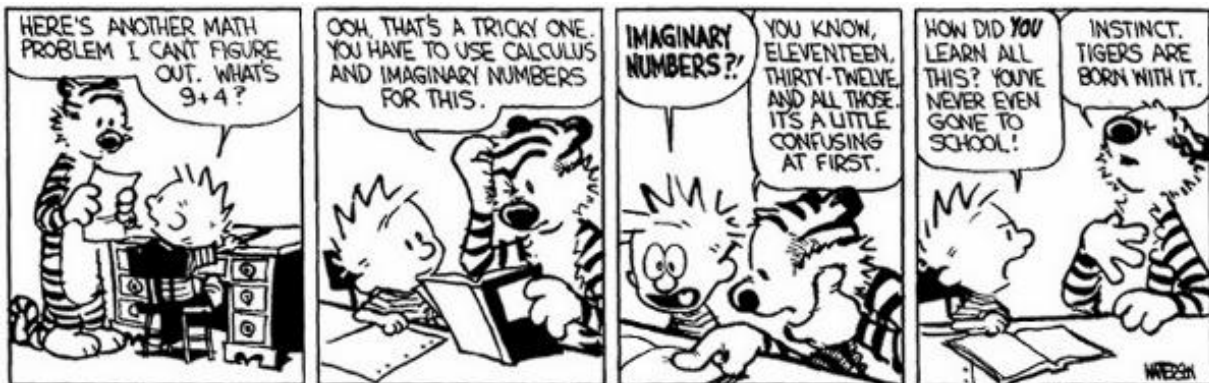


# Math 120 Test 3D

Student Name: \_\_\_\_\_ Student Number: \_\_\_\_\_

## Directions:

- SHOW ALL YOUR WORK OR JUSTIFICATION FOR ANSWERS ON THE TEST. Scrap paper is sometimes hard to read and I want to give you partial credit!
- Simplify all answers.
- Round answers as indicated.
- Include units with final answers.



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1. Use the following two points to answer the questions below:  $(-2,3)$  and  $(1,-1)$

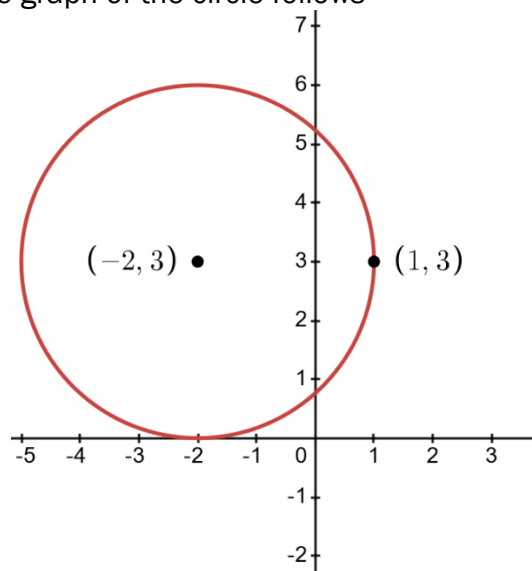
a. Find the distance between the pair of points. (3 points)

a. \_\_\_\_\_

b. Find the midpoint between the two given points. (2 points)

b. \_\_\_\_\_

2. The graph of the circle follows



a. Find the radius of the circle given that  $(-2,3)$  is the center. Show your work for full credit. (2 points)

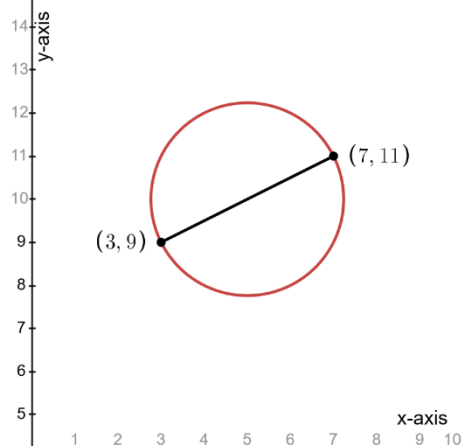
a. \_\_\_\_\_

b. Use the graph and part a to write the equation of the circle in standard form. (3 points)

