Outcome: 1. Solve systems of linear equations.

- Solve the following system of linear equations by graphing:
  $$\begin{cases} y = -2x - 3 \\ 3x - 2y = -4 \end{cases}$$

- Solve the following system of linear equations using substitution or elimination:
  $$\begin{cases} x + 2y = 9 \\ 3x - 4y = -13 \end{cases}$$

- I'm 12 years older than a first-gen iPod. In ten years, the sum of our ages will be 64. How old am I?

- Jack runs a food cart that sells hamburgers and hot dogs. He sells hamburgers for $5 each and hot dogs for $3 each. His total revenue for the day was $245 and he sold 15 more hot dogs than hamburgers. How many of each did he sell?

- Your dog must eat 4 cups of dog food per day. Dry dog food has 4 grams of protein per cup. Canned dog food has 8 grams of protein per cup. If your dog needs to consume 26 grams of protein per day, how many cups of canned food and how many cups of dry food should you feed your dog per day?

- Company A starts with 20 employees, and hires 4 per year. Company B starts with 15 employees and has 24 after two years.
  - Assuming company B is growing linearly, construct linear models for the number of employees at both companies.
  - When will company will B have more employees? Use your models from the previous part to determine the answer.

These problems also fall under Outcome 2.

Outcome: 2. Write equations of lines and create linear models.

- Write the equation for a line through (2,7) and (−2,9). Your answer should be in slope-intercept form.

- Write an equation for the line graphed below. (Include graph)

A final exam should include one like this…

- A copier was worth $30,000 in 2010 and $21,000 in 2013.
  - Find the average rate of change of the copier's value.
  - Let V be the copier's value t years after 2010. Write a linear model relating V and t.

- Let T be the average temperature (in $°C$) of the Earth d kilometers below the surface. The relationship between T and d is given by $T = 25d + 20$. (**You could also show the graph instead of giving an equation**)
  - What is the vertical intercept of this line? What does it mean in the context of the situation?
  - What is the slope of the line? What does it mean in the context of the situation? What are the units of the slope?

- If you start with $20 in a piggy bank and add $3 every week, how long will it be until you have $120?

- A scientist estimates that the population of carp in a local lake was 80 in 2010 and is 240 in 2016. Let P represent the population of carp t years after 2010.
  - Write an equation relating P and t assuming that the growth was linear.
  - Write an equation relating P and t assuming that the growth was exponential.

and one like this.

This part falls under outcome 6

Outcome: 3. Solve linear equations and inequalities in one variable. Use linear equations to solve application problems.

- Solve the following equations for the unknown variable:
  - $\frac{1}{3}(x+6)+5=x-1$
  - $\frac{3}{4}x-\frac{2}{3}=\frac{1}{12}x+\frac{5}{4}$ (**This is on the difficult end of problems to ask.**)

- A water tank is holding 3000 gallons of water. A valve is opened, and water flows out at a constant rate of 6 gallons per second. Let V represent the volume of water in the tank t seconds after the valve is opened.
  - Write an equation modeling the relationship between V and t.
  - Find the t-intercept of the equation from the previous part. Explain what it means in the context of the situation.

- A commodity has its demand function modeled by $p=-0.01q+5$ and its supply function modeled by $p=0.04q+1$, where p is the unit price and q is the quantity sold.
  - Find the market equilibrium. That is, find the value of p and q so that supply equals demand.
  - When does this model break down?

Supply and demand are not part of core Math 098 material, so expect to spend class time on this if you want to ask something like it.

- Put the linear equation $2(x+y)-4=x$ into slope-intercept form.

Outcome: 4. Graph Functions, particularly linear and exponential functions.

- Graph the following lines and label their intersection:
  - $3x - 2y = 8$
  - $y = 3x - 5$

Related to outcome 1

- Graph $y = 2^x$, Clearly label at least two points on your graph.

- Consider the equation $y = 3 \cdot 16^x$. Fill out the following table and use it to draw the graph.
  (Include table with $x = 1$, $x = \frac{1}{2}$, $x = \frac{1}{4}$, etc.)

