



Government of **Western Australia**
Department of **Training**
and **Workforce Development**

METALS AND FABRICATION

Introduction to Metallurgy

Weldability of Metals

Review Questions

Metals and Engineering



ENG1295

Introduction to Metallurgy

Weldability of Metals

Review Questions

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Chapter 1 – Carbon steel

1. State the percentage range of each element in low carbon steel.

- Iron _____
- Carbon _____
- Phosphorous _____
- Silicon _____
- Sulphur _____
- Manganese _____

2. State eight (8) effects an increase of carbon will create in low carbon steel.

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____

3. Is it possible to harden mild steel with carbon content less than 0.3%?

Yes

No



4. State the influence of the following elements in mild steel.

- Phosphorous

- Silicon

- Sulphur

- Manganese

5. State the carbon percentage range of the following.

- Low carbon steels

- Medium carbon steels

- High carbon steels

6. What should be done to thick sections of low carbon steel to reduce shrinkage stresses?

7. What needs to be considered before, during and after welding medium carbon steels?



8. State four (4) things that you may need to consider when welding high carbon steels.

1. _____

2. _____

3. _____

4. _____





Chapter 2 – Cast iron

1. Briefly describe the following cast irons.

- Grey cast iron

- White cast iron

- Malleable cast iron

2. How can cracking be avoided when welding cast iron?

3. How can the oil and water that has deeply penetrated the cast iron be removed prior to welding?



4. When attempting to repair a crack in cast iron, the crack may tend to propagate due to the heat of the arc. How can this be rectified?

5. Sketch the type of joint preparation that is recommended for repairing cracks, showing the recommended dimensions.

6. Describe the 'hot' welding procedure for welding cast iron.

7. Describe the 'cold' welding procedure for welding cast iron.

8. If machinability of the cast is required upon welding, what is the best type of electrode to use?



Chapter 3 – Low alloy steels

1. Define the term 'low alloy steel'.

Definition

2. State the changes to the mechanical properties of steel that will occur with the addition of the following alloying elements.

- Manganese

- Chromium

- Nickel

- Molybdenum

3. How can the risk of cracking be reduced when cutting and welding low alloy steels?



4. Why is pre-heat necessary when welding low alloy steels?

5. Which of the following is the type of manual metal arc electrode most suited for welding low alloy steels? (Tick the correct answer/s)

- Cellulose
- Iron powder
- Hydrogen-controlled
- Rutile



6. Before welding a low alloy steel, what must you do first? (Tick the correct answer/s)
- Select a pre-heat temperature
 - Write a weld procedure
 - Identify the steel
 - Select a weld consumable
7. What are the mechanical advantages of the following steels, compared to plain carbon steels?
- Weather resistant steels

 - Quenched and tempered steels

 - Chrome/molybdenum steels

 - Nickel steels

8. What may be caused by incorrect heating and inter-run temperature when welding quenched and tempered steels?
- _____





Chapter 4 – Classification of alloy steels

1. Define the following.

- Low alloy steels

- High alloy steels

2. A material stated as 'killed' means what?

3. Define the classification WR **350/1LO**.

- WR _____
- 350 _____
- 1LO _____

4. State the common structural grades of quenched and tempered steels produced in Australia.

5. What considerations are required for the welding of quenched and tempered steels?



6. What conditions would determine the choice of chrome/molybdenum steels?

7. State the physical advantages of adding nickel to steel.





Chapter 5 – High alloy steels

1. State the minimum chromium and maximum carbon content of stainless steel.

2. What is described by the term 18/8 in austenitic stainless steels?

3. List four (4) procedures or techniques that should be adopted when welding austenitic stainless steels.

1.

2.

3.

4.

4. Define the term 'carbide precipitation'.

Definition

5. What may be used to minimise the occurrence of intergranular corrosion?



6. Why do austenitic stainless steels suffer from high levels of distortion?

7. Define the term 'co-efficient of linear expansion'.

Definition

8. Describe the 'sigma' phase, and how can this be rectified.

9. Describe the considerations required for the welding of martensitic stainless steels.

10. Austenitic manganese steels must not be allowed to cool slowly from elevated temperatures. Why is this?





Chapter 6 – Non-ferrous metals

1. Define the term 'non-ferrous metals'.

Definition

2. List eight (8) types of aluminium alloys and the series number for each one.

1.

