0. Safety

King

考点一：Name

0.1 identify the Workplace Hazardous Materials Information System (WHMIS) symbols for compressed gas, flammable and combustible material, oxidising material, poisonous and infectious material, corrosive material, and dangerously reactive materials
0.2 state examples of, and identify materials indicated by the WHMIS symbols listed above
0.3 identify the WHMIS symbols appropriate to different materials
0.4 recognize safe handing procedures for materials and apparatus generally found in high school chemistry laboratories

1. Term

• **WHMIS** stands for **W**orkplace **H**azardous **M**aterials **I**nformation **S**ystem

Its purpose is to provide people with enough information to make reasonable and rational decisions regarding their work with hazardous materials

--WHMIS 1988

--WHMIS 2015

• **SDS-Safety Data Sheets**

SDS informs users of: Hazards of the product, How to **use** the product safely, What to **expect** if the recommendations are not followed, How to **recognize** symptoms of exposure, What to **do** if emergencies occur

MSDS (Material Safety Data Sheet)

• Material Safety Data Sheets are information sheets that contain detailed information on:

– the **chemical properties**,

– **health** and **physical hazard**s and

– **safe handling**, **storage** and **disposal** of controlled products

2. WHMIS symbols and materials

WHMIS Chemical Hazards Pictograms 2015

WHMIS 1988 Hazard Class	WHMIS 1988 Symbols	WHMIS 2015 Symbols	WHMIS 2015 Hazard Class
A			Gases Under Pressure
B1 to B6			Flammables, Self-Heating, Emit Flammable Gases, Pyrophoric Gases, Liquids & Solids Organic Peroxides
C			Oxidizing Gases, Liquids, Solids
D1			Acute Toxicity - Oral, Dermal, Inhalation
D2			Eye Irritation, Skin Irritation Skin/Respiratory Sensitization, Carcinogenicity Mutagenicity Reproductive Hazards
D3			Biohazardous Infectious Materials
E			Skin/Eye Corrosion Corrosive to Metals
F			Self-Reactive Substances Organic Peroxides
N/A	N/A		Explosive Substances (Explosives are still covered under WHMIS exclusions for now)
N/A	N/A		Aspiration, STOT (Single Exposure, Repeated Exposure)
N/A	N/A	N/A	Combustible Dusts
N/A	N/A	N/A	Simple Asphyxiants
N/A	N/A	Use appropriate symbol	Physical Hazards Not Otherwise Classified, Health Hazards Not Otherwise Classified

Class A – Compressed Gases

Examples:
- **Oxygen**
- **Carbon Dioxide**
- **Nitrogen**

Definition:

• Contains gases and mixtures of gases stored under pressure within cylinders

Storage & Handling Precautions:

• Ruptured cylinders or broken valves can cause the release of the high pressure gas and cause the cylinders to become jet propelled rockets. Keep cylinders away from potential ignition sources.

• Cylinders should be secured properly during transportation, storage and use

• Not to be rolled, slid or dropped

Class B – Combustible & Flammable Materials

Examples:
- Isopropyl alcohol
- Ethyl alcohol
- Acetone

Definition: Substances that can burn

Storage precautions: Must not be stored with oxidizing materials

To be stored within flammable storage cabinets

Class C – Oxidizing Materials

Examples:
- Oxygen
- Nitrogen Peroxide
- Nitric Oxide

Definition

• Liquids or solids that readily give off oxygen or other oxidizing substances (e.g. chlorine, bromine)

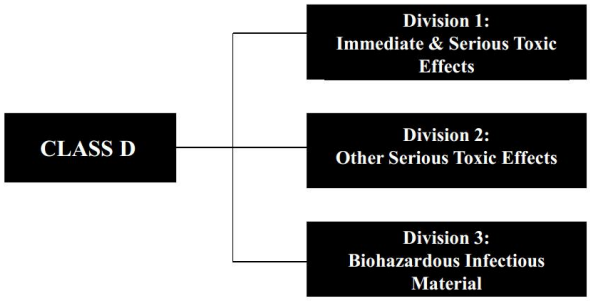
• React chemically to oxidize combustible (burnable) materials increasing the chance of a fire or explosion

Storage & Handling Precautions:

• Store away from combustible and flammable materials and incompatible oxidizers

• Use in well ventilated areas

Class D – Poisonous and Infectious Materials



Division 1: Immediate and Serious Toxic Effects

Examples:
- Formalin
- Methanol
- Isopropyl Alcohol

Definition:

• Materials that are poisonous substances which can cause serious health effects such as loss of consciousness, coma or death within minutes or hours after exposure

Division 2: Other Serious Toxic Effects

Definition:

• Material causing toxic effects such as skin or respiratory sensitization, carcinogenicity, mutagenicity, etc.

