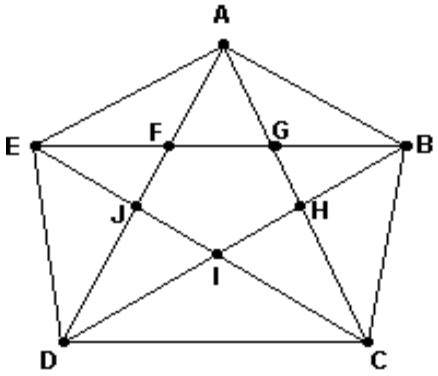
Name: _____ Class: _____ Date: _____

Chapter 2

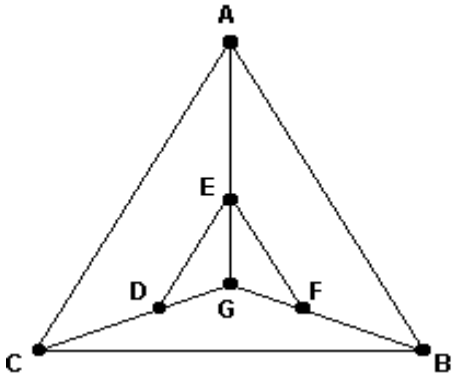
1. Which of the following describes a Hamiltonian circuit for the graph below?



a. *ABCDEFJIHG*
b. *ABCDEAFJDIHBGFEJICHGA*
c. *ABCDEAGHIJFA*
d. *AEDCBGHIJFA*

ANSWER: d

2. Which of the following describes a Hamiltonian circuit for the graph below?



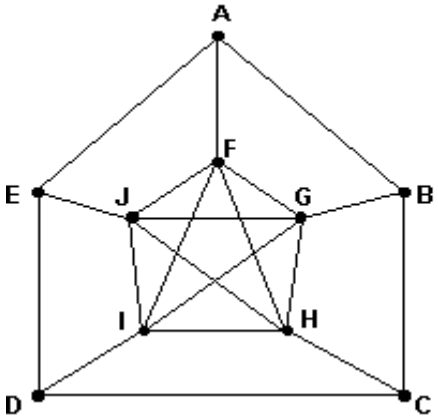
a. *ABCDEFGA*
b. *ACBAEGFDEA*
c. *ACBFGDEA*
d. *ABCDGEF*

ANSWER: c

3. Which of the following describes a Hamiltonian circuit for the graph below?

Name: _____ Class: _____ Date: _____

Chapter 2



a. *ABCDEJHIGF*

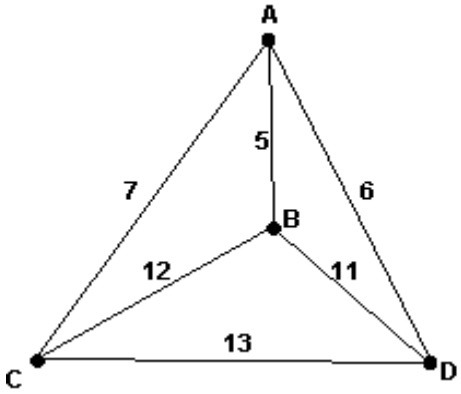
b. *AEDCBGIHJFA*

c. *ABCDEAFGHIJFA*

d. *ABCDEAFGBGIDIHCHJEJFA*

ANSWER: b

4. On the graph below, which routing is produced by using the nearest-neighbor algorithm to solve the traveling salesman problem, starting at *A*?



a. *ABCDA*

b. *ABDCA*

c. *ACBDA*

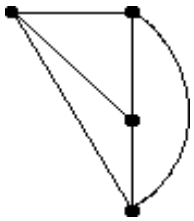
d. *ABCD*

ANSWER: b

5. Construct a complete graph on four vertices.

ANSWER:

Answers will vary. One solution is:



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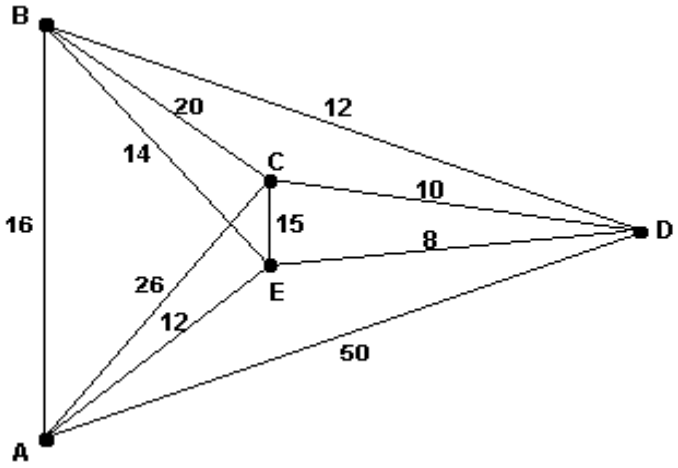
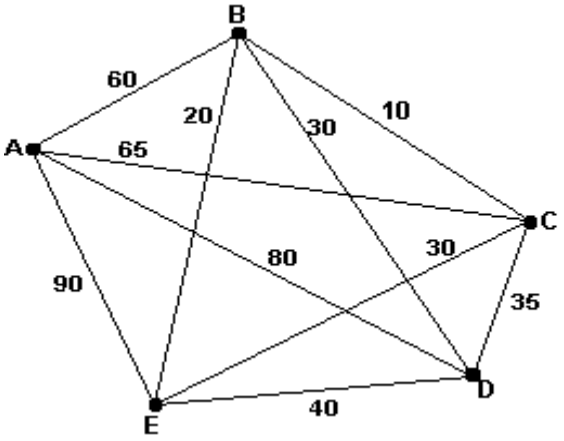
6. For the graph below, what is the cost of the Hamiltonian circuit obtained by using the nearest-neighbor algorithm, starting at *A*?



a. 60
b. 54
c. 62
d. 66

ANSWER: d

7. For the graph below, what is the cost of the Hamiltonian circuit obtained by using the nearest-neighbor algorithm, starting at *A*?



a. 215
b. 220
c. 235
d. 295

ANSWER: b

8. For the graph below, what is the cost of the Hamiltonian circuit obtained by using the nearest-neighbor algorithm, starting at *C*?

Name: _____ Class: _____ Date: _____

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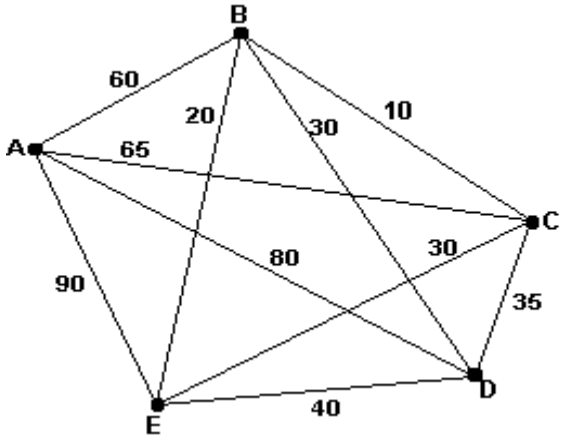
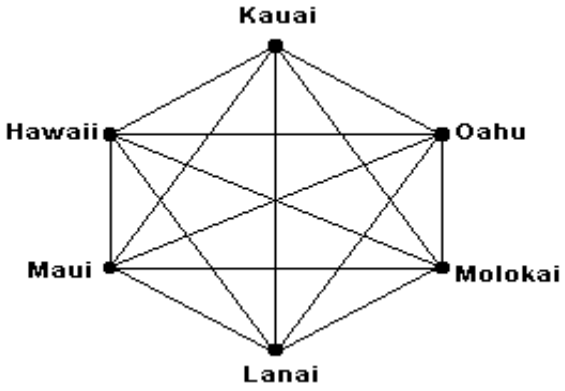


a. 215
b. 220
c. 235
d. 295

ANSWER: a

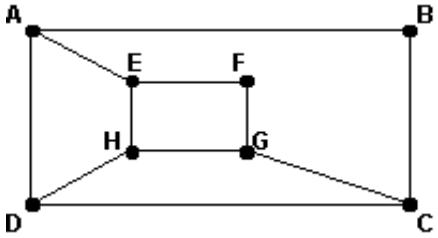
9. Construct a complete graph whose vertices represent the six largest islands of Hawaii: Kauai, Oahu, Molokai, Lanai, Maui, and Hawaii.

