1. **(A)** $x + 1 > 2 \Rightarrow x + 1 - 1 > 2 - 1 \Rightarrow x > 1$

2. **(C)** $x = y + 1 = (z - 1) + 1 = z = 1$

3. **(B)** $3x = 9 \Rightarrow x = \frac{1}{3}(9) = 3 \Rightarrow 5x + 11 = 5(3) + 11 = 26$

4. **(D)** $3^{4x} = \tan\frac{\pi}{6} = \frac{\sqrt{3}}{3} = 3^{-\frac{1}{2}} \Rightarrow 4x = -\frac{1}{2} \Rightarrow x = -\frac{1}{8}$

5. **(A)** $3x + 4 = 22 \Rightarrow 3x = 18 \Rightarrow x = 6$ and $6 - y = 12 \Rightarrow -y = 6 \Rightarrow y = -6$, so $x + y = 6 + (-6) = 0$.

6. **(C)** $x^2 = i = \text{cis}(90°) \Rightarrow x = [\text{cis}(90°)]^{\frac{1}{2}} \Rightarrow x = \text{cis}(45°) = \frac{\sqrt{2}}{2} + \frac{\sqrt{2}}{2}i$ or $x = \text{cis}(225°) = -\frac{\sqrt{2}}{2} - \frac{\sqrt{2}}{2}i$

7. **(E)** $\text{Sin}^{-1}\left(\sin\left(\frac{7\pi}{6}\right)\right) = \text{Sin}^{-1}\left(-\frac{1}{2}\right) = -\frac{\pi}{6}$

8. **(D)** $x - 2y = 1 \Rightarrow x = 2y + 1 \Rightarrow x + y = (2y + 1) + y = 3y + 1 = 16 \Rightarrow 3y = 15 \Rightarrow y = 5 \Rightarrow$ $x = 2(5) + 1 = 11$, so $5x - 11y = 5(11) - 11(5) = 0 \neq 30$. Choices (A), (B), and (C) are all true.

9. **(E)** The sum of the $7^{\text{th}}$ roots of 2 is the sum of the solutions to $x^7 - 2 = 0$. The sum of the roots of any polynomial equation $a_nx^n + a_{n-1}x^{n-1} + \ldots + a_1x + a_0 = 0$ is $\frac{-a_{n-1}}{a_n}$. The coefficient of $x^6$ is 0, so the sum is 0.

10. **(B)** $x^2 - 6x + 5 = (x - 1)(x - 5) > 0 \Rightarrow x < 1$ or $x > 5$

    I. $-|x - 3| < -2 \Rightarrow |x - 3| > 2 \Rightarrow x - 3 < -2$ or $x - 3 > 2 \Rightarrow x < 1$ or $x > 5$ (equivalent)

    II. Discriminant $= (-6)^2 - 4(1)(-5) = 56 \Rightarrow$ irrational roots $\Rightarrow$ not equivalent to $x^2 - 6x + 5 > 0$

    III. $1 < x < 5$ and $x^2 - 6x + 5 > 0$ are mutually exclusive, so they are not equivalent.

    IV. $\frac{1}{10}|(3x - 9) + (4x - 12)i| = \frac{1}{10}\sqrt{(3x - 9)^2 + (4x - 12)^2} = \frac{1}{10}\sqrt{25x^2 - 150x + 225} =$ $\frac{1}{2}\sqrt{(x - 3)^2} = \frac{1}{2}|x - 3| > 1 \Rightarrow |x - 3| > 2 \Rightarrow$ equivalent to I.

11. **(A)** $\frac{1}{\ln 2}[1 - S(\text{Arcsin } x)] = 2S(e) \Rightarrow S(\text{Arcsin } x) = 1 - 2 \cdot \frac{\ln e}{\ln \pi} \cdot \ln 2 = \log_\pi \pi - 2\log_\pi 2 = \log_\pi\left(\frac{\pi}{4}\right)$ $S(\text{Arcsin } x) = \log_\pi(\text{Arcsin } x) = \log_\pi\left(\frac{\pi}{4}\right) \Rightarrow \text{Arcsin } x = \frac{\pi}{4} \Rightarrow x = \frac{\sqrt{2}}{2} = .7\underline{0}71\ldots$

12. **(D)** $f(\sin\theta) = 1 - 2\sin^2\theta = \cos 2\theta$

13. **(A)** $2^{6x} + 4^{9+3x} = 2^{6x} + 2^{6x+18} = 2^{6x}(1 + 2^{18}) = 4 + 2^{20} \Rightarrow 2^{6x} = \frac{4 + 2^{20}}{1 + 2^{18}} = \frac{4(1 + 2^{18})}{1 + 2^{18}} = 4 = 2^2 \Rightarrow$ $6x = 2 \Rightarrow x = \frac{1}{3}$

14. **(B)** $A^{-1} = \frac{1}{\det\ A}\begin{bmatrix} 1 & -4 \\ -3 & 11 \end{bmatrix} = \frac{1}{-1}\begin{bmatrix} 1 & -4 \\ -3 & 11 \end{bmatrix} = \begin{bmatrix} -1 & 4 \\ 3 & -11 \end{bmatrix}$
$AX = B \Rightarrow A^{-1}AX = A^{-1}B \Rightarrow (A^{-1}A)X = IX = X = A^{-1}B$
$X = A^{-1}B = \begin{bmatrix} -1 & 4 \\ 3 & -11 \end{bmatrix}\begin{bmatrix} 2 & 7 \\ 1 & 8 \end{bmatrix} = \begin{bmatrix} (-1)(2)+(4)(1) & (-1)(7)+(4)(8) \\ (3)(2)+(-11)(1) & (3)(7)+(-11)(8) \end{bmatrix} = \begin{bmatrix} 2 & 25 \\ -5 & -67 \end{bmatrix}$
$2 + 25 + (-5) + (-67) = -45$

15. **(B)** $\lfloor x \rfloor$ represents the integer part of $x$, which is equivalent to $x$ only if $x$ is an integer.

16. **(A)** $x_1 + x_2$ is simply the sum of the solutions to the equation $f(x) = 1 - x^2 = a$. This equation is the same as $x^2 + (a-1) = 0$, and it is readily apparent that the sum of the solutions to this equation is 0. Thus, $(x_1 + x_2)^2 = 0^2 = 0$.

17. **(B)** $\ln x + \ln(3x) = \ln 3x^2 = 12 + \ln 3 = \ln 3e^{12} \Rightarrow x^2 = e^{12} \Rightarrow x = \pm e^6$. $x = -e^6$ is extraneous because $\ln x$ is not defined for $x = -e^6$.

18. **(D)** $y = x\sin\theta + \cos\theta \Rightarrow x = \frac{y - \cos\theta}{\sin\theta} = y\csc\theta - \cot\theta$

19. **(B)** If $\vec{u} = \langle u_1, u_2 \rangle$, then $\vec{u} \bullet \langle 9, 26 \rangle = 9u_1 + 26u_2 = 0 \Rightarrow u_2 = -\frac{9}{26}u_1$, so II. is false. It can be shown using the law of cosines that the cosine of the angle $\theta$ between two vectors $\vec{u}$ and $\vec{v}$ is $\cos\theta = \frac{\vec{u} \bullet \vec{v}}{\|\vec{u}\|\|\vec{v}\|}$, which implies that the dot product of two vectors is 0 if and only if they are orthogonal, i.e. they make an angle of 90°. Thus, I. and III. are false, and IV. is true.

20. **(A)** $2x^2\cot\theta + \sin 2\theta = 4x \Rightarrow 2x^2 - 4x + 2\sin\theta\cos\theta = 0$
$x = \frac{-(-4) \pm \sqrt{(-4)^2 - 4(2\cot\theta)(2\sin\theta\cos\theta)}}{2(2\cot\theta)} = \frac{4 \pm 4\sqrt{1-\cos^2\theta}}{4\cot\theta} = \tan\theta(1 \pm \sin\theta) =$
$\frac{\sin\theta \pm \sin^2\theta}{\cos\theta} = \frac{\sin\theta \pm (1-\cos^2\theta)}{\cos\theta} = \tan\theta \pm \sec\theta \mp \cos\theta$

21. **(A)** $x^2 + 2ax = 3a \Rightarrow x^2 + 2ax - 3a = 0$
Determinant $= (2a)^2 - 4(1)(-3a) = 4a^2 + 12a = 4a(a+3) < 0 \Rightarrow -3 < a < 0$

22. **(C)** The region is outside the circle $x^2 + y^2 = 9$ and inside the rhombus with vertices $(-5, 0)$, $(5, 0)$, $(0, 10)$, and $(0, -10)$. The circle lies completely within the rhombus. The area of the circle is $\pi r^2 = 9\pi$, and the area of the rhombus is $\frac{1}{2}$ the product of the diagonal lengths, or $\frac{1}{2}(10)(20) = 100$. Thus, the area of the region is $A = 100 - 9\pi$. $\cos A = \cos(100 - 9\pi) = -.\underline{8}623\ldots$

23. **(C)** $2 + 4 + 6 + \ldots + 2n$ is an arithmetic series with $n$ terms, first term 2, and last term $2n$, so its value is $\frac{1}{2}n(2 + 2n) = n(n + 1) \neq n^2 + 1$. (A) and (B) can be confirmed similarly, and (D) can be proved easily by induction.

24. **(B)** $1 + \sin^2 x + \sin^4 x + \sin^6 x + \ldots = \sum_{i=0}^{\infty}(\sin^2 x)^i = \dfrac{1}{1 - \sin^2 x} = \dfrac{1}{\cos^2 x} = \sec^2 x = 1 + \tan^2 x$
The two sides of the equation are equivalent for all $x$ for which $\sec x$ and $\tan x$ are defined (all $x$ except $\pm\frac{\pi}{2}, \pm\frac{3\pi}{2}, \pm\frac{5\pi}{2}, \ldots$). Thus, the solution set is $\{x \mid x \neq \frac{n\pi}{2}\}$, where $n$ is an odd integer.

25. **(D)** Since $0 < a < c$, $a - c < 0$. Then $ax + b < cx + d \Rightarrow (a - c)x < d - b \Rightarrow x > \dfrac{d - b}{a - c}$

26. **(B)** The solution set of $\sin(\pi x) = 0$ is $\{0, \pm 1, \pm 2, \pm 3 \ldots\}$.

   I. Solution set: $\{0, \pm 1, \pm 2, \pm 3 \ldots\}$

   II. Solution set: $\{0, 1, 2, 3 \ldots\}$

   III. Solution set: $\{0, \pm 2, \pm 4, \pm 6 \ldots\}$

   IV. Solution set: $\{0, \pm 1, \pm 2, \pm 3 \ldots\}$

   2 of the equations have the solution set $\{0, \pm 1, \pm 2, \pm 3 \ldots\}$.

27. **(A)** To reflect a curve about the $y$-axis, replace $x$ with $-x$. Thus, when the curve is reflected about the $y$-axis, the equation becomes $y = (-x)^2 - 6(-x) + 16 = x^2 + 6x + 16$.

28. **(E)** $\{x | \sqrt{(x - \pi)^2} \leq \pi\} = \{x |\ |x - \pi| \leq \pi\} = \{x |\ 0 \leq x \leq 2\pi\} = [0, 2\pi]$
$\{x | \sec x \leq 2\} = \{x | \cos x \geq \frac{1}{2}\} \cup \{x | \cos x < 0\} = ([0, \frac{\pi}{3}] \cup [\frac{5\pi}{3}, 2\pi]) \cup (\frac{\pi}{2}, \frac{3\pi}{2}) = [0, \frac{\pi}{3}] \cup (\frac{\pi}{2}, \frac{3\pi}{2}) \cup [\frac{5\pi}{3}, 2\pi]$
$\{x | \csc x \leq 2\} = \{x | \sin x \geq \frac{1}{2}\} \cup \{x | \sin x < 0\} = [\frac{\pi}{6}, \frac{5\pi}{6}] \cup (\pi, 2\pi)$
$\{x | \cot x > 0\} = \{x | \tan x > 0\} = (0, \frac{\pi}{2}) \cup (\pi, \frac{3\pi}{2})$
The intersection of all four sets is $[\frac{\pi}{6}, \frac{\pi}{3}] \cup (\pi, \frac{3\pi}{2})$.

29. **(D)** The determinant is equivalent to

$$x\begin{vmatrix} 7x & -1 \\ 9 & 4-x \end{vmatrix} - (-2)\begin{vmatrix} 3 & -1 \\ 2x+5 & 4-x \end{vmatrix} + (1-x)\begin{vmatrix} 3 & 7x \\ 2x+5 & 9 \end{vmatrix} =$$

$x[(7x)(4-x)-(-1)(9)]-(-2)[(3)(4-x)-(-1)(2x+5)]+(1+x)[(3)(9)-(7x)(2x+5)] =$

$x(48x-7x^2+9)+2(12-x+5)+(1+x)(27-14x^2-35x) = -21x^3-21x^2-x+61.$

For $ax^3+bx^2+cx+d=0$, the sum of the roots (i.e., $x_1+x_2+x_3$) is $\frac{-b}{a}$, and the sum of the roots taken two at a time (i.e., $x_1x_2+x_2x_3+x_1x_3$) is $\frac{c}{a}$. Thus, the sum of the squares of the roots (i.e., $x_1^2+x_2^2+x_3^2$) is given by $\left(\frac{-b}{a}\right)^2-2\left(\frac{c}{a}\right)$. For this equation, $\left(\frac{-b}{a}\right)^2-2\left(\frac{c}{a}\right) = \left(\frac{21}{-21}\right)^2-2\left(\frac{-1}{-21}\right) = \frac{19}{21}$.

$\sqrt{(19)(21)} = 19.\underline{9}749\ldots$

30. **(C)** For any real number $n$, $n-\lfloor n\rfloor$ denotes the fractional part of $n$ and is 0 for any integer. Thus, $\lfloor \frac{6}{\pi}\arccos\sqrt{x}\rfloor - \frac{6}{\pi}\arccos\sqrt{x} = 0$ implies that $\frac{6}{\pi}\arccos\sqrt{x}$ is an integer, so $\arccos\sqrt{x}$ must be a multiple of $\frac{\pi}{6}$. The values of $x$ for which $\arccos\sqrt{x}$ is a multiple of $\frac{\pi}{6}$ are 0, $\frac{1}{4}$, $\frac{3}{4}$, and 1.

$16x(x-\frac{1}{4})(x-\frac{3}{4})(x-1) = 16x^4-32x^3+19x^2-3x = 0 \Rightarrow a=-32,\ b=-19,\ c=-3,\ d=-1$

$(a-b-c)(b+c-d) = (-32-(-19)-(-3))(-19+(-3)-(-1)) = 210$