2.

3.

4.

5.

6.

7.

8.

3. Which of the following is true about pure aluminium? (Tick the correct answer/s)

- | | |
|--------------------------|--------------------------|
| • Cannot be welded | • Is heavier than steel |
| • Does not form an oxide | • Is corrosive resistant |

4. Which non-ferrous metal forms the highest melting point oxide?

5. List four (4) factors that affect the weldability of aluminium.

1.

2.

3.

4.



6. High co-efficient of expansion may lead to what problems when welding aluminium?

7. Cuprous oxides lead to cracking, but how are the cracks formed?

8. Circle ☒ T if the statement is true or ☐ F if the statement is false.

The co-efficient of thermal expansion of aluminium is approximately twice that of mild steel.	<input checked="" type="radio"/> T	<input type="radio"/> F
Because of the high thermal conductivity of copper, pre-heat is not required.	<input type="radio"/> T	<input type="radio"/> F
The welding of titanium requires the operator to follow strict weld procedures.	<input type="radio"/> T	<input type="radio"/> F
Welding of nickel alloys requires thorough cleaning and the use of a pure shielding gas.	<input type="radio"/> T	<input type="radio"/> F
The low melting point of aluminium simplifies the control of the welding process.	<input type="radio"/> T	<input type="radio"/> F
Copper has a density greater than low carbon steel.	<input type="radio"/> T	<input type="radio"/> F



Chapter 7 – Grain structure

1. Describe the formation of the grain structure as solidification occurs.

2. If a metal is heated to above the Upper Critical Temperature, state the metallurgical difference between cooling the metal slowly rather than rapidly.

3. State the meaning of the following terms.

- Lower Critical Temperature (LCT)

- Upper Critical temperature (UCT)

- Transformation zone

4. Briefly state the effect that welding has on the grain structure of the parent metal.



5. Briefly state the effect that a multi-pass weld has on previous runs, if heat remains in the weld until fully complete.

6. State the purpose of the following terms, including the temperature and holding time for each.

- Annealing

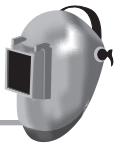
- Normalising

- Hardening

- Tempering

- Stress relieving

7. What is the purpose of pre-heating?



8. Name two (2) methods of pre-heating.
1. _____
 2. _____
9. A digital thermometer is one way of measuring temperature. Name two (2) other ways.
1. _____
 2. _____
10. Circle ☐ T if the statement is true or ☐ F if the statement is false.

A large grain structure is very ductile.	<input type="radio"/> T	<input type="radio"/> F
Austenite exists in low carbon steels below the Lower Critical Temperature of 723°.	<input type="radio"/> T	<input type="radio"/> F
Ferrite in steel is magnetic.	<input type="radio"/> T	<input type="radio"/> F
Steels with a carbon content of 0.83% are easily welded.	<input type="radio"/> T	<input type="radio"/> F
Grain growth will occur below the lower critical range.	<input type="radio"/> T	<input type="radio"/> F
Undesirable grain structures can be produced by welding.	<input type="radio"/> T	<input type="radio"/> F
For a hardenable steel to be hardened, it must be cooled rapidly.	<input type="radio"/> T	<input type="radio"/> F



METALS AND FABRICATION

Introduction to Metallurgy

Weldability of Metals

Review Questions

DESCRIPTION

This book contains review questions based on the content of Introduction to Metallurgy – Weldability of Metals, product code ENG549. It can be used as a ‘partner’ to that book, to provide students with the opportunity to review their learning. It may also be used as an assessment tool, enabling students to demonstrate their understanding of introductory arc welding principles including:

- carbon steels
- cast iron
- low alloy steels
- classification of alloy steels
- high alloy steels
- non-ferrous metals
- grain structure.

The book is divided into chapters, to match the chapters in ENG549. For more information about the content covered by Introduction to Metallurgy, please refer to our product catalogue description using its product code; ENG549.

EDITION

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CATEGORY

Metals and Engineering

TRAINING PACKAGE

- MEM05

RELATED PRODUCTS

- ENG549: Introduction to Metallurgy – Weldability of Metals



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