1. C. $\sin\frac{\pi}{3} = \frac{\sqrt{3}}{2} = \cos\frac{11\pi}{6}$
2. C. $h(t) = 40 - 32\cos(6\pi t)$ Vertical Shift = 40. Amplitude = 32. @ $t = 0$, height is at a minimum (negative amplitude for cosine). Period is 1/3 minute. $1/3 = 2\pi/B \Rightarrow B = 6\pi$
3. A. $7 = 5\sin(2x-3)+4 \Rightarrow \frac{3}{5} = \sin(2x-3) \Rightarrow (2x-3) = 2\pi n + \begin{cases} Sin^{-1}.6 \\ \pi - Sin^{-1}.6 \end{cases} \Rightarrow$

   $x = \frac{3}{2} + \pi n + \frac{1}{2}\begin{cases} Sin^{-1}.6 \\ \pi - Sin^{-1}.6 \end{cases} \Rightarrow x = 1.5 + \pi n + \frac{1}{2}\begin{cases} Sin^{-1}.6 \\ \pi - Sin^{-1}.6 \end{cases}$
4. D. $2-\sqrt{3}$ $\quad \tan\left(\frac{\pi}{12}\right) = \tan\left(\frac{\pi}{3} - \frac{\pi}{4}\right) = \frac{\tan\frac{\pi}{3} - \tan\frac{\pi}{4}}{1 + \tan\frac{\pi}{3} \times \tan\frac{\pi}{4}} = \frac{\sqrt{3}-1}{1+\sqrt{3}} = 2-\sqrt{3}$
5. E. $\cos\phi = \frac{-12}{13}; \tan\phi > 0 \Rightarrow \tan\phi = \frac{5}{12}; \ \sin\theta = \frac{3}{5}; \tan\theta < 0; \Rightarrow \tan\theta = \frac{-3}{4}$.

   $\tan(\theta+\phi) = \frac{\frac{5}{12} + \frac{-3}{4}}{1 - \frac{5}{12} \times \frac{-3}{4}} = \frac{-16}{63}$.
6. C. The ninth term in the expansion of $\left(4y - \frac{1}{2}x^2\right)^{12}$ has an exponent of 12-8 on the first term of the binomial and 8 on the second term of the binomial. $\binom{12}{8}(4y)^4\left(\frac{1}{2}x^2\right)^8 = 495x^{16}y^4$
7. D. Det $\begin{vmatrix} 1 & 0 & 0 & 2 \\ 0 & 3 & 4 & 0 \\ 0 & 5 & 6 & 0 \\ 7 & 0 & 0 & 8 \end{vmatrix} .= 1 \times \begin{vmatrix} 3 & 4 & 0 \\ 5 & 6 & 0 \\ 0 & 0 & 8 \end{vmatrix} - 2 \times \begin{vmatrix} 0 & 3 & 4 \\ 0 & 5 & 6 \\ 7 & 0 & 0 \end{vmatrix} = 1 \times 8 \times (18-20) - 2 \times 7 \times (18-20) = 12$
8. A. $\sum_{i=15}^{42}(7i-3) = \sum_{i=1}^{42}(7i-3) - \sum_{i=1}^{14}(7i-3) = 7 \times \frac{42 \times 43}{2} - 3 \times 42 - 7 \times \frac{14 \times 15}{2} + 3 \times 14 = 5502$
9. D. The length of the chord connecting the endpoints is 40. The depth of the slice at the center of the chord is 8. A right triangle exists with the radius as hypotenuse, half the chord as one of the legs and the radius minus the depth as the other leg. $\Rightarrow r^2 = 20^2 + (r-8)^2 \Rightarrow r = 29$.
10. C. $\frac{\sqrt{2}}{2} - i\frac{\sqrt{2}}{2}$ is NOT a square root of i.
11. C. $\frac{\sqrt{2}}{4}$ $\quad \lim_{x\to 2}\frac{\sqrt{2}-\sqrt{x}}{2-x} = \lim_{x\to 2}\frac{\sqrt{2}-\sqrt{x}}{(\sqrt{2}-\sqrt{x})(\sqrt{2}+\sqrt{x})} = \lim_{x\to 2}\frac{1}{(\sqrt{2}+\sqrt{x})} = \frac{1}{2\sqrt{2}} = \frac{\sqrt{2}}{4}$
12. D. $p \wedge \sim q$. $\sim(p \to q) \Rightarrow \sim(\sim p \vee q) \Rightarrow p \wedge \sim q$ (DeMorgan's)

13. C. 62 $254 \div 5 = 50R4$, $50 \div 5 = 10R0$, $10 \div 5 = 2R0$. 50+10+2=62. There are 62 factors of five in 254!. That means there are 62 zeros at the end of the number. If the first zero is numbered 0, then the last zero will be numbered 61, so the first nonzero digit will be numbered 62.

14. C. If $\vec{u} \cdot \vec{v} = 20 + 5k$ therefore, $k = -4$ makes the vectors perpendicular.

15. B. $\sqrt{\dfrac{1-\cos\theta}{1+\cos\theta}} \times \sqrt{\dfrac{1-\cos\theta}{1-\cos\theta}} = \sqrt{\dfrac{(1-\cos\theta)^2}{1-\cos^2\theta}} = \sqrt{\dfrac{(1-\cos\theta)^2}{\sin^2\theta}} = \dfrac{1-\cos\theta}{\sin\theta}$

16. C. $27^{(\log_3 4)} = \left(3^3\right)^{(\log_3 4)} = (3)^{\left(\log_3 4^3\right)} = 4^3 = 64$

17. C. $(a+b)^3 = a^3 + 3ab(a+b) + b^3 \Rightarrow a^3 + b^3 = (a+b)^3 - 3ab(a+b) = 22^3 - 3 \times 57 \times 22 = 6886$

18. A. There are ${}_{32}C_2$ line segments joining the 32 points that form the vertices of a convex 32-gon. 32 of those line segments are called sides. Therefore there are ${}_{32}C_2$ - 32 diagonals = 464.

19. B. $|x^2| - 5|x| - 14 = 0$ has solutions $|x| = 7$ or $|x| = -2$. Both 7 and -7 make $|x| = 7$. However, no value for x makes $|x| = -2$.

20. C. $f(x) = \log_{200\pi} x$ is a function that slowly increases from zero at $x = 1$ to one at $x = 200\pi$. That increasing line intersects the cosine function twice per period until it is greater than one. There are 100 periods with two intersections each. Therefore there are 200 intersections.

21. C. The graph $|x| + |y| = 4$ is a square with its vertices at $(0, \pm 4)\, and\, (\pm 4, 0)$. Therefore the area is $\left(4\sqrt{2}\right)^2 = 32$

22. B. The remainder theorem states that P(b) is the remainder when P(x) is divided by (x - b).

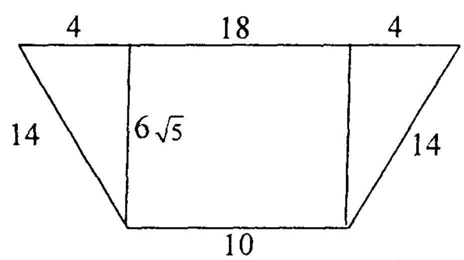
P(-1) = $(-1)^{101} - (-1)^{50} + 7 = -1 - 1 + 7 = 5$

23. E. $x = \dfrac{1}{2 - \dfrac{1}{2 + \dfrac{1}{2 - \dfrac{1}{2 + \mathrm{O}}}}} \Rightarrow x = \dfrac{1}{2 - \dfrac{1}{2+x}} \Rightarrow x = \dfrac{1}{\dfrac{4+2x-1}{2+x}} \Rightarrow x = \dfrac{2+x}{4+2x-1} \Rightarrow$

$x = \dfrac{2+x}{3+2x} \Rightarrow 2x^2 + 3x = 2 + x \Rightarrow x = \dfrac{-1 \pm \sqrt{5}}{2}$

24. A. $1 - \sin 2\theta = \sin^2\theta + \cos^2\theta - 2\sin\theta\cos\theta = \sin^2\theta - 2\sin\theta\cos\theta + \cos^2\theta = (\sin\theta - \cos\theta)^2$

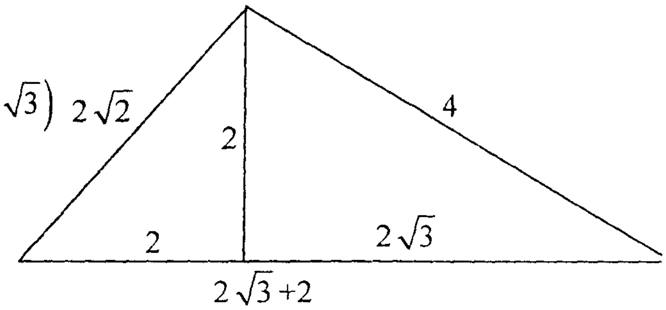
25. B. Area = $\dfrac{1}{2}(6\sqrt{5})(10+18) = 84\sqrt{5}$.



26. A. $10^{\left(\sum_{i=1}^{100}\log i\right)} = 10^{(\log 1+\log 2+\log 3+\ldots+\log 99+\log 100)} = 10^{\log(1\times 2\times 3\times\ldots\times 99\times 100)} = 100!$

27. B. $\sum_{n=0}^{\infty}\left(12\times\left(\frac{1}{3}\right)^{(n-1)}\right) = 36 + 12 + 4 + \ldots = \frac{36}{1-\frac{1}{3}} = 36\times\frac{3}{2} = 54$

For #28 and #29, use the triangle on the right.



28. C. $2\sqrt{2}+4+2+2\sqrt{3} = 6+2\sqrt{2}+2\sqrt{3} = 6+2\left(\sqrt{2}+\sqrt{3}\right)$

29. B. $\frac{1}{2}\times(2)\times\left(2+2\sqrt{3}\right) = \left(2+2\sqrt{3}\right) = 2\left(1+\sqrt{3}\right)$

30. A. There are 4 different letters. Therefore there are $4\times 3\times 2$ or 24 three letter "words" that do not repeat a letter. If both As are used, there are $\binom{3}{2}$ or 3 ways to put the As in two places and there are three different letters for the third place. Therefore there are 9 distinguishable "words" with repeated As. That makes 24 + 9 or 33.