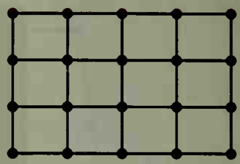
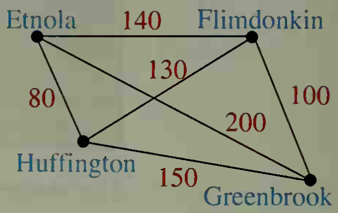
3. **a.** Is a Hamilton circuit possible for the 4-by-5 rectangular dot pattern shown at the right?
   **b.** For which of these dot patterns is a Hamilton circuit possible: 2-by-3, 2-by-8, 3-by-5, 4-by-6, 5-by-7?
   **c.** Given an $x$-by-$y$ dot pattern, what must be true about $x$ and $y$ if a Hamilton circuit is possible?



4. Solve the traveling salesperson problem for the four cities shown in the graph at the right. Begin and end at Flimdonkin.




5. Use the nearest neighbor algorithm for the graph in Exercise **4.** Begin and end at Flimdonkin. Does this algorithm give you the shortest circuit?
6. Suppose a traveling salesperson must leave city $A$ and visit each of 14 other cities before returning to city $A$.
   **a.** How many Hamilton circuits are possible? (Give your answer as a factorial and then use a calculator to evaluate this factorial.)
   **b.** Since each circuit involves adding 15 numbers, there are 14 additions per circuit. So the total number of additions to check all 14! circuits is $14 \times 14!$. If a computer can do one addition per nanosecond (one billionth of a second), how long will it take a computer to compute the distances for all circuits?
7. Suppose a traveling salesperson must leave city $A$ and visit each of 20 other cities before returning to city $A$.
   **a.** How many Hamilton circuits are possible?
   **b.** How many additions per circuit are there to compute the distance traveled?
   **c.** What is the total number of additions required to find the distance traveled for each circuit?
   **d.** How long would it take a computer to do all the additions given in part **c** if the computer can do one billion additions per second?
8. Repeat Exercise **7** if 25 cities are to be visited before returning to city $A$.
9. The table gives the cost of transportation between 5 cities, $A$, $B$, $C$, $D$, and $E$.

| To/From | $A$ | $B$ | $C$ | $D$ | $E$ |
|---|---|---|---|---|---|
| $A$ | — | \$220 | \$150 | \$100 | \$130 |
| $B$ | \$220 | — | \$160 | \$200 | \$240 |
| $C$ | \$150 | \$160 | — | \$180 | \$110 |
| $D$ | \$100 | \$200 | \$180 | — | \$190 |
| $E$ | \$130 | \$240 | \$110 | \$190 | — |

   **a.** Make a graph similar to the one in the Example on page 678 showing these costs.
   **b.** Use the nearest neighbor algorithm to find a circuit beginning and ending at city $A$. (Note that the nearest neighbor in this problem means the city which is the least expensive to reach.)
   **c.** Find a circuit that is less expensive than the circuit the nearest neighbor algorithm produced.