60	425	$\frac{10-11i}{17}$	3	6
8	$\frac{5}{7}$	15	519	6
-8	11	1	$26\pi\sqrt{41}$	-29
$\frac{22}{89}$	$\frac{\sqrt{13}}{7}$	$x=2, x=3$	0	-15
$-\frac{49}{4}$	13400	2937	2	12

1. 60

$$Area = \frac{1}{2}ab\sin C$$
$$27\sqrt{3} = \frac{1}{2}\cdot 9\cdot 12\cdot \sin C$$
$\frac{\sqrt{3}}{2} = \sin C$ so, $C = 60$ degrees

2. 425

First we will calculate the inner sum, and then the outer sum.
Inner sum: $-1+5+11+17=32$
Outer sum: $21+53+85+117+149=425$

3. $\frac{10-11i}{17}$

We will start from the bottom and work our way up with such problems.
$\frac{5i}{(1+2i)}\cdot\frac{(1-2i)}{(1-2i)} = 2+i \quad 2+i+2 = 4+i$
$$\frac{3-2i}{(4+i)}\cdot\frac{(4-i)}{(4-i)} = \frac{10-11i}{17}$$

4. 3

We can rewrite the inside of the summation as $\sum_{n=10}^{9999}\log_n(n+1) = \sum_{n=10}^{9999}(\log(n+1)-\log n)$. We can see that the series will telescope, and only the first term and the last term will be included in the summation. This gives $\log 10000 - \log 10 = 4-1 = 3$. C

5. 6

$\log_7 7 = 1$ & $\log_5 1 = 0$
$$\frac{1}{3}\log_{20}(2x-1) - \log_{20}(11) + \frac{2}{3}\log_{20}(2x-1) = 0$$
$$\log_{20}(2x-1) - \log_{20}(11) = \log_{20}(\frac{2x-1}{11}) = 0$$
$$\frac{2x-1}{11} = 1 \quad 2x-1 = 11 \quad x = 6$$

6. 8

First we have to factor the equation in to standard form.
$$9x^2 - 90x - 16y^2 + 64y + 17 = 0$$
$$9(x^2-10x+25) - 16(y^2-4y+4) = -17-64+225 = 144$$
$$\frac{(x-5)^2}{16} - \frac{(y-2)^2}{9} = 1$$
From this we can see that $a = 4$ and $2a = 8$, so the transverse axis is 8.

7. $\frac{5}{7}$

We can assume that the roots are a, b, c, d, e
$$\frac{1}{abcd}+\frac{1}{abce}+\frac{1}{abde}+\frac{1}{acde}+\frac{1}{bcde} = \frac{e+d+c+b+a}{abcde} = \frac{\frac{5}{6}}{\frac{7}{6}} = \frac{5}{7}$$

