INSTRUCTIONS: **Simplify** and **box** all your answers. Write neatly and **show all work**. A correct answer with incorrect or no supporting work may receive no credit. Books, notes, electronic devices (such as calculator or other unauthorized electronic resources) are not permitted. **Give all answers in exact form.**

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.

Name: ____

1. For $R(x) = \dfrac{x^2 - 4}{x^3 + 10x^2 + 16x}$ (9 pts)

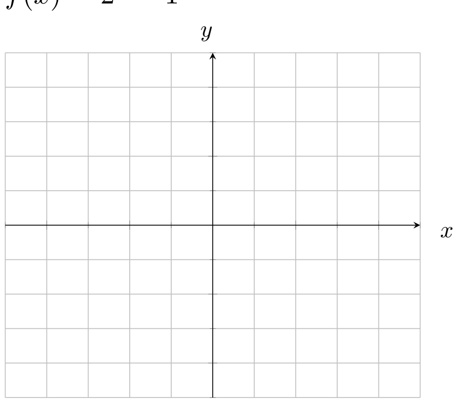
   (a) Find the location (x, y -coordinates) of any hole(s). If there are none state NONE.

   (b) Find any horizontal or slant asymptote(s). If there are none state NONE.

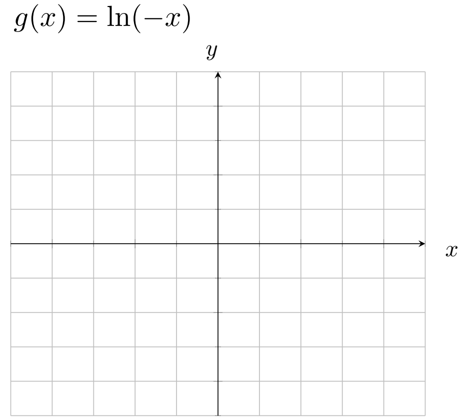
   (c) Find any vertical asymptote(s). If there are none state NONE.

2. Sketch the following graphs: Be sure to label any asymptotes and intercepts for each graph. (8 pts)

   (a) $f(x) = 2^x - 1$



   (b) $g(x) = \ln(-x)$



3. (a) Simplify (rewrite without logs): $\ln(1) - \log_2(16) + \log_8(4) + \log_8(2) + 2^{3\log_2(4)}$ (4 pts)

(b) Rewrite as the sum/difference of logarithms without exponents: $\ln\left(\frac{e^3a^2}{\sqrt{b}}\right)$ (4 pts)

4. Solve the following equations for x. If there are no solutions write "no solutions" (be sure to justify answer for full credit).

   (a) $\log(x+2) = \log(3-2x)$ (4 pts)

   (b) $3^{x^2-1} = 9$ (4 pts)

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

   (a) $\log(2x) = \log\left(\frac{1}{3}x - 2\right) + \log(3)$ (4 pts)

   (b) $\log_2(5)x = x - 1$ (4 pts)

6. Simplify the expression: $\left(e^x - e^{-x}\right)\left(e^x + e^{-x}\right) - (e^x)^2$ (4 pts)

7. The temperature of a cup of coffee in a room is modeled to cool according to the temperature model $T(t) = 110e^{-0.08t} + 75$ where T is the temperature of the coffee in degrees Fahrenheit and t is the time in minutes.

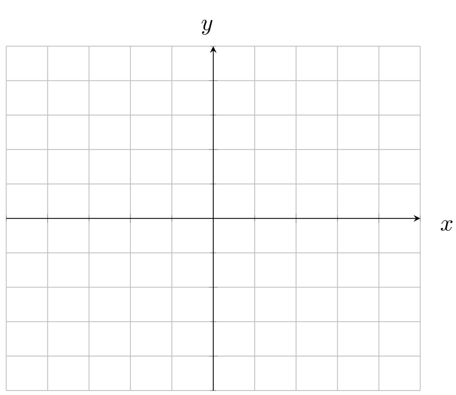
   (a) What is the initial temperature of the coffee? (3 pts)

   (b) What is the temperature of the coffee after 100 minutes (do not attempt to approximate the value with decimals)? (4 pts)

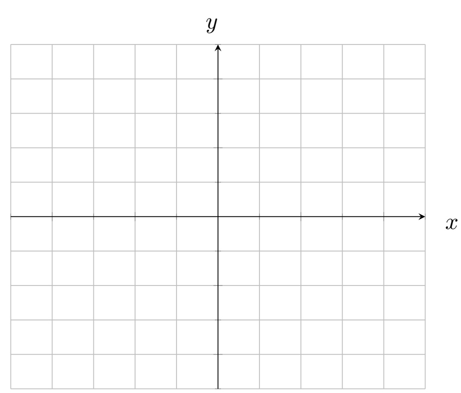
   (c) According to the model, what is the temperature of the room? (2 pts)

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

   (a) $\theta = \dfrac{5\pi}{4}$ (2 pts)



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



9. The following are unrelated.

(a) The point, (x, y), lies on the unit circle $x^2 + y^2 = 1$ in quadrant II. If $y = \dfrac{\sqrt{3}}{5}$ find x. (4 pts)

(b) For an angle θ in standard position, suppose we know $\cos(\theta) < 0$ and $\sin(\theta) < 0$. What quadrant does the terminal side of θ lie? (3 pts)

(c) Find two angles that are co-terminal with $\theta = 160^\circ$. (3 pts)

10. Answer the following for $\sin(\theta) = \dfrac{2}{3}$ where θ lies in the interval $\left[0, \dfrac{\pi}{2}\right]$.

(a) Sketch a triangle that has acute angle θ and use the given information to help find the lengths of all three sides (3 pts).

(b) Find $\tan\theta$ (3 pts)

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

11. Find the exact value of each of the following. If a value does not exist write DNE.

(a) $\cos\left(\frac{3\pi}{4}\right)$ (3 pts)

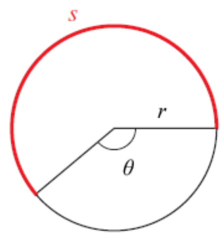
(b) $\sin\left(120^\circ\right)$ (3 pts)

(c) $\tan\left(0\right)$ (3 pts)

(d) $\cot\left(\frac{\pi}{4}\right)$ (3 pts)

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

12. Given that $r = 3$ and $\theta = 140°$. Find the length s of the circular arc as shown in the image. (4 pts)



13. The angle of elevation to the top of a very tall building is found to be $30°$ from the ground at a distance of 0.8 mile from the base of the building. Using this information, find the height of the building (do not attempt to approximate your answer as a decimal). (4 pts)