



Australian Government

MEM48011 Apply basic chemical principles to metallurgy

Release: 1

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Modification History

Release 1. Supersedes and is equivalent to MSATCM406A Apply basic chemical principles to metallurgy.

Application

This unit of competency defines the general chemical knowledge for basic metallurgy operations. It applies to metallurgists working in industrial environments such as foundries, steel plants and smelters and in areas of work such as die casting, fabrication and welding. The unit provides a basic understanding of chemical principles as applied to basic metallurgy operations.

No licensing, legislative or certification requirements apply to this unit at the time of publication.

Pre-requisite Unit

Nil

Competency Field

Metallurgy

Elements and Performance Criteria

Elements	Performance Criteria
<i>Elements describe the essential outcomes.</i>	<i>Performance criteria describe the performance needed to demonstrate achievement of the element.</i>
1. Apply basic chemical concepts relevant to metallurgical processes	1.1 Determine the properties of elements from the periodic table of elements 1.2 Use Boyle's and Charles' laws to determine the relationship between volume, temperature and pressure for a gas 1.3 Define and provide examples of elements, compounds and mixtures 1.4 Use chemical formulae 1.5 Identify the relationship between temperature and the kinetic energy of particles
2. Contrast the physical properties of crystalline solids	2.1 Categorise solids from their physical properties 2.2 Relate the physical properties of crystalline solids to the nature of the forces between particles

Elements	Performance Criteria
<i>Elements describe the essential outcomes.</i>	<i>Performance criteria describe the performance needed to demonstrate achievement of the element.</i>
3. Identify the key chemical properties of metals	3.1 Determine the activity of metals and other key properties in terms of their position on the Periodic Table 3.2 Determine the importance of first ionisation energy in determining the relative reactivity of metals
4. Define the key chemical properties of acids and bases	4.1 Identify acids and bases 4.2 Apply the pH scale 4.3 Define relationship between an acid and its conjugate base and a base and its conjugate acid 4.4 Identify salts which form acidic, basic or neutral solutions and explain their acidic, neutral or basic nature 4.5 Define and identify strong and weak acids and bases
5. Analyse chemical reactions	5.1 Determine chemical reactions using appropriate balanced chemical equations 5.2 Determine chemical reactions between elements and compounds in terms of atomic structures and periodicity 5.3 Determine the heat of reaction in chemical reactions 5.4 Define the factors affecting reaction rate including concentration, surface area, pressure, temperature and catalysis 5.5 Use the stoichiometry of a reaction to determine the amounts of reactants consumed or products made

Foundation Skills

This section describes those language, literacy, numeracy and employment skills that are essential to performance.

Foundation skills essential to performance are explicit in the performance criteria of this unit of competency.

Range of Conditions

This field allows for different work environments and conditions that may affect performance. Essential operating conditions that may be present (depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts) are included.

Industrial environments include one or more of the following:	• foundries • steel plants • smelters • die casting • fabrication • welding.
Crystalline solids include:	• molecular • metallic • ionic • extended covalent solids.
Physical properties of crystalline solids include one or more of the following:	• boiling point • melting point • solubility in polar or non-polar solvents • conductivity • ductility • brittleness • hardness.
Key properties of metals in terms of their position on the periodic table includes:	• electrical conductivity • ionisation energy • atomic radius • melting point • boiling point • combining power (valency) • electronegativity • reactivity.
Definitions of acids and bases include:	• Arrhenius definition • Bronsted-Lowry definition.
Strong acids include one or more of the following:	• hydrochloric acid • nitric acid • sulfuric acid • hydrobromic acid • hydroiodic acid • perchloric acid • chloric acid.
Weak acids include one or more of the following:	• formic acid • acetic acid • benzoic acid • hydrofluoric acid • phosphoric acid • sulfurous acid

	• carbonic acid • nitrous acid • hydrocyanic acid • hydrosulfuric acid • citric acid.
Strong bases include one or more of the following:	• lithium hydroxide • sodium hydroxide • potassium hydroxide • calcium hydroxide • rubidium hydroxide • strontium hydroxide • cesium hydroxide • barium hydroxide.
Weak bases include one or more of the following:	• ammonium hydroxide • aniline • ammonia • methylamine • ethylamine • aluminum hydroxide • magnesium hydroxide • pyridine • sodium bicarbonate.

Unit Mapping Information

Release 1. Supersedes and is equivalent to MSATCM406A Apply basic chemical principles to metallurgy.

Links

Companion Volume implementation guides are found in VETNet -

<https://vetnet.gov.au/Pages/TrainingDocs.aspx?q=b7050d37-5fd0-4740-8f7d-3b7a49c10bb2>

Assessment Requirements for MEM48011 Apply basic chemical principles to metallurgy

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Performance Evidence

Evidence required to demonstrate competence in this unit must be relevant to and satisfy the requirements of the elements and performance criteria and include:

- writing and using chemical formulae in relevant metallurgical processes on at least two occasions
- writing and balancing chemical equations
- calculating heat of reaction
- determining the amounts of reactants consumed and/or products made using the stoichiometry of a reaction on at least two occasions.

Note: Where a volume and/or frequency is not specified, demonstration must be provided at least once.

Knowledge Evidence

Evidence required to demonstrate the required knowledge for this unit must be relevant to and satisfy the requirements of the elements and performance criteria and include knowledge of:

- context and industrial environments
- structure of atoms including sub-atomic particles, charge, atomic number, mass number and valency
- three states of matter in terms of shape, volume and compression
- difference between organic and inorganic compounds
- concepts of latent and sensible heat
- kinetic theory including:
 - Boyle's Law and Charles' Law
 - ideal gas equation $PV=nRT$
- molar volume of a gas
- Gay-Lussac's Law
- Avogadro's Law
- gas reaction calculations
- symbols of common elements including:
 - importance of valence in formulae and reactions
 - model of an atom including electron shells
- ionic, covalent and metallic bonding

- chemical basis of energy transformations in chemical reactions
- properties of crystalline solids
- periodic table
- acids and bases
- stoichiometry.
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Assessment Conditions

- Assessors must:
 - have vocational competency in applying basic chemical principles to metallurgy at least to the level being assessed with relevant industry knowledge and experience
 - satisfy the assessor requirements in the Standards for Registered Training Organisations 2015 or its replacement and comply with the National Vocational Education and Training Regulator Act 2011, its replacement or equivalent legislation covering VET regulation in a non-referring state/territory as the case requires.
- Where possible, assessment must occur in operational workplace situations. Where this is not possible or where personal safety or environmental damage are limiting factors, assessment must occur in a sufficiently rigorous simulated environment that reflects realistic operational workplace conditions that cover all aspects of workplace performance, including environment, task skills, task management skills, contingency management skills and job role environment skills.
- Conditions for assessment must include access to all tools, equipment, materials and documentation required including relevant workplace procedures, product and manufacturing specifications.
- Assessment processes and techniques must be appropriate to the language, literacy and numeracy requirements of the work being performed and the needs of the candidate.
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