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

1. D 2 weeks is 14 days. He can run for 2 then take 1 day off and continue this pattern for a total of 10 run days. He could also start with 2 days off and then run for 1 day. If he continues this pattern he only gets 4 days of running. The difference is 6
2. C Just list them out and you get 7 choices but the order can be flipped for a total of 14. 1 and 32, 2 and 32, 4 and 16, 4 and 32, 8 and 16, 8 and 32, 16 and 32
3. B $\left(\sqrt{13}\right)^2 + a^2 = 5^2 \rightarrow a = 2\sqrt{3}$ a is the apothem. This makes base edge =4

   $\frac{1}{3}Bh = \frac{1}{3} \bullet \frac{3}{2} 4^2 \bullet \sqrt{3} \bullet \sqrt{13} = 8\sqrt{39}$
4. A As you approach zero the first absolute value is negative and the second is positive so it simplifies to $\lim\limits_{x\to 0} \frac{|3x-2|-|3x+2|}{x} \rightarrow \frac{2-3x-3x-2}{x} = -6$
5. A $\tan 30^\circ = \frac{1}{\sqrt{3}} \rightarrow x - y\sqrt{3} = 0 \rightarrow 6 \bullet y\sqrt{3} - 3 \bullet 3y^2 = y$

   $9y = 6\sqrt{3} - 1 \rightarrow y = \frac{6\sqrt{3}-1}{9}$
6. D Rewrite and you can see it is just the infinite/infinite sequence

   $\frac{1}{3} + \frac{2}{9} + \frac{3}{27} + \frac{4}{81} = \rightarrow \frac{\frac{1}{3}}{1-\frac{1}{3}} = \frac{1}{2} \rightarrow \frac{\frac{1}{2}}{1-\frac{1}{3}} = \frac{3}{4}$
7. B Watch for extraneous solutions.

   $\log 25x + \log 4x - 4\log(x-1) = 2$

   $\log \frac{100x^2}{(x-1)^4} = 2 \rightarrow 100 = \frac{100x^2}{(x-1)^4} \rightarrow (x-1)^4 = x^2 \rightarrow (x-1)^2 = \pm x$

   $x^2 - 2x + 1 = \pm x \rightarrow x^2 - 3x + 1 = 0 \; or \; x^2 - x + 1 = 0$ so only 1 solution

   $\frac{3 \pm \sqrt{5}}{2} \rightarrow \frac{3+\sqrt{5}}{2}$
8. E As you go to infinity you get y=0.2 and when you go to negative infinity you get y= -2
9. C $\begin{pmatrix} i & j & k \\ -2 & 1 & 3 \\ 4 & -1 & 0 \end{pmatrix} \rightarrow -4k + 3i + 12j + 2k \rightarrow (3,12,-2)$
10. D The smallest set would be 1 through 80 and the largest would be 11 to 90. Each of the elements differ by 10 and there are 80 so that is 800 but must add 1 to get 801.
11. E $sin\, t = \frac{x}{3} \rightarrow y = \left(\frac{9-x^2}{9}\right) - 9\left(\frac{x^3}{27}\right) + x^2$

    $1 - \frac{x^2}{9} - \frac{x^3}{3} + x^2 = 0 \rightarrow 3x^3 + 8x^2 + 9 = 0 \rightarrow x = -3$

12. D You could use combinatorics or since we only need 4th one, we can use coefficient times exponent divided by position $\frac{1\bullet\frac{1}{2}}{1}=\frac{1}{2}\rightarrow\frac{\frac{1}{2}\bullet\frac{-1}{2}}{2}=-\frac{1}{8}\rightarrow\frac{\frac{-1}{8}\bullet\frac{-3}{2}}{3}=\frac{1}{16}$

$$\frac{1}{16}\bullet 4^{\frac{-5}{2}}=\frac{1}{512}$$

13. C Draw a good picture. Use LOC twice with angle A and set them equal

$$\frac{x^2+5^2-5^2}{2\bullet 5\bullet x}=\frac{x}{10}\rightarrow\frac{5^2+9^2-7^2}{2\bullet 5\bullet 9}=\frac{19}{30}=\frac{x}{10}$$

$$x=\frac{19}{3}\rightarrow\frac{\frac{19}{3}}{\frac{8}{3}}=\frac{19}{8}\rightarrow 27$$

14. D Plug in 1, 2 and 3 to get 3 equations with 3 variables:

$-3=A+B+C\rightarrow -2=4A+2B+C\rightarrow 3=9A+3B+C$

$1=3A+B\rightarrow 5=5A+B\rightarrow 4=2A\rightarrow A=2\rightarrow B=-5\rightarrow C=0\rightarrow 2--5-0=7$

