1. $\dfrac{\tan x - \sec x}{\tan x + \sec x} =$

   (a) $-\dfrac{(\sin x - 1)^2}{\cos^2 x}$

   (b) $(\tan x - \sec x)^2$

   (c) 1

   (d) $\dfrac{(1 - \sin x)^2}{\cos x}$

   (e) $\sec^2 x - \sec x \tan x + \tan^2 x$

2. When simplified, the expression $\dfrac{\sin x + \csc x \cos^2 x + 1}{\sec x \csc x - \tan x} =$

   (a) $\sec x + \tan x$

   (b) $\tan x - \csc x$

   (c) $\cos x + 1$

   (d) 0

   (e) $\sec x + \cot x$

3. $\dfrac{1-\tan 21^\circ \cot 51^\circ}{\tan 21^\circ + \tan 39^\circ} =$

(a) $\dfrac{\sqrt{3}}{3}$

(b) $-\sqrt{3}$

(c) $-\dfrac{\sqrt{5}}{2}$

(d) $2\sqrt{2}$

(e) $\dfrac{\sqrt{3}}{2}$

4. If $\cos\alpha = \dfrac{-3}{5}$, $\sin 2\alpha > 0$, $\sin\beta = \dfrac{5}{13}$ and β is in quadrant I, then $\cos(\alpha+\beta) =$

(a) $\dfrac{-16}{65}$

(b) $\dfrac{56}{65}$

(c) $\dfrac{24}{65}$

(d) $-\dfrac{56}{65}$

(e) $\dfrac{16}{65}$

5. If $\sqrt{3}\cos x - \sin x = 2\sin(x+\alpha)$, then α is equal to

(a) $\dfrac{2\pi}{3}$

(b) $-\dfrac{\pi}{3}$

(c) $-\dfrac{\pi}{6}$

(d) $\dfrac{5\pi}{6}$

(e) $\dfrac{3\pi}{4}$

6. $\cos 3x$ is equal to

(a) $\cos x\left[1-4\sin^2 x\right]$

(b) $\cos^3 x$

(c) $\cos x$

(d) $\cos x\left[1+2\sin^2 x\right]$

(e) $3\cos x$

7. $\dfrac{\sin 105^\circ}{\cos 165^\circ}$ is equal to

(a) -1

(b) $\dfrac{\sqrt{2-\sqrt{3}}}{\sqrt{2+\sqrt{3}}}$

(c) 0

(d) 1

(e) $\dfrac{\sqrt{2+\sqrt{3}}}{\sqrt{2-\sqrt{3}}}$

8. If $\csc x = \dfrac{-5}{3}$ and x is in quadrant III, then $\sin 2x + \cot \dfrac{x}{2}$ is equal to

(a) $\dfrac{47}{75}$

(b) $-\dfrac{51}{75}$

(c) $-\dfrac{63}{25}$

(d) $\dfrac{11}{75}$

(e) $-\dfrac{11}{75}$

9. If P is a point of intersection of the ellipse given by $4x^2 + y^2 - 24x - 8y + 48 = 0$ and its minor axis and if F is one of its foci, then the distance $d(P, F)$ is equal to

(a) 2

(b) $\sqrt{3}$

(c) 3

(d) $4 - \sqrt{3}$

(e) $\sqrt{6}$

10. If the foci of the ellipse

$$5x^2 + 9y^2 - 20x + 54y + 56 = 0$$

are (m, n) and (p, q), then $m + n + p + q$ is equal to

(a) -2

(b) 1

(c) -3

(d) 2

(e) 3

11. The equation of an ellipse with eccentricity $\frac{1}{4}$ and foci at $(-2, 4)$ and $(-2, -2)$ is

(a) $\frac{(x+2)^2}{135} + \frac{(y-1)^2}{144} = 1$

(b) $\frac{(x+2)^2}{135} + \frac{(y-3)^2}{144} = 1$

(c) $\frac{(x-2)^2}{144} + \frac{(y+1)^2}{135} = 1$

(d) $\frac{(x-2)^2}{12} + \frac{(y+1)^2}{\sqrt{135}} = 1$

(e) $\frac{(x+2)^2}{\sqrt{135}} + \frac{(y-1)^2}{12} = 1$

12. If $\mathbf{v} = 2i + j$ and $\mathbf{w} = 6i + 3j$, then $\text{Proj}_{\mathbf{w}}\,\mathbf{v}$ is equal to

(a) $\sqrt{5}$

(b) $\frac{\sqrt{5}}{5}$

(c) $3\sqrt{5}$

(d) $\frac{12\sqrt{5}}{5}$

(e) $\frac{1}{9}$

13. If $\mathbf{u} = \langle -2, 4 \rangle$ and $\mathbf{v} = \langle -3, -2 \rangle$, then $\|3\mathbf{u} - 4\mathbf{v}\|$ is equal to

