Midterm Exam Two

Math 113-001/6 College Algebra

Colorado Mesa University Fall 2022

Name: _____

1. What are the values of x where the graph of $q(x) = x^2 + 4x - 77$ crosses the x-axis?

2. List all the roots of the quadratic function

$$f(x) = -(x-1)^2 + 5.$$

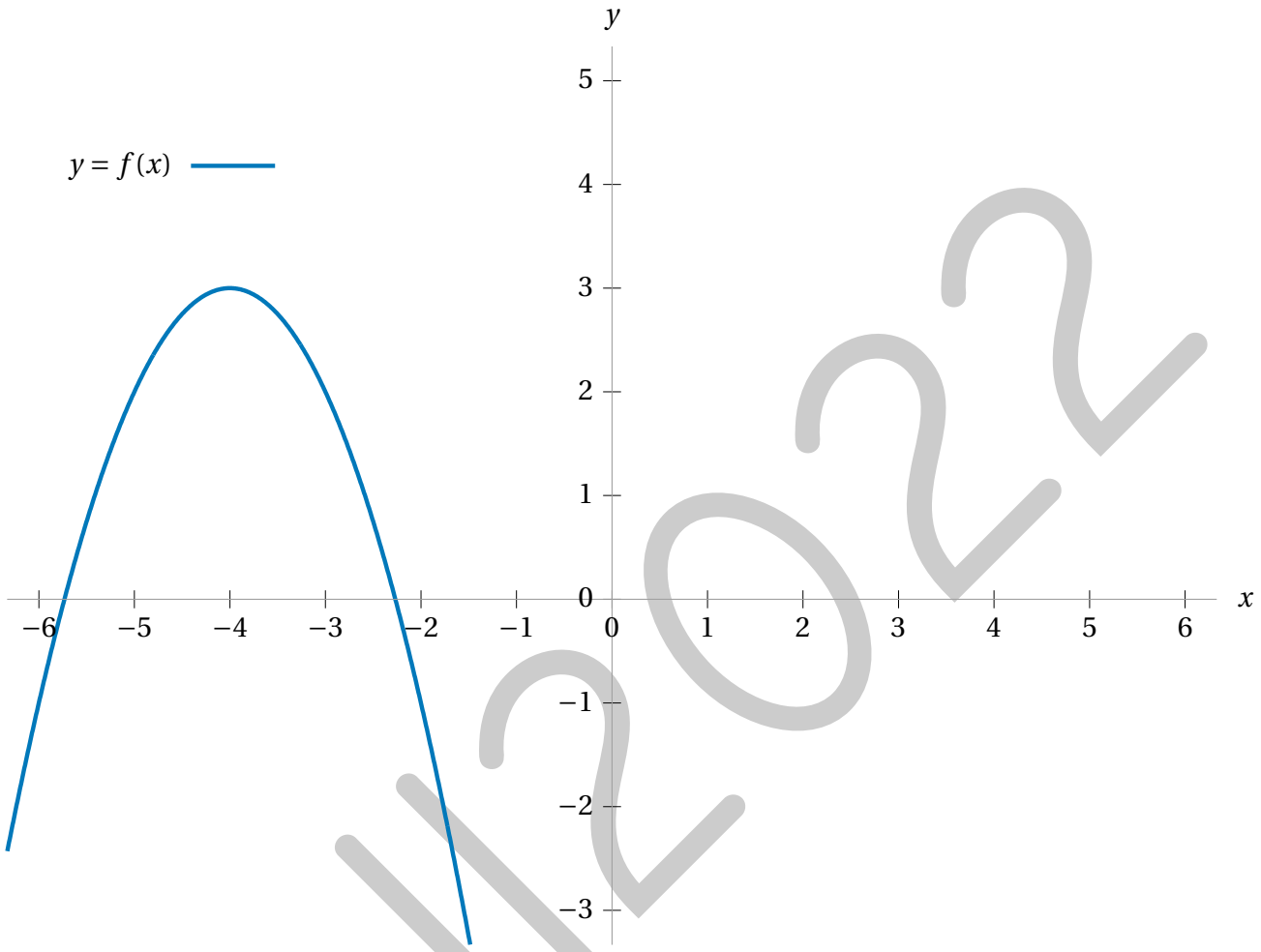
3. What must k be if $3.14 = 9.81k^{2.71}$?

4. The function g defined by the formula

$$g(x) = \frac{11}{7}(x+9)^3$$

is a one-to-one function. Write down a formula for its inverse function g^{-1}.

5. Below is the graph of a function $f(x)$.



(a) What's a formula for the function $f(x)$?

(b) On these same axes sketch the graph of $-6f(x-9)$.

(c) Without using technology, on these same axes sketch the parabola that is the graph of the function $g(x) = \frac{8}{9}\left(x - \frac{3}{2}\right)^2 - 2$. Label the x-intercepts and vertex with their coordinates. Hint: One of the x-intercepts is at $(0,0)$.

6. The function with formula $f(t) = \frac{5}{9}(t - 32)$ takes a temperature t measured in °F and returns that temperature measured in °C. The function with formula $g(t) = t + 273.15$ takes a temperature t measured in °C and returns that temperature measured in Kelvins.

   (a) Write down a formula for the function that take a temperature measured in °F and returns that temperature measured in Kelvins.

   (b) Write down a formula for the function that take a temperature measured in Kelvins and returns that temperature measured in °F.

7. According to Pearson, the average annual wage W in the US measured in *thousands of dollars* can be modelled by the function $W(t) = 2.465t^{1.096}$, where t is the number of years since 2000.

   (a) According to this model, what is the current annual wage in the US?

   (b) What year will the average annual wage in the US be $1 million?

8. The city of Grand Junction charges residents $C(w)$ dollars per month per w thousand gallons of water used according to the following piecewise-defined function[1].

$$C(w) = \begin{cases} 21.34 & \text{for } 0 < w \leq 3 \\ 21.34 + 3.41(w-3) & \text{for } 3 < w \leq 10 \\ 45.21 + 4.11(w-10) & \text{for } 10 < w \leq 20 \\ 86.31 + 4.79(w-20) & \text{for } 20 < w \end{cases}$$

(a) If a Grand Junction resident uses $7{,}000$ gallons of water in October, how much do they owe the city on their water bill?

(b) If a Grand Junction resident uses $21{,}800$ gallons of water in September, how much do they owe the city on their water bill?

(c) If someone receives a water bill for $\$120$ how many gallons of water must they have used?

[1] gjcity.org/314/Utility-Rates

9. A projection for the population of earth according to the UN[2] is given in the table below:

year	1995	2000	2025	2050	2075	2100	2125	2150
population (in millions)	5666	6028	7275	7343	6402	5153	4074	3236

(a) Using your TI graphing calculator, perform quadratic regression to find a formula $P(t)$ for the quadratic function that best models this data as a function of t years after 2000. (The value of t corresponding to 1995 will be -5.) Write the formula for your model below with coefficients rounded to two decimal places. If you do not have a calculator capable of data regression, write "NO CALC" below and use the model $P(t) = -\frac{1}{3}t^2 + 30t + 6000$ for the rest of this page.

(b) According to your model, how many people will be on earth in the year 2060?

(c) According to your model, what year will the earth's population hit it's peak (maximum)?

(d) According to the US Census Bureau[3], the current world population is about 7,924,512,000. What is the difference between the population predicted by your model and this figure?

(e) How would the formula for your model $P(t)$ have to change if instead of letting t be the number of years since 2000, you let t be the literal year? Hint: Think about *transformations* of functions.

[2] according to Pearson

[3] census.gov/popclock/world