MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Find the exact value of the expression.

1) $\tan^{-1}\dfrac{\sqrt{3}}{3}$ 1) _____

   A) $\dfrac{5\pi}{6}$ B) $\dfrac{\pi}{6}$ C) $\dfrac{\pi}{3}$ D) $\dfrac{5\pi}{4}$

Use a calculator to find the value of the expression rounded to two decimal places.

2) $\cos^{-1}\left(-\dfrac{\sqrt{3}}{5}\right)$ 2) _____

   A) 1.92   B) -20.27   C) 110.27   D) -0.35

3) $\tan^{-1}(-2.9)$ 3) _____

   A) -1.24   B) -70.97   C) -19.03   D) -0.33

Find the exact value of the expression.

4) $\sin^{-1}\left[\sin\left(\dfrac{5\pi}{7}\right)\right]$ 4) _____

   A) $\dfrac{2\pi}{7}$ B) $\dfrac{5\pi}{7}$ C) $\dfrac{7}{2\pi}$ D) $\dfrac{7}{5\pi}$

Find the exact value of the expression.

5) $\tan\left(\cos^{-1}\dfrac{4}{7}\right)$ 5) _____

   A) $\dfrac{\sqrt{33}}{7}$ B) $\dfrac{\sqrt{33}}{4}$ C) $\dfrac{7}{4}$ D) $\sqrt{33}$

6) $\sin^{-1}\left(\sin\dfrac{5\pi}{4}\right)$ 6) _____

   A) $\dfrac{\pi}{4}$ B) $\dfrac{3\pi}{4}$ C) $-\dfrac{\pi}{4}$ D) $\dfrac{5\pi}{4}$

Find the exact value of the expression.

7) $\tan^{-1}\left[\tan\left(\dfrac{3\pi}{5}\right)\right]$ 7) _____

   A) $\dfrac{3\pi}{5}$ B) $-\dfrac{2\pi}{5}$ C) $\dfrac{2\pi}{5}$ D) $-\dfrac{3\pi}{5}$

Find the exact value of the expression.

8) $\sec^{-1}\left(-\dfrac{2\sqrt{3}}{3}\right)$ 8) _____

   A) $\dfrac{\pi}{3}$ B) $\dfrac{5\pi}{6}$ C) $-\dfrac{\pi}{6}$ D) $-\dfrac{5\pi}{6}$

Use a calculator to find the value of the expression in radian measure rounded to two decimal places.

9) $\sec^{-1}\left(-\dfrac{7}{3}\right)$

    A) -2.01   B) 0.50   C) 1.13   D) 2.01

9) _____

Solve the equation on the interval $0 \le \theta < 2\pi$.

10) $2\cos^2\theta - 1 = 0$

  A) $\left\{\dfrac{\pi}{3}, \dfrac{2\pi}{3}, \dfrac{4\pi}{3}, \dfrac{5\pi}{3}\right\}$ B) $\left\{\dfrac{\pi}{3}, \dfrac{5\pi}{3}\right\}$

  C) $\left\{\dfrac{\pi}{4}, \dfrac{7\pi}{4}\right\}$ D) $\left\{\dfrac{\pi}{4}, \dfrac{3\pi}{4}, \dfrac{5\pi}{4}, \dfrac{7\pi}{4}\right\}$

10) _____

11) $\sec\dfrac{3\theta}{2} = -\sqrt{2}$

  A) $\left\{\dfrac{\pi}{2}, \dfrac{5\pi}{6}, \dfrac{7\pi}{6}, \dfrac{11\pi}{6}\right\}$ B) $\left\{\dfrac{5\pi}{6}, \dfrac{7\pi}{6}\right\}$

  C) $\left\{\dfrac{\pi}{2}, \dfrac{5\pi}{6}\right\}$ D) $\left\{\dfrac{\pi}{2}, \dfrac{5\pi}{6}, \dfrac{11\pi}{6}\right\}$

