to be taken when opening a bottle. It should be stored in the dark. Decomposition is speeded up by catalysts such as some metal oxides and some enzymes. The oxygen formed will assist fires. |
| Dilute hydrogen peroxide solution*Below 28 vol / 8% but above 18 volume / 5%* | irritant | It irritates the eyes and skin. Wear **eye protection**The typical concentration used in school science practical work.It decomposes slowly to produce oxygen gas pressure may build up and care needs to be taken when opening a bottle.  |
| Very dilute hydrogen peroxide solution*Below 18 vol / (5%)]* | low hazard  | It decomposes slowly to produce oxygen gas; Old stock may have insufficient peroxide molecules for the intended activity so it is best if low concentrations are made up not too long before the activity. |

### Control Measures

• Use the lowest concentration and smallest volume possible.

• Wear eye protection for all but the most-dilute solutions.

• Store concentrated solutions away from heat and light, in bottles with special vented caps. Beware of a rapid release of pressure when opening a bottle.

• Avoid accidental contamination of solutions which may speed up the formation of oxygen and pressure build-up.

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| **Think about the risks** | **Ask yourself** |
| ***What are the details of the activity to be undertaken?*** ***What are the hazards?******What is the chance of something going wrong?*** Eg, Could an impurity / catalyst cause rapid decomposition and frothing?***How serious would it be if something did go wrong?***  *Eg, If the solution splashes onto the skin, is it sufficiently concentrated to cause burns?****How can the risk(s) be controlled for this activity?*** *Eg, Can it be done safely? Does the procedure need to be altered? Should goggles or safety spectacles be worn?* | Can I do a safer experiment instead?Can I use a safer chemical for this experiment?Can I use a lower concentration?Can I use a smaller volume?Do I need to use a fume cupboard?What sort of eye or skin protection do I need? |
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| Iodine |
| Substance | Hazard | Comment |
| IodineSolid | harmful | It is harmful if breathed in or by contact with the skin. It causes burns to the skin if left for some time.It is easily vapourised if heated - the violet vapour is dangerous to the eyes. Wear **eye protection** but more importantly avoid exposure to iodine vapour. (It is also dangerous for the environment because it is very toxic to aquatic organisms.) |
| Iodine solution,in potassium iodide / water or in organic solvent*(If 2 M or more)* | harmful | There may be hazards associated with the organic solvent; Ethanol is often used; it is highly flammable. |
| Dilute iodine solution,in potassium iodide / water or in organic solvent*(If less than 2 M)* | low hazard | There may be hazards associated with the organic solvent; Ethanol is often used; it is highly flammable.‘Tincture of iodine’, used as a mild antiseptic, is a dilute solution in ethanol (about 0.1 M). |

### Control Measures

• Use the lowest concentration and smallest amount possible.

• Wear eye protection for all but dilute solutions.

• Handle iodine solid using forceps or, better, wear protective gloves as well.

• **Avoid breathing iodine vapour, eg, by the use of a fume cupboard if using more than small amounts.**

