University of Malta – Department of Chemistry
GUIDE TO RISK ASSESSMENT

Obtain the Material Safety Data Sheets (MSDS's) for all chemicals used in the practical. These are readily available online. Determine the Hazard Rating for each chemical, using the Risk Assessment Excel Spreadsheet available online. The Hazard Rating for each individual task is determined using the following formula:

$$\textit{Hazard Rating} = S \times F \times P \times N$$

S is related of the severity of any injuries that may occur as a result of exposure to the chemical
F is a measure of the frequency of the task
P is a measure of the probability of an injury occurring
N is dependant on the number of people exposed

STEP 1: Severity Factor (S)
This involves a five-step process, and uses information related to the hazard group of the chemicals involved, the amount being used and the volatility or dustiness of the chemical.

STEP 1A: Hazard Group
Use the R-phrases associated with the chemical to determine the appropriate Hazard Group.

A	B	C	D	E
R36	R20	R23	R26	R42
R36/38	R20/21	R23/24	R26/27	R42/43
R38	R20/21/22	R23/24/25	R26/27/28	R45
R65	R20/22	R23/25	R26/28	R46
R67	R21	R24	R27	R49
	R21/22	R24/25	R27/28	
	R22	R25	R28	
	R68	R34	R39/26	
	R68/20	R35	R39/26/27	
	R68/20/21	R36/37	R39/26/27/28	
	R68/20/21/22	R36/37/38	R39/26/28	
	R68/20/22	R37	R39/27	
Plus all	R68/21	R37/38	R39/27/28	
substances that	R68/21/22	R39/23	R39/28	
do not have	R68/22	R39/23/24	R40	
R-phrases in		R39/23/24/25	R48/23	
groups B to E		R39/23/25	R48/23/24	
		R39/24	R48/23/24/25	
		R39/24/25	R48/23/25	
		R39/25	R48/24	
		R41	R48/24/25	
		R43	R48/25	
		R48/20	R60	
		R48/20/21	R61	
		R48/20/21/22	R62	
		R48/20/22	R63	
		R48/21	R64	
		R48/21/22		
		R48/22		

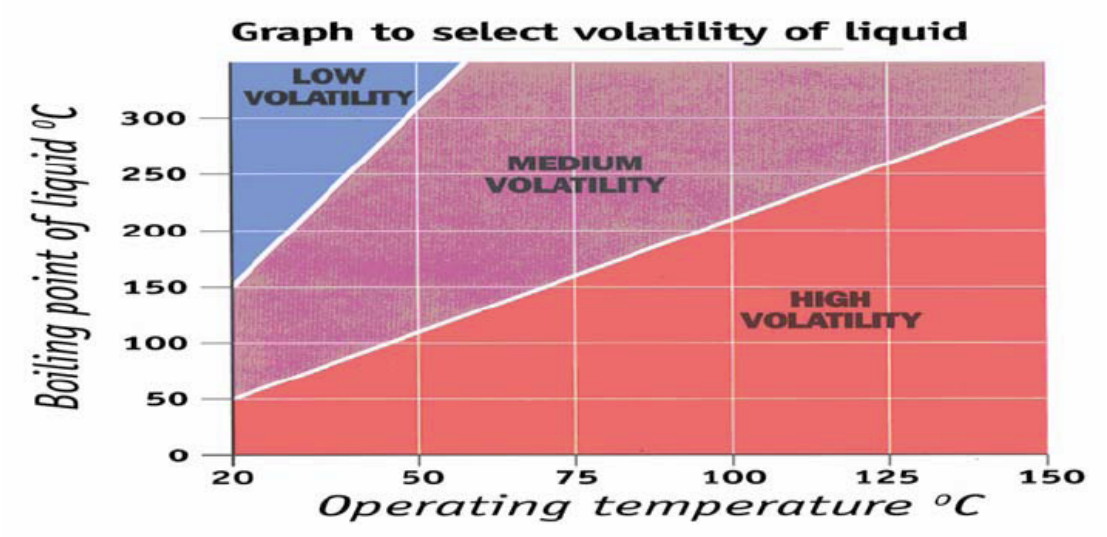
STEP 1B: Amount being used

Determine whether the amount of the chemical being used is small, medium or large from the following table.

