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-heating 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’.

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
   • Does not form an oxide
   • Is heavier than steel
   • 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.

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

<table>
<thead>
<tr>
<th>Statement</th>
<th>T</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>A large grain structure is very ductile.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Austenite exists in low carbon steels below the Lower Critical Temperature of 723º.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ferrite in steel is magnetic.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Steels with a carbon content of 0.83% are easily welded.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grain growth will occur below the lower critical range.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Undesirable grain structures can be produced by welding.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>For a hardenable steel to be hardened, it must be cooled rapidly.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
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
2009

CATEGORY
Metals and Engineering

TRAINING PACKAGE
• MEM05

RELATED PRODUCTS
• ENG549: Introduction to Metallurgy – Weldability of Metals