• Effects may be acute or chronic

Examples:
- Acetone
- Xylene

Division 3: Biohazardous Infectious Materials

Examples:
- AIDS/HIV virus
- Hepatitis B

Definition:

• A material that contains organisms which can cause disease in humans or animals

Class E: Corrosive Materials

Examples:
- Bleach
- Hydrochloric Acid

Definition:

• Chemicals that can attack or chemically destroy tissue or metals

• Most corrosives are either acids or bases

Storage & Handling Precautions:

• Store away from incompatible products such as other corrosives (e.g. acids and bases)

• Use in well ventilated areas

• Wear the appropriate personal protective equipment

Class F: Dangerously Reactive Material

Examples:
- Hydrogen Peroxide (91% by weight)
- Ethylene Oxide

Definition:

• Materials that are very unstable. May react with water to release a toxic or flammable gas. May explode if heated when in a closed container and can undergo vigorous polymerization (small molecules joining together to form larger molecules).

Storage & Handling Precautions:

• Store away from incompatible substances

• Do not subject to friction, shock or impact.

附录：Chemical Segregation and Storage Table

Class of Chemicals	Common Chemical Examples	Additional Concerns and Storage Recommendations	Common Incompatible Chemical Types	Possible Reaction if Mixed/Health Concerns
Corrosive Acids-Organic 	Acetic Acid Glacial Acetic Acid Butyric Acid Trifluoroacetic Acid Picric Acid Propionic Acid Formic Acid	Store in ventilated corrosives cabinet on protected shelving using secondary containment, keep away from water sources *Do not store under the sink *Do not store acids on metal shelving	Flammable Liquids Flammable Solids Bases Oxidizers Inorganic Acids Cyanides Sulfides Poisons/Toxins	Heat Gas Generation Violent Reaction * DO NOT POUR WATER INTO ACID
Corrosive Acids-Inorganic 	Nitric Acid Sulfuric Acid Perchloric Acid Phosphoric Acid Hydrochloric Acid Chromic Acid Hydrofluoric Acid	Store concentrated Nitric acid (≥68%) and Sulfuric acid (≥93%) in a secondary container Store in a corrosive cabinet labeled “Acid” or on shelving using a secondary containment *Do not store under the sink *Do not store acids on metal shelving *Hydrofluoric acid should be stored in an area accessible only by authorized personnel; do not store in glass; use plastic containers and secondary containment	Flammable Liquids Flammable Solids Bases Oxidizers Organic Acids Cyanides Sulphides Poisons/Toxins	Heat Gas Generation Violent Reaction *DO NOT POUR WATER INTO ACID *Perchloric acid vapor can form explosive compounds within fume hood ducts *Hydrofluoric acid can result in severe burns to skin and lungs
Corrosive Bases-Organic/Caustic 	Hydroxylamine Tetramethylethylamine Diamine Triethylamine	Store in separate cabinet, preferably with ventilation, corrosive cabinet or storage area with a spill tray, away from potential water sources (DO NOT store under the sink)	Acids Oxidizers Flammable Liquids Flammable Solids Inorganic Bases Poisons/Toxins	Heat Gas Generation Violent Reaction
Corrosive Bases-Inorganic/Caustics 	Ammonium Hydroxide Potassium Hydroxide Sodium Hydroxide Calcium Hydroxide	Store in separate cabinet, preferably with ventilation, corrosive cabinet or storage area with a spill tray, away from potential water sources (DO NOT store under the sink); Store solutions of inorganic hydroxides in labeled polyethylene containers	Acids Oxidizers Flammable Liquids Flammable Solids Organic Bases Poisons/Toxins	Heat Gas Generation Violent Reaction
Flammable Solids 	Charcoal Carbon Paraformaldehyde Phosphorus Magnesium	Keep in a dry, cool area away from oxidizers and corrosives	Acids Bases Oxidizers Poisons/Toxins	Fire Hazard Violent Reaction
Flammable Liquids 	Ethanol, Ethyl Acetate, Methanol, Acetone, Benzene, Xylene, Toluene Diethyl Ether Tetrahydrofuran Acetonitrile Glacial Acetic Acid Acetone liquids with flashpoints < 100 F	Flammable storage cabinet or refrigerator rated for flammable/ hazardous storage/explosion proof *Peroxide-forming chemicals must be dated upon delivery and opening (two dates)	Oxidizers Acids Bases Reactives Poisons/Toxins	Fire Hazard Heat Violet Reaction