11) _____

12) $\cos(2\theta) = \dfrac{\sqrt{3}}{2}$

  A) $\left\{\dfrac{3\pi}{2}\right\}$ B) $\left\{\dfrac{\pi}{12}, \dfrac{11\pi}{12}, \dfrac{13\pi}{12}, \dfrac{23\pi}{12}\right\}$

  C) $\left\{\dfrac{\pi}{6}, \dfrac{11\pi}{6}\right\}$ D) $\left\{\dfrac{\pi}{2}\right\}$

12) _____

13) $\cos\left(2\theta - \dfrac{\pi}{2}\right) = \dfrac{\sqrt{2}}{2}$

  A) $\left\{\dfrac{3\pi}{8}, \dfrac{7\pi}{8}\right\}$ B) $\left\{\dfrac{3\pi}{8}, \dfrac{9\pi}{8}, \dfrac{11\pi}{8}\right\}$

  C) $\left\{\dfrac{\pi}{4}, \dfrac{5\pi}{4}, \dfrac{9\pi}{4}, \dfrac{13\pi}{4}\right\}$ D) $\left\{\dfrac{3\pi}{8}, \dfrac{9\pi}{8}\right\}$

13) _____

Solve the equation. Give a general formula for all the solutions.

14) $\csc\dfrac{\theta}{3} = \dfrac{2\sqrt{3}}{3}$

  A) $\left\{\theta \mid \theta = \dfrac{\pi}{18} + 2\pi n\right\}$ B) $\left\{\theta \mid \theta = \dfrac{\pi}{2} + 6\pi n\right\}$

  C) $\left\{\theta \mid \theta = \dfrac{\pi}{9} + 2\pi n\right\}$ D) $\{\theta \mid \theta = \pi + 6\pi n\}$

14) _____

Use a calculator to solve the equation on the interval $0 \le \theta < 2\pi$. Round the answer to two decimal places.

15) $4\cot\theta = -5$

    A) 2.25, 7.18   B) 2.47, 3.82   C) 2.47, 5.61   D) 2.25, 5.39

15) _____

16) $7\sin\theta + 3 = 0$

    A) 2.70, 5.84   B) 3.58, 5.84   C) 2.01, 5.16   D) 2.01, 4.27

16) _____

Solve the equation on the interval $0 \le \theta < 2\pi$.

17) $\cos^2 \theta + 2 \cos \theta + 1 = 0$

    A) $\{2\pi\}$ B) $\{\pi\}$ C) $\left\{\dfrac{\pi}{2}, \dfrac{3\pi}{2}\right\}$ D) $\left\{\dfrac{\pi}{4}, \dfrac{7\pi}{4}\right\}$

17) _____

18) $\csc^5 \theta - 4 \csc \theta = 0$

    A) $\left\{\dfrac{\pi}{4}, \dfrac{3\pi}{4}, \dfrac{\pi}{3}, \dfrac{5\pi}{6}\right\}$ B) $\left\{\dfrac{\pi}{4}, \dfrac{5\pi}{4}, \dfrac{\pi}{3}, \dfrac{5\pi}{3}\right\}$

    C) $\left\{\dfrac{\pi}{4}, \dfrac{3\pi}{4}, \dfrac{5\pi}{4}, \dfrac{7\pi}{4}\right\}$ D) $\left\{\dfrac{\pi}{4}, \dfrac{3\pi}{4}, \dfrac{\pi}{6}, \dfrac{5\pi}{6}\right\}$

18) _____

19) $3 \cot^2 \theta - 4 \csc \theta = 1$

    A) $\left\{\dfrac{7\pi}{6}, \dfrac{11\pi}{6}\right\}$ B) $\left\{\dfrac{\pi}{6}\right\}$ C) $\left\{\dfrac{7\pi}{6}\right\}$ D) $\left\{\dfrac{\pi}{6}, \dfrac{5\pi}{6}\right\}$

19) _____

20) $\cos^2 \theta - \sin^2 \theta = 1 + \sin \theta$

    A) $\left\{0, \dfrac{\pi}{6}, \dfrac{5\pi}{6}, \pi\right\}$ B) $\left\{\dfrac{\pi}{2}, \dfrac{7\pi}{6}, \dfrac{3\pi}{2}, \dfrac{11\pi}{6}\right\}$

    C) $\left\{0, \pi, \dfrac{7\pi}{6}, \dfrac{11\pi}{6}\right\}$ D) $\left\{0, \pi, \dfrac{4\pi}{3}, \dfrac{5\pi}{3}\right\}$

20) _____

Find the exact value of the expression.

