1. $2-i$ A: Multiplying the three numbers, we get $(-i)(i)(1)=-i^2=1$

   B: Multiplying both top and bottom by the conjugate of the bottom, we get $\frac{(1+i)^6}{(2)^3}=\frac{-8i}{8}=-i$

   C: Since the imaginary parts always cancel out, the sum of the roots is still -2.

   D: Factoring the sum of cubes, we get $x^3+27=(x+3)(x^2-3x+9)$. Therefore, the product of the imaginary roots is 9.

   Thus, $1-i-8+9=2-i$.
2. **-4** To find the equation of the reflected line, we just need a reflected point and the intersection. The intersection is (2,0). A random point on line B is (4,3). The line that runs through this point and runs perpendicular to A is $y-3=-2(x-4)\Rightarrow y=-2x+11$ and intersects A at the point $\left(\frac{24}{5},\frac{7}{5}\right)$. The reflected point must be the same x and y distances from the intersection,

   or $\left(\frac{24}{5}+\frac{24}{5}-4,\frac{7}{5}+\frac{7}{5}-3\right)=\left(\frac{28}{5},-\frac{1}{5}\right)$. The slope of the reflected line is $\frac{0+\frac{1}{5}}{2-\frac{28}{5}}=-\frac{1}{18}$ and the line

   is $y=-\frac{1}{18}(x-2)=-\frac{x}{18}+\frac{1}{9}$. Thus, $\frac{FB}{K}=\frac{2\left(\frac{1}{9}\right)}{-\frac{1}{18}}=-4$.
3. **94** A: The determinant of the inverse is the reciprocal of the determinant of the original matrix. $-\frac{1}{21}$

   B: For a diagonal, upper triangular, or lower triangular matrix, the determinant is equal to the product of the elements in the diagonal. 120

   C: 1

   D: First replace each element by its minor to get $\begin{bmatrix}-16 & -1 & 12\\ -1 & -4 & 6\\ -4 & 5 & 3\end{bmatrix}$. Next, switch the sign on every other element to get $\begin{bmatrix}-16 & 1 & 12\\ 1 & -4 & -6\\ -4 & -5 & 3\end{bmatrix}$. The next step is to transpose the matrix: $\begin{bmatrix}-16 & 1 & -4\\ 1 & -4 & -5\\ 12 & -6 & 3\end{bmatrix}$. The final step is to multiply by the reciprocal of the determinant, but we can sum the terms first, so $\frac{-18}{-21}=\frac{6}{7}$

   $-21+120+1-6=94$

4. $\frac{7}{170}$ A: Through binomial probability, we see that

$P(Y \le 3) = \left(\frac{1}{2}\right)^7 \left(7C0 + 7C1 + 7C2 + 7C3\right) = \frac{1}{2}$.

B: The setup is as follows: $n(n-1) = \frac{n(n-1)(n-2)}{6} \Rightarrow n-2=6 \Rightarrow n=8$.

C: For the condition to be satisfied, the permutation must have the following form: _X_X_X_X_, where the _ are places for the vowels to go and the X's are places for the consonants. There are 5 slots for the first vowel, 4 for the next, and 3 for the one after, so there are 120 ways to arrange the vowels, and 4!=24 ways to arrange the consonants, for a probability of $\frac{(4!)(60)}{7!} = \frac{2}{7}$.

$\left(\frac{1}{2}\right)\left(\frac{12}{85}\right)\left(\frac{7}{2}\right) = \frac{21}{85}$.

D: Factoring 180, we see that the prime factorization is $180 = 2^2 \cdot 3^2 \cdot 5$, so there are (3)(3)(2)=18 positive integral factors. A number is even if it is divisible by two, so we can see that there are 3(2)=6 factors of 180 that are comprised of only 3's and 5's. Therefore, the probability that a chosen factor is even is $1 - \frac{1}{3} = \frac{2}{3}$.

The final answer is $\frac{7}{170}$

5. **438** A: Completing the square, we can put the equation in vertex form, or $\left(y-1\right)^2 = x-2$, so the length of the latus rectum is $4p = 1$.

B: Completing the square, we rearrange the equation to be $\frac{(x-1)^2}{6} + \frac{(y+2)^2}{18} = 1$, which tells us that $a = 3\sqrt{2}, b = \sqrt{6}, c = 2\sqrt{3}$. Therefore, c^2=12.

C: Rearrange the equation to get $(x+2)^2 - (y-3)^2 = 7$, so the sum of the coordinates of the center is 1.

D: Plugging in y = 2x into the circle, we get $5x^2 - 15x + 10 = 0$, so the product of the x-coordinates of the intersection is 2. Since every y value is twice the x value (y =2x), the product of the y values should be 4 times the product of the x values. Thus, the product of all coordinates is 16.

The final answer is $A + 3B^2 + C + 25D = 1 + 36 + 1 + 400 = 438$.

6. **1341** A: If we let $\begin{array}{l} S = 1(2) + 2(2^2) + 3(2^3) + \ldots + 6(2^6) \\ 2S = 2^2 + 2\left(2^3\right) + 3(2^4) + \ldots + 6\left(2^7\right) \end{array}$, then $S - 2S = -S = 2 + 2^2 + 2^3 + \ldots + 2^6 - 6\left(2^7\right)$,

or $-S = \frac{2 - 2\left(2^6\right)}{1-2} - 6\left(2^7\right) = 642$

B: This is just an infinite geometric series, which has a sum $\frac{1}{1 - \frac{2}{3}} = 3$.