Class of Chemicals	Common Chemical Examples	Additional Concerns and Storage Recommendations	Common Incompatible Chemicals Types	Possible Reaction if Mixed/Health Concerns
Poisons/Toxins 	Chloroform Cyanides Heavy metal compounds (e.g. Cadmium, Mercury, Osmium, Oxalic Acid, Phenol, Formic Acid), Formamide, Carbon Tetracholride, 2-Mercaptoethanol Phenol, *Hydrofluoric Acid - Hydrofluoric Acid is a highly acute poison Acrylamide Ethidium Bromide Sodium Azide	Store in a dark, dry, ventilated, cool area in an unbreakable chemically resistant secondary container (polyethylene) * Store volatile toxins with evaporation rate above 1.0 - (ether =1.0) in flammable cabinet; Store non-volatile liquid poisons in a refrigerator or cabinet; amounts less than 1 liter can be stored in a cabinet above bench level, ONLY if the cabinet has sliding doors (not swinging)	Flammable liquids Acids Bases Reactives Oxidizers Corrosives Please consult Division of Environmental Protection (DEP) for assistance *Hydrofluoric Acid should be stored in an area accessible only by authorized personnel; do not store in glass; use plastic containers and secondary containment	Generation of Toxic and Flammable Gas Combustion Heat Fire Hazard Explosion Hazard Violent Reaction Chloroform explosively reacts with chemically-reactive metals (e.g., Aluminum or Magnesium powder, Sodium, and Lithium), Strong Oxidizers, Strong Caustics (e.g., Alkalis), and decomposes in sunlight
Explosives 	Picric Acid Ammonium Nitrate Nitro Urea Trinitroaniline Benzoyl Peroxide Trinitrobenzene Trinitrobenzoic Acid Trinitrotoluene Urea Nitrate Trinitrophenol Diazoisbutylnitrile	Store in a secure location away from other chemicals; store in an area away from friction or shock	Please consult the SDS and the DEP	Explosion Hazard Violent Reaction Heat Shock Friction
Oxidizers 	Peroxides, Nitrates, Perchlorates Permanganates Sodium Hypochlorite Ethyl Acetate, Iodine, Benzoyl Peroxide Potassium Dichromate Chlorates, Bromates, and Superoxides, Ammonium Persulfate, Ferric chloride	Store in secondary containment separately from combustibles and flammable materials	Combustibles Flammables Organic Materials Reducing Agents	Fire Hazard Gas Generation Toxic Gas
Peroxide Formers 	Acrylonitrile Isopropyl Alcohol Ethers (e.g. Diethyl ether, Isopropyl Ether), Acetals and Ketals, especially Cyclic Ethers and those with primary and/or secondary Alkyl groups Aldehydes (e.g. Acetaldehyde, Benzaldehyde) Vinyl and Vinylidene compounds, Dienes Tetrahydrofuran Dioxane Butylated Hydroxytoluene (BHT) Isopropyl Ether	Store in airtight bottles, away from light and heat in a dark, cool dry area; avoid using containers with loose-fitting lids and ground glass stoppers; crystallization, discoloration, and formation or deposition of layers are signs a peroxide former may have become shock sensitive; do not use or move such containers: contact DEP; all bottles of peroxide-forming chemicals must have the received date marked on the container; when the bottle is first opened, the container must be marked with the date opened	Always consult the Safety Data Sheet (SDS) and the Division of Environmental Protection (DEP)	Explosion Hazard Violent Reaction Shock Sensitive Combustion (Exothermic Reaction) If an old or expired container of a peroxide-forming chemical or reactive is found, do not move it. Contact the DEP at 301-496-4710 for assistance in disposing of the container
Water Reactive	Sodium Metals Lithium Metals Potassium Metals Sodium Borohydride Alkali Metal Hydrides	Store in a dry, cool area away from potential spray from fire sprinklers and other water sources (DO NOT store under the sink) Label this area for water-reactive storage	Aqueous solutions Oxidizers Please consult the Safety Data Sheet (SDS) and the Division of Environmental Protection (DEP)	Heat Violent Reaction