21) $\tan 75°$

    A) $\sqrt{3} - 2$ B) $-\sqrt{3} + 2$ C) $\sqrt{3} + 2$ D) $-\sqrt{3} - 2$

21) _____

22) $\sin \dfrac{11\pi}{12}$

    A) $-\sqrt{2}(\sqrt{3} - 1)$ B) $-\dfrac{\sqrt{2}(\sqrt{3} - 1)}{4}$ C) $\dfrac{\sqrt{2}(\sqrt{3} - 1)}{4}$ D) $\sqrt{2}(\sqrt{3} - 1)$

22) _____

23) $\cos \dfrac{2\pi}{9} \cos \dfrac{\pi}{18} + \sin \dfrac{2\pi}{9} \sin \dfrac{\pi}{18}$

    A) $\dfrac{\sqrt{3}}{2}$ B) $\dfrac{1}{2}$ C) 1 D) $\dfrac{1}{4}$

23) _____

24) $\dfrac{\tan 170° - \tan 50°}{1 + \tan 170° \tan 50°}$

    A) $-\sqrt{3}$ B) -2 C) $-\dfrac{\sqrt{3}}{3}$ D) $-\dfrac{1}{2}$

24) _____

Find the exact value under the given conditions.

25) $\sin \alpha = \dfrac{20}{29}, \dfrac{\pi}{2} < \alpha < \pi;$ $\cos \beta = \dfrac{4}{5}, 0 < \beta < \dfrac{\pi}{2}$ Find $\sin (\alpha - \beta)$.

    A) $\dfrac{24}{145}$ B) $\dfrac{143}{145}$ C) $\dfrac{144}{145}$ D) $\dfrac{17}{145}$

25) _____

26) $\sin \alpha = -\dfrac{5}{13}$, $\dfrac{3\pi}{2} < \alpha < 2\pi$; $\tan \beta = -\dfrac{20}{21}$, $\dfrac{\pi}{2} < \beta < \pi$ Find $\cos(\alpha + \beta)$.   26) _____

A) $-\dfrac{352}{377}$ B) $\dfrac{345}{377}$ C) $-\dfrac{135}{377}$ D) $-\dfrac{152}{377}$

Use the information given about the angle θ, $0 \le \theta \le 2\pi$, to find the exact value of the indicated trigonometric function.

27) $\tan \theta = \dfrac{7}{24}$, $\pi < \theta < \dfrac{3\pi}{2}$ Find $\tan(2\theta)$.   27) _____

A) $-\dfrac{336}{527}$ B) $\dfrac{527}{336}$ C) $\dfrac{336}{527}$ D) $-\dfrac{527}{336}$

Find the exact value of the expression.

28) $\cos\left[2 \sin^{-1}\left(-\dfrac{5}{13}\right)\right]$ 28) _____

A) $\dfrac{119}{169}$ B) $\dfrac{2\sqrt{5} + 10}{13}$ C) $\dfrac{10}{13}$ D) $-\dfrac{12}{13}$

Simplify the expression.

29) $\dfrac{\cos \theta}{1 + \sin \theta} + \tan \theta$ 29) _____

A) $\sec \theta$ B) 1   C) $\cos \theta + \sin \theta$ D) $\sin^2 \theta$

30) $(1 + \cot \theta)(1 - \cot \theta) - \csc^2 \theta$ 30) _____
   A) $-2 \cot^2 \theta$ B) $2 \cot^2 \theta$ C) 0   D) 2

Use the information given about the angle θ, $0 \le \theta \le 2\pi$, to find the exact value of the indicated trigonometric function.

