



Australian Government

Department of Education, Employment and Workplace Relations

MSATCM501A Calculate and predict chemical outcomes in metallurgical situations

Revision Number: 1

MSATCM501A Calculate and predict chemical outcomes in metallurgical situations

Modification History

Not applicable.

Unit Descriptor

Unit Descriptor	This unit covers applying appropriate chemical principles and techniques to calculate and predict outcomes in metallurgical situations.
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Application of the Unit

Application of the unit	This unit requires application of chemical principles and techniques as a member of a team or as an individual in metallurgical situations.
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Licensing/Regulatory Information

Not applicable.

Pre-Requisites

Pre-requisite Units	MSATCM406A	<i>Apply basic chemistry principles to metallurgy</i>

Employability Skills Information

Employability Skills	This unit contains employability skills.
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Elements and Performance Criteria Pre-Content

Not applicable.

Elements and Performance Criteria

ELEMENT	PERFORMANCE CRITERIA
1. Select chemical techniques and principles relevant to <i>metallurgy</i>	1.1. Consultations and briefings are undertaken with managers, employers and customers and other sources of information researched as appropriate to determine situation requiring metallurgical analysis 1.2. Relevant chemical techniques and principles are selected for particular metallurgical situation. 1.3. Technologies associated with chemical techniques relevant to the particular metallurgical situation are selected
2. Apply the relevant chemical principles and techniques appropriately	2.1. The basic chemical principles are applied in a consistent and appropriate manner to obtain required solutions. 2.2. Appropriate calculations and coherent units are used in the solution of chemical calculations. 2.3. Significant figures are used in chemical calculations. 2.4. The chemical techniques and associated technologies, are applied in a consistent and appropriate manner to obtain required solutions. 2.5. Solutions are communicated to appropriate personnel and situations and solutions recorded in accordance with procedures.

Required Skills and Knowledge

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge and their level, required for this unit.

Required skills:

- select appropriate chemical principles to suit specific applications
- select appropriate basic mechanical techniques and associated technologies, software and hardware to suit specific applications
- apply basic chemical principles to particular engineering situations
- apply and manipulate appropriate formulas for applications involving engineering calculations
- apply appropriate calculations to engineering and metallurgical situations
- refer solutions to the original aim of the application
- quote solutions in appropriate units, using appropriate significant figures.
- quote limitations of solutions, due to assumptions, chemical principles and techniques used
- present solutions referring to the original aim of the application.

Required knowledge:

Competency includes sufficient knowledge of:

- basic chemical principles as described in the range statement
- limitations of selected chemical principles

Evidence Guide

EVIDENCE GUIDE

The Evidence Guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment Guidelines for the Training Package.

Overview of assessment

A person who demonstrates competency in this unit must be able to calculate and predict chemical outcomes in metallurgical situations. Critical aspects for assessment and evidence are required to demonstrate competency in this unit.

Critical aspects for assessment and evidence required to demonstrate competency in this unit

It is essential that competence is demonstrated in the ability to:

- Apply the appropriate chemical theory to a given situation, leading to an appropriate solution.

Relationship to other units

This unit may be assessed concurrently with other relevant units.

Assessment method and context

This unit may be assessed on the job, off the job or a combination of both on and off the job. Where assessment occurs off the job, that is the candidate is not in productive work, then an appropriate simulation must be used where the range of conditions reflects realistic workplace situations. The competencies covered by this unit would be demonstrated by an individual working alone or as part of a team. The assessment environment should not disadvantage the candidate. This unit could be assessed in conjunction with any other units addressing the safety, quality, communication, materials handling, recording and reporting associated with applying basic scientific principles and techniques in mechanical engineering situations or other units requiring the exercise of the skills and knowledge covered by this unit.

