

## Section 1

Select ONE correct answer from the following multiple choice questions (1 mark each)

1. Which one of the following features least promotes corrosion?
  - A. Entrapment of moisture
  - B. Crevices
  - C. Shape
  - D. Thickness of the metal or alloy used
2. To eliminate entrapment of moisture, it is advised to
  - A. Make corners smooth
  - B. Coat the containers
  - C. Use corrosion resistant alloy, like cupro-nickel
  - D. Provide a drainage hole
3. Steel columns rest on ground levels. In certain situations water and debris collects at the junction of the ground and the columns. The most practical way to resolve the problem is to
  - A. Keep the junction clean by physical means
  - B. Eliminate the source of water and debris
  - C. Use coated steel columns
  - D. Use concrete plinths with provision for water to runoff
4. Storage containers should be designed in such a way that
  - A. No crevices are formed
  - B. No obstacle to drainage occurs
  - C. The design should ensure that the containers are drained in minimum time
  - D. The containers should be constructed from plastics rather than metals or alloys
5. In storage tanks, design plays an important role. Which one of the following should be a major consideration?
  - A. The lining of the tank must be uniform
  - B. The tank material should be highly resistant to corrosive fluids
  - C. The exterior of the tank should be protected
  - D. All outlet materials, such as pipes, should be galvanically compatible with the tank material
6. If moisture and dirt entrapment is a major problem, it would be a good practice to
  - A. spot weld
  - B. skip weld
  - C. stitch weld
  - D. butt weld

7. The corrosion resistance of metals, such as stainless steels and copper alloys, depends upon the buildup of uniform surface films. Which one of the following would require a maximum attention of the designer?
  - A. Accessibility of oxygen in the operating medium
  - B. Coating of the metal
  - C. The drainage capability of the vessel
  - D. The period of storage of the liquid in a container
  
8. To maintain a smooth flow in pipes, it is usual to avoid throttles, valves, and orifices unless absolutely necessary. This is usually done to
  - A. maintain smooth flow
  - B. avoid impingement of fluids
  - C. eliminate surging of pressure
  - D. change the fluid directions
  
9. Pipes of different materials, such as copper and steels, should not be embedded in a trench in close proximity to avoid
  - A. deposition of copper on steel pipe
  - B. depassivation of steel
  - C. corrosion of copper pipes
  - D. galvanic corrosion, in general
  
10. The first step in the materials selection process is
  - A. Define required material characteristics
  - B. Select test procedures
  - C. Conduct tests
  - D. Identify corrosion monitoring techniques

## Section 2

### Briefly discuss the following questions (5 marks each)

11. A type 316 stainless steel pump shaft failed after two years of continuous service in seawater. There was little or no corrosion of the shaft. The shaft failed just above a bearing in the pump. The fractured surface was relatively flat but showed some indication of seashell patterns. The outermost  $\frac{1}{4}$  of the fracture surfaces were covered with a light film of corrosion products, but the inner  $\frac{3}{4}$  was free of corrosion products.
- (a) What form of corrosion is most likely to have occurred?
  - (b) Are the seashell shaped patterns significant?
  - (c) Why was only the outer  $\frac{1}{4}$  of the fracture surface covered with corrosion products?
  - (d) Would a shaft with higher tensile strength solve the problem?
12. A 70% copper – 30% zinc brass fitting was used to connect galvanized steel pipe in an underground service line from a ductile cast iron water main to a residence. The pipe was electrically isolated from the ductile cast iron water main. The pipe adjacent to the fittings failed after about 5 years of service. Only the pipe within 6" of the fitting was significantly corroded with the greatest amount of corrosion at the threaded joint between the pipe and the fitting.
- (a) What was the most likely form of corrosion?
  - (b) Should a bronze fitting be used instead of the brass fitting?
  - (c) What would be the effect if the insulating coupling between the ductile cast iron and the galvanized steel pipe were replaced with a galvanized steel (non-isolating)?
  - (d) Would the situation have been better or worse if the pipe had been copper and a galvanized fitting was used?

**Answer Key for Test "demo.tst", 17/11/06**

No. in Q-Bank	No. on Test	Correct Answer
6-24	1	D
6-25	2	A
6-26	3	D
6-28	4	B
6-29	5	D
6-30	6	D
6-31	7	A
6-32	8	B
6-33	9	D
6-15	10	A
4-159	11	(a) Corrosion fatigue (b) Yes, they are indicative of fatigue (c) This area failed some time prior to the final fracture and corrosion products had time to form on these surfaces and not on the rest of the fracture surface. (d) Only if the material had better resistance to corrosion fatigue in seawater.
4-160	12	(a) Galvanic corrosion (b) Brass and bronze have similar potentials. The galvanic corrosion of the galvanized pipe would not be significantly reduced. (c) The galvanized steel would corrode at a higher rate due to coupling with the large area of cathodic ductile iron. (d) Yes, due to the adverse area ratio with a small galvanized steel fitting surface area and a large copper pipe surface area.