1. How many mL of a 50% acid solution should be aded to 40 mL of a 20% acid solution to obtain a solution that is 25% acid?

   A. 10 mL B. 8 mL C. 6 mL D. 4 mL E. None of the above

2. Determine $(f \circ g)(x)$ for the following functions: $f(x) = 1 - \sqrt{x}$ and $g(x) = \dfrac{1}{x}$

   A. $-\sqrt{x}$ B. $1 - \sqrt{\frac{1}{x}}$ C. $1 - \sqrt{x}$ D. $\frac{1}{1-\sqrt{x}}$ E. $\frac{1}{\sqrt{x}}$

3. If $\dfrac{x}{x^2+1}$ find $\dfrac{1}{f(3)}$

   A. $\frac{3}{10}$ B. $\frac{3}{16}$ C. $\frac{16}{3}$ D. $\frac{10}{3}$ E. None of the above

4. If $f(x) = \dfrac{1}{3x-2}$, find the inverse function $f^{-1}(x)$.

   A. $f^{-1}(x) = 3x + 2$ B. $f^{-1}(x) = \dfrac{1+2x}{3x}$ C. $f^{-1}(x) = \dfrac{1}{2-3x}$
   D. $f^{-1}(x) = \dfrac{3}{x+6}$ E. None of the above

5. If $f(x) = x^2 - 2x + 4$ then $\dfrac{f(x+h) - f(x)}{h} =$

   A. $2x + h - 2$ B. $x + 2h - 2$ C. $x + 2h + 2$ D. $2x - h - 2$ E. $2x - h + 2$

6. A square of side x is inscribed in a circle. Express the area A of the circle as a function of x

   A. $A = \frac{\pi}{2}x^2$ B. $A = x^2$ C. $A = \pi x^2$ D. $A = \frac{\pi}{4}x^2$ E. None of the above

7. An aquarium in the shape of a rectangular box is to have a height of 1.5 feet and a volume of 6 cubic feet. Let x denote the length of the base a y the width of the base. Express y as a function of x.

   A. $y = 1.5x$ B. $y = \frac{4}{x}$ C. $y = x^2$ D. $y = \frac{6}{x}$ E. $y = 9x$

8. Find the vertex of the parabola $x^2 - 4x - 2y - 4 = 0$

   A. $(2, -2)$ B. $(2, -4)$ C. $(-4, 2)$ D. $(-2, 4)$ E. $(-2, 2)$

9. Find an equation of a quadratic function whose graph has the points $(1, 0), (-1, 0)$ and $(0, 2)$

   A. $y = 2x^2 + 2$ B. $y = -2x^2 + 2$ C. $y = -2x^2 - 2$ D. $y = 2x^2 - 2$ E. $y = -(x-2)^2$

10. Express as one logarithm: $\log_b y^3 + \log_b y^2 - \log_b y^4$.

A. $\log_b y^2$ B. $\log_b y$ C. $\log_b(y^3 + y^2 - y^4)$ D. $\log_b \dfrac{y^3 + y^2}{y^4}$ E. None of the above

11. Which are true of the function $f(x) = \log_a x$ if $a > 1$?

I. f is an increasing function II. f as a as an x-intercept III. f has 1 as a y-intercept IV. The domain of f is $(0, \infty)$

A. I, II and III B. I and II C. II and III D. I and IV E. I and III

12. Which of the following is equal to $\log\left(\dfrac{432}{\sqrt{0.095}\sqrt[3]{72.1}}\right)$?1

A. $\log 432 - \frac{1}{2}\log 0.095 - 3\log 72.1$ B. $\log 432 - \frac{1}{2}\log 0.095 - \frac{1}{3}\log 72.1$
C. $\log 432 - 2\log 0.095 + 3\log 72.1$ D. $\log 432 - \frac{1}{2}\log 0.095 + \frac{1}{3}\log 72.1$
E. $\log 732 - 2\log 0.095 - 3\log 72.1$

13. If $\log_x 2 = 5$, solve for x to four decimal places

A. 2.2361 B. 1.4142 C. 0.6990 D. 1.1487 E. 0.3010

14. Evaluate $\dfrac{\log_5 \frac{1}{8}}{\log_5 2}$

A. -4 B. $-\frac{1}{3}$ C. $-\frac{1}{4}$ D. -3 E. None of the above

15. Solve for x : $3^{x-5} = 4$

A. $x = \log 4 + 5\log 3$ B. $x = 5 + \log(4/3)$ C. $x = 5 + \dfrac{\log 4}{\log 3}$
D. $x = 5 + \log 4$ E. $x = \dfrac{5 + \log 4}{\log 3}$