ANSWER:



Answers will vary. One solution is:

10. Which path listed forms a Hamiltonian circuit on the graph below?



a. *ADCBFGHEA*
b. *ABCDHGFE*
c. *ABCDHGFEA*
d. *ABCDHGFEHDA*

ANSWER: c

Chapter 2

11. On a map there are roads from Town *A* of length 10, 26, 12, and 50 miles. Using the nearest-neighbor algorithm for finding a Hamiltonian circuit starting at Town *A,* which road would be traveled first?

a. Road of length 10
b. Road of length 26
c. Road of length 12
d. Road of length 50

ANSWER: a

12. When the traveling salesman problem (Hamiltonian circuit) is applied to six cities, how many tours are possible?

a. 60
b. 120
c. 360
d. 720

ANSWER: b

13. When the traveling salesman problem (Hamiltonian circuit) is applied to six cities, how many distinct circuits are possible?

a. 120
b. 60
c. 24
d. 12

ANSWER: b

14. When the traveling salesman problem (Hamiltonian circuit) is applied to four cities, how many distinct tours are possible?

a. 3
b. 6
c. 12
d. 24

ANSWER: b

15. When the traveling salesman problem (Hamiltonian circuit) is applied to seven cities, how many distinct circuits are possible?

a. 360
b. 720
c. 2520
d. 5040

ANSWER: a

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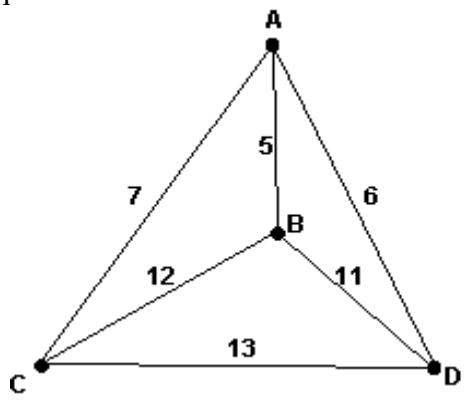
Chapter 2

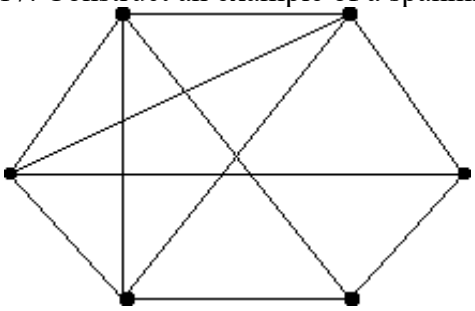
16. On the graph below, which algorithm has different routing from others to solve the traveling salesman problem?



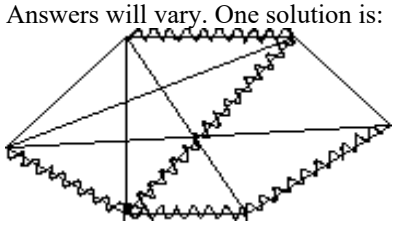
a. The sorted-edges algorithm
b. The nearest-neighbor algorithm starting from *A*
c. The nearest-neighbor algorithm starting from *B*
d. The nearest-neighbor algorithm starting from *D*

ANSWER: b

17. Construct an example of a spanning tree on the graph given below.



ANSWER: Answers will vary. One solution is:



18. For the graph below, what is the cost of the Hamiltonian circuit obtained by using the sorted-edges algorithm?

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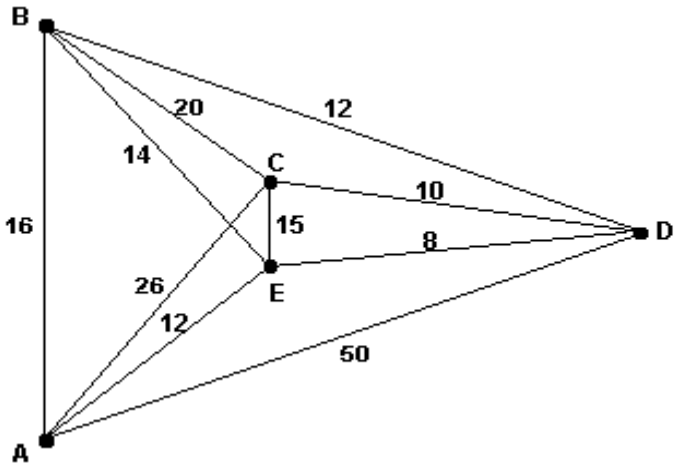


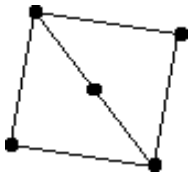
a. 40
b. 58
c. 60
d. 66

ANSWER: d

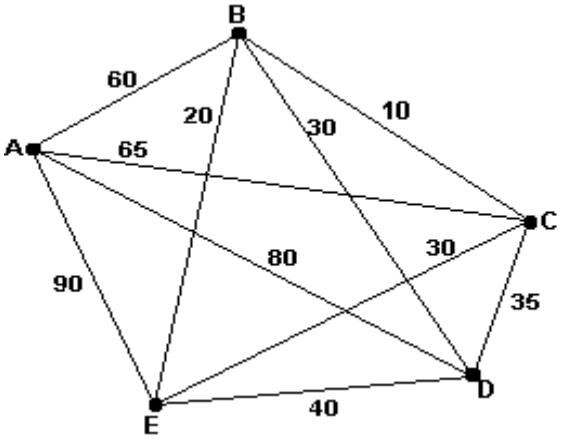
19. Construct an example of a graph with no Hamiltonian circuit.

ANSWER:

Answers will vary. One solution is:



20. For the graph below, what is the cost of the Hamiltonian circuit obtained by using the sorted-edges algorithm?



a. 220
b. 225
c. 235
d. 295

ANSWER: c

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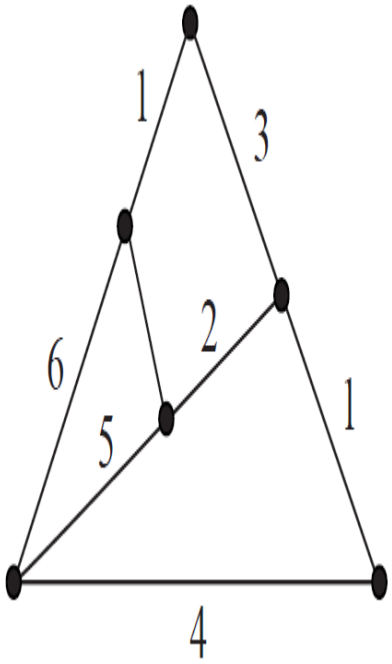
Chapter 2

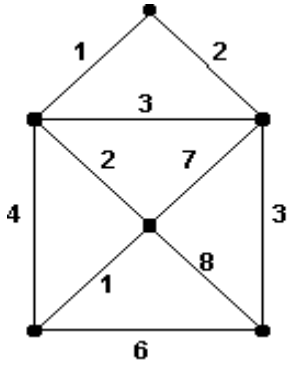
21. Use Kruskal's algorithm for minimum-cost spanning trees on the graph below. What is the cost of the tree found?