C: The first few terms are as follows: $\{a_0, a_1, a_2, a_3 ... a_{15}\} = \{1, 1+1, 1+1+2, ... 1+1+2+...15\}$, so it's clear that each number is one more than a triangular number. The sum of the first 20 triangular numbers is $\frac{n(n+1)(n+2)}{6} = \frac{15(16)(17)}{6} = 680$. Adding 16 to this number gives us 696.

Thus, $A+B+C = 696+642+3 = 1341$

7. $[3,\infty)$ The domain of the functions are A: $(-\infty-2)\cup(-1,\infty)$, B: $(2,\infty)$, C: $(-\infty-1)\cup(1,\infty)$, D: $[3,\infty)$. The intersection of these domains is $[3,\infty)$.

8. **84** We see that $f(1+1) = f(1)+f(1)+1+1 \Rightarrow f(2) = 8$ and $f(3) = f(2)+f(1)+1+2 = 14$. There are two different values of f(4), namely $\begin{matrix} f(4) = f(3)+f(1)+3+1 = 21 \\ f(4) = f(2)+f(2)+2+2 = 20 \end{matrix}$. There are three different values of f(5),

$f(5) = f(2)+f(3)+2+3 = 27$

$f(5) = f(1)+f_1(4)+1+4 = 29$. Doing the same operations, we see the values of f(6) are

$f(5) = f(1)+f_2(4)+1+4 = 28$

The sum of these values is $\frac{3}{2}(27+29) = 84$.

9. **7** The asymptotes are as follows: a) x = 0, b) y=5, c) y = 1, x = 1, d) y = 1, x = 4, e) None f) y = 2, x= -3 The number of distinct asymptotes is 7.

10. **12** A: Working off the distance = rate X time formula, we get $1 = \frac{3}{2}\left(\frac{1}{2}+\frac{1}{J}\right) \Rightarrow J = 6$.

B: Same formula, $1 = 1\left(\frac{1}{2}+\frac{1}{6}+\frac{1}{R}\right) \Rightarrow R = 3$.

C: Same formula, $1 = \frac{3}{4}\left(\frac{1}{2}+\frac{1}{6}+\frac{1}{3}+\frac{1}{M}\right) \Rightarrow M = 3$

The sum is **12**.

11. $78-4\sqrt{5}$ A: The sum is $-\frac{b}{a} = -2$.

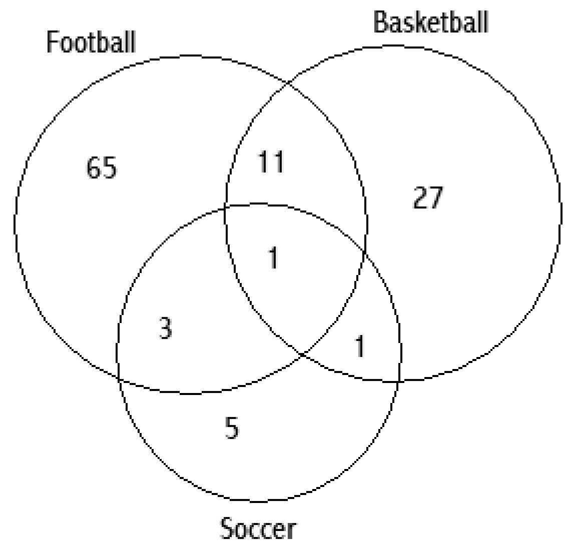
B: We see that $(a+b)^2 - 4ab = a^2 - 2ab + b^2 = (a-b)^2$. Therefore, $a-b = \sqrt{4-4(-4)} = 2\sqrt{5}$. We also know that $a^2 - b^2 = (a+b)(a-b) = -2(2\sqrt{5}) = -4\sqrt{5}$.

C: We can see that $(a+b)^2 - 2ab = a^2 + b^2$, so $a^2 + b^2 = 4 - 2(-3) = 10$. Also, $a^3 + b^3 = (a+b)(a^2 - ab + b^2) = -2(12+4) = -32$.

D: Our answer is $a^4 + b^4 = (a^2 - b^2)^2 + 2a^2b^2 = 80 + 2(-4)^2 = 112$

The sum is $78-4\sqrt{5}$.

12. **124** Refer to the accompanying Venn diagram.
A: The sum of the elements in the diagram is 113, so 7 are not fans of any of the three sports.
B: 5 of the soccer fans are fans of either football or basketball.
C: 15 students are fans of exactly 2 sports.
D: The number of students that satisfy this condition is $65+27+5=97$



13. $\frac{1}{8}$ Putting the parabola in vertex form gives us $y=(x+1)^2$, so the length of the latus rectum is 1, and $p=\frac{1}{4}$, so the area is $A=\frac{1}{2}\cdot\frac{1}{4}\cdot 1=\frac{1}{8}$.

14. $-\frac{1}{2}$ The inverse functions are $f^{-1}(x)=\frac{x}{2}+\frac{1}{2}$ and $g^{-1}(x)=x+2$. Plugging in all the values, we get $-\frac{1}{2}$ as the final answer.

15. $2\sqrt{10}$ Since the snake is only 10 units long, we only need to worry about the last ten units traveled. Thus, vertical distance between head and tail is 6 and the horizontal distance is 2. Total distance is $\sqrt{36+4}=2\sqrt{10}$.