	Small	Medium	Large
Weight	Less than 500g	500g to 500kg	More than 500kg
Volume	Less than 500ml	500ml to 500l	More than 500l

STEP 1C Volatility/Dustiness

For **liquids** determine whether the chemical is of low, medium or high volatility using the boiling point and operating temperature of the chemical and the graph below:



For **solids** determine whether the chemical is low, medium or high dustiness using the following definitions:

Low Dustiness	Pellet-like solid Little dust produced or seen
Medium Dustiness	Crystalline solid Dust is visible but settles quickly Dust on surfaces
High Dustiness	Fine light powder Dusts clouds produced Dust is visible and remains in the air

STEP 1D: Control Approach
Use the hazard group, amount being used and volatility/dustiness to find the control approach from the table below:

Amount Used	Low dustiness or volatility	Medium volatility	Medium dustiness	High dustiness or volatility
	Hazard Group A			
Small	**1**	**1**	**1**	**1**
Medium	**1**	**1**	**1**	**2**
Large	**1**	**1**	**2**	**2**
	Hazard Group B			
Small	**1**	**1**	**1**	**1**
Medium	**1**	**2**	**2**	**2**
Large	**1**	**2**	**3**	**3**
	Hazard Group C			
Small	**1**	**2**	**1**	**2**
Medium	**2**	**3**	**3**	**3**
Large	**2**	**4**	**4**	**4**
	Hazard Group D			
Small	**2**	**3**	**2**	**3**
Medium	**3**	**4**	**4**	**4**
Large	**3**	**4**	**4**	**4**
	Hazard Group E			
	For all Hazard Group E substances, use control approach 4			

STEP 1E: Severity Factor (S)
Use the table below to determine the severity factor from the control approach:

	Severity Factor
Control Approach 1	**1**
Control Approach 2	**3**
Control Approach 3	**4**
Control Approach 4	**6**

STEP 2: Frequency Factor (F)

F = Frequency of task	**Frequency Factor**
> Annually	0.1
Annually	0.2
Monthly	1
Weekly	1.5
Daily	2.5
Hourly	4
Continuously	5

STEP 3: Probability Factor (P)
Determine the Probability Factor using the following table. The effect of any preventative measures taken and the circumstances of the work undertaken should be considered. Use the Hazard Symbols, R phrases and S phrases to judge what the Probability Factor should be.

		Probability Factor
Impossible	It is inconceivable that injury could happen	**0.1**
Unlikely	It is conceivable that injury could happen though it is very unlikely	**1**
Possible	Injury could occur but its occurrence would be unusual	**2**
Even chance	Injury could occur	**3**
Probable	Injury is sufficiently probable or no surprise when it happens	**4**
Likely	The occurrence of an injury is to be expected	**5**
Certain	It is almost certain that injury will occur	**6**

STEP 4: Number Factor (N)

N = Number of people exposed	**Number Factor**
1 to 2 persons	1
3 to 7 persons	2
8 to 15 persons	3
16 to 50 persons	4
More than 50 persons	5

STEP 5: Hazard Rating Number
Calculate the hazard rating number and interpretation using the following formula and table.

$$Hazard\ Rating = S \times F \times P \times N$$

Hazard Rating Number	**Interpretation**
0 – 5	Acceptable Hazard
5 – 15	Low Hazard
15 – 40	Significant Hazard
40 – 100	High Hazard
> 100	Extreme Hazard

APPENDIX I
EUROPEAN HAZARD SYMBOLS AND INDICATIONS OF DANGER

Indication of Danger	Symbol	Pictogram
Explosive	E	
Oxidising agent	O	
Highly flammable	F	
Extremely flammable	F+	
Toxic	T	
Very toxic	T+	
Harmful	Xn	
Irritant	Xi	
Corrosive	C	
Dangerous for the environment	N	