a. 10
b. 11
c. 14
d. 15

ANSWER: b

22. Use Kruskal's algorithm for minimum-cost spanning trees on the graph below. What is the cost of the tree found?

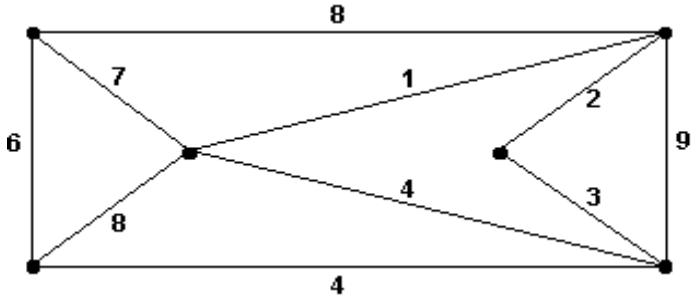


a. 5
b. 9
c. 12
d. 15

Chapter 2

ANSWER: b

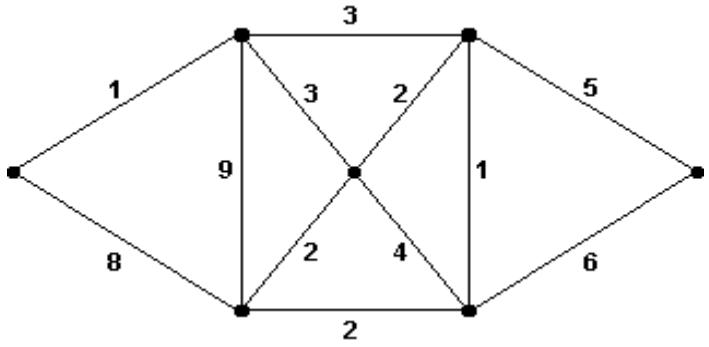
23. Use Kruskal's algorithm for minimum-cost spanning trees on the graph below. What is the cost of the tree found?



a. 23
b. 20
c. 16
d. 5

ANSWER: c

24. Use Kruskal's algorithm for minimum-cost spanning trees on the graph below. What is the cost of the tree found?



a. 20
b. 14
c. 19
d. 22

ANSWER: b

25. Use Kruskal's algorithm for minimum-cost spanning trees on the graph below. What is the cost of the tree found?

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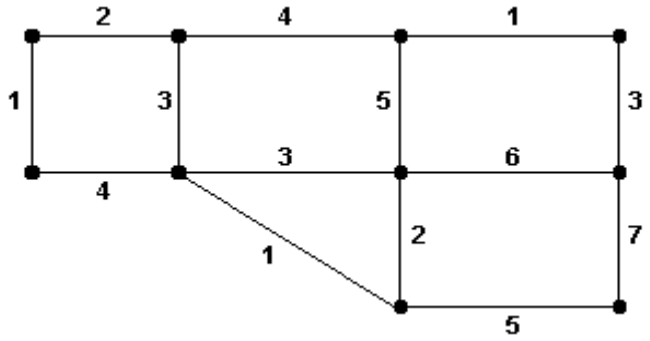
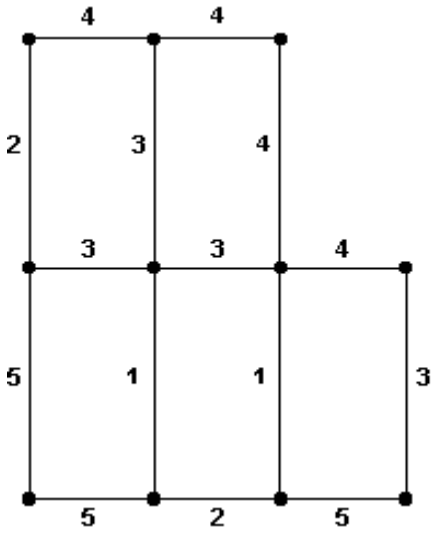


a. 47
b. 25
c. 22
d. 15

ANSWER: c

26. Use Kruskal's algorithm for minimum-cost spanning trees on the graph below. What is the cost of the tree found?

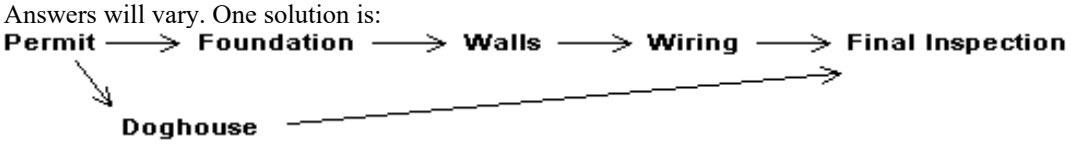


a. 22
b. 28
c. 32
d. 49

ANSWER: b

27. Construct a digraph for the following tasks necessary when building a house: get a building permit, install wiring, pour foundation, build walls, build doghouse, pass final inspection.

ANSWER: Answers will vary. One solution is:



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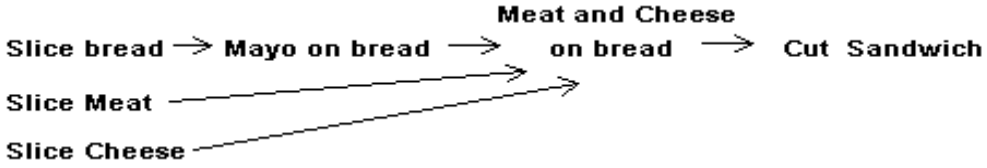
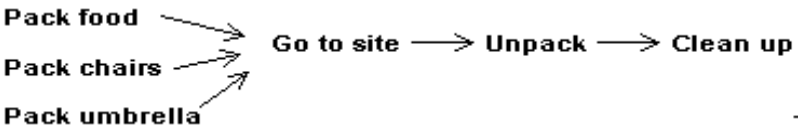
28. Identify six tasks necessary when building a sandwich and construct a digraph for these tasks.

ANSWER: Answers will vary. One solution is:



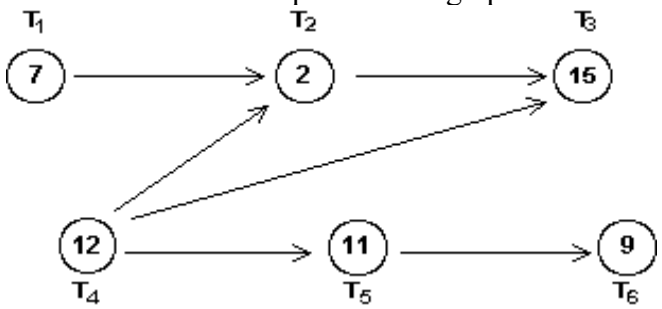
29. Identify six tasks necessary when preparing for a picnic and construct a digraph for these tasks.

