Exercise 9.2

Rewrite each function in the form $f(x) = a(x-h)^2 + k$.

1. $f(x) = x^2 + 12x + 30$
2. $f(x) = x^2 - 10x + 34$
3. $f(x) = x^2 - 14x + 56$
4. $f(x) = 3x^2 - 12x + 12$
5. $f(x) = -x^2 + 6x - 4$
6. $f(x) = -2x^2 - 4x - 1$
7. $f(x) = 3x^2 + 12x + 5$
8. $f(x) = 3x^2 - 8$
9. $f(x) = -3x^2 - 24x - 58$
10. $f(x) = x^2 + 12x + 35$

Is the orientation concave up of concave down.

11. $f(x) = -\frac{1}{4}x^2 + 3x - 6$
12. $f(x) = -x^2 + 10x - 31$
13. $f(x) = x^2 + 12x + 35$
14. $f(x) = 7x^2 - 10x - 25$

State the vertex and the orientation of each parabola.

15. $f(x) = x^2 - 6x - 1$
16. $f(x) = -\frac{1}{4}x^2 - 2x - 13$
17. $f(x) = x^2 + 16x + 62$
18. $f(x) = -4x^2 - 16x - 24$
19. $f(x) = -3x^2 - 30x - 76$
20. $f(x) = -5x^2 + 1$
21. $f(x) = -x^2 - 14x - 42$
22. $f(x) = 4x^2 - 32x + 61$
23. $f(x) = -x^2 + 14x - 56$
24. $f(x) = x^2 - 8x + 16$

Find the maximum (max) or minimum (min) value of the function. Be sure to say whether it is max or min.

25. $f(x) = x^2 + 8x + 18$
26. $f(x) = x^2 - 6x + 10$
27. $f(x) = x^2 + 2x + 5$
28. $f(x) = x^2 + 2x$
29. $f(x) = 3x^2 - 24x + 49$
30. $f(x) = -2x^2 - 12x - 25$
31. $f(x) = -x^2 + 8x - 8$
32. $f(x) = \frac{1}{3}x^2 + 6x + 18$
33. $f(x) = 2x^2 - 12x + 17$
34. $f(x) = -2x^2 + 12x - 22$

State the range of each function.

35. $f(x) = -\frac{1}{3}x^2 - 2x$
36. $f(x) = x^2 - 16x + 60$
37. $f(x) = -x^2 + 2x - 4$
38. $f(x) = -x^2 - 12x - 33$
39. $f(x) = x^2 - 6x + 3$
40. $f(x) = -2x^2 - 8x - 15$
41. $f(x) = x^2 - 2x - 9$
42. $f(x) = 2x^2 - 24x + 65$
43. $f(x) = \frac{5}{6}x^2 - \frac{10}{3}x + \frac{28}{3}$
44. $f(x) = x^2 + 20x + 94$

State the vertex and x-intercepts. Sketch the graph.

45. $f(x) = \frac{1}{4}x^2 - 1$
46. $f(x) = -2x^2 + 8x - 9$
47. $f(x) = -x^2 - 6x - 5$
48. $f(x) = 2x^2 + 12x + 10$
49. $f(x) = x^2 + 4x + 3$
50. $f(x) = -2x^2 + 24x - 73$
51. $f(x) = -\frac{1}{2}x^2 - x - \frac{3}{2}$
52. $f(x) = x^2 + 6x + 12$
53. $f(x) = 2x^2 + 20x + 48$
54. $f(x) = -x^2 + 4x - 5$