APPENDIX II
LIST OF EUROPEAN RISK PHRASES

R1: Explosive when dry
R2: Risk of explosion by shock, friction, fire or other sources of ignition
R3: Extreme risk of explosion by shock, friction, fire or other sources of ignition
R4: Forms very sensitive explosive metallic compounds
R5: Heating may cause an explosion
R6: Explosive with or without contact with air
R7: May cause fire
R8: Contact with combustible material may cause fire
R9: Explosive when mixed with combustible material
R10: Flammable
R11: Highly flammable
R12: Extremely flammable
R14: Reacts violently with water
R15: Contact with water liberates extremely flammable gases
R16: Explosive when mixed with oxidising substances
R17: Spontaneously flammable in air
R18: In use, may form flammable/explosive vapour-air mixture
R19: May form explosive peroxides
R20: Harmful by inhalation
R21: Harmful in contact with skin
R22: Harmful if swallowed
R23: Toxic by inhalation
R24: Toxic in contact with skin
R25: Toxic if swallowed
R26: Very toxic by inhalation
R27: Very toxic in contact with skin
R28: Very toxic if swallowed
R29: Contact with water liberates toxic gas.
R30: Can become highly flammable in use
R31: Contact with acids liberates toxic gas
R32: Contact with acids liberates very toxic gas
R33: Danger of cumulative effects
R34: Causes burns
R35: Causes severe burns
R36: Irritating to eyes
R37: Irritating to respiratory system
R38: Irritating to skin
R39: Danger of very serious irreversible effects
R40: Limited evidence of a carcinogenic effect
R41: Risk of serious damage to eyes
R42: May cause sensitisation by inhalation
R43: May cause sensitisation by skin contact
R44: Risk of explosion if heated under confinement
R45: May cause cancer
R46: May cause heritable genetic damage
R48: Danger of serious damage to health by prolonged exposure
R49: May cause cancer by inhalation
R50: Very toxic to aquatic organisms
R51: Toxic to aquatic organisms
R52: Harmful to aquatic organisms
R53: May cause long-term adverse effects in the aquatic environment
R54: Toxic to flora
R55: Toxic to fauna
R56: Toxic to soil organisms
R57: Toxic to bees
R58: May cause long-term adverse effects in the environment
R59: Dangerous for the ozone layer

R60: May impair fertility
R61: May cause harm to the unborn child
R62: Possible risk of impaired fertility
R63: Possible risk of harm to the unborn child
R64: May cause harm to breast-fed babies
R65: Harmful: may cause lung damage if swallowed
R66: Repeated exposure may cause skin dryness or cracking
R67: Vapours may cause drowsiness and dizziness
R68: Possible risk of irreversible effects

