1. Sum of roots is $-\dfrac{b}{a} = -\dfrac{-4}{2} = 2$.

2. $\displaystyle\sum_{x=1}^{10}(x(x+1)) = \sum_{x=1}^{10}x^2 + \sum_{x=1}^{10}x = 385 + 55 = 440$

3. Add the second and third equations and get $v + 2w + x + y = 4$. Note that the first equation is $v + 2w + 4x + y = 4$. Subtracting the two gives $-3x = 0 \rightarrow x = 0$.

4. Susan paints $\dfrac{1}{2}$ a barn each day and Pam paints $\dfrac{1}{4}$ a barn each day, so together they paint $\dfrac{3}{4}$ a barn each day so they paint 30 barns in 40 days.

5. $|x^2 - 1| \geq 0$, so $|x^2 - 1| + 4 \geq 4$ so 4 is the minimum.

6. $3|x-1| - |x-1| + 4|x-1| = 6|x-1| = 18 \rightarrow |x-1| = 3 \rightarrow x = -2, 4 \rightarrow sum = 2$

7. $41^2 - 17^2 = (41-17)(41+17)$, which is divisible by 58
$19^4 - 16 = 361^2 - 4^2 = (361-4)(361+4)$, which is divisible by 365
$18^2 + 22^2 = 4(9^2 + 11^2)$, which is divisible by 4
$12^3 + 11^3 = (12+11)(12^2 - (12)(11) + 11^2)$ which is divisible by 23
So none are prime.

8. By definition of inverse, for any function $g(x)$ with an inverse, $g(g^{-1}(1)) = 1$.

9. Let $x = \sqrt{\pi + \sqrt{\pi + \sqrt{\pi + \ldots}}}$ so $x = \sqrt{\pi + x} \rightarrow x^2 - x - \pi = 0$. We want the positive root since the radical is obviously positive: $\dfrac{1 + \sqrt{1 + 4\pi}}{2}$.

10. For the sum to be even, there has to be either 0 odd terms, 2 odd terms, or 4 odd terms. This is just as likely as the opposite, which is 5 odd terms (0 even), 3 odd terms (2 even) or 1 odd term (4 even), so the probability A is just $\dfrac{1}{2}$.

11. By the AM-GM theorem, the geometric mean of 69 and 71 is less than their arithmetic mean, so $\sqrt{(69)(71)} < \dfrac{69 + 71}{2} = 70$, and $\sqrt{(69)(71)} > \sqrt{(69)(69)} = 69$, so $\sqrt{(69)(71)}$ is between 69 and 70, so the answer is 70.

12. $\displaystyle\sum_{x=0}^{10}\sqrt{x^2 y} = \sqrt{y}\sum_{x=0}^{10}\sqrt{x^2} = \sqrt{y}\sum_{x=0}^{10}x = 55\sqrt{y} = 220 \rightarrow y = 16$.

13. Distance is $\sqrt{(4-3)^2+(7-1)^2}=\sqrt{37}$.

14. $y=x^2-2\sqrt{2}x+2=(x-\sqrt{2})^2$, so there are no rational roots.

15. $y=2x$ has slope 2, so any line that is perpendicular to $y=2x$ has slope $-\dfrac{1}{2}$

16. Say the shoes originally cost $\$x$. After the first discount, the cost is down to $\dfrac{6x}{10}$, but after the markup it's back up to $\dfrac{72x}{100}$. After the final discount the price is down to $\dfrac{36x}{100}=9\to x=25$.

17. $x+y=\sqrt{48}, xy=4\to x^2+y^2=(x+y)^2-2xy=48-8=40$

18. $(4+2i)^2-(4-2i)^2=(4+2i+4-2i)(4+2i-4+2i)=(8)(4i)=32i$

19. $\dfrac{x^4y^2zx}{xyz^4}=\dfrac{x^4y}{z^3}$.

20. Set the two equal. $-x^2=2x+1\to x^2+2x+1=0\to x=-1\to(-1,-1)$

21. Perimeter is sum of lengths of sides $(x+2y-1)+(y+4)+(y-x+4)=4y+7$

22. Call the sides $a,b\ \ a>b$.
$a+b=9,\ ab=17\to b=\dfrac{17}{a}\to a+\dfrac{17}{a}=9\to a^2-9a+17=0\to a=\dfrac{9+\sqrt{13}}{2}$

23. $\log 4^{10}=10\log 4=20\log 2=6$, $\log 5^9=9\log 5=9(1-\log 2)=6.3$, so 5^9 is larger.

24. Number of gophers goes up by a factor of 13, so 91 gophers can lay 182 eggs in 14 minutes. Now double the time, so 91 gophers can lay 364 eggs in 28 minutes.

25. $x+2y-1=0\to y=-\dfrac{1}{2}x+\dfrac{1}{2}$, so slope is $-\dfrac{1}{2}$.