

## Micro-Module Courseware Development Grant

### (a) Personal protective equipment

For in-class discussion:

What to discuss (initiated by teacher)	Key points
When you are working in a chemical laboratory, explain the purposes of wearing different types of personal protective equipment	Glasses or goggles for eye protection Gloves for handling chemicals and protection against physical hazards such as heat Lab coat for protection of body and the clothing Long pants and shoes with completely coverage for foot protection
Discuss why contact lenses are not allowed in the chemical laboratory	Contact lenses will absorb and concentrate volatile irritants which will cause dangers to your eyes. Even though you wear spectacles, goggles or face shield, you cannot stop contact lenses from absorbing and concentrating volatile irritants.
The use of different types of gloves	Different of latex gloves with nitrile gloves in terms of human allergies, handling of chemical and resistance against puncture Cotton gloves for handling mild heat and cold, and cryo-gloves for handling extreme cold substances such as liquid nitrogen.
Items that are not allowed to wear when working in chemical laboratory	Short pants Skirt Scandals Open-toed shoes

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### (b) Corrosive chemical

For in-class discussion:

What to discuss (initiated by teacher)	Key points
How are bases stored in the laboratory?	Bases should be stored carefully in well-designed cabinets. The inside of the cabinet should be made from Teflon which can resist corrosion from bases. There are trays to retain any spillage. The cabinet is connected to the fume hood through a pipe and the alkaline vapor can be evacuated.
How should one react to corrosive spillage on the skin and eyes?	In case of accident, stay calm and ask for assistance. Wash the affected area with flushing water for a minute. If the chemicals get into eyes, immediately go to the eye wash and rinse the eyes for one or two minutes. Consult medical advice if situation does not improve.
What is the disposal method if a chemical is sensitive to water?	Firstly, consult the material safety data sheet about the disposal method on that particular chemical. Generally, if a chemical is sensitive to water, it must not be poured to water directly. Instead, the chemical can be transferred to a beaker and put it in the fume hood. The moisture in air will slowly react and decompose the chemical.
In the disposal of acid waste, why should the acid added to the water instead of the other way round?	Dilution of acid is an exothermic reaction. When acid is poured to the water, the heat is dissipated homogenously and effectively. On the other hand, if water is added to the acid, local heating occurs at the layer between acid and water, possibly leading to acid spillage.

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### (c) Flammable chemical

For in-class discussion:

What to discuss (initiated by teacher)	Key points
What is fire tetrahedron?	Fire tetrahedron is a simple model to understand the necessary ingredients to start a fire. In the fire tetrahedron, there are four elements, namely, fuel, oxidizing agent, heat and propagation.
What is propagation in fire tetrahedron?	Propagation refers to the chemical chain reaction that occurs after the fire is started. Combustion is a radical type reaction. Accordingly, halon type extinguisher is a quite useful extinguisher because haloalkanes are radical scavengers.
“In case of fire accident, quickly put off the fire by water.” Comment on this statement.	It depends on the type of fire. Water is effective for fire from Class A and Class B fuels but not for Class C, Class D and Class K. Class A fire includes combustibles such as wood, paper, trash or anything else that leaves an ash. Class B fire includes combustibles such as oil and gasoline. Fire resulting from electronics (Class C), metals (Class D) or cooking oil and grease (Class K) cannot be put off by water.

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### (d) Toxic chemical

For in-class discussion:

What to discuss (initiated by teacher)	Key points
There is no toxicological information on certain chemicals in MSDS. What does it mean?	It means that that chemical has not been deliberately tested on animals. It has no correlation on the toxicity of the chemicals. Students should be more cautious when handling chemicals with no stated toxicological information.
“It is sufficient to handle toxic chemicals when one wears safety goggles, lab coat and gloves.” Comment on this statement.	Personal protective equipment should be specific to the chemicals concerned. Latex gloves, neoprene gloves and nitrile gloves are resistant to certain categories of chemicals but not all. Before working on toxic chemicals, students should consult the MSDS. On the other hand, some toxic chemicals are volatile. The basic PPE could not give enough protection in this case. Volatile toxic chemicals should be handled in fume hood.
Discuss the ways to reduce intoxication by toxic chemicals.	<ol style="list-style-type: none"><li>1. Seek for alternative. Toluene can replace very toxic benzene as an organic solvent.</li><li>2. Work in fume hood. Toxic vapor can be evacuated.</li><li>3. Contingency plan in case of accident. Always have sulfur available when working with mercury.</li><li>4. Consult MSDS before working on any chemicals.</li></ol>

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### (e) Chemical Information




For in-class discussion:

What to discuss (initiated by teacher)	Key points
Some hazard labels are black symbols on orange background with black rimmed squares	The orange labels are from the old systems. The nine GHS pictograms are from the new CLP regulations of UN. The regulations came into force on 2009 and will apply directly on June 2015.
How can the manufacturer trace the chemical in the market if there are somethings wrong with certain lot of products.	Normally the label on the chemical container has the product number, lot number or the process number so that the manufacturing company can find out the lot of products that have to be retrieved from the market. The data matrix barcode also contains the information if present.
Where can you access to the MSDS?	Chemical manufacturer Laboratory or workplace University safety office Environment or occupation health office
Is it any fixed format of the MSDS?	No fixed format. Depending on the preparator Contain the same kind of basic information
Who is going to use the MSDS	Employees may expose to hazard chemicals such as laboratory working staff Firefighters Emergency medical personnel

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### (f) System under Pressure

For in-class discussion:

What to discuss (initiated by teacher)	Key points
<p>How to read a pressure gauge?</p> 	<p>Pressure gauge used for gas cylinder is usually a “positive” pressure gauge. The value read is the pressure relative to 1 atm. Therefore, if the reading is 2 bar, the actual pressure is <math>1 + 2 = 3</math> bar.</p>
<p>What is the problem in the setup in the photo?</p> 	<p>A regulator is missing in the setup. A regulator consists of two pressure gauges. The first one monitors the pressure of the gas in the cylinder (when the main valve of the cylinder). The second one monitors the actual pressure of the gas to be released. The regulator also consists of a valve which allows a user to control the flow rate of the gas to be released.</p> 
<p>What liquid is used in a gas bubbler? What is the requirement on the property of the liquid?</p>	<p>Usually glycerol. The liquid needs to have high viscosity and it should not vaporize easily.</p>

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### (g) Extreme Temperature

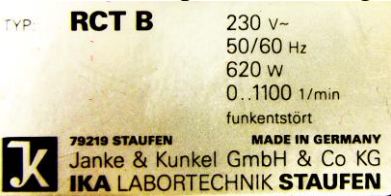

For in-class discussion:

What to discuss (initiated by teacher)	Key points
What are the advantages of using low temperature to speed up crystallization?	<ul style="list-style-type: none"><li>- Larger temperature difference <math>\Rightarrow</math> faster heat transfer <math>\Rightarrow</math> faster cooling down</li><li>- Lower temperature <math>\Rightarrow</math> lower solubility <math>\Rightarrow</math> more solid formed</li></ul>
What is the temperature of liquid CO <sub>2</sub> ?	CO <sub>2</sub> only exists at elevated pressure ( $> 5.1$ atm, at which the temperature is $-57$ °C)
What kinds of thermometers can be used to measure low temperature?  Follow-up: How do you know the working range of a thermometer?	<ul style="list-style-type: none"><li>- Glass thermometers: glass may be broken upon cooling, the liquid inside may not have low enough freezing point (e.g., <math>-114</math> °C for ethanol, <math>-39</math> °C for mercury)</li><li>- Thermocouple and resistance thermometers may work for lower temperature, but not all of them do.</li> <li>- Check the manual of the thermometer.</li></ul>
How do you know that O <sub>2</sub> is liquefied?	Liquid O <sub>2</sub> is blue in color.
What should and shouldn't be done when you get a frost bite?	<ul style="list-style-type: none"><li>- Should do: rinse the affected area with warm water.</li><li>- Shouldn't do: don't rub or massage the affected area.</li></ul>
(For English version only) What is the difference between "suffocation" and "asphyxiation"?	<ul style="list-style-type: none"><li>- Suffocation: you can't breathe in any gas (e.g., under water)</li><li>- Asphyxiation: you can breathe in gas(es) but the oxygen content is not high enough in the gas(es), so you may also die.</li></ul>

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### (h) Electrical hazard

For in-class discussion:

What to discuss (initiated by teacher)	Key points
<p>Overcurrent results in overheating, which, in turn, results in high temperature, and finally fire. What can you tell the current drawn by an electrical appliance or instrument?</p>	<ul style="list-style-type: none"> <li>- There should be a specification on output current for each electrical appliance or instrument, e.g., in the following label, <math>\text{current} = \text{power} \div \text{voltage} = 2.7 \text{ A}</math>.</li> </ul>  <p>The total current for all appliance or instrument should not exceed the rating.</p> <ul style="list-style-type: none"> <li>- The current actually drawn can also be measured with a plug which shows the current.</li> </ul> 
<p>What type of fire extinguishers should be used to put off an electrical fire?</p>	<p>Electrical fire is a Class C fire. Appropriate fire extinguishers include the following types: ABC Dry Chemical, CO<sub>2</sub>, and dry chemical.</p>
<p>In some countries, the standard electrical plug consists of two pins. What is the disadvantage of a 2-pin plug, compared with a 3-pin plug?</p>	<p>Both types of plugs consist of a pair of pins for electrical current to pass through (“live” and “neutral”). The third pin in a 3-pin plug connects to the “earth” line which is connected to the metal enclosure and frame of the appliance or instrument for grounding. If there is a leak of electrical current into the enclosure or frame, the current can be brought away from through the “earth” line.</p>