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| **Think about the risks** | **Ask yourself** |
| ***What are the details of the activity to be undertaken?*** ***What are the hazards?******What is the chance of something going wrong?*** ***How serious would it be if something did go wrong?***  *NB Iodine vapour can crystallise painfully on the eye.****How can the risk(s) be controlled for this activity?*** *Eg, Can it be done safely? Does the procedure need to be altered? Should goggles or safety spectacles be worn?* | Can I do a safer experiment instead?Can I use a safer chemical for this experiment?Can I use a lower concentration?Can I use a smaller volume?Do I need to use a fume cupboard?What sort of eye or skin protection do I need? |
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| Iron & its compounds*Note: iron(II) compounds are often called ferrous and iron(III) compounds ferric* |
| Substance | Hazard | Comment |
| Iron metal *(filings, sheets or bars of metal)* | low hazard | Iron filings or powder in the eye are very painful because the iron oxidises rapidly in the saline environment. Samples of iron are often not very pure and on reacting with dilute acids may produce toxic hydrogen sulphide gas (smelling of bad eggs). |
| Iron metal*(powder)* | highly flammable |
| Iron oxides *or*iron(II) carbonate | low hazard | Applies to all iron oxides: iron(II) oxide, iron(III) oxide (haematite), iron(II) iron(III) oxide (magnetite). Iron(II) carbonate is usually sold mixed with a sugar (saccharated), to slow down oxidation. |
| Iron(II) or (III) sulphate *or* ammonium iron(II) or III sulphate*Solid or concentrated solutions**(0.25 M or more)* | harmful, irritant | Harmful if swallowed and eye irritants – wear **eye protection.** Often solutions are made up in dilute sulphuric acid (which may itself be hazardous) to slow down oxidation. Ammonium iron(II) solutions are more stable but are often still made up in acid to limit oxidation. |
| Iron(II) or (III) sulphate *or* ammonium iron(II) or III sulphate*Dilute solutions**(less than 0.25 M)* | low hazard | Solutions which have been made up in sulphuric acid may be hazardous if the acid is more than 0.5 M. |
| Iron(II) *or* iron(III) chloride *Hydrated or anhydrous solid or concentrated solutions (If 0.2 M or more).* | corrosive, harmful | Both are corrosive to skin and eyes as solids or solutions of over 5 %. 0.25M for Fe(II) and 0.18M for Fe(III) – wear **eye protection.** Solutions are sometimes made up in hydrochloric acid to slow down oxidation. |
| Iron(II) *or* iron(III) chloride *Dilute solutions less than 0.2M)* | low hazard | - |
| Iron(III) nitrate | oxidiser, irritant | The solid is an oxidising agent. Keep away from flammables.An eye irritant above 0.25 M – wear **eye protection**. Often made up in acid solutions which may add to the hazard. |

### Control Measures

• Use the lowest possible quantities and concentrations.

• Take care not to rub the eye with fingers contaminated with iron filings or powder.

• Wear eye protection for corrosive and irritant solutions.

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| **Think about the risks** | **Ask yourself** |
| ***What are the details of the activity to be undertaken?*** ***What are the hazards?******What is the chance of something going wrong?*** *Eg, Solutions spurting out of test tubes when heated or solutions heated to dryness and decomposing.****How serious would it be if something did go wrong?*** *Eg, Are there hazardous reaction products (such as chlorine from the electrolysis of copper chloride)?****How can the risk(s) be controlled for this activity?*** *Eg, Can it be done safely? Does the procedure need to be altered? Should goggles or safety spectacles be worn?* | Can I do a safer experiment instead?Can I use a safer chemical for this experiment?Can I use a lower concentration?Can I use a smaller volume?Do I need to use a fume cupboard?What sort of eye or skin protection do I need? |
| **Spills** |  | **What to do if you have an accident** |
| - Make sure you don’t spill much. Decant as small an amount as you can and use that for your experiment – do not try to use a large reagent bottle.-if you do spill any, unless it is either dilute or a very small amount, call your teacher.- Wipe up small amounts with a damp cloth and rinse it well | **• In the eye** **• Vapour breathed in** **• Swallowed****• Spilt on skin or clothing****• Spilt on floor, bench, etc**  | Flood the eye with gently-running tap water for at least 20 minutes (for alkalis). See a doctor. If it is necessary to go to hospital, continue washing the eye during the journey in an ambulance.Remove the casualty to fresh air. Call a doctor if breathing is difficult. Do no more than wash out the mouth with water. Do not induce vomiting. Sips of water may help cool the throat and help keep the airway open. See a doctor. Remove contaminated clothing. Drench the skin with plenty of water. If a large area is affected or blistering occurs, see a doctor. Consider the need to evacuate the laboratory and open windows if large amounts are spilt and especially for (moderately) concentrated solutions. Cover with mineral absorbent (eg, cat litter) and scoop into a bucket. Neutralise with citric acid. Rinse with plenty of water. Wipe up small amounts with a damp cloth and rinse it well. |
| **Personal Protective Equipment (PPE)** |
| Only think about this once you have reduced all the other risks as low as possible – PPE is your last line of defence.**Eye protection** – If you are using anything corrosive or toxic or that is a health hazard (carcinogenic, mutagenic etc) then wear chemical resistant goggles, NOT safety specs.For anything of lower hazard, safety spectacles are fine.**Gloves** – if you are using anything corrosive, toxic in contact with skin or that is a skin sensitiser, you should wear gloves. Be careful not to spill anything – you might not be able to handle things as easily as without them.**Lab coa**t – These are a good idea – though their main use is to protect your clothing rather than you.**Respirators and masks** – not a good idea. These are much harder to fit and use properly than you might think. Dust masks for some activities might be acceptable but it is preferable to remove your exposure to dust and fumes by using, for instance, a fume cupboard. |

