1. Find the exact value of $\cos\left(-\dfrac{9\pi}{4}\right)$.

1) $\sqrt{3}-1$

2) $1-\sqrt{3}$

3) $\dfrac{-1}{\sqrt{3}-1}$

4) $\dfrac{1}{\sqrt{3}-1}$

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

6) $\dfrac{\sqrt{2}}{2}$

7) $-\sqrt{2}$

8) $\sqrt{2}$

9) None of the above

2. A tourist, who is standing on level ground 300 meters from the base of a redwood tree, observes that that the angle between the ground and the line of sight from her to the top of the tree is 22°. Approximate the height of the redwood tree to the nearest tenth of a meter.

1) 13.6 meters

2) 112.4 meters

3) 121.2 meters

4) 278.2 meters

5) 323.6 meters

6) 442.5 meters

7) 500.8 meters

8) 742.5 meters

9) 800.8 meters

3. How much money, invested at an interest rate of 11% per year compounded monthly, will amount to $250,000 in 20 years? Round your answer to the nearest cent.

1) $27,700.79

2) $27,979.81

3) $29,111.20

4) $31,008.48

5) $113,636.36

6) $550,000.00

7) $2,233,753.84

8) $2,256,253.38

9) None of the above

4. Staring with c milligrams of radium, the amount remaining after t days may approximated by
$A(t) = ce^{-0.004t}$. If the initial amount of radium is 100 milligrams, approximate the amount of radium left after 200 days. Round your answer to the nearest hundredth of a milligram.

1) 445.11 milligrams

2) 298.36 milligrams

3) 222.55 milligrams

4) 149.18 milligrams

5) 134.06 milligrams

6) 89.87 milligrams

7) 67.03 milligrams

8) 44.93 milligrams

9) None of the above

5. Poiseuille's law states that the blood flow rate F (in L/min) through a major artery is directly proportional to the product of the blood pressure P and the fourth power of the radius r. If during exercise the normal blood flow rate doubles and the radius of a major artery increases by 5%, then approximately how much harder must the heart pump?

