1. **A**. $3a\left(-4x+2\right)+4=-4\left(3ax+4\right)+2\rightarrow -12ax+6a+4=-12ax-16+2\rightarrow 6a=-18\rightarrow a=-3.$
2. **B.** Setting the two functions equal, we get $5x^{2}-13=3x^{2}+11x-28 \rightarrow 2x^{2}-11x+15\rightarrow \left(2x-5\right)\left(x-3\right)\rightarrow x=\frac{5}{2},3. $**3** is the only integer solution.
3. **A.** By rearranging the equation in order of ascending instead of descending power, the sum of the reciprocal of the roots can easily be found with -b/a, yielding 1/1=**1**.
4. **B**. The domain must satisfy $16-x^{2}\geq 0 $and $x^{2}-9 \ne 0$, so it must be $x\geq -4$ and $x\leq 4$ and $x\ne -3,3$. This gives $[-4,-3)∪(-3,3)∪(3,4]$ as our answer.
5. **D.** We call $\sqrt{z+…}=y$, so $y=\sqrt{z+y}$. Squaring both sides, $y^{2}=z+y$, and substituting 5 for y, we get $25=z+5->z=20$.
6. **C**. $f^{-1}(h(g^{-1}(h\left(3\right))))=f^{-1}(h(g^{-1}(4)))=f^{-1}(h(^{}2))=f^{-1}(5)=3$.
7. **B**. $p\left(1\right)= 3f\left(1\right)- 6g\left(1\right)+ 9h\left(1\right)+ 12=9-36-9+12=-24$

.$p\left(2\right)= 3f\left(2\right)- 6g\left(2\right)+ 9h\left(2\right)+ 12=20-24+45+12=53$

 $p\left(3\right)= 3f\left(3\right)- 6g\left(3\right)+ 9h\left(3\right)+ 12=15-12+36+12=51$

 $p\left(x\right)= 3f\left(4\right)- 6g\left(4\right)+ 9h\left(4\right)+ 12=6-6+9+12=21$

2 gives the highest value of p(x)

1. **B**. Notice that the sum of the values of (𝑥), (𝑥), and ℎ(𝑥) for $x=2$ is $19$. Therefore, $N=2$.
2. **C**. We know that $f\left(-4\right)=5$ and $g\left(-4\right)=2$ due to symmetry, so $h\left(x\right)=\frac{f\left(-4\right)\*\left(g\left(-4\right)\right)^{3}}{g(-4)}=\frac{5\*2^{3}}{2}=20$
3. **C.** $A\left(L\left(d\right)\right)=x^{2}-3-5=x^{2}-8$. $L\left(A\left(d\right)\right)=\left(x-5\right)^{2}-3=x^{2}-10x+22$. $A\left(L\left(d\right)\right)=L(A\left(d\right))\rightarrow x^{2}-8=x^{2}-10x+22\rightarrow 10x=30\rightarrow x=3$
4. **A**. To find the sum of the coefficients, simply replace 1 for x: $\left(3+1\right)^{5}=4^{5}=1024$.
5. **D**. Using the points, the equation is $y=-x-3$, so $f\left(2\right)+f\left(-2\right)=-5-1=-6$
6. **D**. Joy’s equation factors to $(x-1)(x-6)(x-9)$ while Jade’s equation factors to $(x-1)(x-4)(x-9)$, so the sum is $6+4=10$
7. **D**. First find the inverse of the function: $x=\frac{3y+2}{4y}+1=\frac{3}{4}+1+\frac{1}{2y}\rightarrow x-\frac{7}{4}=\frac{1}{2y}\rightarrow \frac{1}{x-\frac{7}{4}}=2y$. $f^{-1}\left(x\right)=\frac{1}{2\left(x-\frac{7}{4}\right)}$. Then plugging it back in for x: $f\left(x\right)=\frac{2}{2\left(x-\frac{7}{4}\right)}=\frac{4}{4x-7}$
8. **B**. This function is equivalent to $4\*4^{x}=4^{x+1}$. Then $\left(4^{x+1}\right)^{2}=\left(4^{2}\right)^{x+1}=16^{x+1}$.
9. **C**. An even function has the property $f\left(x\right)=f(-x)$ while an odd one has the property $f\left(-x\right)=-f\left(x\right).$ Option A is even, option B is odd, option C ($-\left(-x-1\right)^{2}$) is neither, option D ($-\frac{1}{x^{2}}-x^{6}$) is even.
10. **B**. The other roots of $p(x)$ are 2 + 𝑖, 𝑖, and 1 + 𝑖. 𝑎 is the leading coefficient.