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| Lead & its compounds*including* Lead oxides, bromide, nitrate(V), ethanoate (acetate) etc |
| Substance | Hazard | Comment |
| Lead (metal) | low hazard | Wash hands after handling lead metal. |
| Lead compoundsSolids | Health Hazard | These are harmful if swallowed or dust is breathed in. They may accumulate over time. They are all reproductive toxins causing harm to unborn children.Lead chromate(VI) (used in the yellow lines on roads) may cause cancer.  (They are also dangerous for the environment because they are very toxic to aquatic organisms.) |
| Lead compoundsSolutions of lead salts in water(*If 0.05 M or more*) | Health Hazard | They may accumulate over time. They are all reproductive toxins causing harm to unborn children.(They are also dangerous for the environment because they are very toxic to aquatic organisms.) |
| Lead compoundsExtremely-dilute solutions of lead salts in water(*If less than 0.01 M*) | low hazard | They may accumulate over time. In soft-water areas, lead pipes may very slowly dissolve.(They are also dangerous for the environment because they are very toxic to aquatic organisms.) |

### Control measures

• Wear eye protection; use the lowest possible amounts and concentrations.

• Preferably, heat lead compounds in a fume cupboard; avoid raising dust (eg, by dampening powders).

• Less-volatile compounds (eg, oxides) may be heated in small amounts in a well-ventilated room (but not if those who are, or who might be, pregnant are present).

• Use lead nitrate rather than lead ethanoate (acetate) when a soluble lead salt is needed.

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| **Think about the risks** | **Ask yourself** |
| ***What are the details of the activity to be undertaken?*** ***What are the hazards?******What is the chance of something going wrong?*** *Eg, Solution spurts out of a test tube when heated or dust is breathed in.****How serious would it be if something did go wrong?*** *Eg, Could anybody be exposed to dangerous lead levels for long periods of time?****How can the risk(s) be controlled for this activity?*** *Eg, Can it be done safely? Does the procedure need to be altered? Should goggles or safety spectacles be worn?* | Can I do a safer experiment instead?Can I use a safer chemical for this experiment?Can I use a lower concentration?Can I use a smaller volume?Do I need to use a fume cupboard?What sort of eye or skin protection do I need? |
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| Manganese & its compounds*including* **Manganese(IV) oxide (dioxide)** *&* **Potassium manganate(VII) (permanganate)**  |
| Substance | Hazard | Comment |
| **Manganese** (metal)*Solid (not dust)* | low hazard | It is harmful by inhalation, hence exposure to dust or fume would present a risk but not bulk metal. |
| Manganese(II) salts*Solid and concentrated solutions**(If about 0.6 M or more)* | Health hazard, irritant | These include manganese(II) chloride and sulphate(VI).These are generally quite low hazard (slight irritants) but long-term exposure is a health hazard to the nervous system.Manganese(II) carbonate is considered low hazard. |
| Manganese(II) saltsDilute solutions*(If less than about 0.6 M)* | low hazard | These include manganese(II) chloride and sulphate(VI). |
| Manganese(IV) oxide (Manganese dioxide)Solid | harmful | It is harmful by inhalation or if swallowed. It is often used as a fine powder. Many hazardous reactions can occur with reducing agents or concentrated acids.  |
| Potassium manganate(VII) (permanganate)Solid | oxidising, harmful | It is harmful if swallowed and stains the hands and clothing. Many hazardous reactions occur with reducing agents or concentrated acids. On heating, it liberates oxygen gas and releases a fine dust of potassium manganate(VI). |
| **All manganates(VII)** **(permanganates)**Solutions | low hazard | They stain hands and clothing. |

