



# Case Interview Playbook



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For each problem, identify what type of problem is being posed, solve the original question asked, and complete any follow-on questions.

## Set 1

### Question 1:

You own a business selling high-end shoes. Last month, your company produced and sold 300 pairs of shoes. It costs \$45 to produce a pair of shoes, which you sell for \$65. Additionally, you are renting your production equipment and pay for advertising on social media. Your equipment rental cost is \$2,500/month, and the cost to advertise on social media is \$1,000/month.

**Question:** *What is your total monthly profit?* **Follow-Up:** *What are some ways you might improve your monthly profit*

### Question 2:

You are corresponding with a colleague who would like you to convert the following values and given units to the corresponding desired units. **Question:** *What are the correct new values, given these relationships:*

Question	Value	Given Unit	Desired Unit
1	538	miles	kilometers
2	29.5	hours	weeks
3	43	pounds per inch	pounds per millimeter

- 1 mile = 1.609 kilometers
- 63,360 inches = 1 mile
- 1,000,000 millimeters = 1 kilometer
- Type of problem: Unit Conversion

### Question 3:

You own a burrito food truck and are considering selling at two different locations. Selling outside the library, you profit \$2.80 per burrito sold, and typically sell 450 burritos in a day. Selling outside the shopping district, you only sell 400 burritos a day, but you believe you may be able to increase your prices at this location without decreasing the number of burritos sold.

**Question:** *At what profit per burrito does selling outside the shopping district become more profitable?* **Follow-Up:** *Initial testing shows that we are able to sell 400 burritos at a profit of \$3.20 per burrito outside the shopping district. What location should we choose? The cost for you to produce a burrito is \$2.85. If local laws are changed to cap the maximum price of burritos at \$5.85, how will this impact our optimal truck location, assuming a change in price will not impact the total quantities of burritos sold?*

**Question 4:**

You are a traveling car salesman, and have just been assigned a new position in a country you have never heard of. You are selling a new speed racer, with a top speed of 195 miles per hour. On your first day, some of your onboarding materials tell you that the country's preferred unit of measure for distance is not a mile, but a "furlong". Your materials tell you that a furlong is equivalent to 1/8th of a mile. When you begin work, your first customer asks you, "What is the car's top speed, in **furlongs per minute**?" **Question: What is the correct response?**

**Follow-Up: The customer tells you they are seeking a that can travel up to 24 furlongs/minute. Should you recommend the new speed racer?**

**Question 5:**

You own a small, lightbulb manufacturing company. Currently, you own a single warehouse where you produce all of your lightbulbs. You pay \$750 in monthly rent for your warehouse, and \$200 in monthly upkeep costs for your production equipment. The cost to produce a lightbulb is \$2.75, and you sell them to consumers for \$3.50 each. You typically sell 2,000 light bulbs per month.

You have just been approached by a company that produces lamps, seeking a partnership deal with your company. They believe your light bulbs are the best fit for their most popular lamps, and want to list you as their official recommended lightbulb on all packaging and advertising. In exchange, they would like to receive 4% of all revenues from your light bulb sales. They believe this deal will increase the number of sales for your light bulbs by 55%. **Question: If their estimates hold true, would the terms of this partnership yield greater monthly profits for your company?** **Follow-Up: Our investors are curious how this deal will impact our expected monthly profits. What % change in profit will this deal yield for us?**

**Question 6:**

You are the owner of a medium sized farm in California growing grapes, almonds, and strawberries in varying quantities. You know from your record keeping that you typically earn the following profits per acre of each crop sold:

	Almond	Grapes	Strawberries
Profit per Acre	\$400	\$320	\$275

You also know that last year, you grew almonds on 55% of your available acres, grapes on 30% of your available acres, and strawberries on 15% of your available acres.

You have been happy with your past production, but a neighbor has just approached you suggesting you try selling walnuts, which he has found are very hardy and profitable.