R14/15: Reacts violently with water, liberating extremely flammable gases
R15/29: Contact with water liberates toxic, extremely flammable gases
R20/21: Harmful by inhalation and in contact with skin
R20/22: Harmful by inhalation and if swallowed
R20/21/22: Harmful by inhalation, in contact with skin and if swallowed
R21/22: Harmful in contact with skin and if swallowed
R23/24: Toxic by inhalation and in contact with skin
R23/25: Toxic by inhalation and if swallowed
R23/24/25: Toxic by inhalation, in contact with skin and if swallowed
R24/25: Toxic in contact with skin and if swallowed
R26/27: Very toxic by inhalation and in contact with skin
R26/28: Very toxic by inhalation and if swallowed
R26/27/28: Very toxic by inhalation, in contact with skin and if swallowed
R27/28: Very toxic in contact with skin and if swallowed
R36/37: Irritating to eyes and respiratory system
R36/38: Irritating to eyes and skin
R36/37/38: Irritating to eyes, respiratory system and skin
R37/38: Irritating to respiratory system and skin
R39/23: Toxic: danger of very serious irreversible effects through inhalation
R39/24: Toxic: danger of very serious irreversible effects in contact with skin
R39/25: Toxic: danger of very serious irreversible effects if swallowed
R39/23/24: Toxic: danger of very serious irreversible effects through inhalation and in contact with skin
R39/23/25: Toxic: danger of very serious irreversible effects through inhalation and if swallowed
R39/24/25: Toxic: danger of very serious irreversible effects in contact with skin and if swallowed
R39/23/24/25: Toxic: danger of very serious irreversible effects through inhalation, in contact with skin and if swallowed
R39/26: Very Toxic: danger of very serious irreversible effects through inhalation
R39/27: Very Toxic: danger of very serious irreversible effects in contact with skin
R39/28: Very Toxic: danger of very serious irreversible effects if swallowed
R39/26/27: Very Toxic: danger of very serious irreversible effects through inhalation and in contact with skin
R39/26/28: Very Toxic: danger of very serious irreversible effects through inhalation and if swallowed
R39/27/28: Very Toxic: danger of very serious irreversible effects in contact with skin and if swallowed
R39/26/27/28: Very Toxic: danger of very serious irreversible effects through inhalation, in contact with skin and if swallowed
R42/43: May cause sensitisation by inhalation and skin contact
R48/20: Harmful: danger of serious damage to health by prolonged exposure through inhalation
R48/21: Harmful: danger of serious damage to health by prolonged exposure in contact with skin
R48/22: Harmful: danger of serious damage to health by prolonged exposure if swallowed
R48/20/21: Harmful: danger of serious damage to health by prolonged exposure through inhalation and in contact with skin
R48/20/22: Harmful: danger of serious damage to health by prolonged exposure through inhalation and if swallowed
R48/21/22: Harmful: danger of serious damage to health by prolonged exposure in contact with skin and if swallowed
R48/20/21/22: Harmful: danger of serious damage to health by prolonged exposure through inhalation, in contact with skin and if swallowed
R48/23: Toxic: danger of serious damage to health by prolonged exposure through inhalation
R48/24: Toxic: danger of serious damage to health by prolonged exposure in contact with skin
R48/25: Toxic: danger of serious damage to health by prolonged exposure if swallowed

R48/23/24: Toxic: danger of serious damage to health by prolonged exposure through inhalation and in contact with skin
R48/23/25: Toxic: danger of serious damage to health by prolonged exposure through inhalation and if swallowed
R48/24/25: Toxic: danger of serious damage to health by prolonged exposure in contact with skin and if swallowed
R48/23/24/25: Toxic: danger of serious damage to health by prolonged exposure through inhalation, in contact with skin and if swallowed
R50/53: Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment
R51/53: Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment
R52/53: Harmful to aquatic organisms, may cause long-term adverse effects in the aquatic environment
R68/20: Harmful: possible risk of irreversible effects through inhalation
R68/21: Harmful: possible risk of irreversible effects in contact with skin
R68/22: Harmful: possible risk of irreversible effects if swallowed
R68/20/21: Harmful: possible risk of irreversible effects through inhalation and in contact with skin
R68/20/22: Harmful: possible risk of irreversible effects through inhalation and if swallowed
R68/21/22: Harmful: possible risk of irreversible effects in contact with skin and if swallowed
R68/20/21/22: Harmful: possible risk of irreversible effects through inhalation, in contact with skin and if swallowed