b. \_\_\_\_\_

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3. The graph of the circle follows



a. Find the coordinates of the circle's center. Show your work for full credit. (2 points)

a. \_\_\_\_\_

b. Find the radius of the circle. Give the exact answer. (2 points)

b. \_\_\_\_\_

c. Use your answers from parts *a* and *b* to write the standard form of the circle's equation. (2 points)

c. \_\_\_\_\_

4. Write the following equation in standard form. Then give the center and radius of the circle. (5 points)

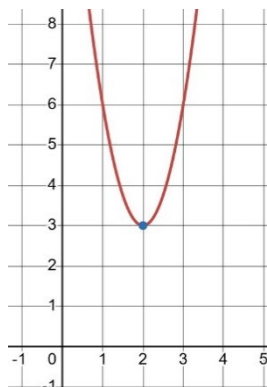
$$x^2 + y^2 - 4x + 8y + 11 = 0$$

Standard Form \_\_\_\_\_

Center \_\_\_\_\_

Radius \_\_\_\_\_

5. Use the following graph.



a. Identify the vertex. (1 point)

\_\_\_\_\_

b. Using your answer from part a, write an equation in *standard form* of the parabola that has the same shape as the graph of  $f(x) = 3x^2$  and has the given vertex above. (3 points)

\_\_\_\_\_

6. The Detroit Lions season has wound down but we are still thinking about how much we love them! Against the lowly Green Bay Packers, quarterback Jared Goff threw a ball deep to Jahmyr Gibbs. The ball's height in feet,  $h(t)$ , after  $t$  seconds is given by  $h(t) = -16t^2 + 64t + 6$ . Include units in all your answers. Round all answers to the nearest tenth if necessary.

a. What is the height of the football when Jared Goff releases it? HINT: Think about what your  $t$  value is at this moment. (2 points)

\_\_\_\_\_

b. When does the football reach it's maximum height? (2 points)

\_\_\_\_\_

c. What is the *maximum* height the football reaches? (2 points)

\_\_\_\_\_

7. A quadratic function is given. (5 points)

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

a. Find the vertex without graphing. Show your work for full credit.

a. \_\_\_\_\_

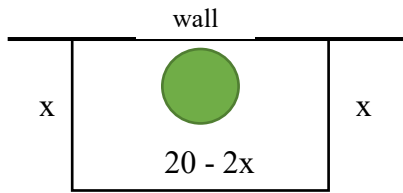
b. Determine whether the vertex is a maximum or minimum. Circle one. MINIMUM OR MAXIMUM

c. Explain in a sentence how you know the answer to part b given only the equation and not looking at the graph.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

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8. It's Christmas time and Eliza has to keep her tree away from her twin toddlers! Below is an overhead picture of her tree pushed up against the wall and the rectangular 3 sides of fencing she is going to use to keep them out! All sides are measured in feet. (5 points)



- a. Find a function  $A(x)$  to express the area of the rectangle as a function of  $x$  the width.

\_\_\_\_\_

- b. Find the width that will maximize the area. Include units.

\_\_\_\_\_

- c. What is the largest area that can be enclosed? Include units.

\_\_\_\_\_

- d. Find the length that will maximize the area. Include units.

\_\_\_\_\_

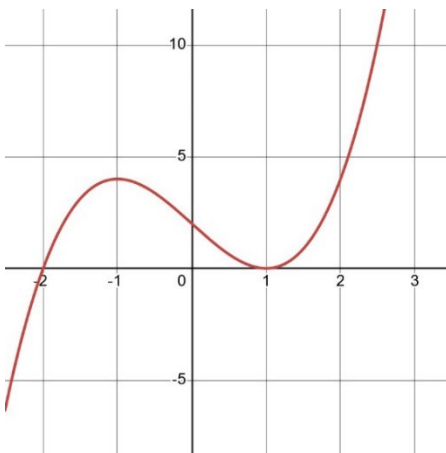
9. For the following function, find the zeros and give the multiplicity of each. CIRCLE whether the graph will cross at the x-axis OR turn and hit. (3 points)

$$f(x) = 7(x+5)^2(x-3)^3$$

Zero \_\_\_\_\_ multiplicity \_\_\_\_\_ CROSS OR TURN

Zero \_\_\_\_\_ multiplicity \_\_\_\_\_ CROSS OR TURN

10. A graph of a polynomial function whose zeros are integers is shown.



- a. Find the zeros and state whether the multiplicity is even or odd. (2 points)