31) $\sin \theta = -\dfrac{4}{5}$, $\dfrac{3\pi}{2} < \theta < 2\pi$ Find $\sin(2\theta)$.   31) _____

A) $\dfrac{7}{25}$ B) $-\dfrac{24}{25}$ C) $-\dfrac{7}{25}$ D) $\dfrac{24}{25}$

32) $\cos \theta = -\dfrac{3}{5}$, $\dfrac{\pi}{2} < \theta < \pi$ Find $\cos\dfrac{\theta}{2}$.   32) _____

A) $-\dfrac{\sqrt{30}}{10}$ B) $\dfrac{\sqrt{30}}{10}$ C) $-\dfrac{\sqrt{5}}{5}$ D) $\dfrac{\sqrt{5}}{5}$

33) $\cos \theta = \dfrac{1}{4}$, $\csc \theta > 0$ Find $\sin\dfrac{\theta}{2}$.   33) _____

A) $\dfrac{\sqrt{6}}{4}$ B) $\dfrac{\sqrt{8 - 2\sqrt{15}}}{4}$ C) $\dfrac{\sqrt{8 + 2\sqrt{15}}}{4}$ D) $\dfrac{\sqrt{10}}{4}$

Write the general form of the equation of the circle with radius r and center (h, k).
   34) $r = 4$; $(h, k) = (-2, 3)$ 34) _____
      A) $(x - 2)^2 + (y + 3)^2 = 4$ B) $(x + 2)^2 + (y - 3)^2 = 4$
      C) $(x + 2)^2 + (y - 3)^2 = 16$ D) $(x - 2)^2 + (y + 3)^2 = 16$

Find the center (h, k) and radius r of the circle with the given equation.

35) $(x + 1)^2 + y^2 = 49$

    A) $(h, k) = (0, -1)$; $r = 49$ B) $(h, k) = (-1, 0)$; $r = 7$

    C) $(h, k) = (-1, 0)$; $r = 49$ D) $(h, k) = (0, -1)$; $r = 7$

35) _____

36) $x^2 + y^2 + 8x - 18y + 97 = 25$

    A) $(h, k) = (4, -9)$; $r = 25$ B) $(h, k) = (-9, 4)$; $r = 25$

    C) $(h, k) = (9, -4)$; $r = 5$ D) $(h, k) = (-4, 9)$; $r = 5$

36) _____

Find the vertex, focus, and directrix of the parabola with the given equation.

37) $x = -\dfrac{1}{20}(y - 4)^2 - 1$

    A) vertex: $(1, -4)$ B) vertex: $(4, -1)$

       focus: $(-4, -4)$ focus: $(-1, -1)$

       directrix: $x = 6$ directrix: $x = 9$

    C) vertex: $(-1, 4)$ D) vertex: $(-1, 4)$

       focus: $(4, 4)$ focus: $(-6, 4)$

       directrix: $x = -6$ directrix: $x = 4$

37) _____

Find an equation for the parabola described.

38) Vertex at $(4, 8)$; focus at $(4, 3)$

    A) $y = \dfrac{1}{20}(x - 4)^2 + 8$ B) $x = \dfrac{1}{4}(y - 8)^2 + 4$

    C) $y = -\dfrac{1}{20}(x - 4)^2 + 8$ D) $x = -\dfrac{1}{4}(y - 8)^2 + 4$

38) _____

Find the center, foci, and vertices of the ellipse.

39) $36x^2 + 49y^2 = 1764$

    A) center at $(0, 0)$ B) center at $(0, 0)$

       foci at $(-\sqrt{13}, 0)$ and $(\sqrt{13}, 0)$ foci at $(0, -\sqrt{13})$ and $(0, \sqrt{13})$

       vertices at $(-7, 0)$, $(7, 0)$ vertices at $(0, -7)$, $(0, 7)$

    C) center at $(0, 0)$ D) center at $(0, 0)$

       foci at $(0, -6)$ and $(0, 6)$ foci at $(-7, 0)$ and $(7, 0)$

       vertices at $(0, -36)$, $(0, 36)$ vertices at $(-49, 0)$, $(49, 0)$

39) _____

Find an equation for the ellipse described.

