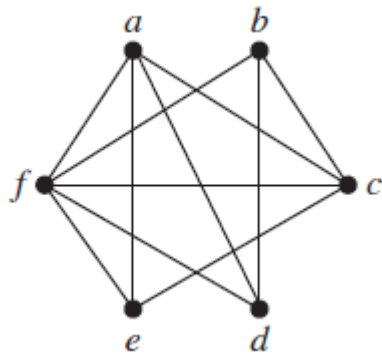


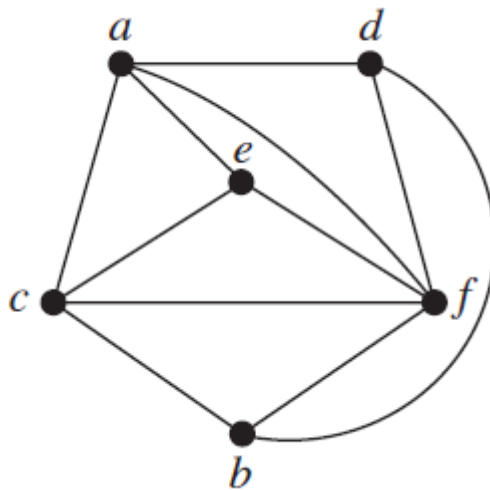
Sec. 10.7 7, 20, 22, 23, 25

In Exercises 5–9 determine whether the given graph is planar. If so, draw it so that no edges cross.

7.

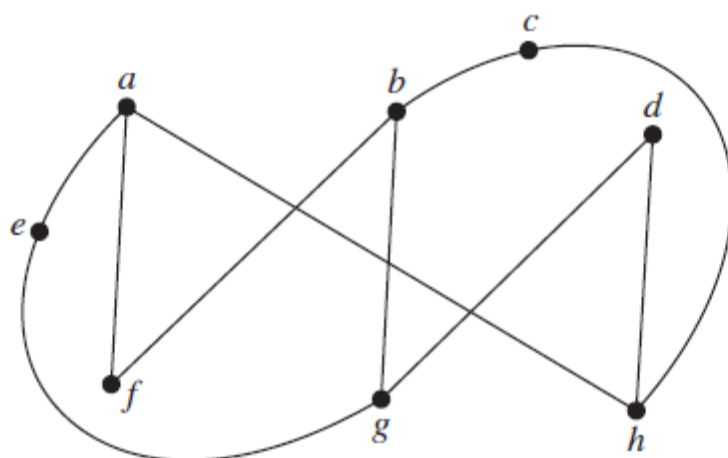


7. Yes



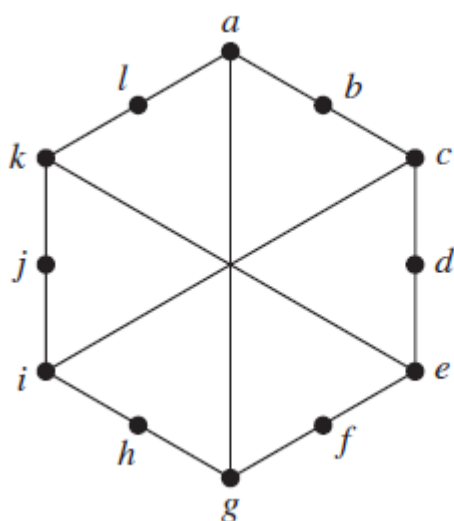
In Exercises 20–22 determine whether the given graph is homeomorphic to $K_{3,3}$.

20.



20. This graph is not homeomorphic to $K_{3,3}$, since by rerouting the edge between a and h we see that it is planar.

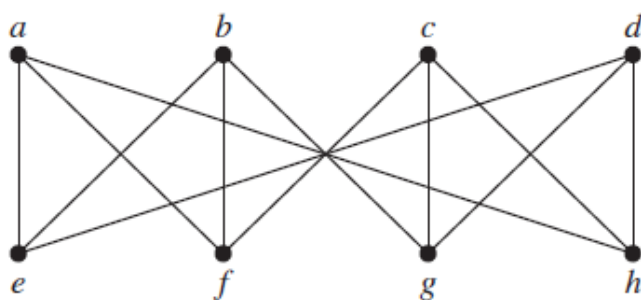
22.



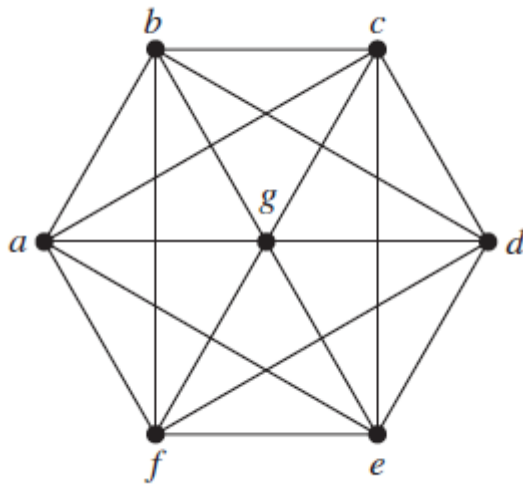
22. Replace each vertex of degree two and its incident edges by a single edge. Then the result is $K_{3,3}$: the parts are $\{a, e, i\}$ and $\{c, g, k\}$. Therefore this graph is homeomorphic to $K_{3,3}$.

In Exercises 23–25 use Kuratowski's theorem to determine whether the given graph is planar.

23.



25.