1) ≈ 1.2 times harder

2) ≈ 1.4 times harder

3) ≈ 1.6 times harder

4) ≈ 1.8 times harder

5) ≈ 1.9 times harder

6) ≈ 2.1 times harder

7) ≈ 2.2 times harder

8) ≈ 2.4 times harder

9) ≈ 2.6 times harder

6. For the acute angle θ, $\cot \theta = \dfrac{3}{8}$. Find the exact value of $\sin \theta$.

1) $\dfrac{3\sqrt{55}}{55}$

2) $\dfrac{\sqrt{55}}{3}$

3) $\dfrac{8\sqrt{55}}{55}$

4) $\dfrac{\sqrt{55}}{8}$

5) $\dfrac{3\sqrt{73}}{73}$

6) $\dfrac{\sqrt{73}}{3}$

7) $\dfrac{8\sqrt{73}}{73}$

8) $\dfrac{\sqrt{73}}{8}$

9) None of the above

7. Which of the following are true of the function $f(x) = \sin x - 3$?

    I. f has a y-intercept at $(0, -3)$.

    II. The period of the function is π.

    III. The range of f is $[-4, -2]$.

1) I

2) II

3) III

4) I and II

5) I and III

6) II and III

7) I, II, and III

8) Cannot be determined

9) None of the above

8. Given $f(x) = x^2 - 3$, where $x \leq 0$, find $f^{-1}(x)$.

1) $f^{-1}(x) = \pm\sqrt{x-3}$

2) $f^{-1}(x) = \sqrt{x-3}$

3) $f^{-1}(x) = -\sqrt{x-3}$

4) $f^{-1}(x) = x - 3$

5) $f^{-1}(x) = \pm\sqrt{x+3}$

6) $f^{-1}(x) = \sqrt{x+3}$

7) $f^{-1}(x) = -\sqrt{x+3}$

8) $f^{-1}(x) = x + 3$

9) None of the above

9. Which of the following is equivalent to $\dfrac{1+\tan\theta}{\sec\theta}$?

1) $\cos\theta$

2) $\sec\theta$

3) $1 + \sin\theta$

4) $\cos\theta + \sin\theta$

5) $1 + \dfrac{1}{\sin\theta}$

6) $\dfrac{1}{\cos\theta} + \dfrac{1}{\sin\theta}$

7) $\cos\theta + \dfrac{\cos^2\theta}{\sin\theta}$

8) $\sin\theta + \dfrac{\sin^2\theta}{\cos\theta}$

9) $\dfrac{\cos\theta + \sin\theta}{\cos^2\theta}$

10. Which of the following are true of the function $f(x) = -(\frac{1}{3})^x + 5$?

    I. f is increasing throughout its domain

    II. The graph of f has an asymptote $x = -4$

    III. The domain of f is $(-\infty, 5)$

1) I
2) II
3) III
4) I and II
5) I and III
6) II and III
7) I, II, and III
8) Cannot be determined
9) None of the above

11. Find the exact values of all angles θ in the interval $\left(-\frac{\pi}{2}, \frac{3\pi}{2} \right)$ that satisfy the following equation.

    $\tan \theta = 1$

1) $\frac{\pi}{2}, \frac{3\pi}{4}$

2) $\frac{\pi}{2}, \frac{5\pi}{4}$

3) $-\frac{\pi}{4}, \frac{\pi}{4}$

4) $-\frac{\pi}{4}, \frac{3\pi}{4}$

5) $-\frac{\pi}{4}, \frac{5\pi}{4}$

6) $\frac{\pi}{4}, \frac{3\pi}{4}$

7) $\frac{\pi}{4}, \frac{5\pi}{4}$

8) $\frac{3\pi}{4}, \frac{5\pi}{4}$

9) None of the above

12. An angle, θ, is in standard position and its terminal side lies in quadrant III on the line $y = \frac{3}{7}x$.

    Find the **exact value** of the trigonometric function $\sec\theta$.

    1) $\sec\theta = \dfrac{7\sqrt{58}}{58}$

    2) $\sec\theta = -\dfrac{7\sqrt{58}}{58}$

    3) $\sec\theta = \dfrac{3\sqrt{58}}{58}$

    4) $\sec\theta = -\dfrac{3\sqrt{58}}{58}$

    5) $\sec\theta = \dfrac{\sqrt{58}}{3}$

    6) $\sec\theta = -\dfrac{\sqrt{58}}{3}$

    7) $\sec\theta = \dfrac{\sqrt{58}}{7}$
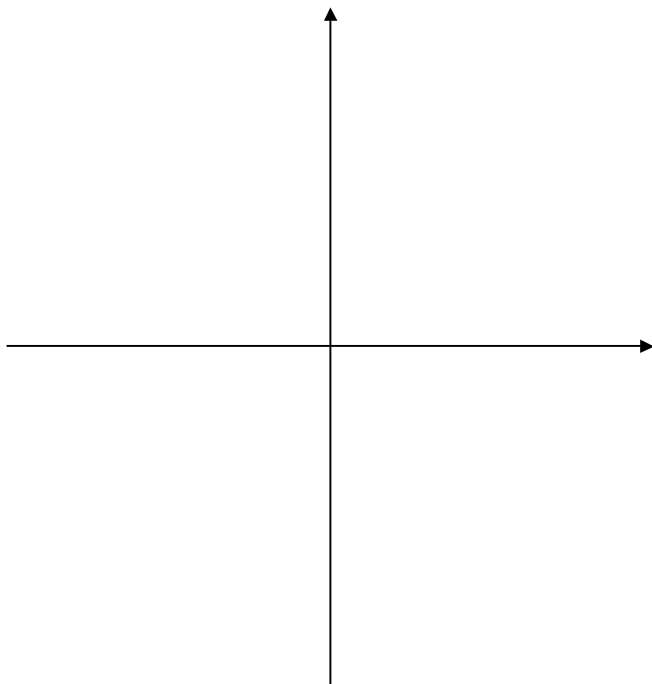
    8) $\sec\theta = -\dfrac{\sqrt{58}}{7}$

