1. Which of the following is NOT a rational number?

    (a) 3.252525 . . .   (b) $\sqrt{25}$ (c) 11/17   (d) 3.141141114 . . .   (e) $\sin(\pi/6)$

2. Given $R^2 = \{(x,y) \mid x,y$ are real numbers$\}$, which of the following does not define a function of x ?

    (a) $y = 4$ (b) $x = 4$ (c) $y = x^2$ (d) $y = x^2 + x$ (e) $x = 1 - y$

3. Solve the inequality $\dfrac{x+1}{x-2} < \dfrac{x+3}{2-x}$.

    (a) $x < -2$ (b) $(-\infty,\infty)$ (c) $-2 < x$ (d) $x < -2$ or $2 < x$ (e) $(-2,2)$

4. Solve the quadratic inequality $x^2 - 4x + 3 \le 0$.

    (a) $x \le 0$ (b) (1,3)   (c) [1,3]   (d) [1,3)   (e) $x = 1$ or 3

5. Find the domain of $f(x) = \sqrt{x^2 + 2x - 15}$.

    (a) $(-\infty, -5)$ (b) (-5, 3)   (c) $(-\infty, -5] \cup [3, \infty)$ (d) $(-\infty, \infty)$ (e) $[3, \infty)$

6. Suppose $f(x) = \dfrac{x-1}{x+2}$ and $g(x) = \dfrac{4+x}{x-3}$. What is $g(f(x))$?

    (a) $\dfrac{x^2 + 3x - 4}{x^2 - x - 6}$ (b) $-\dfrac{5x+7}{2x+7}$ (c) $\dfrac{7}{3x-2}$ (d) $\dfrac{x-1}{x-3}$ (e) $\dfrac{4+x}{x+2}$

7. What are the zeros of the quadratic function $f(x) = x^2 - 8x + 7$?

    (a) {-1, -7}   (b) {1, 7}   (c) {3,4}   (d) {-3, -4}   (e) {0}

8. Let D represent the domain and R the range. Which of the following are true of $f(x) = \dfrac{3x}{|x|}$?

    (a) $D = R = (-\infty, \infty)$ (b) $D = (0, \infty)$ and $R = [3, \infty)$ (c) $D = (-\infty, 0) \cup (0, \infty)$ and $R = \{3\}$

    (d) $D = \{x : x \ne 0\}$ and $R = \{3, -3\}$ (e) $D = \{x : x > 0\}$ and $R = \{-3, 3\}$

9. Suppose $f(0) = \sqrt{17}$. Evaluate $e^{\ln f(x)}$ when $x = 0$.

 (a) 61.7507   (b) 17   (c) $\sqrt{17}$ (d) 1.4166   (e) 1

10. The plot of $0 = y + 4 - x^2$ is which of the following?

 (a) parabola opening upward   (b) hyperbola   (c) s-curve   (d) circle
 (e) parabola opening downward

11. Find the equation of the straight line that contains (5, 4) and is perpendicular to the line $3x + y - 7 = 0$.

 (a) $-3x + y + 11 = 0$ (b) $3x + y - 19 = 0$ (c) $x - 3y + 7 = 0$ (d) $7x - 3y + 2 = 0$

 (e) $x + 3y - 17 = 0$

12. Give the oblique (slant) asymptote for $y = \dfrac{(x+3)(x-2)x}{x^2 + x}$.

 (a) $y = x$ (b) $x = 0$ or -1   (c) $x = -3, 2,$ or 0   (d) $y = 0$ (e) $y = 2x - 3$

13. Find the zeros of the polynomial function $x^4 - 3x^3 - 21x^2 + 43x + 60$.

 (a) {-1, 4, 20, 3}   (b) {3, -1, 5, -4}   (c) {-3, 1, 5, -4}   (d) {3, 10, 2, 1}   (e) {3, -1, -5, 4}

14. The number of subscribers to <u>TV Weekly Magazine</u> was 530 *thousand* in 1990 and 950 *thousand* in 2005. Assume that the number of subscribers grows linearly with respect to time. Find an equation representing the number of subscribers S (in thousands) as a function of t, the number of years since 1990.

