1. **B** The slope of the line is $m=\dfrac{4-(-2)}{1-2}=-6$. Plugging this into point slope form, we get $y-4=-6(x-1)\Rightarrow y=-6x+10$, so the y-intercept is (0,10).
2. **A** The sum of the first *n* even numbers is $n(n+1)$ and the sum of the first *n* odd numbers is n^2. The difference is *n*.
3. **A** The sum of an individual term $a_n=n^2-(n-1)^2=2n-1$.

   Thus $a_1+a_3+a_5+...+a_{15}=1+5+9+...+29=\dfrac{8}{2}(1+29)=120$.
4. **B** Cross-multiplying, we get $-x^2+x+6>4\Rightarrow x^2-x-2<0$. Factoring the quadratic, we get $(x-2)(x+1)<0$ and testing the intervals $(-\infty,-1),(-1,2),(2,\infty)$ shows us that our answer is $(-\infty,-2)\cup(-1,2)$.
5. **E** Since **(1)** $-a=c+d$ and **(2)** $-c=a+b$, we can deduce that **(3)** $-a-c=a+b+c+d=d$. We also know that **(4)** $b=cd$ and **(5)** $d=ab$. From equation (5), we see that $b=\dfrac{d}{a}$, so we can substitute this in to (4) and get **(6)** $\dfrac{d}{a}=cd\Rightarrow ac=1$. Using (1) and (3), we see that **(7)** $d=(-c-d)+b+c+d\Rightarrow b=d$. Thus, from (5), we find that $d=ad\Rightarrow a=1$ and from (6), this implies $c=1$. Going back to (1), we then find that $d=-a-c=-1-1=-2$ and thus $b=-2$. The sum of all roots is -2.
6. **D** Multiplying the numerator and denominator by $(1+i)^{10}$, we get the fraction $\dfrac{(1+i)^{20}}{((1+i)(1-i))^{10}}=\dfrac{(2i)^{10}}{2^{10}}=i^{10}=-1$
7. **B** Simply convert each number to base ten then add them together. $1001_2=1(2^0)+1(2^3)=9$, $2002_3=2(1)+2(3^3)=56$, $3003_4=3(1)+3(4^3)=195$. The sum is 260.
8. **C** The ellipse factors into $4(x+1)^2+9(y+2)^2=144$. Finding the values of *a* ,*b* ,and *c* is unnecessary because the average of the coordinates of the foci are the coordinates of the center. Thus, the sum is $3(-1)+3(-2)=-9$.
9. **D** Simplifying the logs, we see that $\left(\dfrac{2\log 5}{\log 13}\right)\left(\dfrac{\log 12}{2\log 2}\right)\left(\dfrac{6\log 2}{\log 5}\right)\left(\dfrac{2\log 13}{2\log 12}\right)=\dfrac{2\cdot 2\cdot 6}{2\cdot 2}=6$.

10. **B** Since there are 12 desks to seat 8 students, there are $12C8 = \frac{12!}{8!4!}$ ways for them to arrange themselves. If the 8 students are sitting side by side in a row, there are 9 slots for an empty chair to be inserted (2 on the outside, 7 between students). There are $9C4 = \frac{9!}{5!4!}$ ways to arrange this such that no two empty desks are in one slot. Thus, the probability of this occurring is $\frac{\frac{9!}{5!4!}}{\frac{12!}{8!4!}} = \frac{14}{55}$

11. **A** Notice that $x = \sqrt{1+x}$. Squaring both sides, we get $x^2 - x - 1$, which has roots $\frac{1 \pm \sqrt{1+4}}{2} = \frac{1 \pm \sqrt{5}}{2}$.

The only positive root is $\frac{1+\sqrt{5}}{2}$.

12. **E** Two lines are dependent if one is constant multiple of the other. It follows that $\frac{2x}{x} = \frac{3y}{py} \Rightarrow p = \frac{3}{2} \Rightarrow k = 2\left(\frac{9}{4}\right) = \frac{9}{2}$.

13. **A** The definitions boil down to this: how many positive integral factors does 240 have? Factoring it, we get $240 = 2 \cdot 2 \cdot 2 \cdot 2 \cdot 3 \cdot 5 = 2^4 \cdot 3 \cdot 5$. Thus, 240 has $5(2)(2) = 20$ factors.

14. **D** Classic balls-in-bins problem, except each bin must have at least one ball. There are 3 "dividers" and 12 balls to be separated by these dividers. However, since each bin must have a ball, there are only 8 balls to distribute. Now you are simply trying to find the number of permutations of 3 dividers and 8 balls, which is $\frac{11!}{3!8!} = 165$.

15. **A** An easy way to do this problem is to see that point A is halfway along the arc of the circle between B and C. Therefore, the chord from A that is perpendicular to $\overline{BC}$ runs through the center of the circle. The chord formula shows us that $2(2) = 3(x) \Rightarrow x = \frac{4}{3}$. Therefore, the radius is $\frac{3+\frac{4}{3}}{2} = \frac{13}{6}$. This means that the center is located at $(3, 4 - \frac{13}{6}) = \left(3, \frac{11}{6}\right)$. The desired sum is $\frac{11}{6} + 3 + \frac{13}{6} = 7$. If you aren't fond of geometry, put the three points into a system of equations and get the same answer.

16. **A** Plugging in (x+1) for all x's will shift the entire graph one unit to the right. Plugging in $\frac{x}{2}$ for all x's will double the value of all the roots. The result is choice A.