40) Center at $(5, 5)$; focus at $(8, 5)$; vertex at $(10, 5)$

    A) $\dfrac{(x + 5)^2}{25} + \dfrac{(y + 5)^2}{16} = 1$ B) $\dfrac{(x - 5)^2}{64} + \dfrac{(y + 5)^2}{7} = 2$

    C) $\dfrac{(x + 5)^2}{9} - \dfrac{(y - 5)^2}{13} = 1$ D) $\dfrac{(x - 5)^2}{25} + \dfrac{(y - 5)^2}{16} = 1$

40) _____

Find an equation for the hyperbola described.

41) Vertices at $(\pm 8, 0)$; foci at $(\pm 10, 0)$

    A) $\dfrac{x^2}{64} - \dfrac{y^2}{100} = 1$ B) $\dfrac{x^2}{36} - \dfrac{y^2}{64} = 1$ C) $\dfrac{x^2}{64} - \dfrac{y^2}{36} = 1$ D) $\dfrac{x^2}{100} - \dfrac{y^2}{64} = 1$

41) _____

Find the center, transverse axis direction, vertices, foci, and asymptotes of the hyperbola.

42) $\dfrac{(x + 2)^2}{9} - \dfrac{(y + 4)^2}{36} = 1$

42) _____

    A) center at (-4, -2)
       transverse axis is horizontal
       vertices at (-7, -2) and (-1, -2)
       foci at $(-4 - 3\sqrt{5}, -2)$ and $(-4 + 3\sqrt{5}, -2)$
       asymptotes of m = 2 and m = -2

    B) center at (-2, -4)
       transverse axis is vertical
       vertices at (-2, -7) and (-2, -1)
       foci at $(-2, -4 - 3\sqrt{5})$ and $(-2, -4 + 3\sqrt{5})$
       asymptotes of $m = \dfrac{1}{2}$ and $m = -\dfrac{1}{2}$

    C) center at (-2, -4)
       transverse axis is horizontal
       vertices at (-5, -4) and (1, -4)
       foci at $(-2 - 3\sqrt{5}, -4)$ and $(-2 + 3\sqrt{5}, -4)$
       asymptotes of m = 2 and m = -2

    D) center at (-2, -4)
       transverse axis is horizontal
       vertices at (-8, -4) and (4, -4)
       foci at $(-2 - 3\sqrt{5}, -4)$ and $(-2 + 3\sqrt{5}, -4)$
       asymptotes of $m = \dfrac{1}{2}$ and $m = -\dfrac{1}{2}$

Solve the problem.

43) An arch for a bridge over a highway is in the form of a semiellipse. The top of the arch is 35 feet above ground (the major axis). What should the span of the bridge be (the length of its minor axis) if the height 31 feet from the center is to be 16 feet above ground?

43) _____

    A) 69.71 ft   B) 135.63 ft   C) 34.86 ft   D) 68.93 ft

44) A reflecting telescope contains a mirror shaped like a paraboloid of revolution. If the mirror is 24 inches across at its opening and is 2 feet deep, where will the light be concentrated?

44) _____

    A) 0.1 in. from the vertex   B) 1.5 in. from the vertex
    C) 0.2 in. from the vertex   D) 18 in. from the vertex

45) If a satellite is placed in a circular orbit of 200 kilometers above the Earth, what is the equation of the path of the satellite if the origin is placed at the center of the Earth (the diameter of the Earth is approximately 12,740 kilometers)?

45) _____

    A) $x^2 + y^2 = 40{,}000$ B) $x^2 + y^2 = 167{,}443{,}600$
    C) $x^2 + y^2 = 40{,}576{,}900$ D) $x^2 + y^2 = 43{,}164{,}900$

Match the point in polar coordinates with either A, B, C, or D on the graph.

