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Multiple Choice Questions

1. Take a deep breath and write "I got this ...".

2. Expand the following logarithmic expression

$$\ln \left(\frac{(x+8)(x-4)}{(x-2)^2} \right)^{3/5}, \quad x > 4.$$

- A. $\frac{3}{5} \ln(x+8) + \frac{3}{5} \ln(x-4) - \frac{6}{5} \ln(x-2)$
- B. $3 \ln(x+8) - 5 \ln(x-4) - \frac{6}{5} \ln(x-2)$
- C. $\frac{3}{5} \ln(x^2 + 12x - 32) - \frac{6}{5} \ln(x-2)$
- D. $\ln(x+8) + \ln(x-4) + \ln 36 \ln(x-2) - \ln 5$
- E. $\frac{3}{5} \ln(x+8) + \frac{3}{5} \ln(x-4) - \frac{3}{5} \ln(x-2)$

3. Express as a single logarithm:

$$3 \log_a x - \frac{5}{3} \log_a y + \frac{1}{6} \log_a w - 5 \log_a z.$$

- A. $\log_a \frac{x^3 z^5}{w^{1/6} y^{5/3}}$
- B. $\log_a \frac{x^3 w^{1/6}}{y^{5/3} z^5}$
- C. $\log_a \frac{x^3 y^{5/3}}{w^{1/6} z^5}$
- D. $\log_a \frac{x^3}{w^{1/6} y^{5/3} z^5}$
- E. $\log_a \left(3x - \frac{5}{3}y + \frac{1}{6}w - 5z \right)$

4. Solve the following equation for x .

$$\log(x + 9) = 1 - \log x$$

- A. $\{-10, 1\}$
 - B. $\{1\}$
 - C. $\{-1\}$
 - D. $\{-1, 10\}$
 - E. No solution
5. Describe how to transform the graph of the basic function $g(x) = \log x$ into the graph of the function $f(x) = 9 \log(4 - x)$.
- A. Reflect across the y -axis, translate 4 units to the right, and vertically stretch by a factor of 9.
 - B. Reflect across the y -axis, translate 4 units to the left, and vertically stretch by a factor of 9.
 - C. Reflect across the x -axis, translate 4 units to the left, and vertically stretch by a factor of 9.
 - D. Reflect across the x -axis, translate 4 units to the right, and vertically stretch by a factor of 9.
 - E. Reflect across the y -axis, translate 4 units to the right, and vertically compress by a factor of 9.

6. Convert 162° to radians.

- A. $\frac{9\pi}{10}$
- B. π
- C. $\frac{4\pi}{5}$
- D. $\frac{9\pi}{5}$
- E. $\frac{4\pi}{10}$

7. Use basic trigonometric identities to simplify

$$\frac{\cos^2 x}{\sin^2 x} + \cos x \sec x.$$

- A. $\csc x$
- B. $\sec^2 x$
- C. $\tan x$
- D. $\cot^2 x$
- E. $\csc^2 x$

8. Solve the following equation for x :

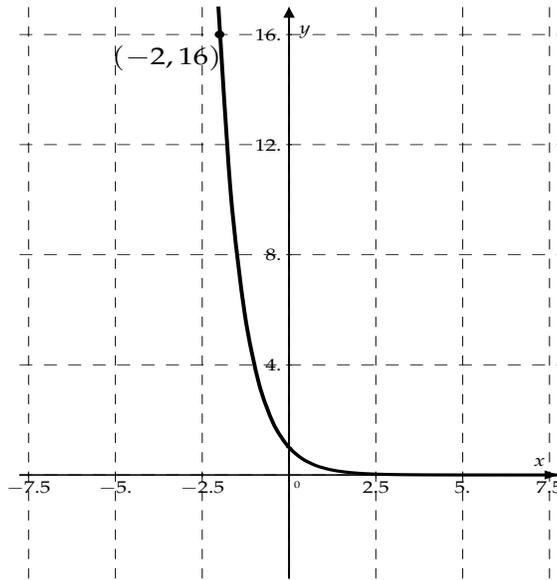
$$9^{2x} \cdot 27^{3-x} = \frac{1}{9}$$

- A. $\{-10\}$
- B. $\{-11\}$
- C. $\left\{\frac{9 + \sqrt{87}}{6}, \frac{9 - \sqrt{87}}{6}\right\}$
- D. $\{-8\}$
- E. $\{10\}$

9. Find $\log_3 13$.

- A. 2.334718
- B. 2.801661
- C. 2.334318
- D. 0.428317
- E. 3.344718

10. Find the exponential function whose graph is given



- A. $y = -4^x$
 B. $y = 4^{x+1}$
 C. $y = 4^{-x}$
 D. $y = x^4$
 E. $y = 4^x$
11. A 50-gallon barrel is filled completely with pure water. Salt water with a concentration of 0.5 lb/gal is then pumped into the barrel, and the resulting mixture overflows at the same rate. The amount of salt in the barrel at time t is given by

$$Q(t) = 25 \left(1 - e^{-0.08t} \right)$$

where t is measured in minutes and $Q(t)$ is measured in pounds. How much salt is in the barrel after 10 min?