17. **D** When we write this as a sum, $S = i + 2i^2 + 3i^3 + ... + 100i^{100}$, we see that S can be multiplied by *i* to get the sum $Si = i^2 + 2i^3 + 3i^4 + ... + 100i^{101}$. Subtracting the second equation from the first, we get $S(1-i) = i + i^2 + i^3 + ... + i^{100} - 100i$. We can see that the sum of every 4 terms cancel each other out, so the sum of the first 100 terms sum to zero. Therefore, $S = \dfrac{-100i}{1-i} = \dfrac{-100i + 100}{2} = 50 - 50i$.

18. **A** When you set $y = x^{\log 3}$ and take the logs of both sides, $\log y = (\log 3)(\log x)$, you see that you can now arrange the equation to be $y = \left(10^{(\log 3)}\right)^{\log x} = 3^{\log x}$. Now our equation is $y^2 - y - 2 = 0$, which has solutions $y = 2, y = -1$. Since we can't take the log of a negative number, our answer is $\log 2 = (\log 3)(\log x) \Rightarrow x = 10^{\log_3 2}$. Therefore, a + b + c = 15.

19. **B** Check which side length is longer by raising both of them to the 30th power. This gives us that $(\sqrt[10]{10})^{30} = 10^3 = 1000$, and $(\sqrt[3]{2})^{30} = 2^{10} = 1024$. Hence, side length $\sqrt[3]{2}$ is longer.

20. **C** The boat can travel 8 miles downstream in $8 = t(10+6) \Rightarrow t = \frac{1}{2}$. In this time, Bobby travels $d = \frac{1}{2}(6) = 3$ miles downstream, so 5 miles separate Bobby from the rest when the boat turns around. The remaining distance can be covered in $t = \frac{d}{r} = \frac{5}{(6+4)} = \frac{1}{2}$ hour, and in this time, the boat travels $d = rt = 4\left(\frac{1}{2}\right) = 2$ miles from the camp.

21. **A** There are $\frac{1000}{2} = 500$ numbers divisible by 2 and $\left\lfloor \frac{1000}{3} \right\rfloor = 333$ numbers divisible by 3, but we must subtract the numbers that are divisible by both. Therefore, $500 + 333 - \left\lfloor \frac{1000}{6} \right\rfloor = 667$.

22. **B** If Alex rolls a 6 (with probability $\frac{1}{6}$), Marshall can roll a 1, 2, 3 or 4 and still lose to Alex. Repeating this process for each possible roll for Alex and Marshall in the first round, we see that the probability that Alex wins in the first round is $\left(\frac{1}{6}\right)\left(\frac{4}{6} + \frac{3}{6} + \frac{2}{6} + \frac{1}{6}\right) = \frac{5}{18}$. If Alex rolls a 2, 3, 4, 5, or 6, Marshall has the chance of tying him by rolling the right number. Therefore, the probability that they tie on the first turn is $\left(\frac{5}{6}\right)\left(\frac{1}{6}\right) = \frac{5}{36}$. Since they have an equal number of chips after the first turn tie, the probability that they

tie again is $\frac{1}{6}$ and the probability that Alex wins is now $\frac{1-\frac{1}{6}}{2}=\frac{5}{12}$. Finally, P(Alex wins)= P(1st turn win) + P(2nd turn win) +…= $\frac{5}{18}+\left(\frac{5}{36}\right)\frac{5}{12}+\left(\frac{5}{36}\right)\left(\frac{1}{6}\right)\frac{5}{12}+\left(\frac{5}{36}\right)\left(\frac{1}{6}\right)^2\frac{5}{12}+\ldots=\frac{5}{18}+\frac{\left(\frac{5}{36}\right)\left(\frac{5}{12}\right)}{1-\frac{1}{6}}=\frac{25}{72}$.

23. **C** The shortest distance between two points is a line. Therefore, if we reflect the given point over the given line, we should be able to find the straight line distance between the two. To reflect the point (2,1) over the line, we need to find the line perpendicular to y=x+1 which runs through (2,1), which is $y=-x+3$. This intersects y=x+1 at $(1,2)$, which is 1 unit west and 1 unit north of (2,1). Thus, the reflected point must also be 1 unit west and north of the intersection, or at (0,3). The distance between (0,3) and (1,-2) is $\sqrt{26}$.

24. **B** The 3rd term is $\frac{5!}{2!3!}(3x)^3(-y)^2=270x^3y^2$.

25. **A** When we multiply each numerator by the least common denominator, we get $(Ax+B)(x-1)+C(x^2+1)=x+1$. Grouping like terms, we get three equations, $\begin{matrix} A+C=0 \\ B-C=-1 \\ A-B=-1 \end{matrix}$, which has the solution $(A,B,C)=(-1,0,1)$. Thus, $-1-0+1=0$.

26. **C** When the inverse is taken of a function, the x and y coordinates are reversed. Therefore, the intersections occur when $x=x^3+3x^2+2x-1 \Rightarrow x^3+3x^2+x-1=0$. The sum of these roots is -3, and since each x-coordinate is equal to its corresponding y-coordinate, the sum is -6.

27. **E** If the width of the rectangle has length of x, then the longer side has length of (200-2x). Thus, the area of the rectangle is $x(200-2x)$, which has a maximum value at x = 50. The area is 5,000.

28. **B** Since it was said that there is a unique solution, the first determinant (with value 0) cannot be the coefficient matrix. This means the two lines are $\begin{matrix} 4x+y=6 \\ 2x-y=3 \end{matrix}$. The solution is $\left(\frac{3}{2},0\right)$.

29. **D** Given the information, we can write $a^2+b^2+c^2=25$ and $2ab+2ac+2bc=50$. Conveniently, $(a+b+c)^2=a^2+b^2+c^2+2ab+2ac+2bc=75$, so $a+b+c=5\sqrt{3}$.

30. **B** If the magnitude of $4+4i\sqrt{3}=z_1$ is 8, it follows that the square root of z_1 is $\sqrt{8}=2\sqrt{2}$.