ANSWER:



Answers will vary. One solution is:

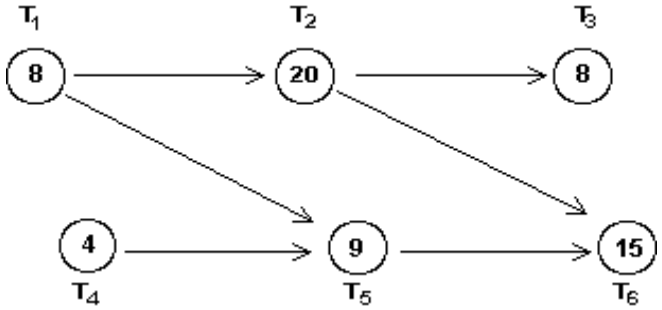
30. Given the order-requirement digraph for a collection of tasks shown below, what would the critical path be?



a. *T*1, *T*2, *T*3
b. *T*4, *T*2, *T*3
c. *T*4, *T*3
d. *T*4, *T*5, *T*6

ANSWER: d

31. If the order-requirement digraph for a collection of tasks is shown below, what is the minimum completion time for the collection of tasks?



a. 64 minutes
b. 43 minutes
c. 36 minutes
d. 28 minutes

ANSWER: b

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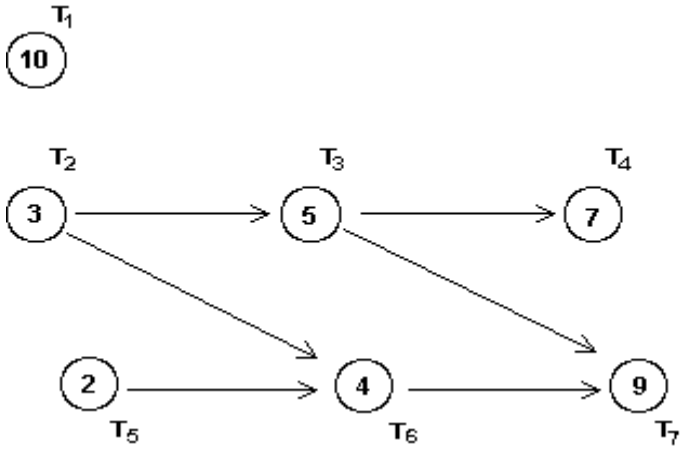
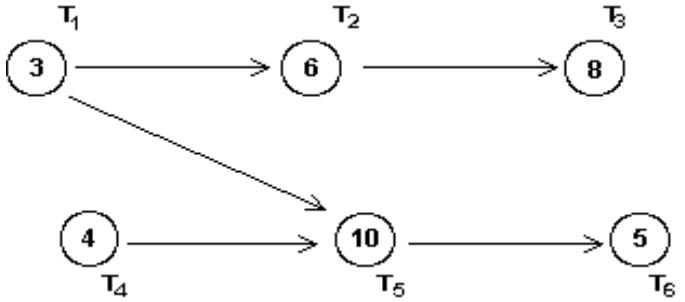
32. What is the earliest possible completion time for a job whose order-requirement digraph is shown below?



a. 10 minutes
b. 17 minutes
c. 40 minutes
d. 15 minutes

ANSWER: b

33. What is the earliest possible completion time for a job whose order-requirement digraph is shown below?



a. 15 minutes
b. 22 minutes
c. 34 minutes
d. 19 minutes

ANSWER: d

34. What is the earliest possible completion time for a job whose order-requirement digraph is shown below?

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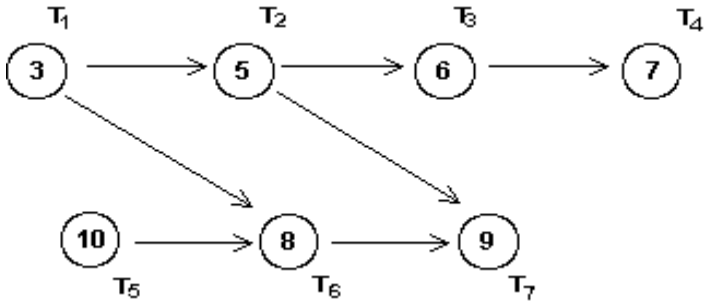
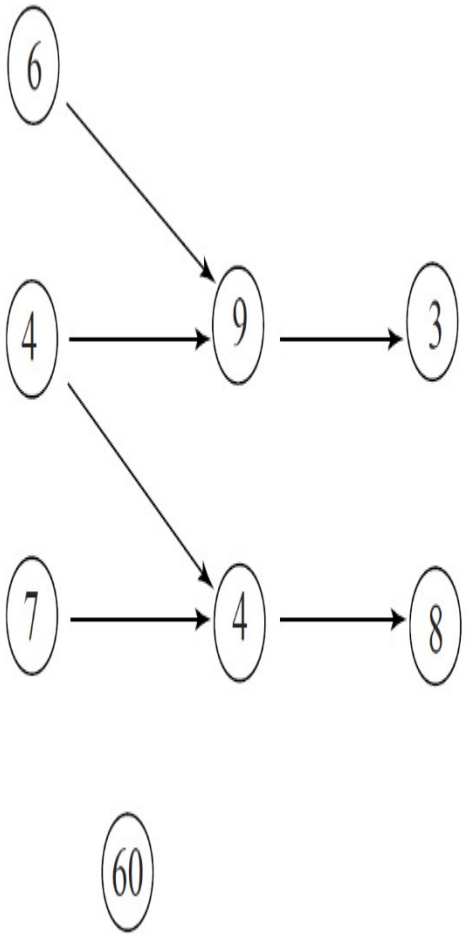


a. 27 minutes
b. 17 minutes
c. 21 minutes
d. 48 minutes

ANSWER: a

35. What is the earliest possible completion time for a job whose order-requirement is shown below?



a. 16 minutes
b. 19 minutes
c. 30 minutes

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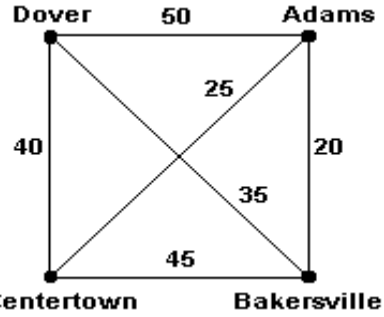
d. 60 minutes

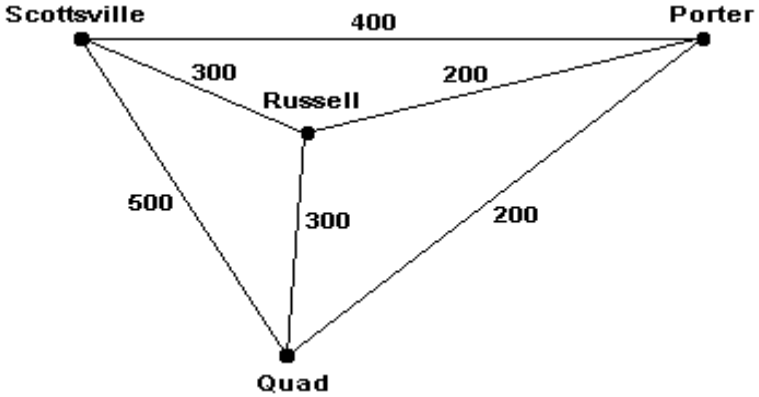
ANSWER: d

36. Use the brute force algorithm to solve the traveling salesman problem for the graph of the four cities shown below.



ANSWER: Routes *ABCDA* and *ACBDA* have cost 155. Route *ABDCA* has (minimum) cost 120.

37. Use the brute force algorithm to solve the traveling salesman problem for the graph of the four cities shown below.



ANSWER: Routes *PQRSP* and *PQSRP* have (minimum) cost 1200. Route *PRQSP* has cost 1400.

38. Making the best choice at each stage for solving the traveling salesman problem always gives optimal results.

a. True

b. False

ANSWER: b

39. The sorted-edges algorithm for solving the traveling salesman problem always gives optimal results.

a. True

b. False

ANSWER: b

40. Kruskal's algorithm for finding minimum-cost spanning trees always gives optimal results.

a. True

b. False

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ANSWER: a

41. The nearest-neighbor algorithm for solving the traveling salesman problem always produces the same result as the sorted-edges algorithm.

a. True
b. False

ANSWER: b

42. The path produced by the nearest-neighbor algorithm when solving the traveling salesman problem may be dependent on the starting city.

a. True
b. False

ANSWER: a

43. The path produced by the sorted-edges algorithm when solving the traveling salesman problem may be dependent on the starting city.

a. True
b. False

ANSWER: b

44. The minimum-cost spanning tree produced by applying Kruskal's algorithm will always contain the lowest cost edge of the graph.

a. True
b. False

ANSWER: a

45. The minimum-cost spanning tree produced by applying Kruskal's algorithm may contain the most expensive edge of the graph.

a. True
b. False

ANSWER: a

46. A heuristic algorithm will always produce optimal results.

a. True
b. False

ANSWER: b

47. The best-known guarantee for a heuristic algorithm for a traveling salesman problem yields a cost no worse than one and a half times the optimal cost.

a. True
b. False

ANSWER: a

Chapter 2

48. When Kruskal's algorithm is used to find a minimum-cost spanning tree on a graph, which of the following is false?

a. Circuits are not permitted in the tree.
b. The tree contains the edge of the graph of minimum cost.
c. The tree is not necessarily connected.
d. The tree may contain the edge of the highest cost.

