1. **(B)** All choices but (B) are based on elementary or sine or tangent sum identities. Choice (B) should have a minus instead of a plus, based on the identity $\cos(\alpha+\beta) = \cos\alpha\cos\beta - \sin\alpha\sin\beta$.

2. **(A)** Any polar graph with an equation of the form $r = a \pm b\cos\theta$ with $|a| < |b|$ is a limacon with an inner loop. This can easily be confirmed graphically.

3. **(C)** The graph of $r = a\cos(n\theta)$ has n petals when n is odd and $2n$ petals when n is even.

4. **(C)** Only (C) is true: the range of Arccot x is $[0, \pi)$.

5. **(A)** $\sin\theta = \sqrt{1-\cos^2\theta} = \sqrt{1-\frac{20^2}{29^2}} = \sqrt{1-\frac{400}{841}} = \sqrt{\frac{441}{841}} = \frac{21}{29}$
$\tan\theta + \sec\theta = \dfrac{\sin\theta + 1}{\cos\theta} = \dfrac{\frac{21}{29}+1}{-\frac{20}{29}} = \dfrac{-21-29}{20} = -\dfrac{5}{2}$
$a - b = -5 - 2 = -7$

6. **(B)** Using the half-angle identity $\cos\theta = \pm\sqrt{\frac{1}{2}(1+\cos 2\theta)}$,
$\cos 15^\circ = \sqrt{\frac{1}{2}(1+\cos 30^\circ)} = \sqrt{\frac{1}{2}(1+\frac{\sqrt{3}}{2})} = \frac{1}{2}\sqrt{2+\sqrt{3}} \Rightarrow (\frac{c}{a})^{\frac{b}{a}} = (3\cdot 2)^{2\cdot 2} = 1296$
Sum of digits $= 1+2+9+6 = 18$

7. **(B)** Area $= \frac{1}{2}ab\sin C = \frac{1}{2}(14)(26)\sin 30^\circ = \frac{1}{2}(14)(26)(\frac{1}{2}) = 91 = 91\sqrt{1} \Rightarrow ab = (91)(1) = 91 \Rightarrow$
Sum of digits $= 9+1 = 10$

8. **(B)** The period of $f(x)$ is the smallest λ such that $f(x) = f(x+\lambda)$. Since it is known that the smallest such λ for $g(x) = \cos x$ is 2π and $f(x) = g(2007\pi x)$, we need $2007\pi\lambda = 2\pi \Rightarrow \lambda = \frac{2}{2007}$.

9. **(A)** Since we have the lengths of two adjacent sides, x and y, we need only the measure of the included angle $\angle ABQ$ to compute the area of the parallelogram as $xy\sin(\angle ABQ)$. Using the law of sines within triangle ABQ,
$\frac{\sin(\angle BAQ)}{y} = \frac{\sin(\angle AQB)}{x} \Rightarrow \frac{z}{y} = \frac{\sin(\angle AQB)}{x} \Rightarrow \angle AQB = \text{Arcsin}(\frac{xz}{y})$
$\angle ABQ + \angle BAQ + \angle AQB = \angle ABQ + z + \text{Arcsin}(\frac{xz}{y}) = \pi \Rightarrow \angle ABQ = \pi - z - \text{Arcsin}(\frac{xz}{y})$
Area of $ABQT = xy\sin(\angle ABQ) = xy\sin(\pi - z - \text{Arcsin}(\frac{xz}{y})) = xy\sin(z + \text{Arcsin}(\frac{xz}{y}))$

10. **(E)** $\cot^2 x + 1 = \csc^2 x \Rightarrow \cot^2 x - 1 = \csc^2 x - 2$

11. **(D)** Four of the functions ($\sin x$, $\tan x$, $\csc x$, and $\cot x$) are odd functions, which means they satisfy the condition $f(-x) = -f(x)$. $\frac{4}{6} = \frac{2}{3}$.

12. **(C)** $2007 > 2008 - 3\cot^2\theta \Rightarrow 3\cot^2\theta > 1 \Rightarrow |\cot\theta| > \frac{1}{\sqrt{3}} \Rightarrow |\tan\theta| < \sqrt{3}$, which is true for $\theta \in [0, \frac{\pi}{3}) \cup (\frac{2\pi}{3}, \frac{4\pi}{3}) \cup (\frac{5\pi}{3}, 2\pi)$, a total length of $\frac{4\pi}{3}$ out of 2π.

13. **(D)** $(-2007, 6267°) = (-2007, 17 \cdot 360° + 147°) = (-2007, 147°) = (2007, 327°)$

14. **(B)** The minimum value of a function of the form $f(x) = a\sin x + b\cos x$ is $-\sqrt{a^2+b^2}$.