Class of Chemicals	Common Chemical Examples	Additional Concerns and Storage Recommendations	Common Incompatible Chemicals Types	Possible Reaction if Mixed/Health Concerns
Flammable Compressed Gases 	Methane Acetylene Butane Propane Hydrogen Silane Ethane Arsine Germane	Handle flammable compressed gases in a chemical fume hood Store in well-ventilated areas; store away from oxidizers, open flames, sparks, and other sources of heat ignition; post NO SMOKING signs around storage area(s) or entrance(s) to storage room(s); flammable gases stored outdoors where ambient temperatures exceed 125 deg F (51.7 deg C) shall be protected from direct sunlight Use a spark proof wrench to attach regulators and make other connections; install a flame/flash arrestor at the regulator outlet flow valve	Oxidizers Toxic Compressed Gases	Fire Hazard Explosion Hazard
Oxidizing Compressed Gases 	Oxygen Chlorine Fluorine Nitrogen oxides Gas mixtures containing Oxygen higher than atmospheric concentrations	Store oxidizers separately from flammable gas containers or combustible materials; minimum separation requirement from these materials is 20 ft or a 5 ft noncombustible barrier with a fire resistance rating of at least 30 minutes Clean equipment used for oxygen and nitrous oxide with oxygen-compatible materials free from oils, greases, and other contaminants Fluorine shall be handled in specially passivated containers and associated equipment	Flammable Compressed Gases Toxic Compressed Gases	Fire Hazard Explosion Hazard
Toxic Compressed Gases  	Carbon Monoxide Hydrogen Chloride Hydrogen Sulfide Nitrogen Dioxide	Handle toxic compressed gases in a chemical fume hood Indoor storage or use of toxic compressed gases shall be provided with a gas cabinet, exhausted enclosure, or gas room Refer to the SDS information for additional guidance on the storage and compatibility requirements Contact DOHS to determine if a fail-safe valve and/or continuous monitoring for toxic gas may be required during use	Flammable Compressed Gases Oxidizing Compressed Gases	Release of Toxic Gas Hydrogen Sulfide is a colorless, flammable, extremely hazardous gas with a “rotten egg” smell; Prolonged exposure may cause nausea, tearing of the eyes, headaches or loss of sleep, airway problems (bronchial constriction) in some asthma patients; possible fatigue, loss of appetite, headache, irritability, poor memory, dizziness and slight conjunctivitis
Strong Reducing Agents	Acetyl Chloride Thionyl Chloride Maleic Anhydride Ferrous Sulfide	Store in cool, dry, well-ventilated location Water reactive Segregate from all other chemicals	Please consult the specific SDS and DEP	Please consult the specific SDS and DEP
Carcinogens 	Benzidine Beta-Naphthylamine Benzene Methylene Chloride Beta-Propiolactone Carbon Tetrachloride	Label all containers as "Cancer Suspect Agents" or the equivalent. Store according to the hazardous nature of the chemical, using appropriate security when necessary	Please consult the specific SDS and DEP	Please consult the specific SDS and DEP
Teratogens 	Lead Compounds Mercury Compounds Benzene Aniline	Label all containers as "Suspect Reproductive Hazard" or “Reproductive Effecter” Store according to the hazardous nature of the chemical, using appropriate security when necessary	Aniline incompatible with Nitric Acid and hHdrogen Peroxide Please consult the specific SDS and DEP	Please consult the specific SDS and DEP
General Stock Chemicals	Sodium Bicarbonate Sodium Chloride Agar Salt buffer Most non-reactive salts	Store on shelves, or laboratory benches or shelving preferably behind glass doors and below eye level with like chemicals	Please consult the SDS and DEP	Please consult the specific SDS and DEP