Assessors should gather a range of evidence that is valid, sufficient, current and authentic. Evidence can be gathered through a variety of ways including direct observation, supervisor's reports, project work, samples and questioning. Questioning techniques should not require language, literacy and numeracy skills beyond those required in this unit of competency. The candidate must have access to all tools, equipment, materials and documentation required. The candidate must be permitted to refer to any relevant workplace procedures, product and manufacturing specifications, codes, standards, manuals and reference materials.

Assessors must be satisfied that the candidate can competently and consistently perform all elements of the unit as specified by the criteria, including required knowledge, and be capable of applying the competency in new and different situations and contexts.

EVIDENCE GUIDE**Resource implications**

This section should be read in conjunction with the range of variables for this unit of competency. A bank of case studies/scenarios and questions will also be required to the extent that they form part of the assessment method. Questioning may take place either in the workplace, or in an adjacent, quiet facility such as an office or lunchroom. No other special resources are required.

Range Statement

RANGE STATEMENT

The range statement relates to the unit of competency as a whole. It allows for different work environments and situations that may affect performance. Bold italicised wording, if used in the performance criteria, is detailed below. Essential operating conditions that may be present with training and assessment (depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts) may also be included.

Codes of practice/standards	Where reference is made to industry codes of practice, and/or Australian/international standards, it is expected the latest version will be used.
Metallurgy	Metallurgy covers the scientific and technical oversight of the extraction, smelting, refining, casting, heat treating, welding, forging and fabrication of metals to produce commercial metal products or to develop new alloys and processes.
Sources of information	Sources of information include reference texts, manufacturers' catalogues and industrial magazines, websites, use of phone, email and fax information gathering.
Chemical techniques and principles	The Constitution of Matter • elements, compounds, mixtures, states of matter; • atomic structure: protons, neutrons electrons; • electron structure of atoms; • the Bohr atom The Periodic Table The Constitution of Matter • chemical bonding: ionic, covalent, metallic; • valencies of common ions and radicals; • chemical reactions: balancing equations; • molecular & ionic equations; • Avogadro's number and the mole concept; • solubility and precipitation, solution concentration; • stoichiometric calculations. The Gas Laws • Kinetic Theory; • Boyles Law, Charles Law, Combined Gas Law; • Ideal Gas equation $PV=nRT$, molar volume of

RANGE STATEMENT

- a gas;
 - Gay-Lussac's Law, Avogadro's Law;
 - gas reaction calculations.
- Oxidation and Reduction
- definitions of oxidation and reduction;
 - half reactions;
 - balancing redox equations;
 - significance of oxidation and reduction in metallurgy
- Thermodynamics
- First Law of Thermodynamics;
 - Exothermic and endothermic reactions
 - Heats of reaction, combustion, etc;
 - Hess' Law
 - Heat capacity, Kirchoff's Law
 - Acid-base theory, hydrolysis;
 - Ionic product for water: pH, and pOH, the pH scale
 - Equilibrium constant
 - Effect of temperature and pressure on equilibrium constant
- Equilibrium and Free Energy Change
- Carnot cycle: concept of entropy;
 - Second Law of Thermodynamics;
 - Gibbs free energy;
 - Relationship between free energy and equilibrium constant;
 - Van't Hoff isotherm, Ban't Hoss isochore
 - Relationship between free energy and temperature
- Rates of Chemical Reactions
- Factors affecting rates of reaction;
 - Collisions theory, activation energy;
 - Theory of absolute reaction times
- Electrochemistry
- Electrolytic conduction: ionic conduction;
 - Theories of ionisation;
 - Ostwalds's dilution law, Onsager equation;
 - Electrode potential, electrical double layer;
 - Redox potentials, e.m.f series;
 - Electrochemical cells, anodes, and cathodes (definition);
 - Nernst equation;
 - Applications of electrochemistry;

RANGE STATEMENT	
	- Galvanic series, Pourbaix diagrams, - Corrosion, electroplating, refining
Significant figures	Are those relevant to accuracy and are appropriate to the process, data and desired range of results

Unit Sector(s)

Unit Sector	Metallurgy
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Competency field

Competency Field	
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Co-requisite units

Co-requisite Units		