You are considering using 20% of your land to grow walnuts, but to do so you would have to give up 10% of the almond acreage, 5% of the grape acreage, 5% of the strawberry acreage.

**Question: What would be the minimum profit per acre of walnuts grown that would make this new proposed land allocation a profitable decision for your farm? Follow-Up: You have asked your neighbor for more details about his walnut profits, and he has suggested his per acre profit of walnuts is similar to that of strawberries. Based on this, would you recommend proceeding with your plan to grow and sell walnuts?**

For each problem, identify what type of problem is being posed, solve the original question asked, and complete any follow-on questions.

## Set 2

### Question 1:

You recently developed a sneaker brand that has gained a bit of traction, but are looking to expand further. Your plan is to begin advertising in a weekly email newsletter for the next 12 weeks. You have done some market research and estimate that for every 2000 people who see your ad, one person will purchase a pair of sneakers, even if they've seen the ad before. Each purchase results in \$25 of profit for your company. You have found two newsletter options that have a reader base similar to your target population, but only want to advertise in one of them for now. Here is what you know about the two options:

Newsletter A:

Subscribers: 60,000

Open Rate: 38%

Cost of Ad Per Newsletter: \$150

Newsletter B:

Subscribers: 125,000

Open Rate: 20%

Cost of Ad Per Newsletter: \$200

***Which newsletter will result in the most profit for your shoe company? Follow up: What would the open rate need to be for the second newsletter to be more profitable than the first? If the number of subscribers increased by 1000 each week for newsletter B, at what point would it become more profitable to advertise in that newsletter?***

### Question 2:

You own a ski rental shop. You average 15 rentals/day. It costs customers \$40/day to rent a pair of skis from you. The maintenance cost to keep the equipment in good shape costs you \$12 per rental day. You pay \$1200 in monthly rent and utilities for your store.

The ski mountains are open from November-April, and you usually close for the off-season. However, you are considering renting mountain bikes during the warmer months. You visited a few bike shops in the area, and learned that bikes typically rent for \$55/day in the area, and the maintenance cost averages \$13/day. For the purpose of this problem, let's ignore the cost to acquire a fleet of bikes.

***How many bikes do you need to rent per month to be as profitable as the winter ski months? Follow up: Do you think 10 bikes/day is reasonable? Why or why not? You found out that you can reduce maintenance costs by \$2 per day. Given this, how many bikes do you need to rent now to breakeven with your winter profit?***

### Question 3:

You are planning on making some homemade ice cream for a friend's birthday tomorrow. She gave you her favorite recipe, but it's in metric units. You only have measuring devices with

imperial measurements. So, before you begin, you decide to convert all the units to your measuring devices first. ***What are the correct new values, given these relationships:***

Here are the ingredients you will need to convert:

	Ingredients	Amount	Unit	Desired Unit
1	Heavy Cream	500	mL	ounces
2	Sugar	114	grams	cups
3	Oreo Crumbs	228	grams	cups
4	Vanilla Extract	10	mL	teaspoons

Key:

1 gram = 1 mL

1 mL = 0.03527 ounces

1 tablespoon = 15 grams

1 tablespoon = 3 teaspoons

1 cup = 8 ounces

#### Question 4:

You are thinking about buying a car, and are considering purchasing an electric vehicle (EV). You are curious about how much you would save in fuel costs over time, and decide to do some research. You have narrowed down your search to either a gas-powered car that averages 25 miles per gallon, or an EV that can travel up to 200 miles on one charge, which requires 46 kwh of electricity. You also know you travel an average of 30 miles per day on weekdays, and 15 miles per weekend days. You expect gas and electricity prices to remain consistent for the time being:

Gasoline: \$2.65/ gallon

Electricity: \$0.13/ kwh

***How much money do you expect to save in gasoline costs each week if you end up purchasing the electric car?***

#### Question 5:

Per your calculations in the previous question, you know that you can save \$13.70 per week fuel costs if you buy an electric car. But, you are still unsure if this will make financial sense, so you would like to dive a bit deeper.

You know that the gasoline car costs you \$22,000 and the electric car costs \$38,000. You also know that electric cars require much less maintenance than combustion engine cars, so you expect to save \$500/ year in maintenance costs.

***If you decide to purchase the electric vehicle, at what point in the future will you start to recover the higher cost of the electric car? Follow up: You just found out that you can expect a \$750 tax credit each year that you own your EV. Given that, how long would it take to start to recover the cost of the EV?***

#### **Question 6:**

You recently moved to Michigan and would like to build an ice skating rink in your backyard. You have a flat space that is 10m in length and 12m in width. You plan to use the whole area. You are planning to build a sturdy wall around the rink, and want to conserve as much water as possible. You plan to only have the ice go 5 cm deep, and know that water expands when it's frozen. You know that 1 cubic meter = 264.172 gallons of water. You also know that water expands approximately 9.3% when frozen.

***What is the least amount of water, in gallons, required to fill your rink with 5 cm of ice? Follow up: You decide you want to make your ice rink a little bit smaller after all. If you decide to reduce the width by 25%, how much less water will you need to fill the rink?***

# Set 1 Answers

## Question 1 - Profit

**Solution:** To solve this problem, we must find the monthly profit of our business today. Profit = total revenues - total costs. Our only revenues come from shoe sales, where we sell 300 pairs of shoes per month at a price of \$65. Multiplying these values, we calculate our monthly revenue as  $300 * \$65 = \$19,500$ .

To calculate our costs, we must sum our fixed and variable costs. We have some fixed costs to rent the production equipment and advertise on social media. The combined cost of these is  $823423\$2,500 + \$1,000 = \$3,500/\text{month}$ . Additionally, each pair of shoes we produce costs us \$45 to make. Multiplying this cost by the 300 monthly pairs made, we calculate our variable cost as  $300 * \$45 = \$13,500/\text{month}$ . Our total costs are  $\$3,500 + \$13,500 = \$17,000$ .

Our total profit is then calculated as total revenue - total costs;  $\$19,500 - \$17,000 = \$2,500$  in monthly profit.

**Follow up Solution:** There are many ways you could improve your monthly profit, including:

- Negotiating better deals with the production equipment rental company and social media advertisers to lower your fixed costs
- Moving your store-front to a location with greater customer accessibility to increase sales
- Optimizing your advertising strategy to reach more relevant audiences and increase sales
- Reducing the cost to produce shoes to reduce variable costs
- Increasing the price charged for shoes to increase revenue, so long as it outweighs any potential loss of demand

## Question 2 - Unit Conversion

1. To convert from miles to kilometers, we multiply the value by 1.609 (from our given relationships):  $538 \text{ miles} * 1.609 \text{ kilometers/mile} = 865.6 \text{ kilometers}$
2. To convert from hours to weeks, we take this in two steps. We first convert hours to days, and then days to weeks.  $29.5 \text{ hours} / 24 \text{ (as we know there are 24 hours in a day)} = 1.23 \text{ days}$ .  $1.23 \text{ days} / 7 \text{ (as we know there are 7 days in a week)} = 0.176 \text{ weeks}$
3. To convert pounds per inch to pounds per millimeter, we must convert the denominator through a series of steps. We can convert the denominator unit from inches to miles, then from miles to kilometers, and then from kilometers to millimeters using the values given.  $43 \text{ pounds per inch} * 63,360 \text{ (there are 63,360 inches in a mile)} = 2,724,480 \text{ pounds per mile}$ .  $2,724,480 / 1.609 \text{ (there are 1.609 kilometers in a mile)} = 1,693,275 \text{ pounds per kilometer}$ .  $1,693,275 / 1,000,000 \text{ (there are 1,000,000 mm in a km)} = 1.69 \text{ pounds per millimeter}$

## Question 3 - Profit/break-even



To answer the question, we must find the break-even point where the profit from selling at the library equals the profit from selling at the shopping district. To do this, we can set up an equation as follows:

$$\text{profit when selling at library} = \text{profit when selling at shopping district}$$

The total profit for each scenario can be calculated as number of sales \* total profit per burrito sold. We have both of these pieces of information for selling at the library, but we don't know the profit per burrito sold at the shopping district which will satisfy our equation. We can use a variable  $x$  to represent this figure, and solve the equation:

$$\text{Profit when selling at library} = \text{profit when selling at shopping district}$$

$$\text{Number of sales at library} * \text{per burrito profit at library} = \text{Number of sales at shopping district} * \text{per burrito profit at shopping district}$$

$$450 * \$2.80 = 400 * x$$

$$1,260 = 400 * x$$

$$1,260 / 400 = x$$

$$3.15 = x$$

Selling at the shopping district becomes more profitable if we are able to achieve  $> \$3.15$  in profit per burrito sold.

**Follow up 1:** We have calculated that the shopping district is the more profitable location if we are able to sell 400 burritos at a per burrito profit greater than  $\$3.15$ . Because our testing indicates we will be able to sell 400 burritos at a per burrito profit of  $\$3.20$ , which is greater than  $\$3.15$ , we should choose the shopping district as our location.

**Follow up 2:** With a new maximum price of  $\$5.85$  per burrito, and a cost of  $\$2.85$  per burrito, our maximum achievable profit per burrito is  $\$5.85 - \$2.85 = \$3.00$ . This per burrito profit is less than  $\$3.15$ , the calculated profit per burrito required for selling at the shopping district to be the more profitable choice. Because of this, we should now choose to sell outside the library to maximize our profits.

#### Question 4 - Unit Conversion

To answer the customer, we must convert our measure of speed from miles per hour to furlongs per minute. We must use two conversions as we are converting both the numerator (distance) and the denominator (time).

$$195 \frac{\text{miles}}{\text{hour}} = x \frac{\text{furlongs}}{\text{minute}}$$

First, we convert from miles to furlongs by multiplying by 8 (we know from our onboarding materials there are 8 furlongs in a mile).

$$8 * (195 \frac{\text{miles}}{\text{hour}}) = 1,560 \frac{\text{furlongs}}{\text{hour}}$$

Now that we have furlongs per hour, we can divide by 60 to convert to furlongs per minute, our desired units (we know there are 60 minutes in an hour).

$$(1,560 \frac{\text{furlongs}}{\text{hour}}) \div 60 = 26 \frac{\text{furlongs}}{\text{minute}}$$

Our final answer is 26 furlongs per minute.

**Follow up 1:** We calculated the top speed of the speed racer to be 26 furlongs/minute. The customer's desired speed is 24 furlongs/minute, which is less than our max speed of 26 furlongs/minute. This car will satisfy the customer's needs and should be recommended.

### Question 5 - Break Even

To answer the customer, we must determine if the profit under the partnership is greater than our profit today. First, we can calculate our monthly profit without the partnership. To do so, we calculate our monthly revenues and costs.

Our only revenues come from lightbulb sales, where we currently sell 2,000 light bulbs per month at a price of \$3.50. Multiplying these, we calculate a monthly revenue of \$7,000. To calculate costs, we add our fixed and variable costs. Our fixed costs are the rent and upkeep, \$750 + \$200 = \$950. Our variable cost is \$2.75 per lightbulb, which multiplied by our 2,000 light bulbs sold gives \$5,500. Summing our fixed and variable costs gives \$950 + \$5,500 = \$6,450. Our total profit today is then total revenue - total cost, or \$7,000 - \$6,450 = \$550.

Under the partnership, we can recalculate the profit given the terms outlined by the deal. If this deal will grow our monthly sales by 55%, we can recalculate our monthly lightbulb sales count by multiplying 2,000 by 155% = 3,100.

To calculate our new revenue, we multiply our new expected sales count and our existing price, 3,100 \* \$3.50 = \$10,850. To calculate our total costs, we take our fixed costs (\$950), and add them to our new variable costs. With 3,100 in sales and \$2.75 production cost per lightbulb, our total production cost is now 3,100 \* 2.75 = 8,525. Additionally, the terms of the deal require us to pay the lamp company 4% of all revenues. This monthly cost to partner is calculated as 4% \* \$10,850 = \$434. Summing all of our monthly costs is \$950 + \$8,525 + \$434 = \$9,909. Our total profit under the partnership is then calculated as total revenues - total costs, \$10,850 - \$9,909 = \$941.

As our profit under the partnership is greater than our profit without the partnership, (\$941 > \$550), it is a profitable decision to participate in this partnership.

**Follow up 1:** We have calculated our monthly profit without the promotion to be \$550, and the monthly profit under the promotion to be \$941. The percent change in profit can be calculated as:

$$\% \text{ change in profit} = \frac{(\text{new profit} - \text{original profit})}{\text{original profit}}$$

$$\% \text{ change in profit} = \frac{(\$941 - \$550)}{\$550}$$

$$\% \text{ change in profit} = 71.1\%$$

### Question 6 - Weighted Avg/Break Even

To solve this problem, we must find the lowest possible per acre profit of walnuts for this new arrangement of crops on our land to be more profitable. This would occur at the point of break-even, where the profit under the current land allocation equals the profit under the new proposed allocation. To solve this, we can set up an equation setting the two equal, and solve for the unknown variable - the per acre profit of walnuts.

$$\text{Current land allocation profit} = \text{proposed land allocation profit}$$

First, we can map out the distributions of land acreage in our “current” setup and in our “proposed” setup:

	Current	Proposed
<b>Almonds</b>	55%	?
<b>Grapes</b>	30%	?
<b>Strawberries</b>	15%	?
<b>Walnuts</b>	0%	?

Based on the problem setup, we know that the 20% of land used for walnuts must come from the almond, grape, and strawberry acreage. We can calculate the new acreage distributions by subtracting the amounts described in the problem setup:

	Current	Proposed
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Almonds	55%	<b>45% (55% - 10%)</b>
Grapes	30%	<b>25% (30% - 5%)</b>
Strawberries	15%	<b>10% (15% - 5%)</b>
Walnuts	0%	<b>20%</b>

With these new distributions, we can fill out our break-even equation using weighted averages to calculate the expected profit in each scenario. As we still don't know the per acre profit of walnuts, we can use the variable x to represent this figure in our equation.

Current land allocation profit = proposed land allocation profit

Current land allocation profit =  
 % acres dedicated to almonds \* per acre profit of almonds +  
 % acres dedicated to grapes \* per acre profit of grapes +  
 % acres dedicated to strawberries \* per acre profit of strawberries

Current land allocation profit =  
 $55\% * \$400 + 30\% * \$320 + 15\% * \$275 = \$357.25$

Proposed land allocation profit =  
 % acres dedicated to almonds \* per acre profit of almonds +  
 % acres dedicated to grapes \* per acre profit of grapes +  
 % acres dedicated to strawberries \* per acre profit of strawberries +  
**% acres dedicated to walnuts \* per acre profit of walnuts**

Proposed land allocation profit =  
 $45\% * \$400 + 25\% * \$320 + 10\% * \$275 + 20\% * x$  (representing per acre walnut profit)

Setting the two profits equal yields the following equation:

Current land allocation profit = proposed land allocation profit

$\$357.25 = 45\% * \$400 + 25\% * \$320 + 10\% * \$275 + 20\% * x$

Solving for x,

$\$357.25 = \$287.50 + 20\% * x$

$\$357.25 - \$287.50 = 20\% * x$

$(\$69.75) / 20\% = x$

$$\$348.75 = x$$

So for this new land allocation to be more profitable than our existing setup, the per acre profit of walnuts must be  $> \$348.75$ .