- A. 15.9 pounds
 B. 15.8 pounds
 C. 14.8 pounds
 D. 13.8 pounds
 E. 13.7 pounds

Free Response Questions

12. Suppose you're driving your car on a cold winter day (18° F outside) and the engine overheats (at about 220° F). When you park, the engine begins to cool down. The temperature H of the engine t minutes after you park satisfies the equation

$$\ln\left(\frac{H - 18}{202}\right) = -0.13t.$$

- (a) Solve the equation for H .
- (b) Use part (a) to find the temperature of the engine after 25 min ($t = 25$). Round your answer to two decimal places.
13. Given that the terminal point for angle θ is $\left(\frac{5}{8}, -\frac{7}{8}\right)$, find

(a) $\sin \theta$

(b) $\cos \theta$

(c) $\tan \theta$

(d) $\cot \theta$

(e) $\sec \theta$

(f) $\csc \theta$

14. Given that $\sec \theta = 7$ and $\sin \theta < 0$, find the values of the other trigonometric functions of θ .

(a) $\sin \theta$

(b) $\cos \theta$

(c) $\tan \theta$

(d) $\cot \theta$

(e) $\sec \theta$

(f) $\csc \theta$

15. Find the domain of the function $f(x) = \ln(x^2 - 16)$.

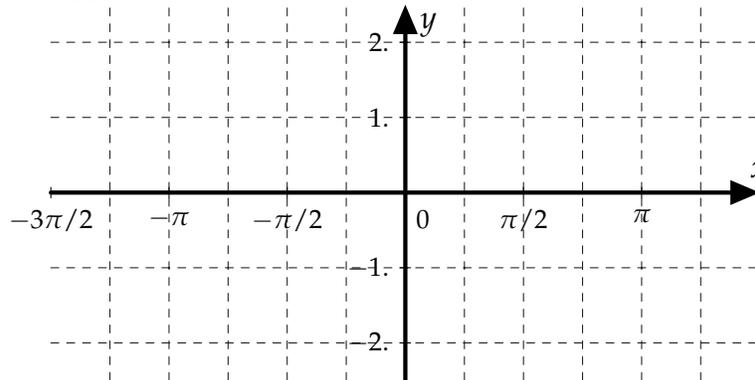
16. Vilfredo Pareto (1848–1923) observed that most of the wealth of a country is owned by a few members of the population. Pareto's Principle is

$$\log P = \log c - k \log W,$$

where W is the wealth level (how much money a person has) and P is the number of people in the population having that much money.

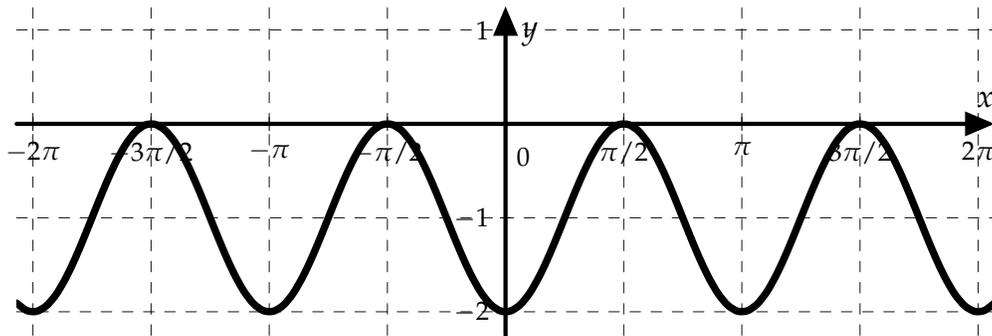
- (a) Solve the equation for P .
- (b) Assume $k = 2.5$, $c = 7,000$, and W is measured in millions of dollars. Use part (a) to find the number of people who have \$2 million or more. Round the answer to the nearest integer.
- (c) How many people have \$11 million or more? Again round the answer to the nearest integer.
17. The elk population in a certain region is given by the function $E(t) = 1050 + 150 \sin\left(\frac{4t}{5}\right)$ where the time t is measured in years.
- (a) What is the largest number of elk present in the region at any time?
- (b) How much time elapses between occurrences of the largest and smallest elk population?

18. Find the amplitude, period and phase shift of $-2 \sin\left(2x - \frac{\pi}{4}\right)$. Sketch a graph of the function on the supplied axes.



19. Simplify the expression $\frac{\sin^2 x - \cos^2 x}{1 - \tan^2 x}$.

20. Determine the equation of the function that is graphed below:



21. Use the properties of logarithms to expand the expression

$$\log \sqrt[6]{x \sqrt[6]{y \sqrt[6]{z}}}$$

in a form with no logarithm of a product, quotient, or power.

END OF TEST