
INSTRUCTIONS: **Simplify** and **box** all your answers. Write neatly and **justify all answers**. A correct answer with incorrect work or no justification may receive no credit. Books, notes, electronic devices, other unauthorized devices, and help from another person are not permitted while taking the exam. The exam is worth 100 points.

Potentially useful formulas:

$$\log_b(B) = \frac{\log_a(B)}{\log_a(b)} \text{ for } a > 0, a \neq 1.$$

$$A = \frac{1}{2}r^2\theta$$

$$S = r\theta$$

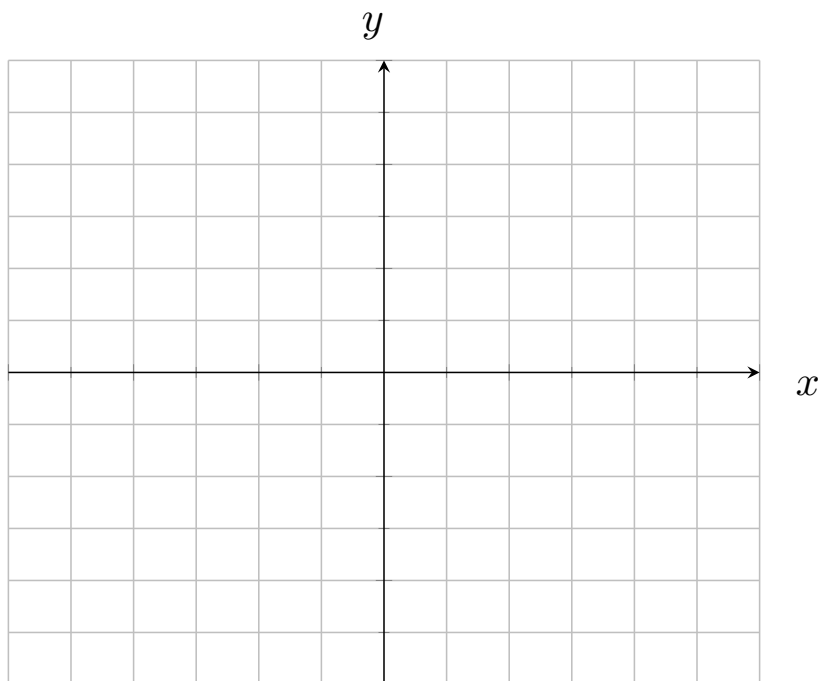
NOTE: YOU MAY TEAR OFF THIS FIRST PAGE AND USE (FRONT AND BACK) AS SCRATCH PAPER.

- i. DO NOT START UNTIL INSTRUCTED BY A PROCTOR.
- ii. THE EXAM IS ON BOTH SIDES OF EACH FOLLOWING EXAM PAGE
- iii. WRITE YOUR NAME ON THE NEXT PAGE.
- iv. WHEN YOU FINISH (IF BEFORE THE EXAM END TIME) PLEASE QUIETLY COLLECT YOUR THINGS AND FOLLOW PROCTOR INSTRUCTIONS IN UPLOADING YOUR EXAM WITH SUPPORTING WORK TO GRADESCOPE. ONLY WORK THAT'S SUBMITTED TO GRADESCOPE WILL BE GRADED.

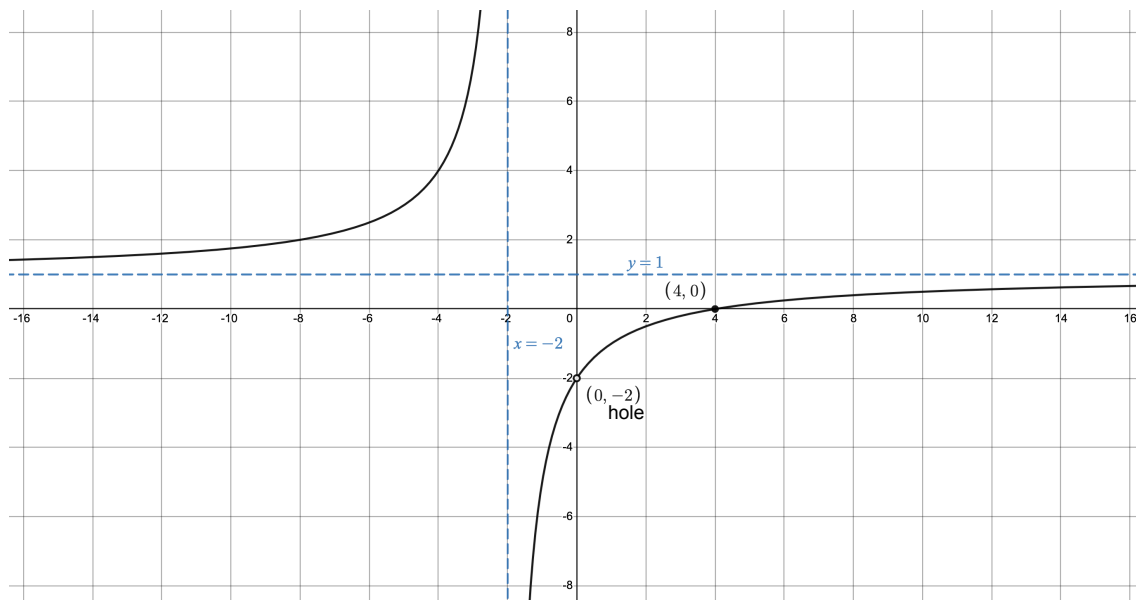
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1. Sketch the shape of the graph of a rational function, $g(x)$, that satisfies **all** of the given information. **Label** all intercepts and asymptotes on the graph. (4 pts)