ANSWER: c

49. A spanning tree of a graph must contain every vertex of the graph.

a. True
b. False

ANSWER: a

50. A digraph is a graph with exactly two vertices.

a. True
b. False

ANSWER: b

51. If a graph of nine vertices is complete, how many edges are there?

ANSWER: (9)(8)/2 = 36 edges

52. Suppose an architect needs to design an intercom system for a large office building. Which technique is most likely to be useful in solving this problem?

a. Finding an Euler circuit on a graph
b. Applying the nearest-neighbor algorithm for the traveling salesman problem
c. Applying Kruskal's algorithm for finding a minimum-cost spanning tree for a graph
d. None of these techniques is likely to apply

ANSWER: c

53. Suppose a veteran wants a visit to all the war memorials in Washington, D.C., in one day. Which technique is most likely to be useful in solving this problem?

a. Finding an Euler circuit on a graph
b. Applying the nearest-neighbor algorithm for the traveling salesman problem
c. Applying Kruskal's algorithm for finding a minimum-cost spanning tree for a graph
d. None of these techniques is likely to apply

ANSWER: b

54. You own a chain of 12 apartment complexes (including your residence), and you want to plan a trip to visit each of your properties. If it takes 1/2 minute to compute the total length of a tour, how long will it take to apply the brute force algorithm to find the optimal tour?

ANSWER: (11!/2)(1/2) = 9,979,200 minutes, or approximately 19 years

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55. You own a chain of 10 one-day photo development kiosks and a lab where the photos are developed. Each morning and evening, a delivery truck leaves the lab, visits each kiosk, and returns to the lab. If it takes 1/3 minute to compute the total length of a tour, how long will it take to apply the brute force algorithm to find the optimal tour for the delivery truck?

ANSWER: (9!/2)(1/3) = 60,480 minutes, or 42 days

56. Suppose an employee of a power company needs to read the electricity meters outside of each house along the streets in a residential area. Which technique is most likely to be useful in solving this problem?

a. Finding an Euler circuit on a graph
b. Applying the nearest-neighbor algorithm for the traveling salesman problem
c. Applying Kruskal's algorithm for finding a minimum-cost spanning tree for a graph
d. None of these techniques is likely to apply

ANSWER: a

57. Suppose a pizza delivery person needs to take pizzas to 10 houses in different neighborhoods and then return to pick up the next set to be delivered. Which technique is most likely to be useful in solving this problem?

a. Finding an Euler circuit on a graph
b. Applying the nearest-neighbor algorithm for the traveling salesman problem
c. Applying Kruskal's algorithm for finding a minimum-cost spanning tree for a graph
d. None of these techniques is likely to apply

ANSWER: b

58. You want to create a mileage grid showing the distance between every pair of the 50 U.S. state capitals. How many numbers will you have to compute?

ANSWER: (50)(49)/2 = 1225

59. You want to create a mileage grid showing the distance between every pair of the 10 Canadian provincial and territorial capitals. How many numbers will you have to compute?

ANSWER: (10)(9)/2 = 45

60. Suppose a college campus decides to install its own phone lines connecting all of the buildings so that calls may be relayed through one or more buildings before reaching their destination. Which technique is most likely to be useful in solving this problem?

a. Finding an Euler circuit on a graph
b. Applying the nearest-neighbor algorithm for the traveling salesman problem.
c. Applying Kruskal's algorithm for finding a minimum-cost spanning tree for a graph
d. None of these techniques is likely to apply

ANSWER: c

61. Suppose that after a storm, an inspection needs to be made of the sewers along the streets in a small village to make sure local flooding is not due to clogging. Which technique is most likely to be useful in solving this

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problem?

a. Finding an Euler circuit on a graph
b. Applying the nearest-neighbor algorithm for the traveling salesman problem
c. Applying Kruskal's algorithm for finding a minimum-cost spanning tree for a graph
d. None of these techniques is likely to apply

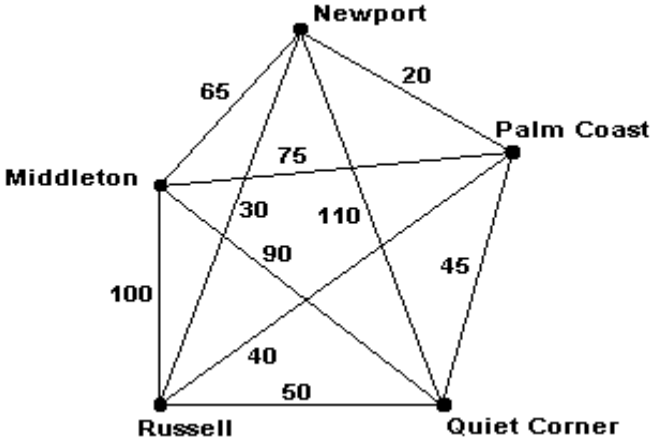
ANSWER: a

62. Suppose a maintenance worker needs to empty garbage dumpsters from five locations on the grounds of a park in the most efficient way possible. Which technique is most likely to be useful in solving this problem?

a. Finding an Euler circuit on a graph
b. Applying the nearest-neighbor algorithm for the traveling salesman problem
c. Applying Kruskal's algorithm for finding a minimum-cost spanning tree for a graph
d. None of these techniques is likely to apply

ANSWER: b

63. Phyllis has her office in Middleton and must visit four clients, each in a different city. The graph below shows each city and the distances between each pair of cities. How many miles will Phyllis travel if she chooses the Hamiltonian circuit for her trip by using the sorted-edges algorithm?

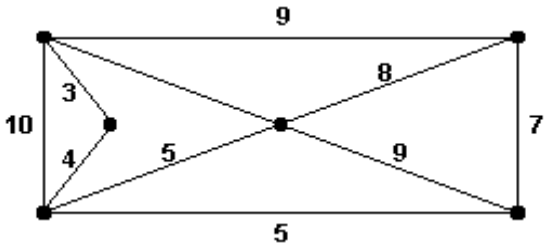


a. 265 miles
b. 300 miles
c. 285 miles
d. 345 miles

ANSWER: c

64. The graph below shows the cost (in hundreds of dollars) of installing telephone wires between the work spaces in an office complex. Use Kruskal's algorithm for minimum-cost spanning trees to find the cost for establishing this phone network.

Chapter 2



a. $2100
b. $2400
c. $2900
d. $6200

ANSWER: b

65. There are 3, 4, and 3 distinct paths from the City *A* to *B, B* to *C,* and *C* to *D,* respectively. Starting from the City *A*, you are planning to travel those cities in the order *B, C,* and *D.* How many different travel routes are possible?

a. 10
b. 24
c. 36
d. 72

ANSWER: c

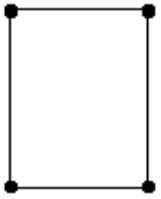
66. Kris has three pairs of pants of different colors, five shirts of different colors, and two pairs of shoes. How many different outfits can Kris create?

a. 2
b. 10
c. 30
d. 50

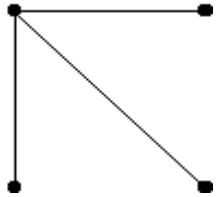
ANSWER: c

67. Given the two graphs shown below, which one represents a tree?

I



II



a. I only
b. II only
c. Both I and II
d. Neither I nor II

ANSWER: b

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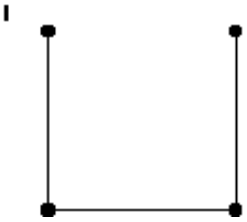
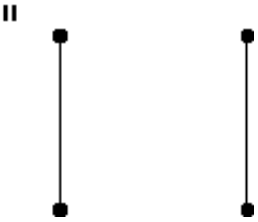
68. Given the two graphs shown below, which one represents a tree?