### Control Measures

• Wear eye protection if required.

• Avoid inhaling dusts.

• Avoid skin contact, especially with manganates(VII).

• Avoid contact between manganates(VII) or manganese(IV) oxide and concentrated acids or reducing agents.

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| **Think about the risks** | **Ask yourself** |
| ***What are the details of the activity to be undertaken?*** ***What are the hazards?******What is the chance of something going wrong?*** *Eg, Dust is accidentally inhaled.****How serious would it be if something did go wrong?***  *Eg, Are there hazardous reactions, eg, violent oxidations or decompositions?****How can the risk(s) be controlled for this activity?*** *Eg, Can it be done safely? Does the procedure need to be altered? Should goggles or safety spectacles be worn?* | Can I do a safer experiment instead?Can I use a safer chemical for this experiment?Can I use a lower concentration?Can I use a smaller volume?Do I need to use a fume cupboard?What sort of eye or skin protection do I need? |
| **Spills** |  | **What to do if you have an accident** |
| - Make sure you don’t spill much. Decant as small an amount as you can and use that for your experiment – do not try to use a large reagent bottle.-if you do spill any, unless it is either dilute or a very small amount, call your teacher.- Wipe up small amounts with a damp cloth and rinse it well | **• In the eye** **• Vapour breathed in** **• Swallowed****• Spilt on skin or clothing****• Spilt on floor, bench, etc**  | Flood the eye with gently-running tap water for at least 20 minutes (for alkalis). See a doctor. If it is necessary to go to hospital, continue washing the eye during the journey in an ambulance.Remove the casualty to fresh air. Call a doctor if breathing is difficult. Do no more than wash out the mouth with water. Do not induce vomiting. Sips of water may help cool the throat and help keep the airway open. See a doctor. Remove contaminated clothing. Drench the skin with plenty of water. If a large area is affected or blistering occurs, see a doctor. Consider the need to evacuate the laboratory and open windows if large amounts are spilt and especially for (moderately) concentrated solutions. Cover with mineral absorbent (eg, cat litter) and scoop into a bucket. Neutralise with citric acid. Rinse with plenty of water. Wipe up small amounts with a damp cloth and rinse it well. |
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| Methanol |
| Substance | Hazard | Comment |
| **Methanol**  | highly flammable, Toxic | Risk of the liquid catching fire. Keep away from sources of ignition.Toxic if swallowed, in contact with skin or if inhaled. There is a risk of very serious irreversible effects (especially to the optic nerve). Wear **goggles.**Methanol is often added deliberately to ethanol (‘methylated spirit’) to make it undrinkable.  |

### Control Measures

• Wear eye protection.

• Make sure the room is well ventilated or, in a laboratory, use a fume cupboard if possible.

• Check ways of putting out any fires.