- i. The graph has a slant asymptote: $y = x + 3$
- ii. The graph bounces (touches but does not cross) at x -intercept: $(-2, 0)$
- iii. The graph has no other x -intercepts.
- iv. The graph has a vertical asymptote: $x = -1$.



2. Consider the graph of a rational function below. Write down a rational function, $R(x)$, whose graph has the same vertical asymptote, horizontal asymptote, hole (as labeled), and x -intercept as that of the graph. (4 pts)

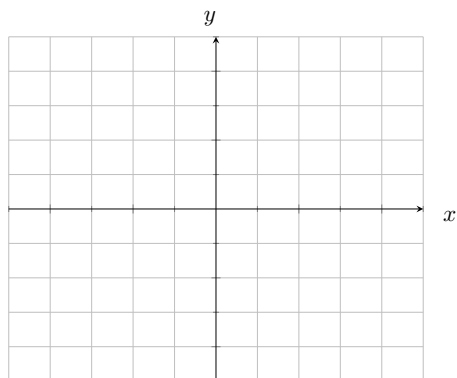


3. (a) Simplify (rewrite without logs or exponents): $-\log_3(27) + \log(1) + \ln(e^2) + 10^0$ (4 pts)

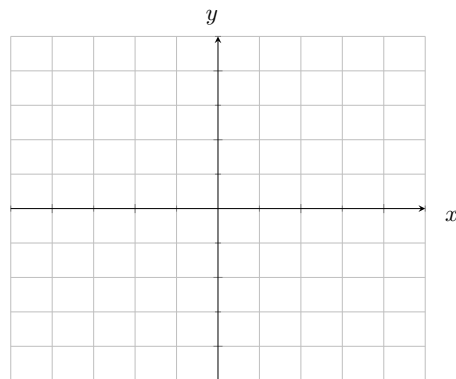
(b) Rewrite as a single logarithm: $4\log(x) - \frac{1}{2}\log(y) + \log(z)$ (4 pts)

4. For parts (a) and (b) sketch the graphs. **Be sure to label any asymptote(s) and intercept(s) for each graph.** (10 pts)

(a) $f(x) = \ln(x - 1)$



(b) $g(x) = -3^x$



(c) For the function from part (b) find the value: $g(3\log_3 2)$

5. Solve the following equations for x . If there are no solutions write “no solutions” (be sure to justify answer for full credit). (8 pts)

(a) $10^{x^2-1} = 10^{7-7x}$

(b) $8 = 2^{-3x-1}$

6. Solve the following equations for x . If there are no solutions write “no solutions” (be sure to justify answer for full credit). (8 pts)

(a) $2x = (x - 5) \ln(3)$

(b) $\log_3(2x - 4) - \log_3(2) = \log_3\left(\frac{7}{2}x + 1\right)$

7. Simplify the expression: $(7^{2x})^3 + 7^{-x}(7^x + 7^{-2x})$ (4 pts)

8. The half-life of cobalt-60 is known to be 5 years. A scientist has a 12 mg (milligram) sample of cobalt-60. (8 pts)

(a) How much of the 12 mg sample of cobalt-60 will remain after 10 years?

(b) Find a function $m(t) = m_0 2^{-t/h}$ that models the mass remaining after t years.

(c) According to the model, how long will it take until 17% of the initial sample remains? As usual, give your answer in exact form (do not attempt to approximate with a rounded value answer).

9. The following are unrelated. (12 pts)

- (a) Determine whether the following two angles are coterminal or not. Make sure to justify your answer to receive

credit: $\frac{34\pi}{3}, \frac{20\pi}{3}$

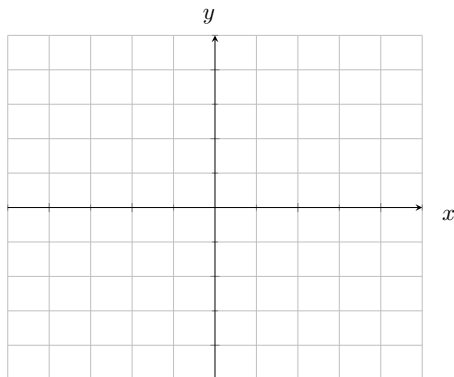
- (b) The point, (x, y) , lies on the unit circle $x^2 + y^2 = 1$ in quadrant IV. If $x = \frac{2}{\sqrt{7}}$ find y .