    9) None of the above

13. Which of the following are true of the function $f(x) = \log_3(x-5) - 1$?

    I. f has an x-intercept at $(8,0)$

    II. The graph of f has an asymptote $x = 5$

    III. The range of f is $(-\infty,\infty)$

    1) I
    2) II
    3) III
    4) I and II
    5) I and III
    6) II and III
    7) I, II, and III
    8) Cannot be determined
    9) None of the above

14. Simplify the following.

$$\frac{\log_8(8x^3)}{\log_8(2x)}$$

1) 2

2) 3

3) 4

4) 12

5) $4x^2$

6) $\log_8(4x^2)$

7) $\log_8(6x^2)$

8) $\log_8(8x^3 - 2x)$

9) None of the above

15. Salt water of concentration 40 grams of salt per liter flows into a large tank that initially contains 20 liters of pure water. The flow rate of salt water into the tank is 3 liters per minute. Find a formula for the salt concentration, c, in the large tank (in grams per liter) after t minutes.

1) $c = \dfrac{120t}{20 - 3t}$

2) $c = \dfrac{40t}{20 - 3t}$

3) $c = \dfrac{3t}{20 - 3t}$

4) $c = \dfrac{120t}{20 + 3t}$

5) $c = \dfrac{40t}{20 + 3t}$

6) $c = \dfrac{3t}{20 + 3t}$

7) $c = \dfrac{120t}{20 + 40t}$

8) $c = \dfrac{40t}{20 + 40t}$

9) $c = \dfrac{3t}{20 + 40t}$

16. If the angle θ is in standard position, which of the following is a pair of angles that are both coterminal to θ? $\theta = \dfrac{37\pi}{15}$

1) $-276°, -\dfrac{8\pi}{15}$

2) $-276°, \dfrac{22\pi}{15}$

3) $-96°, -\dfrac{23\pi}{15}$

4) $-96°, \dfrac{7\pi}{15}$

5) $264°, -\dfrac{23\pi}{15}$

6) $264°, \dfrac{7\pi}{15}$

7) $804°, -\dfrac{8\pi}{15}$

8) $804°, \dfrac{22\pi}{15}$

9) None of the above

17. A 120-milligram tablet of an asthma drug is taken orally. The total amount A in the bloodstream after t minutes is given by $A(t) = 120[1 - (0.9)^t]$. Find the number of minutes needed for 90 milligrams to have entered the bloodstream.

1) $\dfrac{\ln(0.25)}{0.9}$

2) $\dfrac{0.9}{\ln(0.25)}$

3) $\dfrac{\ln(0.25)}{\ln(0.9)}$

4) $\dfrac{\ln(0.9)}{\ln(0.25)}$

5) $\dfrac{\ln(0.75)}{0.9}$

6) $\dfrac{0.9}{\ln(0.75)}$

7) $\dfrac{\ln(0.75)}{\ln(0.9)}$

8) $\dfrac{\ln(0.9)}{\ln(0.75)}$

9) None of the above

18. Solve the equation.

$$\ln(-4-x)+\ln 3 = \ln(2-x)$$

1) $x = \frac{3}{2}$

2) $x = -\frac{3}{2}$

3) $x = 3$

4) $x = -3$

5) $x = 5$

6) $x = -5$

7) $x = 7$

8) $x = -7$

9) No solution exists

19. For research purposes, a tornado can often be modeled as a right circular cylinder that rotates about its axis. A cylindrically shaped tornado has a core diameter of 200 feet. If the tornado has a maximum wind speed of 300 feet per second at the outer edge of the core, approximate the number of revolutions the core makes each minute. Approximate to the nearest unit.

1) 1131

2) 565

3) 283

4) 180

5) 90

6) 57

7) 45

8) 29

9) 14