I



II

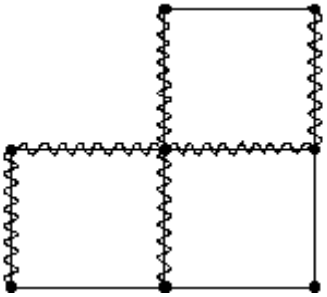


a. I only
b. II only
c. Both I and II
d. Neither I nor II

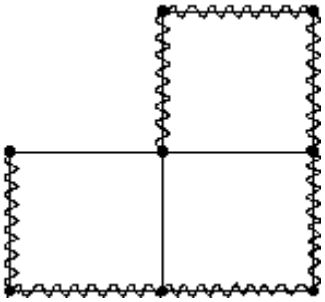
ANSWER: a

69. In which of the diagrams below do the wiggly edges represent spanning trees?

I



II

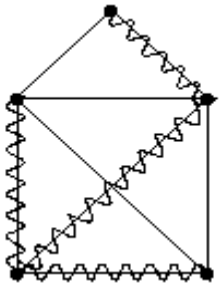


a. I only
b. II only
c. Both I and II
d. Neither I nor II

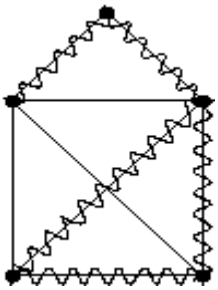
ANSWER: b

70. In which of the diagrams below do the wiggly edges represent spanning trees?

I



II



a. I only
b. II only
c. Both I and II
d. Neither I nor II

ANSWER: a

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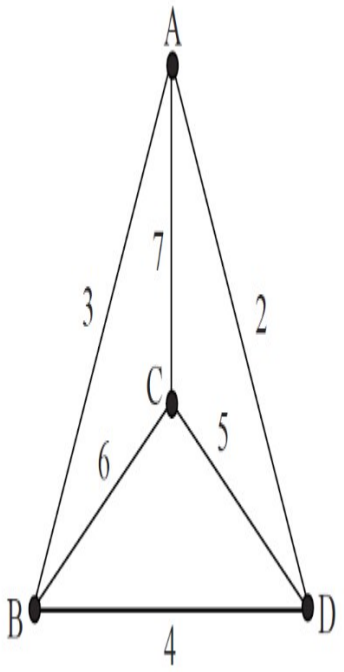
71. For the graph below, what is the cost of the Hamiltonian circuit obtained by using the nearest-neighbor algorithm, starting at *A*?

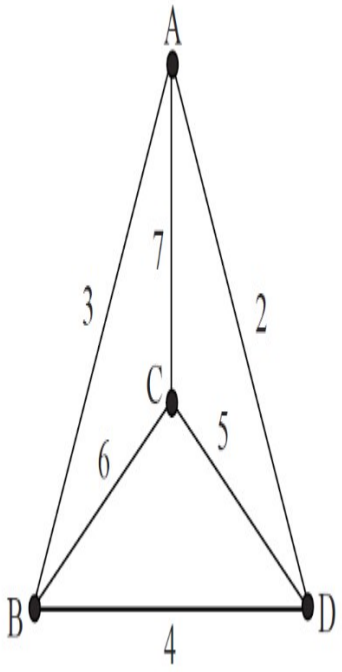


a. 16
b. 17
c. 18
d. 19

ANSWER: d

72. For the graph below, what is the cost of the Hamiltonian circuit obtained by using the nearest-neighbor algorithm, starting at *B*?

Chapter 2

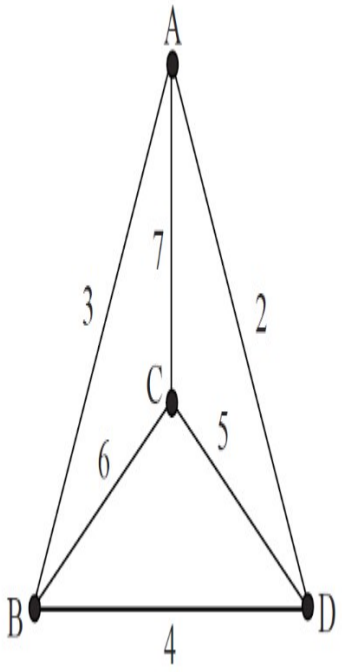


a. 16
b. 17
c. 18
d. 19

ANSWER: a

73. For the graph below, what is the cost of the Hamiltonian circuit obtained by using the sorted-edges algorithm?

Chapter 2



a. 16
b. 17
c. 18
d. 19

ANSWER: a

74. A college student has six pairs of pants, eight T-shirts, three sweatshirts, and two pairs of tennis shoes. If an outfit consists of pants, a T-shirt, a sweatshirt, and a pair of tennis shoes, how many different outfits can the student wear before repeating one?

a. 19
b. 124
c. 288
d. 328

ANSWER: c

75. The local café offers 3 different entrées, 10 different vegetables, and 4 different salads. A "blue plate special" includes an entree, a vegetable, and a salad. How many different ways can a special be constructed?
ANSWER: 120

76. A nearby ice cream shop offers 31 different flavors and 3 different types of cones. How many different single scoop cones can be ordered?
ANSWER: 93

77. An online banking service requires its customers to select a password that is four characters long. The password is case sensitive, so uppercase letters are considered to be different than lowercase letters. The first

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character of the password must be an uppercase letter, and the second character must be a digit. The remaining two characters may each be a digit, an uppercase letter, or a lowercase letter. What is the number of possible passwords?

a. 175,760
b. 336,960
c. 999,440
d. 1,406,080

ANSWER: c

78. In some states, license plates use a mixture of letters and numerals. How many possible plates could be constructed using three letters followed by three numerals?
ANSWER: $26^3 \times 10^3 = 17{,}576{,}000$

79. In some states, license plates use a mixture of letters and numerals. How many possible plates could be constructed using three letters followed by four numerals?
ANSWER: $26^3 \times 10^4 = 175{,}760{,}000$

80. For a connected graph of 18 vertices, every possible spanning tree has exactly 17 edges.

a. True
b. False

ANSWER: a

81. What is an advantage of a *heuristic* algorithm?
ANSWER: Fast

82. What is a disadvantage of a *heuristic* algorithm?
ANSWER: Not always optimal

83. What is *critical* about the *critical path* of an order-requirement digraph?
ANSWER: It requires the critical or essential amount of time required to complete the project.