46) $\left(3, -\dfrac{5\pi}{3}\right)$

46) _____
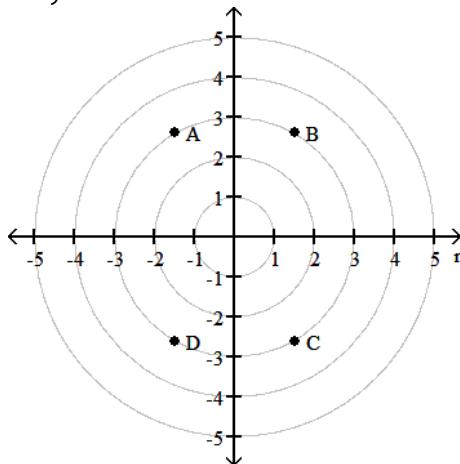
   A) A   B) B   C) C   D) D

The letters r and θ represent polar coordinates. Write the equation using rectangular coordinates (x, y).

47) r = 5

47) _____

   A) x + y = 25   B) x + y = 5   C) $x^2 + y^2 = 25$ D) $x^2 - y^2 = 25$

Write the complex number in polar form. Express the argument in degrees, rounded to the nearest tenth, if necessary.

48) 2 + 2i

48) _____

   A) $2\sqrt{2}$cis 45°   B) 4cis 30°   C) $2\sqrt{2}$cis 30°   D) 4cis 45°

Find zw or $\dfrac{z}{w}$ as specified. Leave your answer in polar form.

49) z = 5cis 35°
   w = 2cis 40°
   Find zw.

49) _____

   A) 7cis 75°   B) 10cis 50.9°   C) 10cis 75°   D) 7cis 50.9°

50) z = 10cis 30°
   w = 5cis 10°
   Find $\dfrac{z}{w}$.

50) _____

   A) 2cis 3°   B) 5cis 3°   C) 5cis 20°   D) 2cis 20°

Write the expression in the standard form a + bi.

51) $(2\text{cis }75°)^3$

51) _____

   A) $4\sqrt{2} - 4\sqrt{2}i$ B) $-4 - 4\sqrt{2}i$ C) $4\sqrt{2} + 4\sqrt{2}i$ D) $-4\sqrt{2} - 4\sqrt{2}i$

Find all the complex roots. Leave your answers in polar form with the argument in degrees.

52) The complex cube roots of -8i

52) _____

   A) 2cis 90°, 2cis 210°, 2cis 330°   B) 8cis 90°, 8cis 210°, 8cis 330°
   C) 512cis 90°, 512cis 210°, 512cis 330°   D) 2cis 180°, 2cis 300°, 2cis 60°

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Plot the complex number in the complex plane.

53) 4 + i   53) _____
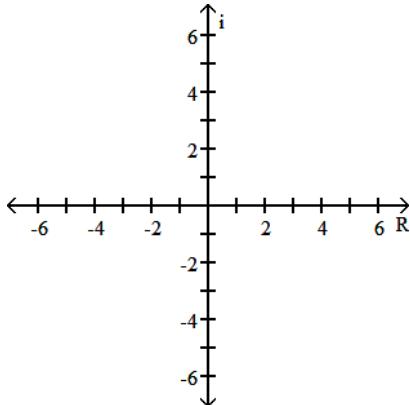
Use a calculator to solve the equation on the interval $0 \le x < 2\pi$. Round the answer to one decimal place if necessary.

54) $\cos x + \sin x = 2x$ 54) _____

55) $x^2 - 4 \cos x = 0$ 55) _____

Establish the identity.

56) $\csc^2\theta - \cos\theta \sec\theta = \cot^2\theta$ 56) _____

57) $\dfrac{1 - \sec\theta}{\tan\theta} + \dfrac{\tan\theta}{1 - \sec\theta} = -2\csc\theta$ 57) _____

58) $\dfrac{1 - \cos\theta}{1 + \cos\theta} = \dfrac{\sec\theta - 1}{\sec\theta + 1}$ 58) _____