$$p\left(x\right)= a\left(x-\left(2+i\right)\right)\left(x-\left(2-i\right)\right)\left(x+i\right)\left(x-i\right)\left(x-\left(1+i\right)\right)\left(x-\left(1-i\right)\right)=a\left(\left(x-2\right)-i\right)\left(\left(x-2\right)+i\right)\left(x-i\right)\left(x+i\right)\left(\left(x-1\right)-i\right)\left(\left(x-1\right)+i\right)= a\left(\left(x-2\right)^{2}+1\right)\left(x^{2}+1\right)\left(\left(x-1\right)^{2}+1\right)$$

$$p\left(1\right)=4=a\left(1+1\right)\left(1+1\right)\left(1\right)\rightarrow a=1\rightarrow p\left(2\right)= 1\left(0+1\right)\left(5\right)\left(2\right)=10$$

**18.** **E**. (2∎3) ∎ (5∎2)$=\left(2^{3}-3^{2}\right)∎\left(5^{2}-2^{5}\right)=-1∎-7=\left(-1\right)^{-7}-\left(-7\right)^{-1}=-1+\frac{1}{7}=-\frac{6}{7}$

**19. A**. $f\left(x\right)=1-\frac{1}{x}=\frac{x-1}{x}\rightarrow f\left(f\left(x\right)\right)=\frac{\frac{x-1}{x}-1}{\frac{x-1}{x}}=\frac{x-1-x}{x-1}=\frac{1}{1-x}$ . $f\left(f\left(f\left(x\right)\right)\right)=\frac{1}{1-\frac{x-1}{x}}=\frac{x}{x-(x-1)}=x$.

**20. E.** Working backwards, we know that $\left(x^{2}+\frac{1}{x^{2}}\right)^{2}=x^{4}+2+\frac{1}{x^{4}}$, and we’re given $x^{4}+\frac{1}{x^{4}}=34$, so $\left(x^{2}+\frac{1}{x^{2}}\right)^{2}=36\rightarrow x^{2}+\frac{1}{x^{2}}=6$. $\left(x+\frac{1}{x}\right)^{2}=x^{2}+2+\frac{1}{x^{2}}$ and $x^{2}+\frac{1}{x^{2}}=6$, so $\left(x+\frac{1}{x}\right)^{2}=8\rightarrow x+\frac{1}{x}=√8$

**21. E.** By Descartes’ Rule of Signs, w has either 4 positive roots, 2 positive and 2 imaginary roots, or 4 imaginary roots. I is false. II is false in the first option. III is true in the third option.

**22. A.** $\left|15-4x\right|>3\rightarrow 15-4x>3$ or $15-4x<-3\rightarrow 4x<12$ or $4x>18\rightarrow x<\frac{12}{4}$ or $x>\frac{18}{4}$. $a+b=\frac{12}{4}+\frac{30}{4}=7.5$

**23. E**. $3x^{2}-24x-16y^{2}-64y-16=0\rightarrow 3\left(x-4\right)^{2}-16\left(y-2\right)^{2}=0$, so the graph is one of two lines intersecting at $(4,2)$.

**24. D**. $C\left(P\left(5\right)\right)=C\left(\left(\_{2}^{5}\right)\right)=C\left(10\right)=9!$

**25. C.** $P\left(C\left(5\right)\right)=P\left(4!\right)=P\left(24\right)=276$

**26. B.** In order for the two solutions to be distinct and real, we must have $\left(a-3\right)^{2}-4\*1\*a>0\rightarrow a^{2}-10a+9\rightarrow \left(a-9\right)\left(a-1\right)\rightarrow a<1$ or $>9$ . For the roots to positive, we must have that their sum and product are positive, meaning that $a-3<0$ and $a>0\rightarrow 0<a<3$. The intersection of these two inequalities is $0<a<1$.

**27. B.** Since constants are insignificant as x becomes very large or small, the asymptote is given by $\frac{2x^{3}}{3x^{3}}=\frac{2}{3}$

**28.** **B.** This would be a square of side length 3, so $3^{2}=9$.

**29. A.** $\left(x+4\right)^{3}+4\left(x+4\right)^{2}-12\left(x+4\right)=0\rightarrow \left(x+4\right)\left(\left(x+4\right)^{2}+4\left(x+4\right)-12\right)=0\rightarrow \left(x+4\right)\left(x+4+6\right)\left(x+4-2\right)=0$. $x=-4,-10,-2$, and the sum is -16.

**30. C**. Since $f^{\left[n\right]}\left(x\right)=f(x)$ by definition, this just evaluates to $1+(-1)=0.$