84. A connected graph *G* has 32 vertices. How many vertices does a spanning tree of *G* have?

a. 30
b. 31
c. 32
d. 33

ANSWER: c

85. Can a graph have a Hamiltonian circuit but not an Euler circuit?
ANSWER: Yes

86. Will the nearest-neighbor algorithm ever use the most expensive edge of a graph?

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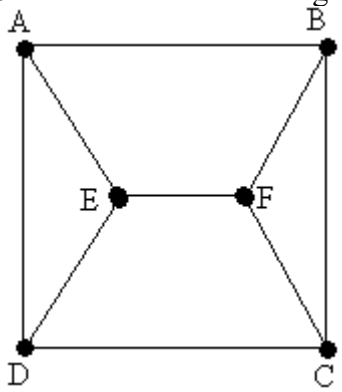
ANSWER: Yes

87. The route of a neighborhood garbage truck generally follows an Euler circuit. Under what circumstances should it instead follow a Hamiltonian circuit?
ANSWER: If it only picks up at the intersection of streets

88. The route of a delivery truck generally follows a Hamiltonian circuit. Under what circumstances should it instead follow an Euler circuit?
ANSWER: If it delivers to houses on the sides of streets

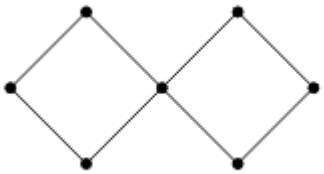
89. Which of the following describes a Hamiltonian circuit for the graph below?



a. *ABFEDCBA*
b. *ABCFEA*
c. *ABCFBAEDA*
d. *ABCFEDA*

ANSWER: d

90. Construct a graph that has an Euler circuit but not a Hamiltonian circuit.
ANSWER:



Answers may vary. One solution is:

91. Use Kruskal's algorithm for minimum-cost spanning trees on the graph below. What is the cost of the tree found?

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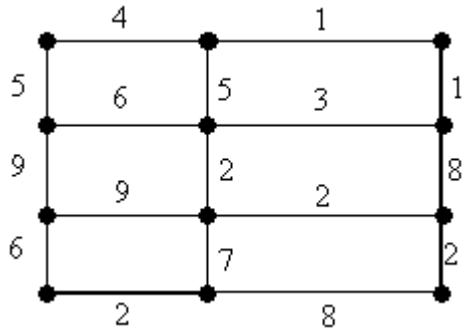
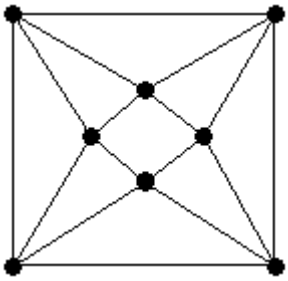


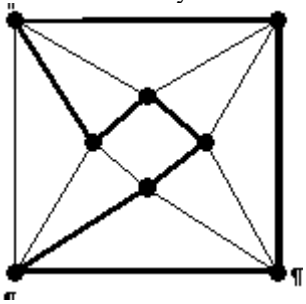
a. 27
b. 31
c. 35
d. 39

ANSWER: c

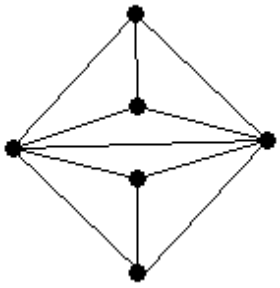
92. In the graph below, construct a Hamiltonian circuit.



ANSWER: Answers will vary. One solution is:



93. In the graph below, construct a Hamiltonian circuit.



ANSWER: Answers will vary. One solution is:

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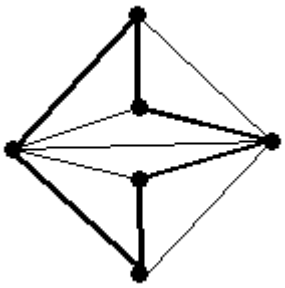
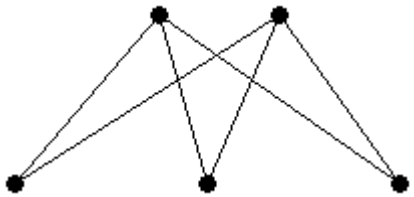


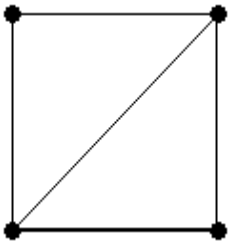
94. Construct an example of a connected graph that does not have a Hamiltonian circuit.
ANSWER:

Answers will vary. One solution is:



95. Construct an example of a connected graph that has a Hamiltonian circuit but does not have an Euler circuit.
ANSWER:

Answers will vary. One solution is:



96. For the graph below, which routing is produced by using the nearest-neighbor algorithm starting at *A*?

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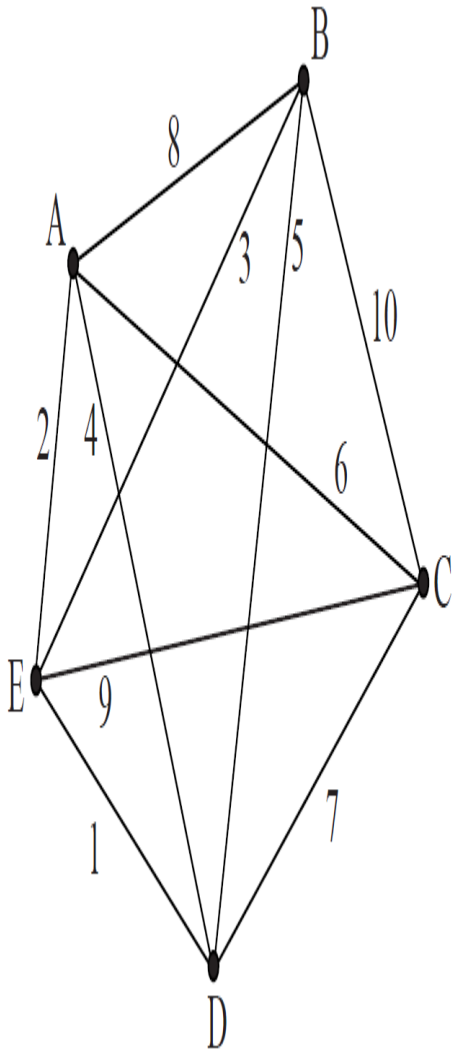
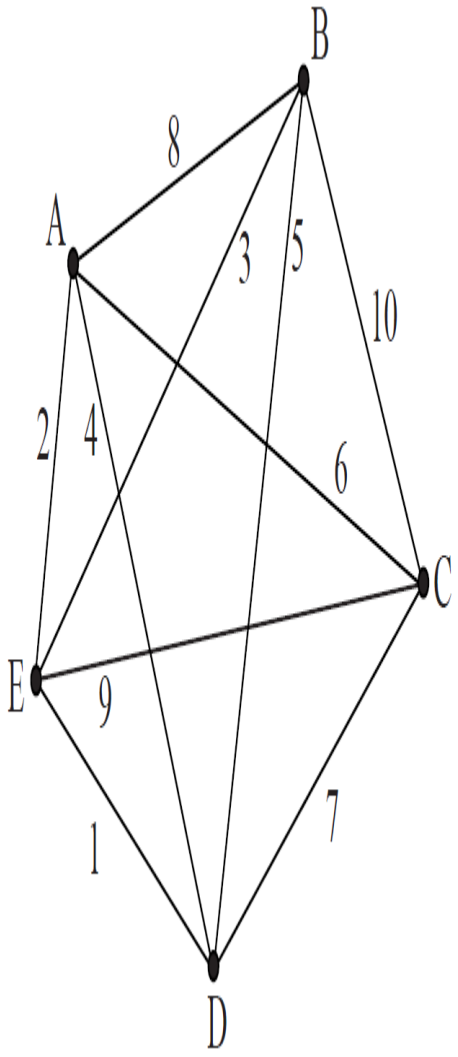