**• Do *not* use near naked flames; if heating is necessary, use an electrically-heated water bath or hot water from a kettle.**

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| **Think about the risks** | **Ask yourself** |
| ***What are the details of the activity to be undertaken?*** ***What are the hazards?******What is the chance of something going wrong?*** *Eg, Does methanol need to be heated? Could there be high levels of vapour?****How serious would it be if something did go wrong?******How can the risk(s) be controlled for this activity?*** *Eg, Can it be done safely? Does the procedure need to be altered? Should goggles or safety spectacles be worn?* | Can I do a safer experiment instead?Can I use a safer chemical for this experiment?Can I use a lower concentration?Can I use a smaller volume?Do I need to use a fume cupboard?What sort of eye or skin protection do I need? |
| **Spills** |  | **What to do if you have an accident** |
| - Make sure you don’t spill much. Decant as small an amount as you can and use that for your experiment – do not try to use a large reagent bottle.-if you do spill any, unless it is either dilute or a very small amount, call your teacher.- Wipe up small amounts with a damp cloth and rinse it well | **• In the eye** **• Vapour breathed in** **• Swallowed****• Spilt on skin or clothing****• Spilt on floor, bench, etc**  | Flood the eye with gently-running tap water for at least 20 minutes (for alkalis). See a doctor. If it is necessary to go to hospital, continue washing the eye during the journey in an ambulance.Remove the casualty to fresh air. Call a doctor if breathing is difficult. Do no more than wash out the mouth with water. Do not induce vomiting. Sips of water may help cool the throat and help keep the airway open. See a doctor. Remove contaminated clothing. Drench the skin with plenty of water. If a large area is affected or blistering occurs, see a doctor. Consider the need to evacuate the laboratory and open windows if large amounts are spilt and especially for (moderately) concentrated solutions. Cover with mineral absorbent (eg, cat litter) and scoop into a bucket. Neutralise with citric acid. Rinse with plenty of water. Wipe up small amounts with a damp cloth and rinse it well. |
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| Nitric(V) acid |
| Substance | Hazard | Comment |
| Concentrated nitric(V) acid | corrosive, oxidising | It causes severe burns; skin is stained yellow and then peels. Nitric acid fumes can be extremely damaging to the lungs and the effect can be delayed by 36 hours or more. Wear **goggles** or a face shield **and gloves**.If over 11 M, the acid may cause fire in contact with combustible materials. |
| Moderately-conc­entrated nitric(V) acid*(If 0.5 M or more)* | corrosive | It causes severe burns. Wear **goggles** |
| Moderately-dilute nitric(V) acid*(If less than 0.5 M but 0.1 M or more)* | irritant | It is irritating to the eyes and skin. Wear **eye protection.** |
| Dilute nitric(V) acid*(If less than 0.1 M)* | low hazard | Though not damaging, it can still cause extreme discomfort in the eyes or in a cut. |

### Control Measures

• Use the lowest concentration possible.

• Use the smallest volume possible.

• Wear eye protection, including when making or disposing of solutions.

• Wear protective gloves if concentrated acid is handled on anything larger than a test-tube scale.

• Ensure good ventilation if oxides of nitrogen could be formed.

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| **Think about the risks** | **Ask yourself** |
| ***What are the details of the activity to be undertaken?*** ***What are the hazards?******What is the chance of something going wrong?*** *Eg, Hazardous products are formed in reactions with the acid (such as oxides of nitrogen) or corrosive fumes are produced if concentrated acid is over-heated.****How serious would it be if something did go wrong?***  *Eg, Peeling skin, from burns caused by concentrated acid, may be very painful.****How can the risk(s) be controlled for this activity?*** *Eg, Can it be done safely? Does the procedure need to be altered? Should goggles or safety spectacles be worn?* | Can I do a safer experiment instead?Can I use a safer chemical for this experiment?Can I use a lower concentration?Can I use a smaller volume?Do I need to use a fume cupboard?What sort of eye or skin protection do I need? |
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| Phosphoric(V) acid*(*Orthophosphoric acid) |
| Substance | Hazard | Comment |
| Concentrated phosphoric(V) acid | corrosive | It causes burns. Wear **goggles and gloves**It reacts violently, becoming very hot, when mixed with water.It decomposes if heated strongly, forming toxic oxides of phosphorus. |
| Moderately-concen­trated phosphoric(V) acid*(If 2.5 M or more)* | corrosive | It causes burns. Wear **goggles** and possibly **gloves**This includes phosphoric acid used in most descaling and rust treatments. |
| Moderately dilute phosphoric(V) acid*(If less than 2.5 M but0.5 M or more)* | irritant | It is irritating to the eyes and skin. Wear **eye protection** |
| Dilute phosphoric(V) acid*(If less than 0.5 M)* | low hazard | Though not damaging, it can still cause extreme discomfort in the eyes or in a cut. |

### Control Measures

**•** Use the lowest concentration possible.

• Use the smallest volume possible.