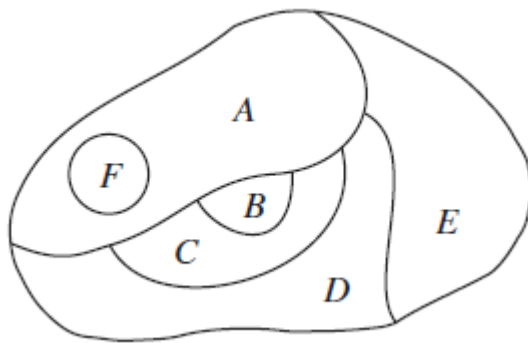


23. Planar 25. Nonplanar

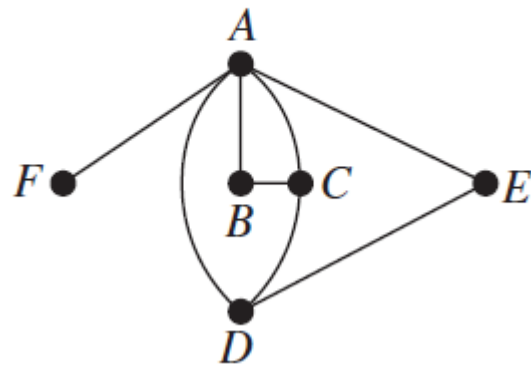
Sec. 10.8 3, 8, 9, 10, 17

In Exercises 1–4 construct the dual graph for the map shown. Then find the number of colors needed to color the map so that no two adjacent regions have the same color.

3.

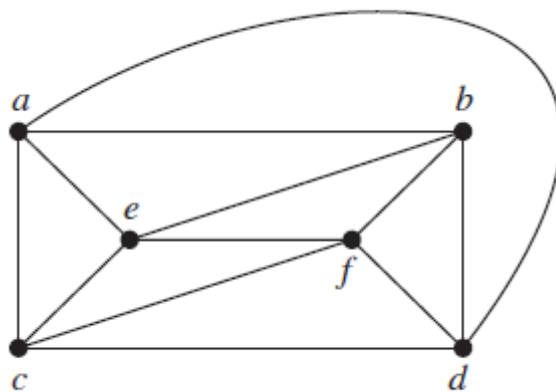


3. Three colors



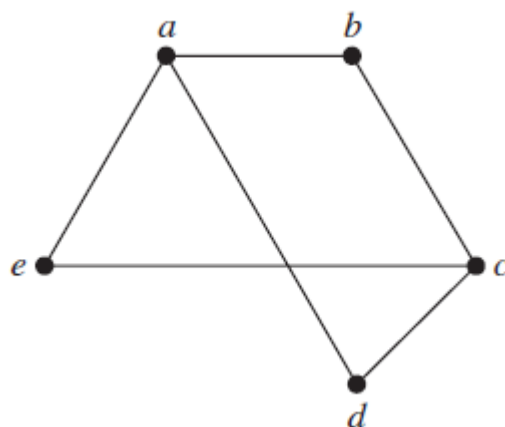
In Exercises 5–11 find the chromatic number of the given graph.

8.



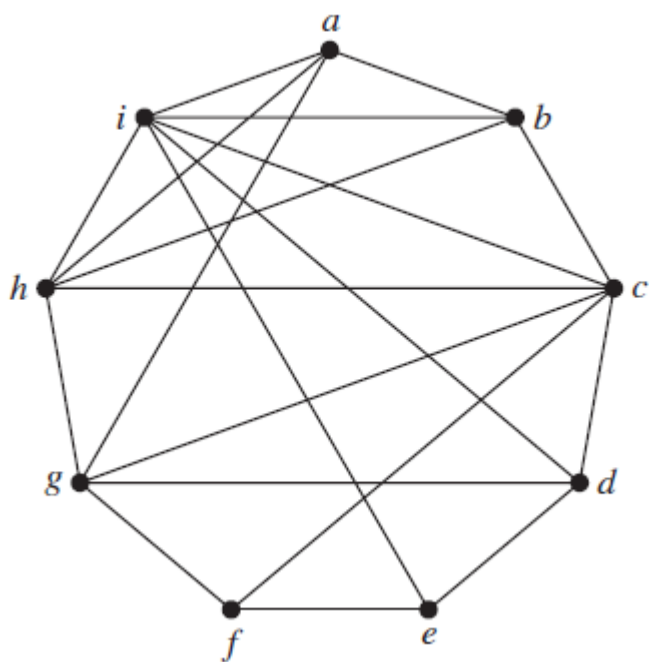
8. Since there is a triangle, at least 3 colors are needed. The coloring in which b and c are blue, a and f are red, and d and e are green shows that 3 colors suffice.

9.



9. 2

10.



10. Since vertices b , c , h , and i form a K_4 , at least 4 colors are required. A coloring using only 4 colors (and we can get this by trial and error, without much difficulty) is to let a and c be red; b , d , and f , blue; g and i , green; and e and h , yellow.

17. Schedule the final exams for Math 115, Math 116, Math 185, Math 195, CS 101, CS 102, CS 273, and CS 473, using the fewest number of different time slots, if there are no students taking both Math 115 and CS 473, both Math 116 and CS 473, both Math 195 and CS 101, both Math 195 and CS 102, both Math 115 and Math 116, both Math 115 and Math 185, and both Math 185 and Math 195, but there are students in every other pair of courses.

15. 3 if n is even, 4 if n is odd 17. Period 1: Math 115, Math 185; period 2: Math 116, CS 473; period 3: Math 195, CS 101; period 4: CS 102; period 5: CS 273 19. 5 21. Exercise 5: