1. League of Legends is a multiplayer online video game. One aspect of the game involves battling other players. A player's *Effective Health* when defending against physical damage is given by

$$E = h + \frac{ha}{100},$$

where h is an indicator of the player's *Health* and a is an indicator of the player's *Armor*. Assume both a and h are continuous variables. Players can purchase more Health and Armor with gold coins. Health costs 2.5 coins per unit and Armor costs 18 coins per unit. Assume a player has 2662 gold coins. What is the maximum Effective Health the player can achieve?

   (a) Assume the player will spend all of their coins. Write the equation for the player's Effective Health in terms of Health h. Do NOT round any decimals!

   (b) What is the domain of this function?

(c) Maximize this function. Do NOT round any decimals!

(d) How do you know your value for (c) is the absolute maximum (not a relative maximum or a absolute/relative minimum)?

2. Now let's change the situation. We still have that a player's *Effective Health* when defending against physical damage is given by

$$E = h + \frac{ha}{100}.$$

Health still costs 2.5 coins per unit and Armor still costs 18 coins per unit. Assume a player still has 2662 gold coins. **However, now players cannot buy partial units of health or armor.**

(a) Is the this maximum Effective Health you found in problem 1 achievable now? Explain.

(b) What is the domain of E (in terms of h) in this new situation?

> **Note:** The variable h is an example of a *discrete variable*, a variable whose number of permitted values is finite (or countably infinite), and the function E is called a *discrete function*.

(c) What is the maximum Effective Health this player can achieve? (Hint: consider the graph of E.)

(d) Justify your answer to part (c) is the absolute maximum.

Cunningham, Chris. Optimization Problems That Today's Students Might Actually Encounter? Mathematics Educators Stack Exchange, matheducators.stackexchange.com/questions/1550/optimization-problems-that-todays-students-might-actually-encounter/1561.

3. A company is producing three types of food in closed cylindrical cans with the dimensions given in the table below. Fill in the blanks in the table.

Type	Radius (in)	Height (in)	Volume (in^3)	Surface Area (in^2)
Chicken Noodle Soup 	1.37	3.68		43.47
Condensed Milk 	1.50	3.07	21.70	
Almonds 	1.63	2.60	21.70	43.32

The company wants to redesign their cans to minimize the amount of aluminum needed. The cans will still need to hold 12 oz each. Use that 12 oz is approximately 21.7 in^3.

(a) Write the equation for the surface area A of a can in terms of the radius r.

(b) What is the domain of this function?

(c) Minimize this function. Justify your answer.

(d) What does your answer to part (c) mean in the context of the problem?

(e) What are the dimensions of the can the company should make?

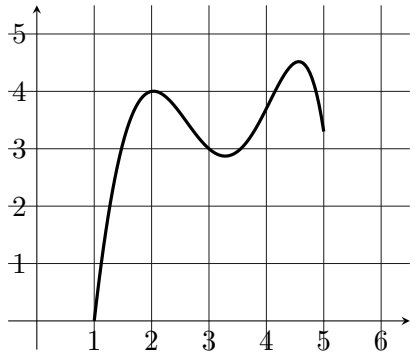
Names: _____ _____

_____ _____

Exit Ticket

1. Give a real-world example of a discrete function. What is the domain of the function?

2. A student would like to maximize a discrete function f that is only defined on $x = 1, 2, 3, 4, 5$. They found that f can be modeled by a continuous function g. That is, $f(a) = g(a)$ when $a = 1, 2, 3, 4, 5$. Below is the graph of g.



   If the student wants to find the absolute maximum value of f, is it enough to find the absolute maximum value of g? Explain.

3. Describe how one could find the absolute maximum of a discrete function f that is modeled by a continuous function g.