• Wear eye protection, including when making or disposing of solutions.

• Wear protective gloves if concentrated acid is handled on anything larger than a test-tube scale.

• **Add the concentrated acid slowly to cold water when diluting, never the reverse; stir frequently to ensure good mixing.**

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| **Think about the risks** | **Ask yourself** |
| ***What are the details of the activity to be undertaken?*** ***What are the hazards?******What is the chance of something going wrong?*** *Eg, Hazardous products are formed in reactions with the acid or corrosive fumes are produced if concentrated acid is over-heated.****How serious would it be if something did go wrong?***  *Eg, Skin and eyes can be seriously burned if not treated quickly.****How can the risk(s) be controlled for this activity?*** *Eg, Can it be done safely? Does the procedure need to be altered? Should goggles or safety spectacles be worn?* | Can I do a safer experiment instead?Can I use a safer chemical for this experiment?Can I use a lower concentration?Can I use a smaller volume?Do I need to use a fume cupboard?What sort of eye or skin protection do I need? |
| **Spills** |  | **What to do if you have an accident** |
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| Propanone / acetone |
| Substance | Hazard | Comment |
| Propanone (acetone)LiquidSometimes used as nail polish (varnish) remover [but ethyl ethanoate (ethyl acetate) is more usual]. | highly flammable, Irritant | There is a serious risk of the liquid catching fire.Its vapour may catch fire above -20°C.It can cause severe eye damage and will degrease the skin. Wear **eye protection.**The smell can be detected by most people at well below the level which could cause harm. |

### Control Measures

• Wear eye protection.

• Make sure the room is well ventilated or, in a laboratory, use a fume cupboard if possible.

• Check ways of putting out any fires.

**• Do *not* use near naked flames; if heating is necessary, use an electrically-heated water bath or hot water from a kettle.**

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| **Think about the risks** | **Ask yourself** |
| ***What are the details of the activity to be undertaken?*** ***What are the hazards?******What is the chance of something going wrong?*** *Eg, Does propanone need to be heated? Could there be high levels of vapour, perhaps as a result of chromatograms drying?****How serious would it be if something did go wrong?******How can the risk(s) be controlled for this activity?*** *Eg, Can it be done safely? Does the procedure need to be altered? Should goggles or safety spectacles be worn?* | Can I do a safer experiment instead?Can I use a safer chemical for this experiment?Can I use a lower concentration?Can I use a smaller volume?Do I need to use a fume cupboard?What sort of eye or skin protection do I need? |
| **Spills** |  | **What to do if you have an accident** |
| - Make sure you don’t spill much. Decant as small an amount as you can and use that for your experiment – do not try to use a large reagent bottle.-if you do spill any, unless it is either dilute or a very small amount, call your teacher.- Wipe up small amounts with a damp cloth and rinse it well | **• In the eye** **• Vapour breathed in** **• Swallowed****• Spilt on skin or clothing****• Spilt on floor, bench, etc**  | Flood the eye with gently-running tap water for at least 20 minutes (for alkalis). See a doctor. If it is necessary to go to hospital, continue washing the eye during the journey in an ambulance.Remove the casualty to fresh air. Call a doctor if breathing is difficult. Do no more than wash out the mouth with water. Do not induce vomiting. Sips of water may help cool the throat and help keep the airway open. See a doctor. Remove contaminated clothing. Drench the skin with plenty of water. If a large area is affected or blistering occurs, see a doctor. Consider the need to evacuate the laboratory and open windows if large amounts are spilt and especially for (moderately) concentrated solutions. Cover with mineral absorbent (eg, cat litter) and scoop into a bucket. Neutralise with citric acid. Rinse with plenty of water. Wipe up small amounts with a damp cloth and rinse it well. |
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| Sodium hydroxide (& Potassium hydroxide)*also* Soda lime *which contains sodium hydroxide* |
| Substance | Hazard | Comment |
| Sodium hydroxide SolidAlso potassium hydroxide (solid) | corrosive | (Caustic soda and potash) Also soda lime.It causes severe burns; it is particularly dangerous to the eyes. Wear **goggles**.It gives out heat when added to water. |
| Sodium or potass­ium hydroxide solution*(If 0.5 M or more)* | corrosive | It causes severe burns; it is particularly dangerous to the eyes. Wear **goggles**.Fehling’s solution contains sodium hydroxide of this concentration. |
| Dilute sodium or potassium hydrox­ide solution*(If less than 0.5 M but 0.05 M or more)* | irritant | It is irritating to the eyes and skin. Wear **eye protection** |
| Very dilute sodium or potassium hydroxide solution*(If less than 0.05 M)* | low hazard | It will not cause harm but may be extremely uncomfortable in the eyes or in a cut. |