8.	15	The first five triangular numbers are: 1, 3, 6, 10, 15
9.	519	$10431_5 = 1(5^0) + 3(5^1) + 4(5^2) + 1(5^4) = 1 + 15 + 100 + 625 = 741_{10}$ $12^1 = 12 \quad 12^2 = 144 \quad 12^3 = 1728$ $\frac{741}{144} = 5\ R\ 21 \quad \frac{21}{12} = 1\ R\ 9$ $741 = 519_{12}$
10.	6	$8^1 = 8 \quad 8^2 = 64 \quad 8^3 = 512 \quad 8^4 = 4096 \quad 8^5 = 32{,}768 \quad \ldots$ The pattern is 8,4,2,6. $\frac{3004}{4}$ leaves no remainder, which means 8^{3004} has units digit of 6.
11.	-8	$N = 7(1) - 6(1) - 5(1) + 2 = -2$ $S = 7(-1) - 6(1) - 5(-1) + 2 = -6$ $N + S = -2 + (-6) = -8$
12.	11	By the transitive property: $x = \sqrt{132 - x}$ $x^2 + x - 132 = 0 \quad (x - 11)(x + 12) = 0 \quad x = 11, x \neq 12$
13.	1	Plug in 1 in place of the variables to find the sum of the coefficients of the expansion. $(7(1) - 6(1))^{11} = 1^{11} = 1$
14.	$26\pi\sqrt{41}$	A =13, $C = \sqrt{5}$, $B = \sqrt{A^2 - C^2} = \sqrt{164} = 2\sqrt{41}$. Therefore, the area is $\pi AB = 26\pi\sqrt{41}$
15.	-29	$\begin{bmatrix} 6 & 4 \\ 5 & 7 \end{bmatrix}\begin{bmatrix} 7 & 11 \\ 12 & 6 \end{bmatrix} = \begin{bmatrix} (6)(7) + (4)(12) & (6)(11) + (4)(6) \\ (5)(7) + (7)(12) & (5)(11) + (7)(6) \end{bmatrix} = \begin{bmatrix} 90 & 90 \\ 119 & 97 \end{bmatrix}$ $b - c = 90 - 119 = -29$
16.	$\frac{22}{89}$	$\frac{odd\ multiples}{total\ multiples} = \frac{\binom{45}{2}}{\binom{90}{2}} = \frac{45 \cdot 44/2}{90 \cdot 89/2} = \frac{22}{89}$
17.	$\frac{\sqrt{13}}{7}$	$a = 7\ \&\ b = 6, a^2 - b^2 = c^2$ $49 - 36 = 13$ so $c = \sqrt{13}$ Eccentricity = $\frac{c}{a} = \frac{\sqrt{13}}{7}$
18.	$x = 2\ \&x = 3$	$y = \frac{x^3 - 2x^2 - 29x + 30}{x^3 - 19x + 30} = \frac{(x+5)(x-1)(x-6)}{(x+5)(x-2)(x-3)}$ We have a hole at $x = 5$, and two vertical asymptotes at $x = 2\ \&\ x = 3$.
19.	0	$7^1 = 7, 7^2 = 49, 7^3 = 343, 7^4 = 2401$. The tens digit pattern is 0, 4, 4, 0, 0, 4, 4, 0, …. , so the tens digit of 7^{2024} is 0.
20.	-15	The ordinate is the y-coordinate, and the parabola has its highest point at the vertex. The x-coordinate of the vertex is $-\frac{b}{2a} = 1$, and $f(1) = -2 + 4 - 17 = -15$.
21.	$-\frac{49}{4}$	We can turn this into a quadratic equation: $(x)(x + 7) = 0$ We then find the minimum of this by saying $-\frac{b^2}{2a} = -\frac{49}{4}$
22.	13400	The number of terms in this series is $\frac{398-2}{6} + 1 = 67$. The sum is $\frac{67}{2}(2 + 398) = 67 \cdot 200 = 13400$.

23. 2937 Since we want to find zeros, we are essentially looking for factors of 2 and 5, but since 5 occurs less frequently than 2, it is the limiting factor and we can use it to find the number of zeros.
(Disregard any remainders while dividing)
$\frac{11760}{5} = 2352 \quad \frac{2352}{5} = 470 \quad \frac{470}{5} = 94 \quad \frac{94}{5} = 18 \quad \frac{18}{5} = 3$
$2352 + 470 + 94 + 18 + 3 = 2937$

24. 2 The sum of the reciprocals of the divisors is the quotient of the sum of the divisors and the number itself. $496 = (2^4)(31^1)$.
$(2^0 + 2^1 + 2^2 + 2^3 + 2^4)(31^0 + 31^1) = (1 + 2 + 4 + 8 + 16)(1 + 31)$
$= (31)(32) = 992$
$\frac{992}{496} = 2$

25. 12 Multiply 0.5 by 5 to get 2.5. The first digit will be 2. Take the "remainder," 0.5, and multiply it by 5. We are at 2.5 again. We will repeat this process five times, so we get six 2's. The sum is 12.