This level of computation needs to be *somewhere* on the exam, if not here. See outcomes 6 and 7.

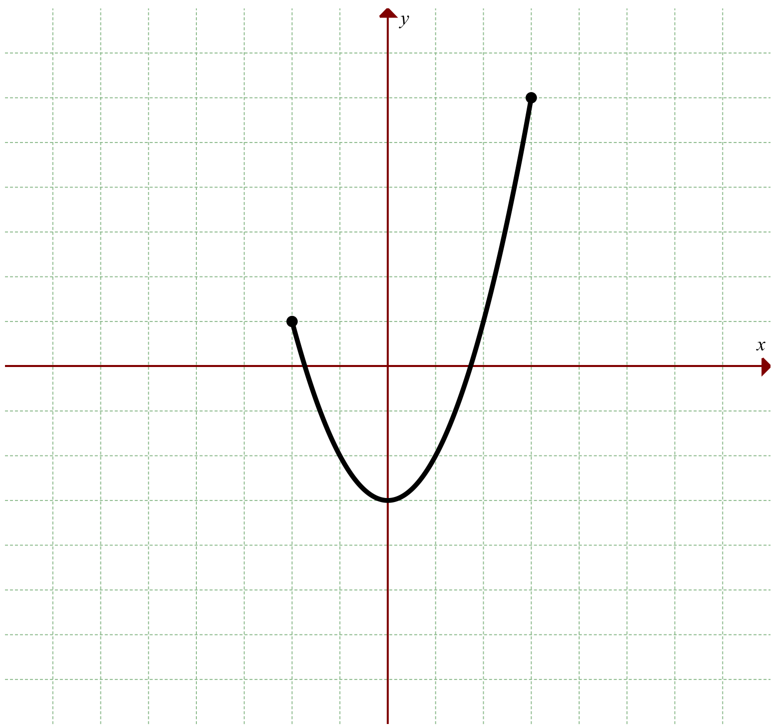
- Three years ago, there were 18 dahlia bulbs in my garden. Currently, there are 36.
  - Assuming the growth was linear, write a model for the number of dahlia bulbs as a function of time. Graph your model.
  - Assuming the growth was exponential, write a model for the number of dahlia bulbs as a function of time. Graph your model.

Outcome: 5. Use function notation correctly. Determine the domain and range of a function. Be able to read graphs with function notation.

- Let $f(x) = 2(x - 1) + 4$
  - Evaluate $f(8)$.
  - Solve $f(x) = 10$

- Let $g(x)$ be the function graphed below.
  - What is the domain of $g(x)$?
  - What is the range of $g(x)$?
  - Evaluate $g(2)$.
  - Find all solutions to $g(x) = -2$.

Students can use inequalities or interval notation to express domain and range.



Outcome: 6. Evaluate exponential and logarithmic expressions. Solve basic exponential and logarithmic equations

Be sure the students can differentiate between using square roots and exponent properties. Compare with outcome 7.

- Solve $2^x = 64$ for x.

- Evaluate the following logarithms:
  - $\log_5(25)$
  - $\log_8(2)$
  - $\log_3\left(\frac{1}{9}\right)$

- Solve the following equations for x:
  - $4 \cdot \log_3(x) = 12$
  - $\log_3(x) = 2$
  - $\log_{\frac{1}{9}}(3) = x$

- (**Nicer Version**) Find the equation for an exponential function whose graph passes through $(0, 2)$ and $(2, 18)$.

- (**Uglier Version**) Find the equation for an exponential function whose graph passes through $(2, 20)$ and $(5, 160)$.

Outcome: 7. Evaluate square roots, cube roots, and simple rational powers of real numbers. Use rational exponents correctly.

- Solve the following for x:
  - $x^2 = 64$
  - $4^x = 2$
  - $x^4 = 81$

- Evaluate the following:
  - $(125)^{1/3}$
  - $(27)^{4/3}$