### Control Measures

• Use the lowest concentration possible; avoid the solid if possible.

• Use the smallest amount possible.

• **Wear eye protection**, including when making or disposing of solutions. Goggles (or a face shield) rather than safety spectacles will be necessary if the chemical is classed as corrosive at the concentration used.

• Wear protective gloves if the concentrated solution is handled in more than tiny amounts.

• If possible, use a safer alternative, eg, sodium carbonate when making salts or Benedict’s solution rather than Fehling’s solution for food tests.

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| **Think about the risks** | **Ask yourself** |
| ***What are the details of the activity to be undertaken?*** ***What are the hazards?******What is the chance of something going wrong?*** *Eg, The solution spurting out of a test tube when being heated.****How serious would it be if something did go wrong?*** *NB Alkali in the eye causes more damage than acid of equivalent concentration.****How can the risk(s) be controlled for this activity?*** *Eg, Can it be done safely? Does the procedure need to be altered? Should goggles or safety spectacles be worn?* | Can I do a safer experiment instead?Can I use a safer chemical for this experiment?Can I use a lower concentration?Can I use a smaller volume?Do I need to use a fume cupboard?What sort of eye or skin protection do I need? |
| **Spills** |  | **What to do if you have an accident** |
| - Make sure you don’t spill much. Decant as small an amount as you can and use that for your experiment – do not try to use a large reagent bottle.-if you do spill any, unless it is either dilute or a very small amount, call your teacher.- Wipe up small amounts with a damp cloth and rinse it well | **• In the eye** **• Vapour breathed in** **• Swallowed****• Spilt on skin or clothing****• Spilt on floor, bench, etc**  | Flood the eye with gently-running tap water for at least 20 minutes (for alkalis). See a doctor. If it is necessary to go to hospital, continue washing the eye during the journey in an ambulance.Remove the casualty to fresh air. Call a doctor if breathing is difficult. Do no more than wash out the mouth with water. Do not induce vomiting. Sips of water may help cool the throat and help keep the airway open. See a doctor. Remove contaminated clothing. Drench the skin with plenty of water. If a large area is affected or blistering occurs, see a doctor. Consider the need to evacuate the laboratory and open windows if large amounts are spilt and especially for (moderately) concentrated solutions. Cover with mineral absorbent (eg, cat litter) and scoop into a bucket. Neutralise with citric acid. Rinse with plenty of water. Wipe up small amounts with a damp cloth and rinse it well. |
| **Personal Protective Equipment (PPE)** |
| Only think about this once you have reduced all the other risks as low as possible – PPE is your last line of defence.**Eye protection** – If you are using anything corrosive or toxic or that is a health hazard (carcinogenic, mutagenic etc) then wear chemical resistant goggles, NOT safety specs.For anything of lower hazard, safety spectacles are fine.**Gloves** – if you are using anything corrosive, toxic in contact with skin or that is a skin sensitiser, you should wear gloves. Be careful not to spill anything – you might not be able to handle things as easily as without them.**Lab coa**t – These are a good idea – though their main use is to protect your clothing rather than you.**Respirators and masks** – not a good idea. These are much harder to fit and use properly than you might think. Dust masks for some activities might be acceptable but it is preferable to remove your exposure to dust and fumes by using, for instance, a fume cupboard. |