 (a) $S = -28t + 530$ (b) $S = 42t + 530$ (c) $S = 28t + 530$ (d) $S = -42t + 530$

 (e) $S = (1/28)t + 950$

15. What is the arc length cut off by a central angle of 73° in a circle of radius 6.75 cm?

 (a) 21.2058 cm   (b) 17.2002 cm   (c) 15.7430 cm.   (d) 10.5791 cm   (e) 8.6001 cm

16. Find the zeros of the polynomial function $x^4 - 5x^2 + 4$.

 (a) {1, -1, 2, 2}   (b) {1, 1, 4, 4}   (c) {1, -1, -2, 2}   (d) {1, 1, -2, -2}   (e) {1, 2, -2, 4}

17. Which of the following is NOT a *possible* factor of $3x^4 - ax^3 + bx^2 - cx + 385$, where a,b and c are integers?

   (a) $(x - 9)$ (b) $(3x - 5)$ (c) $(x - 7)$ (d) $(3x - 1)$ (e) $(x + 11)$

18. If $\sin \theta = 5/12$ and $\cos \theta < 0$, what is $\tan \theta$?

   (a) 5/13   (b) $5/\sqrt{119}$ (c) $-5/\sqrt{119}$ (d) -5/13   (e) -12/13

19. What is the product of the number $3 + 2i$ with its complex conjugate?
   (a) $(3 + 2i)^2$ (b) $3 - 2i$ (c) 5   (d) $9 - 4i$ (e) 13

20. Given that $3 + i$ is a root of $x^3 - 8x^2 + 22x - 20$, what are the other roots?

   (a) $3 + i$ and -2   (b) $3 - i$ and 4   (c) 4 and $-3 - i$ (d) $3 - i$ and 2   (e) $3 - i$ and 5

21. What is the period of the function $-\dfrac{3}{4}\cos\left(6x - \dfrac{3\pi}{4}\right) + 5$?

   (a) 6   (b) 3/4   (c) $\pi/3$ (d) $3\pi/4$ (e) $-\pi/8$

22. Given two complex numbers: $z = 2 + 5i$ and $w = 3 - 2i$ find the sum of $\bar{z}$ and $\bar{w}$.

   (a) $6 - 10i$ (b) $1 + 7i$ (c) $5 - 3i$ (d) $-5 + 3i$ (e) $-5 - 3i$

23. A flag pole is on a hillside. From a point 200 feet from the base of the flagpole, measured along the slope of the hill, the angle of elevation to the base of the flag pole is 15° and to the top of the flagpole is 43°. To the nearest tenth of a foot, how tall is the flag pole?

   (a) 186.5 feet   (b) 128.4 feet   (c) 311.6 feet   (d) 214.5 feet   (e) 70.8 feet

24. Solve $2\sin^2 x = \cos x + 1$ on the interval $0 \le x < 2\pi$.

   (a) $\pi/4$ or $3\pi/4$ (b) $\pi/3$, π, or $5\pi/3$ (c) 0, $\pi/2$, or $3\pi/2$ (d) Ø   (e) $\pi/6$ or $7\pi/6$

25. Which of the following trigonometric identities is correct?

   (a) $\cos \alpha = 1/\sin \alpha$ (b) $\cos \alpha = \sec \alpha/\cot \alpha$ (c) $\cos \alpha = \cot \alpha/\csc \alpha$ (d) $\cos \alpha = \tan \alpha \sin \alpha$

   (e) $\cos \alpha = \sec \alpha/\tan \alpha$

26. At a point 8 miles from one mountain peak and 3 miles from another, the angle between them is 65°. To the nearest tenth of a mile, how far apart are the mountain peaks?

   (a) 6.9 miles   (b) 7.7 miles   (c) 7.0 miles   (d) 7.3 miles   (e) 7.5 miles

27. A man invests $6,900 at 6.25% annual interest, compounded monthly. How much is his account worth after 7 years?

    (a) $9018.75   (b) $10,547.55   (c) $10,490.55   (d) $10,674.80   (e) $9,918.75

28. Which trigonometric identity is correct?

    (a) $\sin 2\alpha = 2 \sin \alpha \cos \alpha$ (b) $\sin 2\alpha = 2\cos^2\alpha - 1$ (c) $\sin 2\alpha = \tan \alpha/(1 + \tan^2\alpha)$

    (d) $\sin 2\alpha = \cos^2\alpha + \sin^2\alpha$ (e) $\sin 2\alpha = \cos^2\alpha - \sin^2\alpha$