APPENDIX III
LIST OF EUROPEAN SAFETY PHRASES

S1: Keep locked up
S2: Keep out of the reach of children
S3: Keep in a cool place
S4: Keep away from living quarters
S5: Keep contents under ... (*appropriate liquid to be specified by the manufacturer*)
S6: Keep under ... (*inert gas to be specified by the manufacturer*)
S7: Keep container tightly closed
S8: Keep container dry
S9: Keep container in a well-ventilated place
S12: Do not keep the container sealed
S13: Keep away from food, drink and animal feedingstuffs
S14: Keep away from ... (*incompatible materials to be indicated by the manufacturer*)
S15: Keep away from heat
S16: Keep away from sources of ignition - No smoking
S17: Keep away from combustible material
S18: Handle and open container with care
S20: When using do not eat or drink
S21: When using do not smoke
S22: Do not breathe dust
S23: Do not breathe gas/fumes/vapour/spray (*appropriate wording to be specified by the manufacturer*)
S24: Avoid contact with skin
S25: Avoid contact with eyes
S26: In case of contact with eyes, rinse immediately with plenty of water and seek medical advice
S27: Take off immediately all contaminated clothing
S28: After contact with skin, wash immediately with plenty of ... (*to be specified by the manufacturer*)
S29: Do not empty into drains
S30: Never add water to this product
S33: Take precautionary measures against static discharges
S35: This material and its container must be disposed of in a safe way
S36: Wear suitable protective clothing
S37: Wear suitable gloves
S38: In case of insufficient ventilation wear suitable respiratory equipment
S39: Wear eye/face protection
S40: To clean the floor and all objects contaminated by this material use ... (*to be specified by the manufacturer*)
S41: In case of fire and/or explosion do not breathe fumes
S42: During fumigation/spraying wear suitable respiratory equipment (appropriate wording to be specified by the manufacturer)
S43: In case of fire use ... (indicate in the space the precise type of fire-fighting equipment. If water increases the risk add - Never use water)
S45: In case of accident or if you feel unwell seek medical advice immediately (show the label where possible)
S46: If swallowed, seek medical advice immediately and show this container or label
S47: Keep at temperature not exceeding ... °C (*to be specified by the manufacturer*)
S48: Keep wet with ... (*appropriate material to be specified by the manufacturer*)
S49: Keep only in the original container
S50: Do not mix with ... (*to be specified by the manufacturer*)
S51: Use only in well-ventilated areas
S52: Not recommended for interior use on large surface areas
S53: Avoid exposure - obtain special instructions before use
S56: Dispose of this material and its container at hazardous or special waste collection point
S57: Use appropriate containment to avoid environmental contamination
S59: Refer to manufacturer/supplier for information on recovery/recycling
S60: This material and its container must be disposed of as hazardous waste
S61: Avoid release to the environment. Refer to special instructions/safety data sheet
S62: If swallowed, do not induce vomiting: seek medical advice immediately and show this container or label
S63: In case of accident by inhalation: remove casualty to fresh air and keep at rest
S64: If swallowed, rinse mouth with water (only if the person is conscious)

S1/2: Keep locked up and out of the reach of children
S3/7: Keep container tightly closed in a cool place
S3/7/9: Keep container tightly closed in a cool, well-ventilated place
S3/9/14: Keep in a cool, well-ventilated place away from ... (incompatible materials to be indicated by the manufacturer)
S3/9/14/49: Keep only in the original container in a cool, well-ventilated place away from ... (incompatible materials to be indicated by the manufacturer)
S3/9/49: Keep only in the original container in a cool, well-ventilated place
S3/14 Keep in a cool place away from ... (*incompatible materials to be indicated by the manufacturer*)
S7/8: Keep container tightly closed and dry
S7/9: Keep container tightly closed and in a well-ventilated place
S7/47: Keep container tightly closed and at temperature not exceeding ... °C (to be specified by the manufacturer)
S20/21: When using do not eat, drink or smoke
S24/25: Avoid contact with skin and eyes
S27/28: After contact with skin, take off immediately all contaminated clothing, and wash immediately with plenty of ... (to be specified by the manufacturer)
S29/35: Do not empty into drains; dispose of this material and its container in a safe way
S29/56: Do not empty into drains, dispose of this material and its container at hazardous or special waste collection point
S36/37: Wear suitable protective clothing and gloves
S36/37/39: Wear suitable protective clothing, gloves and eye/face protection
S36/39: Wear suitable protective clothing and eye/face protection
S37/39: Wear suitable gloves and eye/face protection
S47/49: Keep only in the original container at temperature not exceeding ... °C (to be specified by the manufacturer)