Zero \_\_\_\_\_ multiplicity \_\_\_\_\_

Zero \_\_\_\_\_ multiplicity \_\_\_\_\_

- b. Write an *equation*, expressed as the product of factors, of a polynomial function that might have this graph. Use a leading coefficient of 1 or -1, and make the degree of  $f$  as small as possible. (3 points)

\_\_\_\_\_

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11. Use the quadratic function to answer the following questions.

$$f(x) = 3x^2 + 6x + 5$$

- a. Use the Leading Coefficient Test to determine the graph's end behaviors. Circle one for each end. (2 points)

LEFT: FALL or RISE

RIGHT: FALL or RISE

- b. Find the zeros. Use exact values and simplify. (3 points)

- c. Find the y-intercept. (2 points)

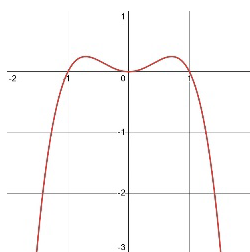
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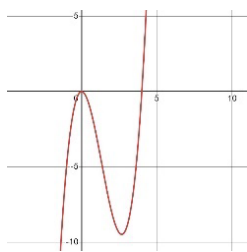
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12. Match the information to the graph. Write in A, B, C, or D in the blanks. (4 points)

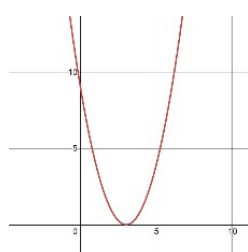
A



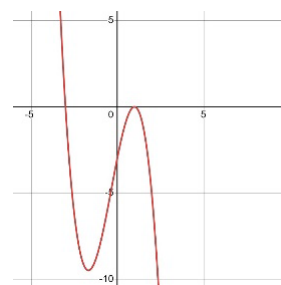
B



C



D



$N$  is odd,  $a < 0$

---

$N$  is odd,  $a > 0$

---

$N$  is even,  $a < 0$

---

$N$  is even,  $a > 0$

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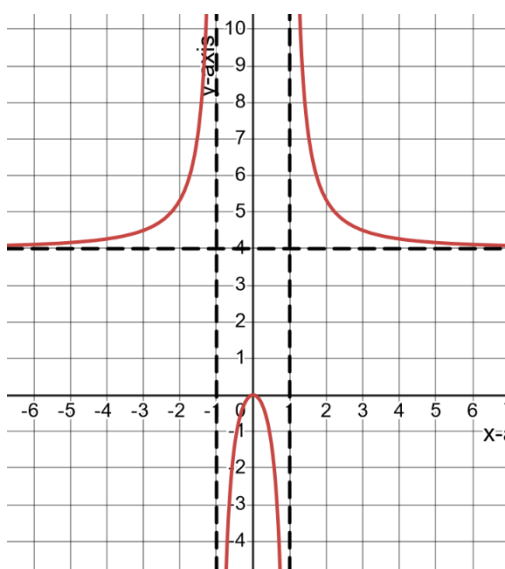
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13. Write the equation of a polynomial function  $f$  with the given characteristics. Use a leading coefficient of either 1 or -1 and make the degree as small as possible. (5 points)

zero at  $x = -4$  with multiplicity 2, zero at  $x = -1$  with multiplicity 1. End-behavior Rise Left, Falls Right

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14. Given the graph below, identify and list any asymptotes. (6 points)