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| Sulphuric(VI) acid |
| Substance | Hazard | Comment |
| Concentrated sulphuric(VI) acid | corrosive | It causes severe burns. Wear **goggles** or a face shield **and gloves.**It reacts violently, becoming very hot, when mixed with water.Avoid inhaling aerosols. |
| Moderately-conc­entrated sulphuric(VI) acid*(If 1.5 M or more)* | corrosive | It causes severe burns. Wear **goggles.**Avoid inhaling aerosols produced eg by electrolysis. |
| Moderately-dilute sulphuric(VI) acid*(If less than 1.5 M but ).5 M or more)* | irritant | It is irritating to the eyes and skin. **Eye protection** is advised.Avoid inhaling aerosols produced eg by electrolysis. |
| Dilute sulphuric(VI) acid*(If less than 05 M)* | low hazard | Though not damaging, it can still cause extreme discomfort in the eyes or in a cut. |

### Control Measures

• Use the lowest concentration possible.

• Use the smallest volume possible.

• Wear eye protection, including when making or disposing of solutions.

• Wear protective gloves if concentrated acid is handled on anything larger than a test-tube scale.

• **When diluting, add the concentrated acid slowly to cold water (or preferably ice) when diluting, never the reverse; stir frequently to ensure good mixing.**

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| **Think about the risks** | **Ask yourself** |
| ***What are the details of the activity to be undertaken?*** ***What are the hazards?******What is the chance of something going wrong?*** *Eg, Hazardous products are formed in reactions with the acid or corrosive fumes are produced if concentrated acid is over-heated.****How serious would it be if something did go wrong?***  *Eg, Skin and eyes can be seriously burned if not treated quickly.****How can the risk(s) be controlled for this activity?*** *Eg, Can it be done safely? Does the procedure need to be altered? Should goggles or safety spectacles be worn?* | Can I do a safer experiment instead?Can I use a safer chemical for this experiment?Can I use a lower concentration?Can I use a smaller volume?Do I need to use a fume cupboard?What sort of eye or skin protection do I need? |
| **Spills** |  | **What to do if you have an accident** |
| - Make sure you don’t spill much. Decant as small an amount as you can and use that for your experiment – do not try to use a large reagent bottle.-if you do spill any, unless it is either dilute or a very small amount, call your teacher.- Wipe up small amounts with a damp cloth and rinse it well | **• In the eye** **• Vapour breathed in** **• Swallowed****• Spilt on skin or clothing****• Spilt on floor, bench, etc**  | Flood the eye with gently-running tap water for at least 20 minutes (for alkalis). See a doctor. If it is necessary to go to hospital, continue washing the eye during the journey in an ambulance.Remove the casualty to fresh air. Call a doctor if breathing is difficult. Do no more than wash out the mouth with water. Do not induce vomiting. Sips of water may help cool the throat and help keep the airway open. See a doctor. Remove contaminated clothing. Drench the skin with plenty of water. If a large area is affected or blistering occurs, see a doctor. Consider the need to evacuate the laboratory and open windows if large amounts are spilt and especially for (moderately) concentrated solutions. Cover with mineral absorbent (eg, cat litter) and scoop into a bucket. Neutralise with citric acid. Rinse with plenty of water. Wipe up small amounts with a damp cloth and rinse it well. |
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