a. *DEABCD*
b. *AEBDCA*
c. *AEDBCA*
d. *DEBACD*

ANSWER: c

97. For the graph below, which routing is produced by using the nearest-neighbor algorithm starting at *D*?

Chapter 2



a. *DEABCD*
b. *AEBDCA*
c. *AEDBCA*
d. *DEACBD*

ANSWER: d

98. For the graph below, which routing is produced by using the sorted-edges algorithm?

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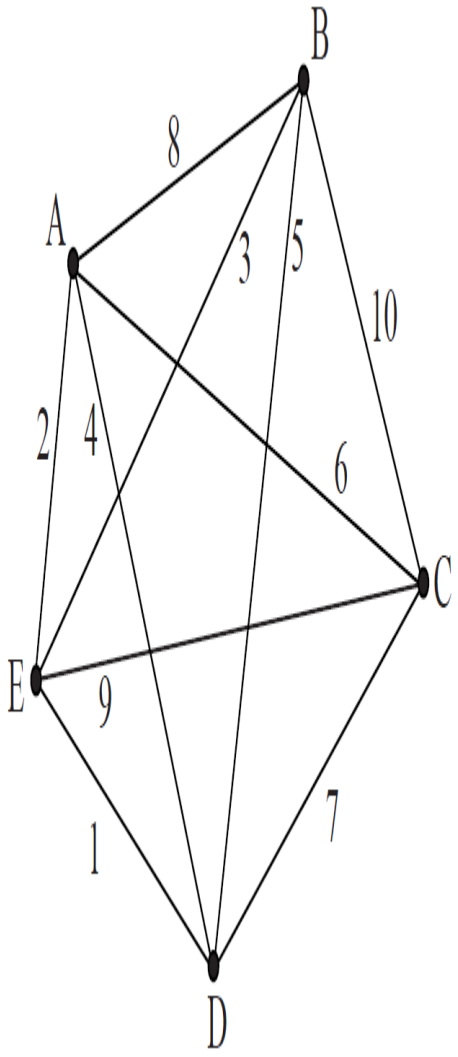

a. *DEABCD*
b. *AEBDCA*
c. *AEDBCA*
d. *DEBACD*

ANSWER: c

99. A connected graph *H* has a spanning tree with 50 edges. How many vertices does the spanning tree have? How many vertices does *H* have? What can one say about the number of edges *H* has?
ANSWER: The spanning tree has 51 vertices. *H* also has 51 vertices. *H* must have at least 50 edges.

100. Find the earliest completion time for the following order-requirement digraph.

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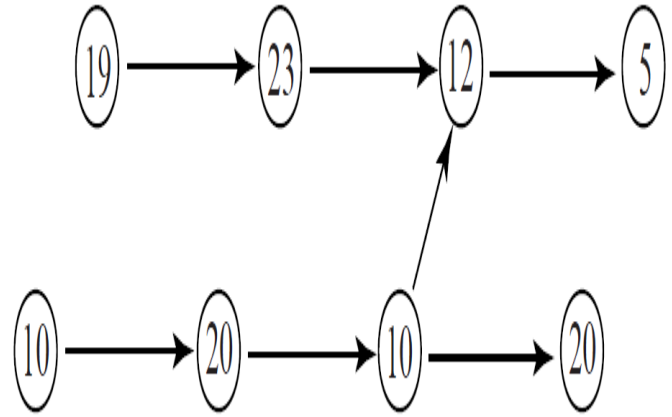
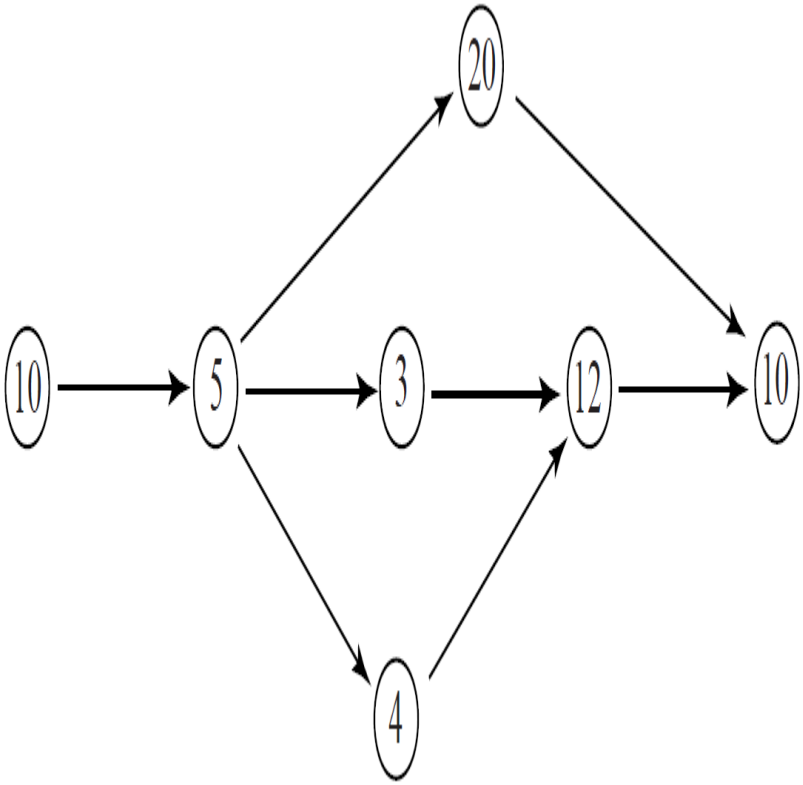


ANSWER: 60

101. Find the earliest completion time for the following order-requirement digraph.



ANSWER: 45

102. How many distinct Hamiltonian circuits can you find on the following graph?

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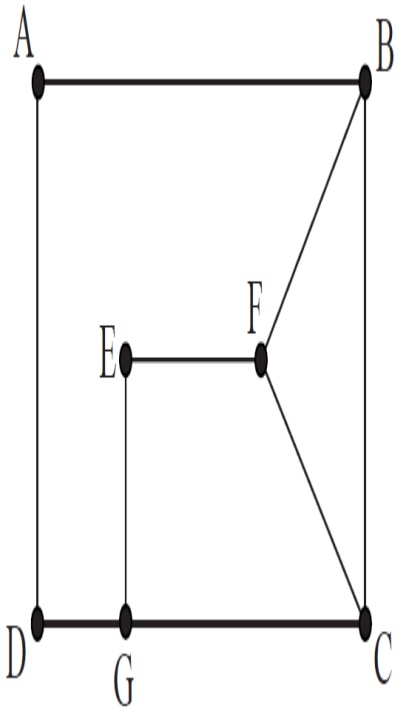
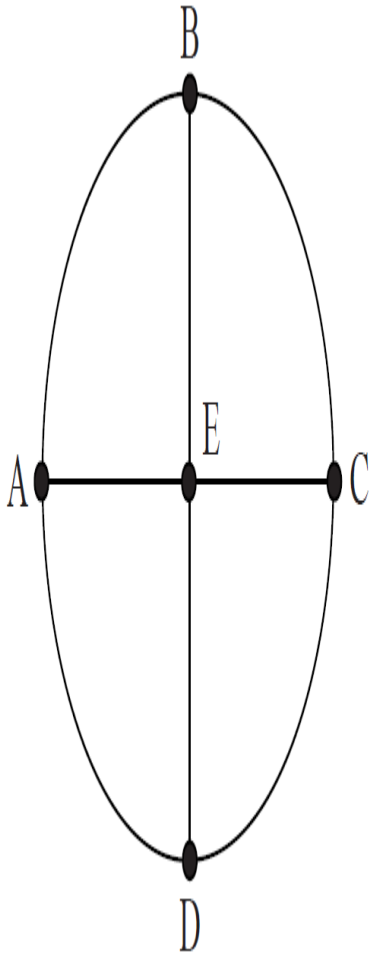


ANSWER: One: *ADGEFCBA*

103. How many distinct Hamiltonian circuits can you find on the following graph? (Do not count a circuit and the reverse of the same circuit as distinct.)

Chapter 2



ANSWER: Four: *ABECDA, ABCEDA, AEDCBA, AEBCDA*

104. If you add a new vertex to a complete graph of 10 vertices, how many new edges are needed to make the new graph complete?

ANSWER: 10