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PRACTICE QUESTIONS

## American Petroleum Institute: Individual Certification Programs (API)

# 577

577 - Welding Inspection Metallurgy

| EDITION | QUESTIONS | FORMAT |
| --- | --- | --- |
| Demo | 9 | Limited Edition PDF |

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# Before you begin

### What this is

9 practice questions for American Petroleum Institute: Individual Certification Programs (API) `577`, each with its answer key and an explanation. Answer a question before you read its key — the explanation is worth more once you have committed.

### If something looks wrong

Send us three things and we will check it:

- the exam code, `577`
- the question number
- the email address on your order

Write to **support@mometrix.net**. We reply within one business day.

**QUESTION 1** SINGLE CHOICE

Which of the following best describes the effect of cold working on a metal?

A It increases the temperature at which recrystallization occurs.

**B It refines the grain size and increases the dislocation density, raising strength and hardness.**

C It converts the body-centered cubic crystal structure to a face-centered cubic structure.

D It reduces the yield strength and increases the ductility of the metal.

**ANSWER** **B**

**WHY** Cold working (plastic deformation below the recrystallization temperature) increases dislocation density and generally refines grains, which increases strength and hardness while reducing ductility. The other options describe annealing (A), allotropic transformation (C), and the opposite of the actual effect (D).

**QUESTION 2** SINGLE CHOICE

A carbon steel is heated above its upper critical temperature and then quenched rapidly in water. Which metallurgical structure is most likely to result?

A Coarse pearlite

B Spheroidite

**C Martensite**

D Ferrite and coarse pearlite

**ANSWER** **C**

**WHY** Rapid quenching of austenite suppresses the diffusion-controlled transformation to pearlite or bainite and instead produces martensite, a supersaturated, body-centered tetragonal phase that is hard and brittle. Slow cooling would produce pearlite (A, D), and prolonged subcritical heat treatment would produce spheroidite (B).

QUESTION 3 SINGLE CHOICE

The addition of chromium to iron primarily provides which property to the resulting alloy?

A Improved magnetic permeability

**B Improved corrosion and oxidation resistance**

C Increased thermal conductivity

D Reduced density

ANSWER **B**

WHY Chromium is the principal alloying element added to steels to provide corrosion and oxidation resistance; when present in sufficient quantity (generally above about 10.5%), it forms a stable passive oxide film. The other options describe properties more associated with silicon electrical steels (A) or other alloying strategies.



QUESTION 4 SINGLE CHOICE

Which nondestructive examination method is most effective for detecting surface-breaking cracks in a ferromagnetic material?

A Radiographic testing

B Ultrasonic testing

**C Magnetic particle testing**

D Liquid penetrant testing

ANSWER **C**

WHY Magnetic particle testing is specifically well suited to detecting surface and slightly subsurface discontinuities in ferromagnetic materials because the leakage field created by a crack attracts the particles. Liquid penetrant (D) also finds surface cracks but is not limited to ferromagnetic materials. Radiography (A) and ultrasonic testing (B) are volume methods less sensitive to tight surface cracks.

**QUESTION 5** SINGLE CHOICE

Hydrogen-assisted cracking in steel welds is most commonly associated with which combination of conditions?

A Low hydrogen input, low restraint, and high preheat

B **High diffusible hydrogen, a sensitive (hard) microstructure, and tensile stress**

C Excessively low interpass temperatures and excessive weld bead overlap

D Lack of filler metal coverage and excessive root opening

**ANSWER** **B**

**WHY** Hydrogen-assisted (or hydrogen-induced) cracking requires the simultaneous presence of three factors: a source of diffusible hydrogen, a hard, susceptible microstructure (typically from rapid cooling), and tensile stress (from restraint or residual stress). The other options describe conditions that either reduce hydrogen cracking risk (A) or describe unrelated weld discontinuities such as lack of fusion or incomplete penetration (C, D).



**QUESTION 6** SINGLE CHOICE

Which of the following is typically required information on a Welding Procedure Specification (WPS) as called out in AWS D1.1 for prequalified procedures?

A Welder's name and qualification test date

B **Joint type, base metal thickness range, and filler metal classification**

C Heat input calculation for each individual pass

D List of all welders authorized to use the procedure

**ANSWER** **B**

**WHY** A WPS documents the essential variables of the joining process, including joint type, base metal thickness range, filler metal classification, and welding parameters. Welder identity and qualification records (A, D) are documented on welder qualification records, not the WPS. Heat input may be calculated for procedure qualification but is not typically a required line item on a prequalified WPS (C).

**QUESTION 7** SINGLE CHOICE

Which phase in the iron–carbon phase diagram has the highest carbon solubility?

- A Ferrite
- B Cementite
- **C Austenite**
- D Martensite

**ANSWER** C

**WHY** Austenite (gamma iron) can dissolve up to about 2.0% carbon by weight at 1147 °C, which is the maximum solubility of carbon in iron. Ferrite (alpha iron) has very limited solubility (≈0.02% at room temperature), cementite is the fixed compound Fe3C (6.67% C), and martensite is a metastable phase whose carbon content equals that of the parent austenite but is not an equilibrium phase on the diagram.

**QUESTION 8** SINGLE CHOICE

What is the principal metallurgical purpose of a postweld heat treatment (PWHT) on a carbon or low-alloy steel weldment?

- A To refine the as-deposited weld metal grain size
- B To increase the hardness of the heat-affected zone
- **C To relieve residual stresses and temper the weld zone**
- D To convert ferrite to pearlite in the weld metal

**ANSWER** C

**WHY** PWHT on carbon and low-alloy steel weldments is performed primarily to relieve residual welding stresses and to temper (soften) the hard, brittle martensitic or bainitic microstructures that form in the heat-affected zone during rapid weld cooling. PWHT typically reduces hardness rather than increasing it and does not convert ferrite to pearlite.

**QUESTION 9** SINGLE CHOICE

Which microstructural constituent in a carbon steel weld heat-affected zone (HAZ) appears as a dark, feathery or plate-like aggregate under the microscope and is generally considered the most detrimental to toughness?

- A Ferrite
- B Pearlite
- C **Widmanstätten structure**
- D Spheroidized cementite

**ANSWER** C

**WHY** Widmanstätten structure forms when austenite transforms at relatively high temperatures with a plate-like growth pattern along preferred crystallographic planes. The resulting coarse, aligned plates produce brittle, low-toughness behavior, especially in coarse-grained HAZ regions of carbon and low-alloy steel welds. Ferrite and pearlite are comparatively tougher constituents, and spheroidized cementite is a soft, ductile product of prolonged high-temperature exposure rather than the dark feathery brittle phase described.