



Australian Government

MEM48012 Calculate and predict chemical outcomes in metallurgical situations

Release: 1

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Modification History

Release 1. Supersedes and is equivalent to MSATCM501A Calculate and predict chemical outcomes in metallurgical situations.

Application

This unit of competency defines the knowledge and skills required to apply appropriate chemical principles and techniques to calculate and predict outcomes in metallurgical situations.

It requires application of chemical principles and techniques as a member of a team or as an individual in metallurgical situations.

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

Pre-requisite Unit

MEM48011 Apply basic chemical principles to metallurgy

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. Determine job requirements	1.1 Follow standard operating procedures (SOPs) 1.2 Comply with work health and safety (WHS) requirements at all times 1.3 Undertake consultations and briefings with managers, employers and customers 1.4 Research information to determine situation requiring metallurgical analysis
2. Select chemical principles and techniques relevant to	2.1 Select relevant chemical techniques and principles for metallurgical situation 2.2 Select technologies associated with chemical techniques relevant to

Elements	Performance Criteria
<i>Elements describe the essential outcomes.</i>	<i>Performance criteria describe the performance needed to demonstrate achievement of the element.</i>
metallurgy	the metallurgical situation
3. Apply chemical principles and techniques	3.1 Apply basic chemical principles to obtain required solutions 3.2 Complete accurate chemical calculations with correct use of significant figures 3.3 Apply chemical techniques and associated technologies to obtain required solutions 3.4 Communicate solutions to appropriate personnel and situations and record in accordance with procedures

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.

Metallurgy includes the scientific and technical oversight of production of commercial metal products or the development of new alloys and processes involving one or more of the following:	• extraction • smelting • refining • casting • heat treating • welding • forging • fabrication.
Sources of information include one or more of the following	• reference texts • manufacturer catalogues and industrial magazines • websites • phone information gathering • email information gathering.

Unit Mapping Information

Release 1. Supersedes and is equivalent to MSATCM501A Calculate and predict chemical outcomes in metallurgical situations.

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 MEM48012 Calculate and predict chemical outcomes in metallurgical situations

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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:

- following work instructions, standard operating procedures (SOPs) and safe work practices
- selecting appropriate chemical principles and techniques to suit specific applications on at least two occasions
- selecting appropriate basic mechanical techniques and associated technologies, software and hardware to suit specific applications on at least two occasions
- applying basic chemical principles and techniques to engineering situations
- applying and manipulating appropriate formulas for applications involving engineering calculations
- applying appropriate calculations to engineering and metallurgical situations
- referring solutions to the original aim of the application
- communicating solutions in appropriate units using appropriate significant figures
- communicating limitations of solutions due to assumptions, chemical principles and techniques used
- presenting solutions on at least two occasions referring to the original aim of the application.

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:

- safe work practices and procedures
- sources of information
- metallurgy including:
 - the scientific and technical oversight of production of commercial metal products
 - the development of new alloys and processes
- calculations appropriate to chemical solutions
- chemical principles and techniques including:

- constitution of matter including:
 - elements, compounds, mixtures, states of matter
 - atomic structure including protons, neutrons and electrons
 - electron structure of atoms
 - the Bohr atom
 - chemical bonding including ionic, covalent and metallic
 - valency of common ions and radicals
 - chemical reactions including balancing equations
 - molecular and ionic equations
 - Avogadro's number and the mole concept
 - solubility and precipitation, and solution concentration
 - stoichiometric calculations
- periodic table
- gas laws including:
 - kinetic theory
 - Boyle's Law, Charles' Law and combined gas law
 - ideal gas equation $PV=nRT$ and molar volume of a gas
 - Gay-Lussac's Law
 - Avogadro's Law
 - gas reaction calculations
- oxidation and reduction including:
 - definitions of oxidation and reduction
 - half reactions
 - balancing redox equations
 - significance of oxidation and reduction in metallurgy
- thermodynamics including:
 - first law of thermodynamics
 - exothermic and endothermic reactions
 - heats of reaction including combustion
 - Hess's Law
 - heat capacity and Kirchoff's Law
 - acid-base theory and hydrolysis
 - ionic product for water including:
 - pH, and pOH
 - the pH scale
 - equilibrium constant
 - effect of temperature and pressure on equilibrium constant
- equilibrium and free energy change including:
 - Carnot cycle including concept of entropy
 - second law of thermodynamics

- Gibbs free energy
- relationship between free energy and equilibrium constant
- van't Hoff isotherm and isochore
- relationship between free energy and temperature
- rates of chemical reactions including:
 - factors affecting rates of reaction
 - collisions theory and activation energy
 - theory of absolute reaction times
- electrochemistry including:
 - electrolytic conduction including ionic conduction
 - theories of ionisation
 - Ostwald's dilution law and Onsager equation
 - electrode potential and electrical double layer
 - redox potentials and electromotive force (EMF) series
 - electrochemical cells, anodes and cathodes (definition)
 - Nernst equation
 - applications of electrochemistry
 - galvanic series and Pourbaix diagrams
 - corrosion, electroplating and refining
- limitations of selected chemical principles.
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Assessment Conditions

- Assessors must:
 - have vocational competency in calculating and predicting chemical outcomes in metallurgical situations 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 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 suitable access to an operating plant or equipment that allows for appropriate and realistic simulation and documentation including relevant workplace procedures, industry codes and standards.
- 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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