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:

1. $\log_b(u) = \dfrac{\log_a(u)}{\log_a(b)}$
2. $A = \dfrac{1}{2}r^2\theta$
3. $S = r\theta$

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. Find the slant asymptote for the following rational function: (5 pts)

$$r(x) = \frac{x^3 - 5x^2 + 4x + 3}{x^2 - 3x}$$

2. Answer the following for $R(x) = \dfrac{2x^2 - 4x - 16}{x^2 - 3x - 4}$ (10 pts)

(a) Find the x-coordinate of any hole(s) in the graph of $R(x)$. If there are none write NONE.

(b) Find the y-coordinate of any hole(s) in the graph of $R(x)$. If there are no hole(s) write NONE.

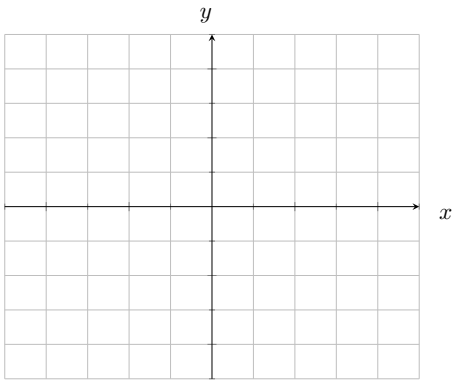
(c) Determine the end behavior of $R(x)$.

(d) Find all vertical asymptote(s) of $R(x)$. If there are none write NONE.

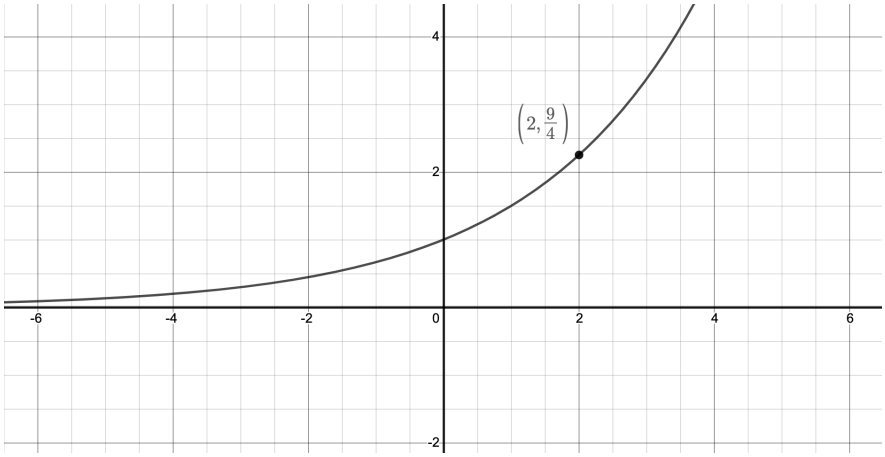
3. The following parts are unrelated:

   (a) Graph the following function. Please label any asymptotes and x, y-intercepts on your axes. (4 pts)

$$f(x) = \ln(x - 2)$$



   (b) Find the function of the form $y = b^x$ whose graph is given. (4 pts)



4. Convert the following to exponential form (4 pts)

   (a) $\log_3(9) = 2$

   (b) $\ln(1) = 0$

5. The following are unrelated: (12 pts)

(a) Evaluate: $\log_3(27)$

(b) Use the properties of logs to simplify the expression: $\log_2(20) - \log_2(10) - \log(1) + e^{\ln t}$.

(c) Express in terms of sums and differences of logarithms without exponents: $\ln\left(\dfrac{e^2}{z^4\sqrt{z}}\right)$

6. Solve the following equations. (10 pts)

(a) $2 = \log(3x + 1)$

(b) $5^{3x+2} = 5^{x-1}$

7. Solve the following equations. (10 pts)

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

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

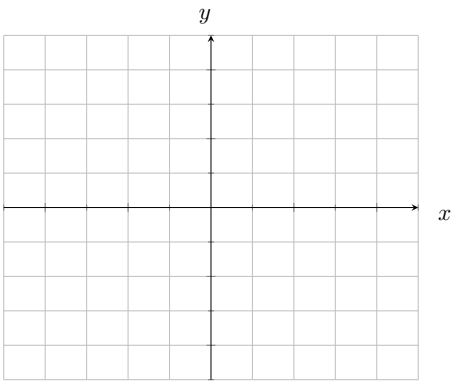
8. A certain type of beetle arrives in Colorado for the first time. The beetle population within the state is expected to double every 8 years. Suppose the initial population is 10 beetles. (6 pts)

   (a) Find an exponential model of the form $N(t) = N_\circ 2^{\frac{t}{a}}$ that models the population of beetles where $N(t)$ is the number of beetles and t is time in years.

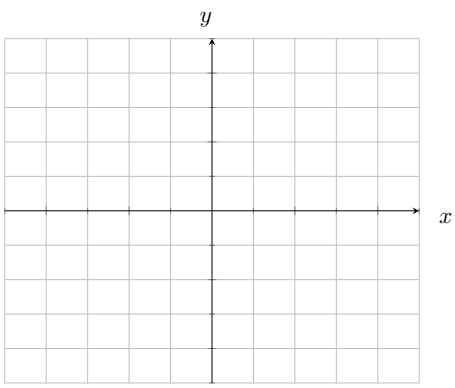
   (b) What will the beetle population be after 16 years? As usual, give your answer in exact form. Do not attempt to approximate with a decimal value.

9. Sketch each angle, θ, in standard position on the x,y-axes. Give a separate graph for each.

(a) $\theta = -\dfrac{7\pi}{6}$ (3 pts)



(b) $\theta = 270^o$ (3 pts)



10. Evaluate the following: (15 pts)

(a) $\sin(0)$

(b) $\tan(-120^o)$

(c) $\sin\left(-\dfrac{5\pi}{4}\right)$

(d) $\cos\left(\dfrac{2\pi}{3}\right)$

(e) $\csc\left(\dfrac{\pi}{3}\right)$

11. A squirrel clings to the trunk of a tree, and she sees a peanut on the flat ground some distance away. A straight line can be drawn between the squirrel and peanut. If the straight-line distance between the peanut and the squirrel is 50 ft, and the angle between that straight line and the tree trunk is $\frac{\pi}{6}$ radians, how far down the tree and across the ground must the squirrel travel to reach the peanut? *Give your answer with appropriate units.* (6 pts)

12. A pizza, whose surface is in the shape of a circle with a radius of 7 inches, is cut into eight equally sized slices such that each slice forms a circular sector. What is the area of the surface of each slice? (4 pts)

EXAM CONTINUED ON BACK

13. Knowing that $\cos^2\theta + \sin^2\theta = 1$ and $\tan^2\theta + 1 = \sec^2\theta$ write $\tan\theta$ in terms of $\sin\theta$ if θ is in Quadrant I (4 pts)