Hustle – Algebra II
2025 MAΘ National Convention

1. 242
2. −9
3. 4
4. 8
5. 81
6. 4
7. −2
8. 25
9. 260
10. $\frac{3}{4}$ (only acceptable answer)
11. −792
12. 54 (g)
13. 80
14. 8
15. 12
16. ($)15
17. 353
18. −63
19. 816
20. $\frac{17}{4}$ (only acceptable answer)
21. 67
22. 37
23. −1
24. 2
25. 11

1. $g(-1)=0,\ g(0)=1,\ f(1)=2,\ g(2)=9,\ f(9)=242$

2. After dividing and discarding the remainder, we get $y=x^2-3x+1$. $-b^{a+c}=-(-3)^{1+1}=-9$

3. $\begin{vmatrix} 2x^2+1 & 10 \\ x-1 & x+2 \end{vmatrix} = 7x^2+9x+20=2x^3+4x^2-9x+12 \rightarrow 2x^3-3x^2-18x-8=0$. Using the Rational Root Theorem, we find the roots to be $-2, -\frac{1}{2}$, and 4. The largest is 4.

4. The base must be positive but not 1: $x-8>0 \rightarrow x>8$ and $x-8\neq 1 \rightarrow x\neq 9$. The antilog must be positive: $(x-7)(x+3)>0 \rightarrow (-\infty, -3)\cup(7, \infty)$. The intersection of these three requirements is $(8, 9)\cup(9, \infty) \rightarrow a+b-c=8+9-9=8$

5. $\dfrac{7x-25}{x^2-7x+12}=\dfrac{A}{x-3}+\dfrac{B}{x-4}\rightarrow 7x-25=A(x-4)+B(x-3)=(A+B)x+(-4A-3B)$

$\begin{cases}A+B=7\\-4A-3B=-25\end{cases}\rightarrow\begin{cases}3A+3B=21\\-4A-3B=-25\end{cases}\rightarrow -A=-4\rightarrow A=4,\ B=3\rightarrow B^A=81$

6. $x+2=\dfrac{4x+1+x-9}{2}\rightarrow 2x+4=5x-8\rightarrow 3x=12\rightarrow x=4$

7. $\begin{array}{r|rrrrr} -\frac{1}{2} & 4 & -8 & 7 & 0 & -5 \\ & & -2 & 5 & -6 & 3 \\ \hline & 4 & -10 & 12 & -6 & -2 \end{array}$ The remainder is -2.

8. $d=\sqrt{(-4-2)^2+(-6-2)^2}=10;\ r=5;\ \text{Area}=25\pi\rightarrow A=25$

9. $\|ab\|=\|a\|\|b\|\rightarrow(26)(10)=260$

10. Multiply each side by 3^x: $3^{2x}a+3-3\left(3^x\right)=0\rightarrow a\left(3^x\right)^2-3\left(3^x\right)+3=0.$ We need the discriminant to be 0 so that we will have one solution: $b^2-4ac=9-4a(3)=0\rightarrow a=\dfrac{3}{4}$

11. $\dbinom{12}{5}(1)^7(-1)^5=-792$

12. $1x+180(0.35)=0.5(x+180)$

$x+63=0.5x+90$

$0.5x=27$

$x=54$

13. $f(x)=\dfrac{x^4-10x^2+9}{x^2-4x+3}=\dfrac{(x+3)(x-3)(x+1)(x-1)}{(x-3)(x-1)}=(x+3)(x+1)$

$f(7)=(10)(8)=80$

14. $c^2=a^2-b^2=25-9=16\rightarrow 2c=8$

15. $2^{3x}=1000=10^3\rightarrow 2^x=10.$ So, $2^x+4\log_{100}2^x=10+4\left(\dfrac{1}{2}\right)=12$

16. Let x represent the number of \$1 increases. $R=(300-15x)(10+x)=-15x^2+150x+3000\rightarrow$

$x=-\dfrac{b}{2a}=\dfrac{-150}{-30}=5\rightarrow \$10+\$5=\$15$

17. $1000x = 60.06006006...$
$- \quad x = -0.06006006...$
$999x = 60$
$x = \dfrac{60}{999} = \dfrac{20}{333} \rightarrow 20 + 333 = 353$

18.
$$\begin{array}{r|rrrrrr} \frac{3}{2} & 6 & -1 & -32 & -20 & 5 & 8 \\ & & 9 & 12 & -30 & -75 & -105 \\ \hline & 6 & 8 & -20 & -50 & -70 & -97 \end{array}$$
Since we are dividing by 2, the quotient is actually $3x^4 + 4x^3 - 10x^2 - 25x - 35,$ and the sum of the coefficients is -63.

19. Assigning the minimum values of a, b, c, and d, the equation becomes $a + b + c + d = 15.$ We can use stars and bars to find our desired value: $\binom{15+4-1}{4-1} = \binom{18}{3} = 816$

20. $-2 = 3\log_8(x-4) \rightarrow -2 = \log_8(x-4)^3 \rightarrow \dfrac{1}{64} = (x-4)^3 \rightarrow \dfrac{1}{4} = x - 4 \rightarrow x = \dfrac{17}{4}$

21. $\displaystyle\sum_{n=5}^{10}\left(3n^2 - 2n + 1\right) = \sum_{n=1}^{6}\left(3(n+4)^2 - 2(n+4) + 1\right) = \sum_{n=1}^{6}\left(3n^2 + 22n + 41\right) \rightarrow 3 + 22 + 41 = 67$

22. $\pm\dfrac{1}{2}\begin{vmatrix} 2 & 3 & 1 \\ 8 & -1 & 1 \\ -2 & x & 1 \end{vmatrix} = 24 \rightarrow 6x - 34 = \pm 48 \rightarrow 6x = 82, -14 \rightarrow \dfrac{82-14}{6} = \dfrac{34}{3} \rightarrow 34 + 3 = 37$

23. $\begin{cases} 2 = 1 - 1 + a + b \\ 17 = 16 - 4 + 2a + b \end{cases} \rightarrow \begin{cases} a + b = 2 \\ 2a + b = 5 \end{cases} \rightarrow a = 3,\ b = -1$
$f(x) = x^4 - x^2 + 3x - 1$
The product of the roots is -1.

24. We can sketch the graphs of $y = |x| - 10$ and $y = -x^4$ to see that there are two real solutions.

25. $\begin{cases} x^2 - 3y^2 = 1 \\ x = \dfrac{7-3y}{2} \end{cases} \rightarrow \dfrac{49 - 42y + 9y^2}{4} - 3y^2 = 1 \rightarrow 3y^2 + 42y - 45 = 0 \rightarrow y^2 + 14y - 15 = 0 \rightarrow$
$(y+15)(y-1) = 0$ To be in Quadrant IV, y must be negative, so $y = -15,\ x = 26 \rightarrow x + y = 11$