Chapter 2

Real Kitchen Exercises

This chapter will cover the following to World Class standards:

- ☑ The Solving Real Kitchen Exercise
- ☑ Fractional Quantities
- ☑ Percentage Quantities
- ☑ Review

Lesson 2-1:
Solving Real Kitchen Exercises

Everyone has done math problems; however, being able to applying the concepts used in solving simple problems is a skill culinary professionals need to acquire. The difference between solving a simple algebra equation and a real-world scenario is not knowing the math, but rather having the ability to pick out the essential information from the situation. Solving equations can seem undemanding, but knowledgeable, practiced chefs can compute volumetric recipe calculations and conversions in the blink of an eye. In this book, you will practice solving culinary math problems through situational problems, called **Real Kitchen Exercises (RKE)**. A Real Kitchen Exercise is basically a word problem pertaining to a culinary situation, so you will get accustomed to the types of problems you will face in a commercial kitchen.

Solving an RKE generally involves 4 steps:

1) Find out what the problem is asking. Is it a conversion? A yield? A recipe cost? Once you know what you need to find out, you won't waste time doing unnecessary calculations or conversions. This will also allow you to choose the appropriate formulas/strategies for solving the problem.
2) Pull the necessary data from the problem so you can solve the formulas/strategies you chose in step 1.
3) Solve the problem by entering the data from step 2 into the formulas/strategies from step 1.
4) Check your answer. Precision and accuracy are critical in the culinary profession; many recipes will fail if ingredients are not added in the correct proportions. Checking your answer with another student or just doing the problem again will save you time from learning the hard way: re-preparing a dish with the correct measurements.

As an example, here is an RKE involving lasagna.

Chef wants to know how many feet of noodles to make for 8 pans of lasagna. The lasagna noodles are 2" wide. There are 7 layers of noodles in each pan. The pans measure 10" x 14".

Start with step with 1: What is this problem asking? We will be trying to find how many feet of noodles we need. This is a recipe conversion, but with some extra steps: we should to figure out how many feet of noodles go in one pan before we can figure out eight pans. Before that, we need to figure out how many feet of noodles go in one layer. So, we will find out how many noodles are in each layer, then how many are in each pan, and then multiply by eight pans to get the total number of feet.

Step 2 comes next: pulling the necessary data from the problem. This RKE, like many you will see in this book, provides just enough information to solve the problem. However, real world problems will not be so clear-cut; this is why being able to pick out the essential data is such a critical element of culinary math. From the problem, we know that the lasagna noodles are 2” wide, there are 7 noodles in each pan, the pans are 10” x 14”, and there are 8 pans.

At this point, let’s look at an RKE workspace. This book provides space for you to organize your data and solve each problem. If you don’t have a specific formula to write down from step 1, the first thing you should put in your workspace is the data you pulled from the problem in step 2. Here’s an example:

Noodles 2” Pan 10” x 14” 7 layers 8 pans

Now we are ready to move to step 3. Like we established in step 1, we need to find the total feet for one layer. We know that the pan is 10” x 17”. Obviously it is best to lay the noodles lengthwise, so we can assume that they will lie side by side along the 10” side of the pan. A simple calculation, 10/2, will tell us that there is exactly enough room for 5 noodles in each pan. We can then say that each noodle will be 14” long.

Laying Out the noodles in the lasagna pan

Number of noodles $\frac{10''}{2''} = 5\ noodles$

Another calculation, 14 x 5, tells us that there are 70 inches of noodle in each layer.

Noodles per layer $\frac{5\ noodles}{layer} \times \frac{14''}{1\ noodle} = 70''\ /layer$

To find the total number of inches in each pan, let’s multiply 70 by the seven 7 layers to get 490 inches per pan.

Noodles per pan $\frac{70''}{layer} \times \frac{7\ layers}{pan} = 490''\ /pan$

Finally, multiplying 490 by the 8 pans of lasagna gives us 3920 inches of noodles.

Inches per job $\frac{490''}{pan} \times \frac{8\ pans}{job} = 3920''\ /job$

We have one more step: Chef needs to know how many feet of noodles to make, not inches. To convert inches to feet, we divide 3920 by 12 to get 326.66 inches, which we can round up to 397 feet. You can see the calculations in the example workspace below.

Convert to inches to feet $\frac{3920''}{job}\times\frac{1''}{12''}=326.66\ feet/job$

We can't forget about step 4—checking our work. You can always try the problem again, but a better way to make sure you are correct is to compare answers with a fellow student. If your answers do not match, you will be able to find out if you were correct or where you made a mistake. Here's another example RKE, just for fun.

Chef wants to know how many ½" cheese cubes we can get from a 10" x 6" x 2.5" block of cheddar cheese.

Once again, let's start with step 1: what are we trying to find? We need to know how many cheese cubes we can get from a block of cheese. This is a volume yield problem, so we will find the total volume of the cheese block and divide it by the volume of an individual cheese cube. We can move easily into step 2, by writing down the essential data from the problem in the RKE workspace. In step 3, we take the data we pulled from step 2 and apply it to the strategy we chose in step 1. To find the volume of the cheese block, multiply 10" by 6" to get 60" squared, and then multiply that by 2.5" to get 150 cubic inches, as you can see below.