29. Convert the polar equation $r^2 = 3\cos(2\theta)$ to rectangular coordinates.

    (a) $(x^2 + y^2)^2 = 3(x^2 + y^2)$ (b) $(x^2 - y^2)^2 = 3(x^2 + y^2)$ (c) $(x^2 + y^2)^2 = 3y$

    (d) $(x^2 + y^2)^2 = 3(x - y)$ (e) $(x^2 + y^2)^2 = 3(x^2 - y^2)$

30. A radioactive substance decays from 17.6 g to 14.8 g in 11 days. Find its half-life.

    (a) 69.142857 days   (b) 5.5 days   (c) 34.5714 days   (d) 44.0038 days

    (e) 8.8001 days

31. Which trigonometric identity is correct?

    (a) $\csc \alpha = 1/\cos \alpha$ (b) $\csc \alpha = \tan \alpha \cot \alpha$ (c) $\csc \alpha = \sec \alpha \cot \alpha$ (d) $\csc \alpha = 1/\sec \alpha$

    (e) $\csc \alpha = \sin(\pi/2 - \alpha)$

32. Change the point $(2\sqrt{3}, 17\pi/6)$ in polar coordinates to rectangular coordinates.

    (a) $(-3, -\sqrt{3})$ (b) $(3, \sqrt{3})$ (c) $(\sqrt{3}, -3)$ (d) $(-3, \sqrt{3})$ (e) $(3, -\sqrt{3})$

33. The number of bacteria in a culture is 10^4. Ten hours later the number has increased to 10^9. Approximate the size of the bacteria population 15 hours after the initial time. Assume an exponential growth model.

    (a) 1.499×10^9 (b) 3.1623×10^{11} (c) 5.0011×10^{13} (d) 1.234×10^{12} (e) 10^{10}

34. Which of the following expressions is equivalent to $\sin(x + y)$?

    (a) $\sin x + \sin y$ (b) $\sin x \sin y$ (c) $\sin x \cos x$ (d) $\cos x \cos y + \sin x \sin y$

    (e) $\sin x \cos y + \cos x \sin y$

35. Simplify $((x^{-1} - y^{-1})^{-1} + z^{-1})^{-1}$

    (a) $(yz - xz)/(xyz - x + y)$ (b) $(xz + yz)/(xyz - x + y)$ (c) $(xz + yz)/(xyz + x - y)$

    (d) $(yz - xz)/(xyz + x - y)$ (e) $(yz - xz)/(xyz + x + y)$

36. The Richter measurement of an earthquake is the base-ten logarithm of its amplitude. How many times greater is the amplitude of an earthquake that measures 8.1 on the Richter scale than the amplitude of one measuring 6.5 on the Richter scale?

    (a) 1.246   (b) 1.1176   (c) 16.01   (d) 27.34   (e) 39.81

37. What is $\arcsin(-1/2)$?

    (a) $7\pi/6$ (b) $-\pi/6$ (c) $-5\pi/6$ (d) a, b, and c   (e) b and c only

38. Simplify $\left(\dfrac{x^{4a+3b-c}}{x^{3a+b}} \right) x^{3c-2b-a}$

    (a) x^{4c} (b) x^{-4c} (c) x^{2c} (d) $x^{(a-2c)}$ (e) x^{-2c}

39. What is the hydrogen ion concentration of a substance with $pH = 9.3$? (The pH of a substance is defined to be $-\log[\text{hydrogen ion concentration}]$.)

    (a) $10^{9.3}$ (b) 93   (c) 1/9.3   (d) .96848   (e) 5.01187×10^{-10}

40. What is the inverse function of $g(x) = \dfrac{x}{x^2 + 1}$, $1 \le x < \infty$?

    (a) The function is not 1:1; there is no inverse   (b) $\dfrac{x^2 + 1}{x}$ (c) $\dfrac{1 + \sqrt{1 - 4x^2}}{2x}$, $x > 0$

    (d) $\dfrac{y}{y^2 + 1}$ (e) $\dfrac{1}{\sqrt{x}} + \sqrt{x}$

EXTRA PROBLEMS

41. A pair of shoes sells for $67.95 after a 15% mark-down. What was its original price?

    (a) $57.76   (b) $79.94   (c) $82.95   (d) $75.50   (e) $78.14

42. Given the identity $\cosh^2 x - \sinh^2 x = 1$, if $\cosh x = 3$, what is $\sinh x$?

    (a) 3   (b) 2   (c) 8   (d) $\pm 2\sqrt{2}$ (e) not enough information is given