**Follow up 1:** We have calculated that the per acre profit of walnuts needs to be greater than \$348.75 for growing walnuts to be a profitable decision for our farm. We know from our own records that strawberries produce a per acre profit of \$275. As this value is much lower than the calculated \$348.75, we can assume the per acre profit of walnuts will not reach the required \$348.75, and we should decide not to sell walnuts on our farm.

## Set 2 Answers

### Question 1 - Profit

We need to calculate the profit for each of the two options. First, we need to figure out how many people we expect to see the ad, then figure out how many of those people we expect to buy a pair of sneakers. To get # of people who see the ad we multiply # subscribers by the open rate. To get the # of people who we expect to buy sneakers, we take the # of people who see the ad and divide it by 2000. The last step is to take that number of people, multiply by your profit per shoe purchase of \$25, then subtract the cost of running the ad in the newsletter.

Profit with Option A:

$$60,000 \cdot .38 / 2000 \cdot 25 = \$150$$

\$135/ profit per newsletter

Profit with Option B:

$$125,000 \cdot .2 / 2000 \cdot 25 = \$200$$

\$112.50/profit per newsletter

So, we would choose Option A because it results in a greater profit per newsletter.

**Follow up 1:** To solve this, we set the Option B equation = Option A profit but instead of using 20% open rate for option B, we set that to x and solve for x to get the following:

$$125,000 \cdot x / 2000 \cdot 25 = \$135$$

$$x = 0.2144, \text{ or } 21.44\%$$

**Follow up 2:** Similar to above, we first set Option B equation = Option A profit but this time, we set the number of subscribers = to x and solve for x, and still use 20% for the open rate:

$$x \cdot 0.2 / 2000 \cdot 25 = \$135$$

$$x = 134,000$$

So, Option B would need a total 134,000 subscribers to break even with Option A profit. This is 9,000 more than the 125,000 current subscribers, so it would take 9 weeks for Option B to be as profitable as Option A. By week 10, it would be more profitable.

### Question 2 - Break Even

To answer the question, we must find the break-even point where the profit from renting bikes in the summer equals the profit from renting skis in winter. To do this, we can set up an equation as follows:

$$\text{profit when renting in winter} = \text{profit when renting in summer}$$

The total profit for each scenario can be calculated as number of rentals per day \* total profit per rental per day. Because monthly rent is the same throughout the year, we only need to calculate the variable profit. We have both of these pieces of information for winter rentals, but we don't know the number of bikes we will rent during the summer. We can use a variable x to represent this figure, and solve the equation:

$$\begin{aligned} &\text{\#ski rentals/day} * (\text{price per rental/day} - \text{maintenance cost}) \\ &15 * (\$40 - \$12) = \$420 \end{aligned}$$

Now, let's figure out how many bike rentals we need to match that daily profit. Since the number of bike rentals is unknown, we will use "x".

$$\begin{aligned} &\text{\# bike rentals/day} * (\text{price per rental/day} - \text{maintenance cost}) \\ &x * (\$55 - \$13) = \$420 \text{ (set to the winter profit)} \\ &x = 10 \end{aligned}$$

So, we need to rent 10 bikes/day, or 300 bikes/ month to break even with our winter profit.

### Question 3 - Unit Conversion

1. To convert from mLs to ounces, we multiply  $500 * 0.03527$  to get 17.635 ounces
2. We know that 114 mL = 114 grams. We need to convert grams to ounces, then ounces to cups. To convert from grams to cups, we first multiple  $114 * 0.03527$  to get 4 ounces (we know 1 g = 1 mL). Then, we divide 4 by 8 to get  $\frac{1}{2}$  cup.
3. We can go through the same process as step 2, or notice that 228 is exactly 2 times as much as 114, so we know we need 1 cup of oreo crumbs.
4. We know 10 mL = 10 g. We then convert grams to tablespoons by dividing 10 by 15. So, we need  $\frac{2}{3}$  of a tablespoon. Then, we multiply by 3 to get 2 teaspoons.

