$\deg^+(a) = 1, \deg^+(b) = 2, \deg^+(c) = 1, \deg^+(d) = 3$ **9.** 5 vertices, 13 edges; $\deg^-(a) = 6, \deg^+(a) = 1, \deg^-(b) = 1, \deg^+(b) = 5, \deg^-(c) = 2, \deg^+(c) = 5, \deg^-(d) = 4, \deg^+(d) = 2, \deg^-(e) = 0, \deg^+(e) = 0$

only one coauthor **15.** In the directed graph $\deg^-(v)$ = number of calls v received, $\deg^+(v)$ = number of calls v made; in the undirected graph, $\deg(v)$ is the number of calls either made or received by v. **17.** $(\deg^+(v), \deg^-(v))$

is the win–loss record of v. **19.** In the undirected graph model in which the vertices are people in the group and two vertices are adjacent if those two people are friends, the degree of a vertex is the number of friends in the group that person has. By Exercise 18, there are two vertices with the same degree, which means that there are two people in the group with the same number of friends in the group. **21.** Bipartite **23.** Not bipartite **25.** Not bi-

23. Not bipartite

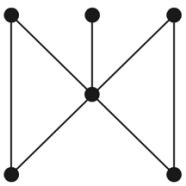
24. Bipartite

b) $(\{a, x, c, d, e\}, \{\{a, x\}, \{c, x\}, \{e, x\}\})$ **37. a)** n vertices, $n(n-1)/2$ edges **b)** n vertices, n edges **c)** $n+1$ vertices, $2n$ edges **d)** $m+n$ vertices, mn edges **e)** 2^n vertices, $n2^{n-1}$ edges

39. a) 3, 3, 3, 3 **b)** 2, 2, 2, 2 **c)** 4, 3, 3, 3, 3 **d)** 3, 3, 2, 2, 2 **e)** 3, 3, 3, 3, 3, 3, 3, 3 **41.** Each of the n vertices is adjacent

e) 3, 3, 3, 3, 3, 3, 3, 3 **41.** Each of the n vertices is adjacent to each of the other $n-1$ vertices, so the degree sequence is $n-1, n-1, \ldots, n-1$ (n terms).

43. 7



55. a) For all $n \geq 1$ **b)** For all $n \geq 3$ **c)** For $n = 3$ **d)** For all $n \geq 0$ **57.** 5

63. $v(v-1)/2-e$

65. $n-1-d_n, n-1-d_{n-1}, \ldots, n-1-d_2, n-1-d_1$

65. $n-1-d_n, n-1-d_{n-1}, \ldots, n-1-d_2, n-1-d_1$ **67.** The union of G and $\overline{G}$ contains an edge between each pair of the n vertices. Hence, this union is K_n.