15. **(D)** By the law of cosines,
$c^2 = a^2 + b^2 - 2ab\cos C = 15^2 + 16^2 - 2(15)(16)(-\frac{1}{2}) = 225 + 256 + 240 = 721$
Sum of digits $= 7 + 2 + 1 = 10$

16. **(A)** $\cos\theta = -\sqrt{1-\sin^2\theta} = -\sqrt{1-(\frac{3}{5})^2} = -\frac{4}{5} \Rightarrow \cot\theta = \frac{\cos\theta}{\sin\theta} = -\frac{4}{3}$

17. **(D)** (A) and (B) do not guarantee $\cos\alpha = \cos\beta$, and (C) does not guarantee that both values be in the interval $[0, 2\pi)$. (D) guarantees both.

18. **(D)** The minimum value of the sine function is -1 and its maximum value is 1, so the minimum value of $f(x)$ is $-2007(1) + 2007 = 0$ and its maximum value is $-2007(-1) + 2007 = 4014$.

19. **(D)** By the cosine sum formula, $\cos(3\theta)\cos(28\theta) - \sin(3\theta)\sin(28\theta) = \cos(3\theta + 28\theta) = \cos(31\theta)$

20. **(C)** $f(\frac{3\pi}{4}) - f(\frac{7\pi}{6}) = (\cos\frac{3\pi}{4} - \sin\frac{3\pi}{4}) - (\cos\frac{7\pi}{6} - \sin\frac{7\pi}{6}) = (-\frac{\sqrt{2}}{2} - \frac{\sqrt{2}}{2}) - (-\frac{\sqrt{3}}{2} + \frac{1}{2}) = \frac{\sqrt{3}}{2} - \sqrt{2} - \frac{1}{2}$

21. **(B)** The coordinates represent the Cartesian points $(1, 1)$ and $(1, -1)$, respectively, which are separated by a distance of 2.

22. **(A)** Let $\vec{u} = i + 2j$ and $\vec{v} = 3i - 5j$. Then $\cos^2\theta = (\frac{\vec{u}\cdot\vec{v}}{|\vec{u}||\vec{v}|})^2 = (\frac{1\cdot 3 + 2\cdot(-5)}{\sqrt{1^2+2^2}\sqrt{3^2+(-5)^2}})^2 = \frac{(-7)^2}{5\cdot 34} = \frac{49}{170}$
$a + b = 49 + 170 = 219 \Rightarrow$ Sum of digits $= 2 + 1 + 9 = 12$

23. **(C)** The period of $\sin(\frac{4x}{5})$ is $2\pi \cdot \frac{5}{4} = \frac{5\pi}{2}$, and the period of $\cos(\frac{x}{3})$ is $2\pi \cdot 3 = 6\pi$. The least common multiple of these two periods is 30π.

24. **(A)** The range of $\sin x$ is $[-1, 1]$; no value of x can produce a sine of $\frac{3}{2}$.

25. **(A)** Since the range of $\tan x$ is all real numbers, so is the domain of $f(x) = \text{Arctan}\ x$.

26. **(A)** $\cot x\cos 2x + \sin 2x = \frac{\cos x}{\sin x}(\cos^2 x - \sin^2 x) + 2\cos x\sin x = \frac{\cos^3 x}{\sin x} - \cos x\sin x + 2\cos x\sin x$
$= \frac{\cos^3 x}{\sin x} + \cos x\sin x = \frac{\cos^3 x + \cos x\sin^2 x}{\sin x} = \frac{\cos x(\cos^2 x + \sin^2 x)}{\sin x} = \frac{\cos x}{\sin x} = \cot x$

27. **(B)** Since α and β sum to π, $\cos\alpha = \cos(\pi - \beta) = -\cos\beta$ and $\sin\alpha = \sin(\pi - \beta) = \sin\beta$.
(A), (C), and (D) follow directly from these relations; (B) contradicts $\sin\alpha = \sin\beta$.

28. **(D)** $(\cos\theta + \sin\theta)^3 = (\cos\theta + \sin\theta)(\cos\theta + \sin\theta)^2 = (\cos\theta + \sin\theta)(\cos^2\theta + 2\cos\theta\sin\theta + \sin^2\theta)$
$= (\cos\theta + \sin\theta)(1 + \sin 2\theta)$

29. **(B)** $\cos\alpha = \frac{7}{8}$ and $0 < \alpha < \frac{\pi}{2}$, so $\sin\alpha = \sqrt{1-\cos^2\alpha} = \sqrt{1-\frac{49}{64}} = \frac{\sqrt{15}}{8}$.
$\sin\beta = \frac{12}{13}$ and $\frac{\pi}{2} < \beta < \pi$, so $\cos\beta = -\sqrt{1-\sin^2\beta} = -\sqrt{1-\frac{144}{169}} = -\frac{5}{13}$.
$\cos(\alpha-\beta) = \cos\alpha\cos\beta + \sin\alpha\sin\beta = (\frac{7}{8})(-\frac{5}{13}) + (\frac{\sqrt{15}}{8})(\frac{12}{13}) = \frac{12\sqrt{15}-35}{104}$
$a+b+q+t+90 = 12+15+35+104+90 = 256 \Rightarrow$ Sum of digits $= 2+5+6 = 13$

30. **(B)** $\sin\pi = 0$