### Question 4 -

First, let's figure out your weekly mileage.

$$5 \text{ weekdays} * 30 + 2 \text{ weekend days} * 15 = 180 \text{ miles/ week}$$

Now, let's calculate the cost of gasoline for traveling 180 miles per week. To do this, we need to figure out the number of gallons of gasoline needed. So, we take 180 miles/ 25 miles per gallon = 7.2 gallons. If it costs \$2.65/ gallon, this would result in:

$$7.2 * \$2.65 = \$19.08 \text{ in fuel costs.}$$

Next, let's calculate the cost of electricity for traveling 180 miles per week. To do this, we need to figure out what percent of a charge is required for 180 miles of travel. So, we take 180 and divide it by the vehicle's range of 200, and get 0.9, so we need 90% of one charge. We know one charge uses 46 kwh of electricity, and each kwh costs \$0.13:

$$0.9(46 \text{ kwh} * \$0.13) = \$5.38 \text{ in electricity costs.}$$

So, for a given week, you will save  $\$19.08 - \$5.38 = \$13.70$  in fuel costs if you end up purchasing the electric vehicle.

### Question 5 - Break Even

First, we need to know how much more you will pay for the electric car so we can figure out how long it will take for us to recover that cost.

$$\$38,000 - \$22,000 = \$16,000.$$

We do not know the amount of time required, so let's set that to x.

Additional cost = (savings from driving an EV)x

$$\$16,000 = x(\$13.70/\text{week} + \$500/\text{year})$$

We need to get these in the same units, so let's convert weeks to years

$$\$16,000 = x(\$13.70/\text{week} * 52 \text{ weeks}/\text{year} + \$500/\text{year})$$

$$\$16,000 = x(\$712.40 + \$500/\text{year})$$

$$\$16,000 = x(\$1,212.40)$$

Then we solve for x by dividing \$16,000 by \$1,212.40, and get 13.19 years. So, it will take just over 13 years for you to make up the additional cost of buying the electric car.

**Follow up:** You just found out that you can expect a \$750 tax credit each year that you own your EV. Given that, how long would it take to start to recover the cost of the EV?

We do the same thing as above, but instead of just \$500 in savings per year, it is now \$1250/year

$$\$16,000 = x(\$712.40 + \$1250/\text{year})$$

$$\$16,000 = x(\$1962.40)$$

$$x = 8.153 \text{ years}$$

### Question 6

First, let's calculate the volume of the ice rink in meters. We know there are 100cm in a meter so we divide 5/100 to convert cm to m.

$$10 \text{ m} * 12 \text{ m} * 0.05 \text{ m} = 6 \text{ cubic meters}$$

Next, let's convert 6 cubic meters to gallons of water by multiplying  $6 * 264.172 = 1585$  gallons.

So, we would need 1585 gallons of water to fill the rink, but, since water expands by 9.3%, we only need 91.5% of this amount ( $1/(100\%+9.3\%)$ ).

$$1585 * (91.5\%) = 1450 \text{ gallons of water.}$$

So, we need 1450 gallons of water to fill the ice rink.



**Follow up:** You decide you want to make your ice rink a little bit smaller after all. If you decide to reduce the width by 25%, how much less water will you need to fill the rink?

- To calculate the new width, we multiple our original 12m by (100%-25%), or  $12 \times 0.75 = 9\text{m}$ .
- Then, we can go through the above calculations again with the new width:  
 $10\text{m} \times 9\text{m} \times 0.05\text{m} = 4.5\text{ cubic meters}$ .  
 $4.5 \times 264.172 = 1188.8$   
 $1188.8 \times 91.5\% = 1087.6\text{ gallons}$