Volume of the cheese block

$$V=L\times W\times H$$
$$V=10''\times 6''\times 2.5''=150''^{3}$$

To find the volume of a cheese cube, multiply ½" by itself to get ¼" squared, and then again by ½" to get 1/8 cubic inch.

Volume of the cheese cube

$$V=L\times W\times H$$
$$V={}^{1}\!/_{2}''\times {}^{1}\!/_{2}''\times {}^{1}\!/_{2}''={}^{1}\!/_{8}''^{3}$$

Finally, we divide 150 by 1/8 to get 1200 cheese cubes. You can see the sample calculations below. As always, we will check our work to make sure our answer is correct.

Cubes yielded from cheese block $\#\ of\ cubes=\frac{vol.of\ block}{vol.of\ cube}=\frac{150''^{3}}{{}^{1}\!/_{8}''^{3}}=1200\ cubes$

Lesson 2-2:
Fractional Quantities

As there are quite a few different measures of volume used in the culinary industry, you will often be working with fractions, but don't worry; knowing how to calculate fractions will be an asset in solving many kitchen problems, as well as a fun and rewarding pastime. A fraction in mathematical terms is a number between (and including) 0 and 1 that signifies the parts of a whole. Let's look at a well known fraction, ½, as an example. The 1 in this fraction is the numerator, and the 2 is the denominator. This signifies that of the two parts that are required to make a whole, one of them is present. The line that separates them technically signifies a division sign (÷), and if you wanted to you could divide 1 by 2 to get 0.5, ½'s decimal value. However, a fraction is more useful in certain situations because you can more easily visualize the relationship between the numerator and the denominator. For example, 1/16 probably makes more sense at first sight than 0.0625. In addition, it is much easier to add ½ and ¾ without first having to do the long division for each value to convert them to decimal values.

There are a few rules we have to remember about fractions. First, the denominator of a fraction can never be zero, because it is impossible to divide any number into zero parts. Also, you should avoid having a fraction inside of a fraction, such as ¾ over ½. There is a simple way to correct this, which we'll cover later. For now, let's start by adding some fractions.

The most difficult thing about adding fractions is that, in order to do so, the fractions you are asking must have common denominators. This is to say that the denominator of each fraction must be the same value, like 5/8 and 3/8. When you have two fractions with a common denominator, all you do to add them is add the numerators together. The sum is then the new numerator over the same common denominator. Remember, the denominator is not really the value of the fraction, but rather the total number of parts required to make a whole. The numerator is the number of parts, so when adding or subtracting fractions, the common denominator stays the same.

In many cases, the denominators of the fractions you are attempting to add will not be the same. To add them, you must convert the denominators so that they are both the same, and then adjust the numerators so that the fractions still have the same value. For instance, adding 2/5 and 3/10 would be impossible without converting one of the fractions so that they both share the same denominator. In this case, the easiest choice would be to convert the denominator of the first fraction, 5, to 10. Because we doubled the denominator of the fraction, we must also double to numerator so that the fraction retains its value. 2/5 and 2/10 are two different values. A good way to check if two fractions are equal is to divide the numerator by the denominator for each one on a calculator; if the decimal values for both fractions are the same, the fractions have the same value. In our example, doubling the 5 to a 10 means we must double the 2 to a 4, making our new fraction 4/10. 4/10 and 2/5 have the same decimal value, 0.4, so we know they are equal. Now we can add the fractions: 4/10 + 2/10 = 6/10. Remember, in adding and subtracting fractions, the denominator stays the same.

In some cases, the fractions will not convert to common denominators so easily. Take the fractions 1/8 and 1/7. If we were to add them, we would have to find a common denominator. However, we cannot just convert one of the fractions to match the other in this case, without introducing fractional or decimal values into the numerator, which we should always try to avoid. So, we will have to convert both. To do this, we have to find a number that both denominators can divide into evenly. For example, if we tried to use 49 as the common denominator, 1/7 would easily convert to 7/49. However, 8 cannot divide evenly into 49, so this number is not ideal. The easiest way to find a common denominator is to take the product (multiply) both denominators: 7 x 8 = 56. Because we multiplied them both together, we know that each must be a common factor of our new denominator value, 56. There is one more step before we can add. Whenever we change the denominator value, we must also change the numerator so that the fraction retains its value. 1/8 changed its denominator to 56. What did we do to 8 to get 56? We multiplied by 7; so, to convert the numerator, we must do the same thing to it as we did to the denominator. 1 times 7 equals 7, so seven must be the new numerator. To check, 1/8 and 7/56 both yield the same decimal results when plugged into a calculator: 0.125. In the same way, we must convert the numerator of 1/7 to match its new denominator, 56. We multiplied 7 times 8 to get 56, so we do the same to the numerator. 1 times 8 is 8, so 8 is our new numerator, and 8/56 is our new fraction. Both 1/7 and 8/56 equal 0.1428571, so we know they must be the same value. Now we can add the two fractions. 7 plus 8 is 15, and the denominator stays the same, so the sum of 1/7 and 1/8 is 15/56.

