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SKU: 9780073373867-SOLUTIONS

24. Four metals which were used by early metal workers may include copper, bronze, silver, gold, and iron. Copper was the first to be worked.
25. The Chinese developed the ability to make steel from wrought iron in 589 A.D.
26. The first patent for electric arc welding was first issued in the United States.
27. The invention of the coated electrodes gave electric arc welding its greatest boost.
28. Answers may vary but should include such process as: GTAW OR TIG, GMAW OR MIG, SMAW, Submerged arc welding, Plasma arc welding, welding of plastics, etc.
29. No. MIG or GMAW has increased very rapidly; it is now used in many industries.
30. Answers may vary but should include such jobs as: welding operator, welder fitter, combination welder, welding supervisor, welding foreman, equipment sales, welding instructor, robotics welding operator, welding engineer, certified welding inspector.
31. Answers may vary but should include such jobs as: welding engineer, technical editor, welding professor.
32. MIG or GMAW process contributed most to aluminum welding.

B. Internet Activities

A. England's Cambridge International Science Publishing's. Sample answer is Welding in Space and Related Technologies, Structural Stability of Deposits and Welded Joints in Power Engineering, Metallurgy of Arc Welding, Arc Slag Remelting of Steel and Alloys.

B. Answers may vary. Sample answer: Safety issues from the AWS Web site (www.aws.org)—noise, tripping and falling, fumes and gases, burn protection.

CHAPTER 2

A. Review Answers

1. b
2. d
3. d

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4. d
5. a
6. d
7. a
8. b
9. b
10. d
11. d
12. d
13. b
14. c
15. c
16. c
17. d
18. c
19. a
20. d
21. The advantages of welding as a means of fabrication are: Greater design flexibility and lower design cost, an elimination of patterns, lower cost of material, fewer man-hours of production, absorption of fixed purchasing charges, and minimized inventory and obsolescence charges.
22. The advantages of welding as a means for maintenance and repair: The addition of new metal to a worn part, repair and replacement of broken parts, special needs for production requirements.
23. Some of the advantage steel has in construction is in the design of fabricated equipment. These designs can reduce the weight of a machine, such as an earthmover, by 15 to 20 percent. It also makes the fabricated part stronger with rigidity.
24. Whether the pipelines are for pressure or overland, welded pipe systems have permanently tight connections of greater strength and rigidity. Other advantages of welding fabrication of pipe include a more pleasing appearance, efficient and economical.

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25. The advantages of welded construction when applied to pressure vessels are: construction and maintenance cost are reduced, less material is used in the construction of welded vessels, thick plated pressure vessels, 3 to 5 inches in thickness must be welded.

26. The advantages in the application of welding to buildings are: materials are standard, readily available and accurate; large parts can be fabricated in the shop under controlled conditions; site erection is fast resulting in lower cost; construction material weigh less and are stronger; prefabricated modules provide flexibility of design and floor plan arrangements.

27. Bridges can have all-welded construction.

28. Due to the welding process, a more rigid frame construction, which include piling sections and reinforcing steel make a structure more resistant to earthquakes, floods, and high winds.

29. No. Pressures of over 1,000 psi and temperatures ranging from −200 to +1,2000 degrees F. are not uncommon in high pressure welded pipelines.

30. Some of the watercraft fabricated by welding includes aircraft carriers, destroyers, cruisers, and atomic-powered submarines.

31. The welding process is now constructing bridges wholly or in part. Savings in typical steel bridges, resulting from welded construction, range up to 20 percent. A welded butt joint is the best type of joint, with greater strength and a more uniform stress distribution in comparison to riveting.

32. Ten of the products manufactured wholly or in part by welding by the military are: pulley brackets, structural fittings, axles, struts, brackets, armor plate assemblies, gun mounts, gas and liquid tanks, engine cowling and wheel boots.

33. Welding is the principal method of joining materials used by the railroad industry. It is used as a maintenance tool, building streamlined diesel and electric locomotives, passenger cars, refrigerator cars, and new track which is continuously welded.

34. The three weaknesses are: service failure, a rivet joint develops a strength equal to only 80 percent of the plate and time consuming due to punching holes in the plate.

35. A tank which is over 3 inches can not be riveted, but can be welded.

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B. Internet Activities

A. Answers may vary. Sample answer: Use a search engine. Enter the key words steel home construction. Determine what to use from the results of the search.

B. See student's work.

CHAPTER 3

A. Review Answers

1. d
2. a
3. c
4. b
5. d
6. d
7. c
8. c
9. c
10. d
11. d
12. a
13. c
14. a
15. c
16. c
17. a
18. c
19. b

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CHAPTER 1

1. False
2. True
3. c
4. 3000
5. c
6. False
7. b
8. False
9. True
10. b
11. Henry Ford
12. True
13. Argon or Helium
14. TIG
15. False
16. b
17. d
18. False
19. True
20. False
21. False
22. d
23. c
24. b
25. b
26. True
27. True
28. False
29. False
30. True

CHAPTER 2

1. Fabrication
2. e
3. False
4. b
5. True
6. False
7. False
8. False
9. 290
10. c
11. False
12. True
13. high pressure
14. strength
15. True
16. False
17. False
18. gondola
19. c
20. True
21. safer
22. d

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23. False
24. Liberty
25. True
26. True
27. False
28. energy cost
29. leakage
30. b

CHAPTER 3

1. nonferrous
2. ferrous
3. c
4. False
5. False
6. carbon
7. steel
8. Assyrians
9. blast
10. crucible
11. cementation
12. 300
13. b
14. False
15. False
16. welding
17. True
18. d
19. False
20. True
21. purify
22. higher
23. c
24. coal
25. coke
26. True
27. True
28. limestone
29. impurities
30. refractory
31. slag
32. graphite
33. blast
34. b
35. pig
36. False
37. vacuum
38. induction
39. a. 2
    b. 3
    c. 1
40. ingot
41. forging
42. slab
43. a. 2
    b. 4
    c. 1
    d. 3

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