1. B
2. C
3. B
4. A
5. E
6. B
7. C
8. C
9. C
10. D
11. C
12. B
13. D
14. D
15. C
16. B
17. B
18. D
19. E
20. B
21. C
22. A
23. B
24. B
25. A
26. A
27. D
28. C
29. B
30. A

1. B The probability that Terri wins on her turn is ¾ and for Avery is ¼. The probability Terri wins is $\frac{3}{4}+(\frac{1}{4})(\frac{3}{4})(\frac{3}{4})+(\frac{1}{4})(\frac{3}{4})(\frac{1}{4})(\frac{3}{4})(\frac{3}{4})\ldots=\frac{12}{13}$
2. C Every consecutive 4 powers of i sums to 0, so the whole sum is $i^{2022}+i^{2023}+i^{2024}=-i$
3. B $12+12+24+24+48+48+96+96+192+192 = 24(1+2+4\ldots+2^4)$= (24)(31)=744.
4. A Since the values are so high, it would be difficult to solve for a_{100}. $a_{101}=a_{100}+a_{99}+1$ and $a_{100}=a_{99}+a_{98}+1$. Plugging a_{100} in gets $a_{101}=2a_{99}+a_{98}+2$. Subtracting over gets the desired value of 2.
5. E The sequence classifies as none of the options.
6. B Using finite differences,
   1: 1, 11, 26, 46, 71
   2: 10. 15. 20. 25
   3: 5, 5, 5
   Since it is constant after 3 differences, the answer is 3.
7. C Let $4+\frac{5}{4+\frac{5}{4+\ldots}}$= S. Then $4+\frac{5}{S}=S$and $S^2-4S-5=0$ so S=5, -1. Since S must be positive S=5.
8. C $\frac{1}{1-r}=4r^2-12r+7$. Multiplying both sides by 1-r and subtracting by 1 gets $-4r^3+16r^2-19r+6=0$. Use rational root theorem to get r=$\frac{1}{2},\frac{3}{2}$,2. The last two are extraneous since they exceed 1 so the answer is 2.
9. C Let the sides be a-d, a, and a+d. Using the pythagorean theorem gets $a^2-2ad+d^2+a^2=a^2+2ad+d^2$ or a=4d. The sides are 3d, 4d, and 5d, so using the area gets $6d^2=96$ gets d=4 and 5d=20.
10. D $\frac{1+5i}{3+2i}=\frac{\sqrt{26}}{\sqrt{13}}>1$.The series diverges.
11. C The series telescopes $\frac{1}{n}-\frac{1}{n+1}$so the workers' combined rate is 1-$\frac{1}{11}$=$\frac{10}{11}$blocks per hour. This means it will take 33 hours to finish($\frac{30}{\frac{10}{11}}$)
12. B f(1) + f(-1) = 2046 = 2a(1+4+16+64+256) = 682a. a=3. Plug f(1) in to get 2048-b=(511)(3). b= 515. 5+1+5=11.
13. D There are 5 single-digit odds so find the 48th digit of the 2-digit odds or the last digit of the 24th 2-digit odd. 11,13,15...57. So the answer is 7.
14. D $\frac{a}{1-r}=6$and $\frac{a^2}{1-r^2}=144$ Squaring the first equation and dividing by the second gets $\frac{1-r^2}{(1-r)^2}=\frac{1}{4}=\frac{1+r}{1-r}$ Solving this gets r=$\frac{-3}{5}$ and a=$\frac{48}{5}$
15. C The highest and lowest possible scores are 6 and 57, and every score in between is possible, so the 20th number in that list is 25.
16. B Chris can get any score between 6 and 57, so 6+7+8+...57=1638.
17. B Break it up into $\frac{x2^x}{4^x}+\frac{1}{4^x}=\frac{x}{2^x}+\frac{1}{4^x}$Solve each one individually. K = $\frac{1}{2}+\frac{2}{4}+\frac{3}{8}\ldots$ $\frac{1}{2}K=\frac{1}{4}+\frac{2}{8}\ldots$Subtracting the two gets $\frac{1}{2}+\frac{1}{4}+\frac{1}{8}\ldots=\frac{1}{2}K.\ K=2$.The second part is an infinite geometric series with sum $\frac{4}{3}$. $S=2+\frac{4}{3}$ 3S=10.

18. D Since RUIWEN is equiangular, it can be an equilateral triangle with 3 equilateral triangles cut out from the corners. Solving for each side of the big equilateral triangle, we get $b^2+b^3=5a$ and $b^2+b=3a$. 3ab=5a. b=$\frac{5}{3}$and a=$\frac{40}{27}$. The largest side length is $b^3=\frac{125}{27}$so 81 times that is 375.

19. E Using the infinite geometric series formula, $\frac{1}{1-r}\frac{1}{1-s}\frac{1}{1-t}=\frac{1}{\frac{1}{12}f(1)}=6$

20. B The minimum possible value of a+b+c would be when they are 4, 2, 1 or 1, 2, 4. This would mean n must be at least 5. 1+2+4+5=12.

21. C The first circle has radius of 1, meaning an area of π. The second square has side length $\sqrt{2}$, so the second circle has radius of $\frac{\sqrt{2}}{2}$and area of $\frac{\pi}{2}$and so on. $\pi+\frac{\pi}{2}+\frac{\pi}{4}\ldots=2\pi$.

22. A To go up 6 terms, we multiply by 3, so to go from 9th term to 12th term would be $9\sqrt{3}$.

23. B 0+1+2...49=$\frac{(50)(49)}{2}$=1225.

24. B Factoring n^2-1 into $(n-1)(n+1)$. Every other term cancels out.

$$\frac{2^2}{1\cdot 3}\cdot\frac{3^2}{2\cdot 4}\cdots\frac{n^2}{(n-1)(n+1)}=\frac{2\cdot n}{1\cdot(n+1)}=\frac{2n}{n+1}=\frac{200}{101}$$

25. A

$$\frac{n^2}{n^2-1}=1+\frac{1}{n^2-1}=1+\frac{1}{2}\left(\frac{1}{n-1}-\frac{1}{n+1}\right)$$

Thus, the summation is

$$9+\frac{1}{2}\left(1-\frac{1}{3}+\frac{1}{2}-\frac{1}{4}\ldots+\frac{1}{8}-\frac{1}{10}+\frac{1}{9}-\frac{1}{11}\right)$$

$$9+\frac{1}{2}\cdot\left(1+\frac{1}{2}-\frac{1}{10}-\frac{1}{11}\right)=\frac{531}{55}$$

26. A S=$\frac{1}{2}+\frac{1}{4}+\frac{2}{8}\ldots.S-\frac{1}{2}S-\frac{1}{4}S=\frac{1}{2}=\frac{1}{4}S$ S=2.

27. D a_2=5, a_5=4, so a_8=3 so the sum of the first fifteen terms is (3)(15)=45.

28. C Call the terms a-11,a-9,a-7….a-1,a+1….a+9,a+11. The sum of the terms would be 12a=372, so a=31. The greatest term would be 31+11=42.

29. B $\frac{2}{5}+\frac{1}{5}+\frac{1}{10}=\frac{\frac{2}{5}}{1-\frac{1}{2}}=\frac{4}{5}$Since the questions asks for the remainder, it is $\frac{1}{5}$

30. A There are 2 cases.

i) n is odd

$\rightarrow\frac{2024}{n}$ is an integer

$\rightarrow n=1,11,23,253$

ii) n is even

$\rightarrow\frac{2024}{n}$ is half of an odd integer

$\rightarrow n=16*(1,11,23,253)$