- (c) For an angle θ in standard position, suppose we know $\cos(\theta) < 0$ and $\sin(\theta) = -\frac{1}{4}$. What quadrant does the terminal side of θ lie?

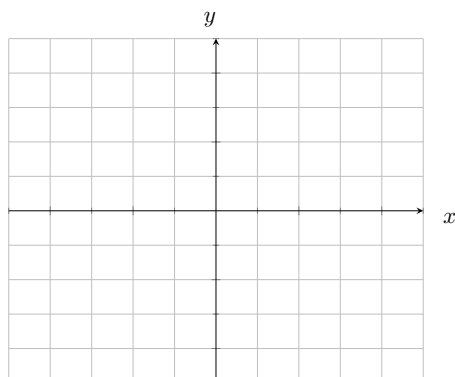
- (d) Simplify: $11 \sin^2\left(\frac{\pi}{9}\right) + 11 \cos^2\left(\frac{\pi}{9}\right)$

10. Sketch each angle in standard position on the unit circle.

(a) $\theta = \frac{5\pi}{3}$ (2 pts)



(b) $\theta = -\frac{3\pi}{4}$ (2 pts)



11. Answer the following for $\tan(\theta) = \frac{2}{7}$ where θ lies in quadrant III.

(a) Sketch a triangle that represents the given information (2 pts).

(b) Find $\cot \theta$ (2 pts)

(c) Find $\sin \theta$ (3 pts)

12. Find the exact value of each of the following. If a value does not exist write DNE. (3 pts each)

(a) $\cos(-150^\circ)$

(b) $\sin\left(\frac{\pi}{2}\right)$

(c) $\tan\left(\frac{\pi}{6}\right)$

(d) $\csc\left(\frac{7\pi}{6}\right)$

(e) $\sec\left(\frac{3\pi}{4}\right)$

13. A company is designing a new corporate graphic and they have decided to take two circular sectors (one with central angle 60° and the other with central angle 90°) from inside a circle that has a radius of 3 inches (image 1 below) and reorient them into the new graphic (image 2 below). Find the area of the graphic in image 2. (4 pts)

Image 1

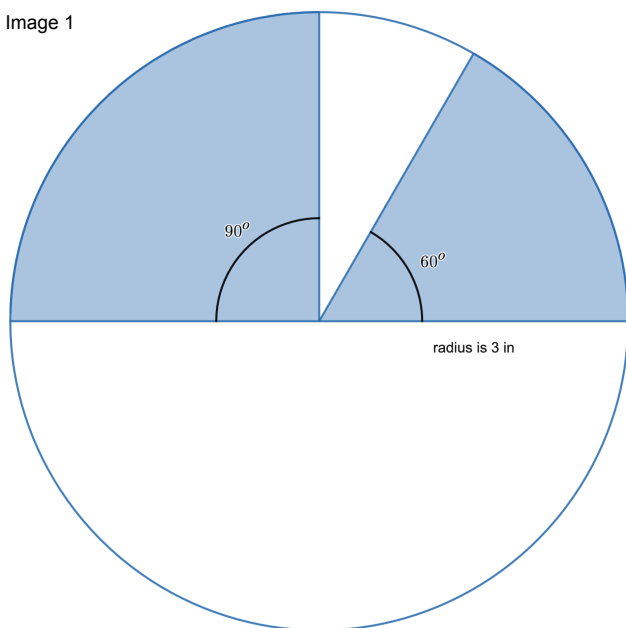
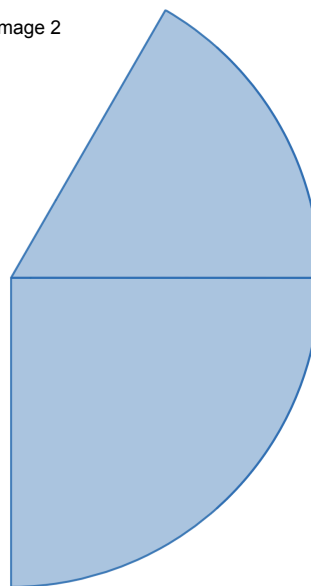


Image 2



14. A 13 ft ladder is leaning against a vertical wall such that a triangle is formed between the ground, ladder, and wall. The angle the ladder makes with the wall is 60° . Find the height of the wall. (4 pts)