(a) $2\sqrt{109}$

(b) $2\sqrt{85}$

(c) $\sqrt{85}$

(d) $2\sqrt{15}$

(e) $2\sqrt{119}$

14. The equation of the parabola with vertex at $(-1, 2)$ and focus $(-1, 3)$ is

(a) $(x+1)^2 = 4(y-2)$

(b) $(x-1)^2 = 4(y+2)$

(c) $(y+1)^2 = 4(x-2)$

(d) $(y-2)^2 = -4(x+1)$

(e) $(x+1)^2 = -4(y-2)$

15. The equation of the parabola with focus $(-2, 4)$ and directrix $x = 4$ is

(a) $(y-4)^2 = -12(x-1)$

(b) $(x-4)^2 = -12(y-1)$

(c) $(x+1)^2 = 12(y-2)$

(d) $(y+1)^2 = 12(x-2)$

(e) $(y-2)^2 = 12(x-4)$

16. The graph of $x = \sqrt{(\sqrt{y})^4 + 1}$ and the graph of $y^2 = 4 - x^2$ intersect only in quadrant

(a) I

(b) I and II

(c) I, II, III and IV

(d) I and IV

(e) II and III

17. The smallest positive angle between the vectors $\mathbf{u} = \langle 2, 1\rangle$ and $\mathbf{v} = \langle -1, -3\rangle$ is

(a) $\frac{3\pi}{4}$

(b) $\frac{2\pi}{3}$

(c) $\frac{3\pi}{2}$

(d) $\frac{5\pi}{4}$

(e) $\frac{5\pi}{6}$

18. Given that a hyperbola is centered at $(3, 3)$, passing through the point $(6, 1)$ and has a transverse axis parallel to the x-axis. If the slope of one of its asymptotes is 2, then its vertices are

(a) $(3 + 2\sqrt{2}, 3)$, $(3 - 2\sqrt{2}, 3)$

(b) $(3, 3 + 2\sqrt{2})$, $(3, 3 - 2\sqrt{2})$

(c) $(3, 11)$, $(3, -5)$

(d) $(11, 3)$, $(-5, 3)$

(e) $(3, \frac{\sqrt{7}}{2}, 3)$, $(3 - \frac{\sqrt{7}}{2}, 3)$

19. The value of $\left(\sin^{-1}\left(-\frac{1}{2}\right)\right)^2 + \left(\cos^{-1}\left(-\frac{1}{2}\right)\right)^2$ is equal to

(a) $\frac{17\pi^2}{36}$

(b) $\frac{13\pi^2}{36}$

(c) $\frac{41\pi^2}{36}$

(d) $\frac{5\pi^2}{36}$

(e) $\frac{\pi^2}{36}$

20. The range of $y = \frac{\pi}{2} - 2\sin^{-1}(x-4)$ is

(a) $\left[-\frac{\pi}{2}, \frac{3\pi}{2}\right]$

(b) $\left[-\frac{\pi}{2}, \frac{\pi}{2}\right]$

(c) $[-\pi, \pi]$

(d) $\left[-\frac{\pi}{2}, \pi\right]$

(e) $\left[-\pi, \frac{3\pi}{2}\right]$

21. The sum of solutions in $[0, 2\pi)$ of the equation $\sin x + \cos x = 1$ is

(a) $\frac{\pi}{2}$

(b) $\frac{5\pi}{2}$

(c) π

(d) $\frac{3\pi}{2}$

(e) 2π

22. The number of solutions in $[0, 2\pi)$ of the equation $2\sin^3 x = \sin x$ is

(a) 6

(b) 3

(c) 7

(d) 4

(e) 5