Answer Key

1. B	6. A	11. E	16. B	21. D	26. C
2. D	7. B	12. A	17. B	22. C	27. C
3. C	8. A	13. D	18. C	23. B	28. D
4. C	9. D	14. C	19. A	24. B	29. C
5. B	10. C	15. E	20. B	25. C	30. C

Solutions

1. Expanding the left and right sides results in $3x+3-x+3=2x-6-2x+2$. Combining like terms yields $2x+6=-4$, which results in $x=-5$.
2. The formula for the sum of the roots of $ax^3+bx^2+cx+d=0$ is $-b/a$. So the sum of the roots of $f(x)$ is b/a. (Note the coefficient of x^2 is $-b$.)
3. Note the portion in the denominator is equal to 5. So $5=1+\sqrt{x}/5 \Rightarrow 20=\sqrt{x} \Rightarrow x=400$.
4. Since $f(f^{-1}(x))=x$, we have $\dfrac{1+f^{-1}(x)}{1-f^{-1}(x)}=x$. Solving for $f^{-1}(x)$ gives $f^{-1}(x)=\dfrac{x-1}{x+1}$.

   So $f^{-1}(10)=\dfrac{9}{11}$.
5. If $2x+5\ge 0$ and $4x+7\ge 0$, then $2x+5+4x+7<30 \Rightarrow x<3$. If $2x+5\le 0$ and $4x+7\le 0$, then $-2x-5-4x-7<30 \Rightarrow x>-7$. Testing the other two cases where one is negative and the other positive result in $x>-16$ and $x<14$. The union of these four inequalities is $-7<x<3$.
6. $(a+b+c)^2=(a^2+b^2+c^2)+2(ab+ac+bc)$. So $(a^2+b^2+c^2)=9/4-2(4/2)=-7/4$. (Note: sum of squares is negative because roots are imaginary. Also, the formula for sum of roots taken 2 at a time can be found by expanding $f(x)=(x-a)(x-b)(x-c)$.)
7. An ellipse with center (h,k), major axis of length $2a$ and minor axis parallel to the x-axis of length $2b$ is in the form $\dfrac{(x-h)^2}{b^2}+\dfrac{(y-k)^2}{a^2}=1$.
8. Completing the square and putting the equation into the standard form yields $\dfrac{(x+2)^2}{4}+\dfrac{(y-3)^2}{9}=1$.

   $a^2=4, b^2=9$. Area is $ab\pi$.
9. $n+d=80$ and $5n+10d=500$. Solve the system to get 60 nickels and 20 dimes.
10. By definition, $f(1)=0+f(0)=1$. $f(2)=1+f(1)=2$. $f(3)=2+f(2)=4$. $f(4)=3+f(3)=7$. $f(5)=4+f(4)=11$. $f(6)=5+f(5)=16$.
11. Since you don't know whether x+2 is negative you cannot cross multiply.

    $\dfrac{x+3}{x-1}-\dfrac{x+5}{x+2}<0;\quad \dfrac{(x+3)(x+2)-(x+5)(x-1)}{(x-1)(x+2)}<0; \dfrac{x+11}{(x-1)(x+2)}<0;\quad x<-11 \cup -2<x<1$
12. $x(x^2-4)-(x-2)+2(2-x)=x^3-7x+6=0$. Product of roots is - 6.
13. Divide both sides of both equations by xy, let $a=1/x$ and $b=1/y$ and solve the system.

14. Cross multiply to get $8x+7 = A(x-1)+B(x+2)$. When $x=1$, $B=5$ and when $x=-2$, $A=3$. $B - A = 2$.
15. There are 3 possibilities. Exponent is 0, base is 1, or base is -1. If exponent is 0, x = 1 or x = 2. But note if x = 2, then the base is also 0. 0^0 is undefined. If the base is 1, $x^2-6x+8=1$. this has irrational solutions that sum to 6. If the base is -1, $x^2-6x+8=-1 \Rightarrow x^2-6x+9=(x-3)^2=0$. If the base is -1, the exponent must be even. At x = 3, the exponent is 2. So the sum of the solutions is 6 + 3 + 1 = 10.
16. $f(g(3)) = f(5) = 11$. $g(f(3)) = g(13) = 15$. 11 - 15 = -4.
17. $\log_3 x + \log_9 x^2 = \log_3 x + 2\log_9 x = 2\log_3 x = 4 \Rightarrow x = 9$.
18. Move the 7 over to get $(x-6)(x+2) < 0$. Test intervals to find -2 < x < 6.
19. Product of the three roots is 27, so the geometric mean is $\sqrt[3]{27} = 3$.
20. Formula is $A = P\left(1+\frac{r}{n}\right)^{nt}$, where *r,n,t* are rate, number of times a year, and time, respectively. Every three months means 4 times a year.
21. Plug $(x/2)$ into $f(2x)$ to get $f(x) = x^2/4 + x + 3$. Product is 12.
22. Multiplying both sides by $\ln x$ and rearranging gives $(\ln x)^2 - 6(\ln x) + 7 = 0$. Let $u = \ln x$. So $u^2 - 6u + 7 = 0$ and $u_1 + u_2 = 6$. Since $u_1 = \ln x_1$ and $u_2 = \ln x_2$, $u_1 + u_2 = \ln x_1 + \ln x_2 = \ln x_1 x_2 = 6$. So $e^6 = x_1 x_2$.
23. Discriminant is $b^2 - 4ac$. In this case, $5^2 - 4\cdot 3 = 13$.
24. This factors into $x^4 + 3x^2 - 4 = (x^2+4)(x^2-1) = (x^2+4)(x-1)(x+1)$. 2 real roots.
25. If $(x-8) \geq 0$, then $11(x-8) \leq 3x \Rightarrow x \leq 11$. Else, $11(8-x) \leq 3x \Rightarrow x \geq 44/7$. So $44/7 \leq x \leq 11$. 5 numbers fall between this, namely 7, 8, 9, 10, and 11.
26. When the expression is expanded completely, the sum of the coefficients will be the value of expression when x = 1. So we can plug in x = 1 to get $2^4 = 16$.
27. The top factors into $(x-1)(x+3)(x-2)$ and the bottom into $(x-2)(x+2)(x+1)$. $(x-2)$ cancels out, leaving two vertical asymptotes, x = -2 and x = -1 and a horizontal of y = 1, for a total of 3.
28. Using the Binomial Theorem, the term will be $\binom{5}{3}(2x^2)^3(-1/x)^2 = 10(8x^6)(x^{-2}) = 80x^4$.
29. If we add the three equations together, we get $2X + 2Y + 2Z = 108 = 2(X+Y+Z)$.
So $X + Y + Z = 54$.
30. $f(3) = 9 + 21 - 3 = 27$