Answers to Exercise 9.2

(**1**) $f(x) = (x+6)^2 - 6$

(**2**) $f(x) = (x-5)^2 + 9$

(**3**) $f(x) = (x-7)^2 + 7$

(**4**) $f(x) = 3(x-2)^2$

(**5**) $f(x) = -(x-3)^2 + 5$

(**6**) $f(x) = -2(x+1)^2 + 1$

(**7**) $f(x) = 3(x+2)^2 - 7$

(**8**) $f(x) = 3(x-0)^2 - 8$

(**9**) $f(x) = -3(x+4)^2 - 10$

(**10**) $f(x) = (x+6)^2 - 1$

(**11**) concave down

(**12**) concave down

(**13**) concave up

(**14**) concave up

(**15**) $(3,-10)$, Concave up

(**16**) $(-4,-9)$, concave down

(**17**) $(-8,-2)$, concave up

(**18**) $(-2,-8)$, concave down

(**19**) $(-5,-1)$, concave down

(**20**) $(0,1)$, concave down

(**21**) $(-7,7)$, concave down

(**22**) $(4,-3)$, concave up

(**23**) $(7,-7)$, concave down

(**24**) $(4,0)$, concave up

(**25**) Min value $= 2$

(**26**) Min value $= 1$

(**27**) Min value $= 4$

(**28**) Min value $= -1$

(**29**) Min value $= 1$

(**30**) Max value $= -7$

(**31**) Max value $= 8$

(**32**) Min value $= -9$

(**33**) Min value $= -1$

(**34**) Max value $= -4$

(**35**) All numbers no greater than 3

(**36**) All numbers no less than -4

(**37**) All numbers no greater than -3

(**38**) All numbers no greater than 3

(**39**) All numbers no less than -6

(**40**) All numbers no greater than -7

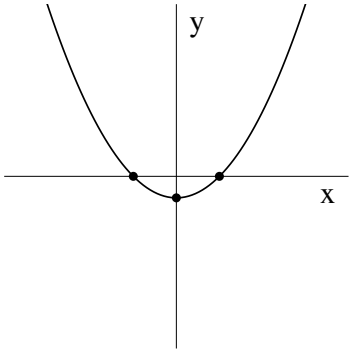
(**41**) All numbers no less than -10

(**42**) All numbers no less than -7

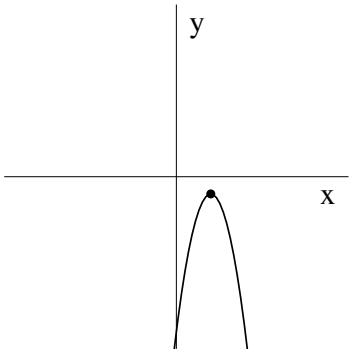
(**43**) All numbers no less than 6

(**44**) All numbers no less than -6

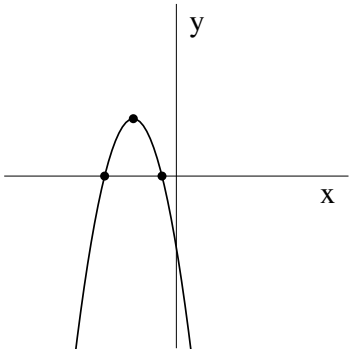
(**45**) Vertex: $(0,-1)$, x-int: 2 and -2.



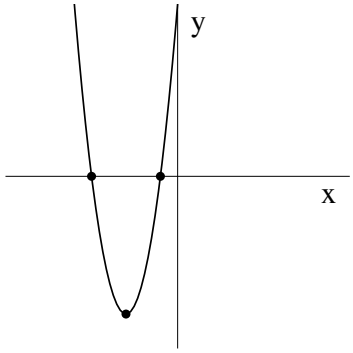
(**46**) V: $(2,-1)$, x-int: None.



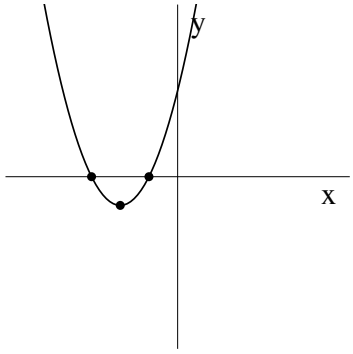
(**47**) V: $(-3,4)$, x-int: -5 and -1



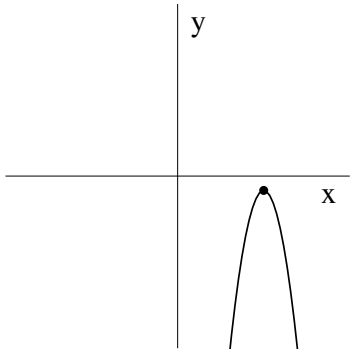
(**48**) V: $(-3,-8)$, x-int: -5 and -1



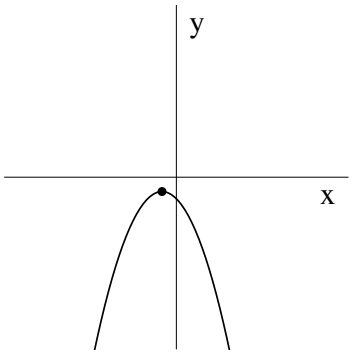
(**49**) V: $(-2,-1)$, x-int: -3 and -1



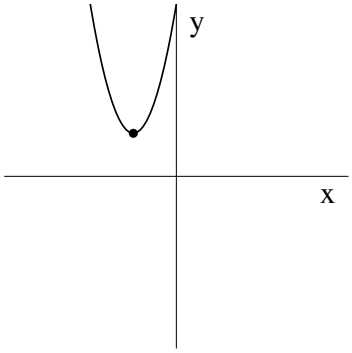
(**50**) V: $(6,-1)$, x-int: None



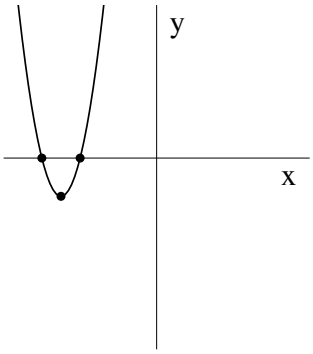
(**51**) V: $(-1,-1)$, x-int: None



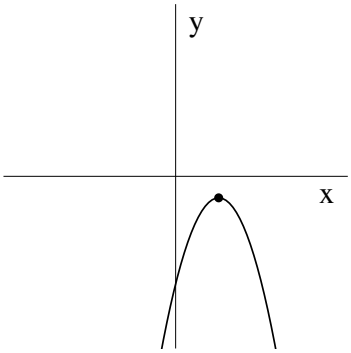
(**52**) V: $(-3,3)$, x-int: None



(**53**) V: $(-5,-2)$, x-int: -6 and -4



(**54**) V: $(2,-1)$, x-int: None



Answers to Exercise 9.3

(**1**) $x=-3, x=8$

(**2**) $x=-\sqrt{2},\ x=\sqrt{2}$
$x\approx -1.4,\ x\approx 1.4$

(**3**) $x=3-\sqrt{2},\ x=3+\sqrt{2}$
$x\approx 1.6,\ x\approx 4.4$

(**4**) $x=1-\sqrt{5},\ x=1+\sqrt{5}$
$x\approx -1.2,\ x\approx 3.2$

(**5**) $x=-2$

(**6**) None

(**7**) $x=2-\sqrt{6},\ x=2+\sqrt{6}$
$x\approx -0.5,\ x\approx 4.5$

(**8**) $x=-\frac{2}{3},\ x=-\frac{1}{2}$
$x\approx -0.7,\ x=-0.5$

(**9**) $x=-4,\ x=-\frac{4}{3}$
$x\approx -1.3,\ x=-4$

(**10**) None