15. C Use your properties of determinates to simplify before expanding: Multiple the first column by 2 and add to the fourth column. This way you only have one expansion:

$$\begin{vmatrix}-1 & 2 & 3 & -1\\ 0 & 3 & 4 & 5\\ 1 & 0 & 0 & 0\\ 4 & 1 & -3 & 10\end{vmatrix}=1\begin{vmatrix}2 & 3 & -1 & 2 & 3\\ 3 & 4 & 5 & 3 & 4\\ 1 & -3 & 10 & 1 & -3\end{vmatrix}=80+15+9+4+30-90=48$$

16. B ${}_{16}C_3-8\bullet{}_4C_3-4\bullet{}_3C_3-2\bullet{}_4C_3=516$

17. B If you use some synthetic division off of your P/Q list you get roots of 7,4,3,-1 so the answer is 7+4-1=10

18. E $\tanh(x)=\frac{e^x-e^{-x}}{e^x+e^{-x}}$ No horizontals since denominator cannot equal 0. We get y =1 or -1 depending on whether or not x is going to plus or minus infinity

19. C Let us prime factor to get $3^4\bullet 5^2\bullet 7^1\bullet 2^8$. You can ignore the 5's and 7's since they cannot be part of perfect cubes. The ones that can are $1^3,2^3,3^3,4^3,6^3,12^3$ for a total of 6.

20. E $\sec^2(x)=1+\tan^2(x)$ so we get

$1+\tan^2(x)-2\cdot\tan(x)=4\Rightarrow\tan^2(x)-2\cdot\tan(x)-3=0$. Factor

$(\tan x-3)(\tan x+1)=0\Rightarrow\tan x=3\ or\ \tan x=-1$. We know $\tan x=3$ will have 2 solutions, when x is in the first and third quadrants and $\tan x=-1$ will have 2 solutions again. Thus, the total number of solutions is 4

21. C If you draw a picture and use power of the point you will see that the perimeter is twice the sum of the bases. We know the median of the trapezoid is 10 which is the average of the bases. So, our answer is 4 times 10 which equals 40

22. D Need to know your Pythagorean triplets. You have 7, 24,,25 and 15,20,25. X and Y can be switched so you get 4 answers in each quadrant plus the 4 quadrantals for a total of 20.

23. C We will solve with cosine and degrees and flip at the end. Double angle identity will be helpful here

$$\cos 20^\circ \cos 40^\circ \cos 80^\circ = ?$$

$$\sin 40^\circ = 2\cos 20^\circ \sin 20^\circ \to \cos 20^\circ = \frac{\sin 40^\circ}{2\sin 20^\circ}$$

$$\cos 20^\circ \cos 40^\circ \cos 80^\circ = \frac{\sin 40^\circ \cos 40^\circ \cos 80^\circ}{2\sin 20^\circ} = \frac{\sin 80^\circ \cos 80^\circ}{4\sin 20^\circ} = \frac{\sin 160^\circ}{8\sin 20^\circ}$$

$$\frac{1}{8} \to 8$$

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24. D $\frac{1}{2}\log_2 k - 3\log_{k^2} 2 = 1 \to \frac{1}{2}\log_2 k - \frac{3}{2}\log_k 2 = 1$

$$\log_2 k - 3\log_k 2 - 2 = 0 \to \log_2 k - \frac{3}{\log_2 k} - 2 = 0$$

$$(\log_2 k)^2 - 2\log_2 k - 3 = 0 \to (\log_2 k - 3)(\log_2 k + 1) = 0 \to 8 \bullet \frac{1}{2} = 4$$

25. B We have $\cos(2\cdot x) = 1 - 2\cdot\sin^2(x)$ and $x = \arcsin\left(\frac{5}{6}\right) \Rightarrow \sin x = \frac{5}{6}$. Thus,

$$\cos(2\cdot x) = 1 - 2\cdot\left(\frac{5}{6}\right)^2 = 1 - \frac{50}{36} = -\frac{7}{18}.$$

26. B $Dx + Ey + F = -\left(x^2 + y^2\right)$

$$D - 2E + F = -5$$

$$10D + 5E + F = -125$$

$$5D + 4E + F = -41 \to 9D + 7E = -120 \to 4D + 6E = -36$$

$$D = -18, E = 6, F = 25 \to (x+9)^2 + (y-3)^2 = -25 + 81 + 9 \to \sqrt{65}$$

27. B $\frac{\pi}{10} + \frac{2\pi}{5} = \frac{\pi}{2}$

28. D We have 2 arcs of 180+74 =254. 360-254 leaves 106. The 2 intercepted arcs can be called x and 106-x. The average of the differences equals the angle formed by the secants. 2x-106=56. 2x=162 so x=81

29. A If you just look at the exponent of 1/x you see that goes to infinity when coming from the right and negative infinity when coming from the left so DNE

30. D $\frac{1 + \tan x \tan y}{\tan x - \tan y} = \frac{1 + \frac{1}{A}\bullet\frac{1}{B}}{\frac{1}{A} - \frac{1}{B}} = \frac{AB+1}{B-A}$