Math113 College Algebra

Second Midterm Exam

Colorado Mesa University · 2026 Spring

NAME: _____

1. Consider the function f defined by the formula $f(x) = (x+1)^2 - 64$.

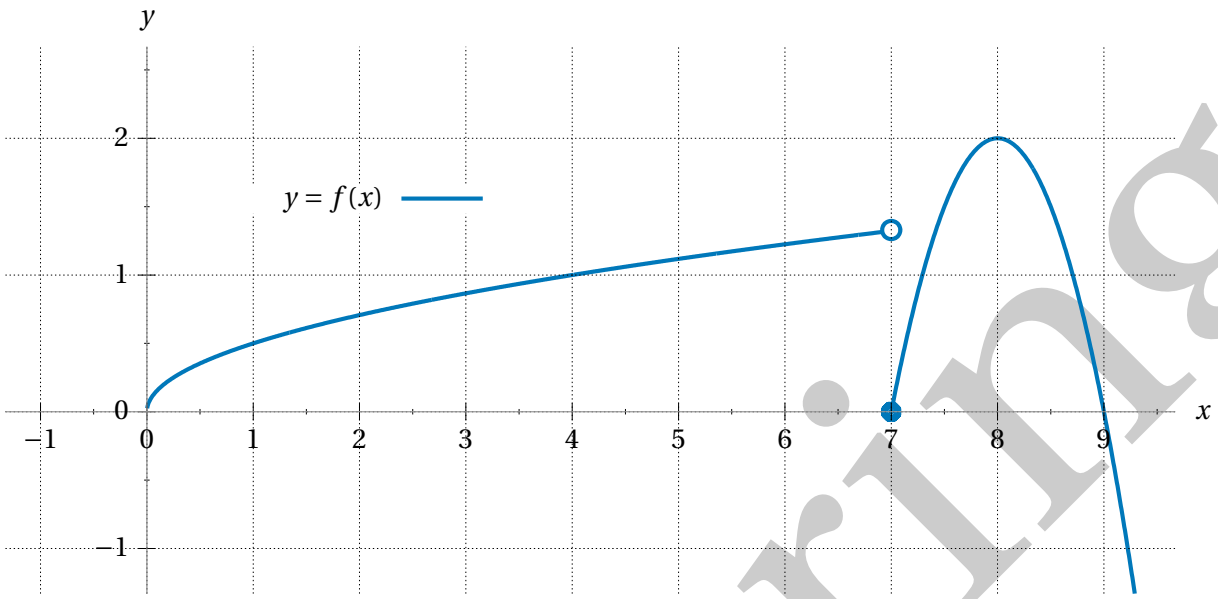
   (a) What is the y-coordinate of the y-intercept of the graph of f?

   (b) What is the y-coordinate of the vertex of the graph of f?

   (c) What is the smallest (minimum) possible output value of f?

   (d) On what interval(s) of its domain is $f(x)$ increasing?

   (e) On what interval(s) of its domain is $f(x)$ negative?



2. Above is the graph of a piecewise-defined function f. One component of the function is quadratic, and the other is a power function. Write down a piecewise-defined formula for $f(x)$.

3. Heaps' law is an empirical observation that the number of *unique* words V in a collection of documents is directly proportional to some power of the total number of words n in those documents. For example, in the case of Jane Austen's body of work we find that $V \approx 121.3n^{0.341}$. Suppose we were to find a manuscript that we suspect is a long lost Jane Austen novel. If it contains 5887 *unique* words, about how may total words should it have?

4. Suppose you are on a space station orbiting the planet Mercury. Bored, you are playing with a small rock. You toss the rock straight up into the air. The altitude (height) of the rock above you, in feet, measured x seconds after you throw it can be modelled by the function $A(x) = 4.8 + 48x - 6x^2$.

   (a) Demonstrate how to calculate the time x at which the rock reaches its highest altitude (apex).

   (b) Demonstrate how to calculate the rock's highest altitude.

   (c) Supposing you don't catch the rock on its way down, demonstrate how to calculate the time x at which the rock hits the ground.

5. Here is data for the population of Hawaii for select decades.

Year	2020	2010	2000	1990	1980	1970	1960	1950	1940
Population (in millions)	1.45	1.36	1.21	1.11	0.96	0.77	0.63	0.50	0.42

From https://worldpopulationreview.com/states/hawaii.

(a) Perform regression to determine the *quadratic* function and the *power* function that best model this data, where the independent variable is measured in "years since 1900." Write down the formulas for your models with parameters rounded to two non-zero decimal digits.

(b) The *quadratic* model indicates Hawaii's population is increasing, but how is the rate of increasing changing? Is it increasing or decreasing? I.e. Is the population's growth accelerating or decelerating? What parameter in the model's formula indicates this?

(c) The *power* model indicates Hawaii's population is increasing, but how is the rate of increasing changing? Is it increasing or decreasing? I.e. Is the population's growth accelerating or decelerating? What parameter in the model's formula indicates this?

(d) (EXTRAPOLATE) Assuming the *power* model remains accurate beyond the domain of the data, what does it predict the current population of Hawaii to be?

(e) (EXTRAPOLATE) Assuming the *power* model remains accurate beyond the domain of the data, what month of what year will the population of Hawaii first exceed two million people? Demonstrate how to manually calculate this from the formula for the power model.