Problem 5-1
Factoring, $(x-1)(x-2) = 0$, so $x^2 - 3x + 2 = 0$ is satisfied when $x = 1$ or $2$. Similarly, $(x+1)(x-2) = 0$, so $x^2 - x - 2 = 0$ is satisfied when $x = -1$ or $2$. The value of $x$ that satisfies the first equation but not the second, is $x = 1$.

Problem 5-2
The area of the square is the same as the area of the circle. Clearly, their overlapping regions are the same, so the area of their common region is the same. Subtracting, their non-overlapping regions must have the same total area. The difference is therefore $0$.

Problem 5-3
Since the sum of the measures of the interior angles of a convex quadrilateral is 360, a convex quadrilateral can have neither 4 acute angles nor 4 obtuse angles. Since a convex quadrilateral can have three 80° angles and one 120° angle, $m = 3$. Since a convex quadrilateral can have three 95° angles and one 75° angle, $M = 3$. Therefore, $m + M = 3 + 3 = 6$.

Problem 5-4
Work backwards. At the end, “8 more than half the remaining clothes pins are blue,” so after counting half, 8 remained (and we're told that they were all blue). Since half the number of clothes pins remaining is 8, the number of blue clothes pins—the only color remaining—was 16. To get the number of green clothes pins, consider the clothes pins remaining after removing the red ones. This mix of green and blue clothes pins was first divided in half, and 1 less than half were green, so 1 more than half, 16, were blue. Therefore, 1 less than half, 14, were green. After removing the red clothes pins, 30 clothes pins remained. We're told that 1 more than half the clothes pins were red. Hence, the number of non-red clothes pins = 30 - 1 less than half. Finally, the number of red clothes pins was 32, and the garbage manager uses a total of 62 clothes pins.

Problem 5-5
Whenever $z$ is a root of the polynomial equation, so is $iz$. Hence, since 2 is a root, $2i$ is a root. Since $2i$ is a root, $(2i)i = -2$ is a root . . . , from which it is clear that the product of 2 and any positive integral power of $i$ is a root. The powers of $i$ are $\{1, i, -1, -i\}$, so the only 4 roots are $\{2, 2i, -2, -2i\}$.

Problem 5-6
An easy way to cube a sum is to use the identity, easily verified, that $(u+v)^3 = u^3+v^3+3uv(u+v)$. Let $u = \sqrt[3]{x+\sqrt{x^2+a^3}}$ and $v = \sqrt[3]{x-\sqrt{x^2+a^3}}$. We're told that $u+v = a$. Using that sum, if we now cube both sides and then combine like terms, we'll get $2x + 3(\sqrt[3]{x^2-x^2-a^3})(a) = a^3$, so $2x - 3a^2 = a^3$. Solving for $x$, we get $x = \frac{a^3+3a^2}{2}$.