16. Solve for x : $\log_3 \sqrt{2x+3} = 2$

A. $x = 5/2$ B. $x = 3/2$ C. $x = 39$ D. $x = 17$ E. $x = 3$

17. Given that $\log_3 m = 8, \log_3 n = 10$ and $\log_3 p = 6$, calculate $\log_3\left(\dfrac{\sqrt{mn}}{p^3}\right)$

A. -9 B. $\frac{2\sqrt{5}}{27}$ C. 22 D. -56 E. -4

18. A radioactive substance decays according to $q(t) = q_0 e^{-0.0063t}$ where q_0 is the initial amount of the substance and t is the time in days. Find the half-life of the substance to the nearest tenth of a day.

A. 110.0 days B. 47.8 days C. 0.5 days D. 2.0 days E. Cannot be determined

19. The graph of $y = 2 + 2^x$ crosses the y-axis at

A. 0 B. 1 C. 2 D. 3 E. 4

20. Determine where the graphs of the equations $x + 4y = 3$ and $2x - 6y = 8$ intersect.

A. $\left(-\frac{12}{5}, \frac{6}{5}\right)$ B. $\left(\frac{1}{3}, \frac{4}{9}\right)$ C. $\left(\frac{2}{7}, \frac{5}{7}\right)$ D. $\left(\frac{1}{8}, \frac{2}{5}\right)$ E. None of the above

21. Determine where the graphs of the equations $x^2 + y^2 = 16$ and $2y - x = 4$ interesect.

A. $(-4, 0), \left(\frac{12}{5}, \frac{16}{5}\right)$ B. $(0, 2), \left(\frac{16}{5}, \frac{18}{5}\right)$ C. $(-4, 0), \left(-\frac{2}{7}, \frac{1}{4}\right)$
D. $(4, 0), \left(-\frac{12}{5}, \frac{16}{5}\right)$ E. None of the above

22. Solve the following system of equations for z.

$$\begin{aligned} x + y + z &= -1 \\ 4x - 3y + 2z &= 16 \\ 2x - 2y - 3z &= 5 \end{aligned}$$

A. $z = \frac{13}{17}$ B. $z = 1$ C. $z = -2$ D. $z = -\frac{29}{27}$ E. $z = 2$

23. Find the quotient $q(x)$ and remainder $r(x)$ if $x^4 - 2x^2 - 3$ is divided by $x^2 - 6x$

A. $q(x) = x^2 - x + 5, r(x) = 3x + 2$ B. $q(x) = x^2 - 2, r(x) = x + 5$
C. $q(x) = x^2 + 6x + 34, r(x) = 204x - 3$ D. $q(x) = x^2 - 6x + 4, r(x) = 24x - 3$
E. None of the above

24. List all places where the graph of $f(x) = \dfrac{x^2 - 9}{x^2 + 2x}$ has vertical asymptotes.

A. $x = 0$ B. $x = 2$ C. $x = 0, x = -2$ D. $x = 3, x = -3$ E. None of the above

25. Given $f(x) = x^2(x - 1)(x + 1)^2$, for what values of x is $f(x) < 0$?

A. $(-\infty, -1) \cup (-1, 0) \cup (0, 1)$ B. $(-\infty, -1) \cup (-1, 0) \cup (1, \infty)$ C. $(-1, 0) \cup (1, \infty)$
D. $(-\infty, -1) \cup (-1, 1)$ E. None of the above

26. Considering the graph of $f(x) = \dfrac{x - 2}{x + 2}$, which statement is true?

A. $f(x)$ is decreasing and has a range of $(-\infty, -1) \cup (-1, \infty)$
B. $f(x)$ is decreasing and has a range of $(-\infty, 1) \cup (1, \infty)$
C. $f(x)$ is increasing and has a range of $(-\infty, 2) \cup (2, \infty)$
D. $f(x)$ is decreasing and has a range of $(-\infty, 2) \cup (2, \infty)$
E. $f(x)$ is increasing and has a range of $(-\infty, 1) \cup (1, \infty)$