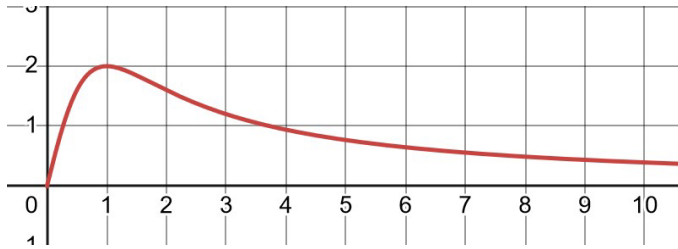


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15. Find the domain of the rational function. Answer in interval or set notation. (4 points)

$$f(x) = \frac{x+9}{x^2-25}$$

16. The Flash (a superhero with super speed) is tracking his speed for short-distance bursts. The amount of additional Speed  $S(t)$ , in meters per second, gained each month  $t$  of specialized speed training can be modeled by  $S(t) = \frac{4t}{t^2 + 1}$   $t \geq 0$ . This model assumes that the rate of speed improvement per month is proportional to the intensity and consistency of the The Flash's training regimen, represented by the numerator  $4t$ . The denominator  $t^2 + 1$  represents potential factors such as biological speed ceilings, training plateaus, or diminishing returns over time as The Flash's body adapts to the stimulus.



- a. Explain why  $t \geq 0$  in both the equation and the graph in the context of the problem. (2 points)

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- b. What is the speed gain The Flash has achieved at 3 months? Round to the nearest tenth and include units. (2 points)

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- c. Find the equation of the horizontal asymptote. In complete sentences, explain its meaning in the context of the problem. (2 points)

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17. The equation of a rational function is given.

$$f(x) = \frac{x+6}{x^2+7x+10}$$

- a. Find the equation of all vertical asymptote(s), if any. (4 points)

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- b. Find the equation of the horizontal asymptote, if any. (1 point)

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18. C varies jointly as A and T.  $C = 2100$  when  $A = 175$  and  $T = 4$ .

- a. Find  $k$  and write the general variation equation showing the relationship between C, A, and T. (2 points)

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- b. Find C when  $A = 240$  and  $T = 6$ . (3 points)

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19. Y varies directly as X and inversely as the square of Z.  $Y = 69$  when  $X = 48$  and  $Z = 4$ . Find Y when  $X = 50$  and  $Z = 5$ . (4 points)

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20. When a stone is tied to a string, and whirled in a circle at constant speed, the tension T in the string varies inversely as the radius R of the circle. If the radius is 55 centimeters, the tension is 80 newtons. Find the tension when the radius is 100 centimeters. (5 points)

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**Formula Sheet: Math 120****Straight Line**

Slope Intercept form

$$y = mx + b$$

Point-slope form

$$y - y_1 = m(x - x_1)$$

Slope

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

**Difference Quotient**

$$\frac{f(x+h) - f(x)}{h}$$

**Quadratic Formula**

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

**Logarithms**

$$\log_b(MN) = \log_b M + \log_b N$$

$$\log_b\left(\frac{M}{N}\right) = \log_b M - \log_b N$$

$$\log_b M^P = P \log_b M$$

$$\text{Distance: } d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

$$\text{Midpoint: } M = \left( \frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2} \right)$$

$$\text{Circle: } (x - h)^2 + (y - k)^2 = r^2$$

**Quadratic Function**

$$f(x) = a(x - h)^2 + k, \text{ Vertex} = (h, k)$$

$$f(x) = ax^2 + bx + c, \text{ Vertex} = \left( -\frac{b}{2a}, f\left(-\frac{b}{2a}\right) \right)$$

$$\text{Compound Interest: } A = P \left( 1 + \frac{r}{n} \right)^{nt}$$

$$\text{Continuous Compound Interest: } A = Pe^{rt}$$

**Arithmetic Sequence**

$$a_n = a_1 + (n - 1)d$$

$$s_n = \frac{n}{2}(a_1 + a_n)$$

**Geometric Sequence**

$$\text{Finite: } a_n = a_1 r^{n-1} \quad s_n = \frac{a_1(1 - r^n)}{1 - r}, r \neq 1$$

$$\text{Infinite: } s = \frac{a_1}{1 - r}, |r| < 1$$

**Even function**

$$f(-x) = f(x)$$

**Odd function**

$$f(-x) = -f(x)$$