27. If θ is in the second quadrant and $\sin\theta = 0.6$, find $\cos\theta$.

A. -0.75 B. 0.2 C. -0.8 D. 0.8 E. None of the above

28. The angles with measures listed are all coterminal except:

A. $\frac{\pi}{3}$ B. $-\frac{5\pi}{3}$ C. -300^o D. 420^o E. -60^o

29. The radian measure of an angle of $135^o$is

A. $\frac{5\pi}{4}$ B. $\frac{3\pi}{2}$ C. $\frac{3\pi}{4}$ D. $\frac{7\pi}{8}$ E. None of the above

30. Use a calculator to find $\sec 126^o$ correct to four decimal places

A. 1.2361 B. -0.5878 C. -1.7013 D. -1.2361 E. None of the above

31. The point $(12, -16)$ is on the terminal side of the angle θ. Find $\tan\theta$.

A. $\frac{5}{3}$ B. $-\frac{5}{4}$ C. $\frac{4}{3}$ D. $\frac{4}{5}$ E. None of the above

32. Find the exact value of $\tan 120^o$.

A. $-\sqrt{3}$ B. $-\frac{1}{\sqrt{3}}$ C. $\sqrt{3}$ D. $\frac{1}{\sqrt{3}}$ E. None of the above

33. If the diameter of a circle is 4, find the length of the arc cut off by a central angle of 30^o. Give your answer to 3 decimal places

A. 1.047 B. 2.361 C. 3.142 D. 3.681 E. None of the above

34. The graph of $y = 3 + \sin x$

I. Crosses the y-axis at 3 II. crosses the x-axis at multiples of π III. is always above the x-axis IV. has a period of 2π

A. I and II B. I, III, and IV C. I, II, and IV D. II and IV E. None of the above

35. Give the domain D and the range R of $f(x) = \cos x$

A. $D = (-\infty, \infty), R = [-1, 1]$ B. $D = [0, \infty), R = (-\infty, \infty)$ C. $D = [0, 2\pi], R = [-1, 1]$
D. $D = (-\infty, \infty), R = [0, 2\pi]$ E. None of the above

36. The expression $\dfrac{\tan^2 x}{1 + \sec x}$ is identically equal to

A. 1 B. $\sec x - 1$ C. $\tan x + \sin x$ D. $\tan^2 x + \sin x \tan x$ E. $\csc x + \sin x$

37. Simplify: $\dfrac{\tan x \cos x \sec x}{\cot x \sec x \sin x}$

A. $\tan^2 x \cos^2 x \sin^2 x$ B. 1 C. $\csc^2 x$ D. 0 E. $\tan^2 x$

38. Given $\cos\theta = 3/4$ and $270^o < \theta < 360^o$, find $\sin 2\theta$.

A. $\frac{-3\sqrt{7}}{8}$ B. $\frac{-\sqrt{7}}{4}$ C. $\frac{-1}{8}$ D. $\frac{1}{8}$ E. $\frac{3\sqrt{7}}{8}$

39. A wire is attached to the top of a radio antenna and to a point on horizontal ground that is 40.0 meters from the base of the antenna. If the wire makes an angle of $58^o20'$ with the ground, approximate the length of the wire to the nearest tenth of a meter.

A. 47.0 m B. 76.2 m C. 47.1 m D. 75.9 m E. None of the above

40. From a point P on level ground the angle of elevation to the top of the tower is $26^o50'$. From a point 25.0 meters closer to the tower and on the same line with P and the base of the tower, the angle of elevation to the top of the tower is $43^o30'$. Find the height of the tower correct to one decimal place.

A. 39.3 m B. 12.6 m C. 27.1 m D. 23.7 m E. None of the above

41. Give the polar coordinates of a point whose rectangular coordinates are $(-2, 3)$

A. $\left(\sqrt{13}, -56.3^o\right)$ B. $\left(\sqrt{13}, 123.7^o\right)$ C. $(13m - 33, 7^o)$ D. $(13, 146.3^o)$ E. $\left(\sqrt{13}, 146.3^o\right)$

42. Find a polar equation which has the same graph as the equation $x^2 - 2x + y^2 = 0$.

A. $r = 1$ B. $r = 2$ C. $r = 2\sin\theta$ D. $r = 2\cos\theta$ E. $r = \sqrt{2\cos\theta}$

SOLUTIONS

1. B; 2. D; 3. D;, 4. B;, 5. A;, 6. A;, 7. B;, 8. B; 9. B;, 10. B;, 11. D;, 12. B;, 13. D; 14. D;, 15. C;, 16. C;, 17. A;, 18. A;, 19. D;, 20. E $\left(\frac{25}{7}, -\frac{1}{7}\right)$;, 21. A;, 22. B;, 23. C;, 24. C;, 25. A; 26. E;, 27. C;, 28. E;, 29. C;, 30. C;, 31. E $[-4/3]$; 32. A;, 33. A;, 34. B;, 35. A;, 36. B;, 37. B;, 38. A; 39. B;, 40. C;, 41. B;, 42. D