When calculating fractions, especially in cases without common denominators, you may end up with relatively large numerator and denominator values. For example, you could add 15/60 and 20/80 using the strategy above to get 2400/4800. However, computing such large values would be unnecessary if we had simplified the fractions first. Simplifying fractions is almost the opposite of multiplying to find a common denominator; instead, the goal is to reduce the numerator and the denominator down to their smallest whole number values. This takes a little more brainpower, because you have to look for a common factor of both the numerator and denominator. In our example from above, 15/60 has a few common factors: 1, 3, 5, and 15. Any common factor higher than 1 can be used to simplify a fraction, but the largest common factor will result in the smallest numerator and denominator values. If we divided both by 3, we would get 5/20, but if we divided both by 15, we would get ¼. Obviously, ¼ is much easier to work with than 15/60, or even 5/20. In the same way, 20/80 has common factors of 1, 2, 4, 5, 10, and 20. We'll just use 20, to get 1/4. Then when we add the two fractions, we come out with a sum of $^2/_4$, which to the trained eye can be instantly simplified by a common factor of 2 down to 1/2, rather than our previous value of 2400/4800. Finding common denominators and simplifying fractions are the most labor-intensive, complex parts of fraction calculation. Once you learn these strategies, working with fractions will become exponentially easier. Here's some practice RKE's to help you get started.

Practice Problems

Chef needs to know how many cups of sour cream to order. The guacamole calls for ½ cup of sour cream, and the tacos calls for ½ cup of sour cream.

Chef wants to know how much shredded parmesan cheese to set aside for the risotto. The recipe calls for ¾ of a cup, and then another ¼ of a cup for a garnish.

Chef needs to know how much rice to prepare for sushi. One sushi recipe calls for ½ cup of rice, and the other calls for ¼ cup of rice.

Chef needs to know how much milk to buy. He needs 1/6 of a gallon for the custard, and $^{1}/_{8}$ of a gallon for the chocolate topping.

Chef needs to know how much ground beef to buy. The hamburgers call for ¾ of a pound, and the chili calls for 1/6 of a pound.

Chef needs to know how much flour to pull from the dry stores. He needs 1/3 of a cup for some cookies, and 3/8 of a cup for a pie.

In many cases, you will add two or more fractions together, and the sum will have a numerator larger than the denominator, such as 8/3. This is called an improper fraction. It would not make sense to use this value in the kitchen, because it would mean that you would need to measure out 1/3 eight times. Instead, we can convert this improper fraction to combination of whole numbers and fractions, also known as a mixed number. In this case, we know that 3/3 is equal to 1, so we can pull 3 from the numerator and add a 1 beside the fraction. For 8/3, we can subtract two 3/3, so we can simplify 8/3 to 2 and 2/3. 2/3 is left over, and the numerator is less than the denominator. Now when measuring in the kitchen, we can measure out two whole units and then the two thirds, rather than making 8 separate measurements. When adding mixed numbers, just add the whole numbers together, and if you are still left with an improper fraction, simplify it by adding more whole numbers from the fraction until the fraction is no longer improper. For practice, try these fraction addition problems:

Practice Problems

$\frac{1}{2}cup+\frac{1}{3}cup=$	$\frac{2}{3}cup+\frac{1}{4}cup=$	$\frac{3}{4}oz+\frac{1}{8}oz=$	$\frac{5}{16}lb+\frac{1}{4}lb=$
$\frac{1}{10}lb+\frac{1}{2}lb=$	$2\frac{1}{2}tsp+1\frac{1}{4}tsp=$	$\frac{1}{2}carrot+\frac{2}{3}carrot=$	$\frac{3}{4}tbsp+\frac{2}{3}tbsp=$
$\frac{5}{6}cup+\frac{1}{4}cup=$	$\frac{9}{12}doz+\frac{5}{12}doz=$	$1\frac{1}{2}cup+4\frac{1}{4}cup=$	$\frac{3}{4}qt+\frac{1}{8}qt=$

Here are some RKE's that use mixed numbers.

A cake recipe calls for 1-1/2 cups of sugar. The icing for the cake calls for 3/4 cup of sugar. Chef needs to know how much sugar to set aside for the cake.

Chef needs to know how much black pepper to grind. A barbeque dry rub recipe needs 4-1/3 tsp. and the vegetable soup needs 1-1/4 tsp.

Chef needs to know how much dough to make for pasta. He needs 3-1/6 lbs. of dough for linguini, and 2-3/8 lbs. for fettuccini.

Chef needs to know how much olive oil to reserve for the salad dressings. The balsamic vinaigrette calls for ¾ of a cup, and the Italian calls for 1-1/3 cup.

Chef needs to know how much roast beef to slice for the sandwiches. The club sandwiches will need 3-1/2 lbs, and the French dip sandwiches will need 4-3/4 lbs.

Chef needs to know how much total pizza is left over after a pizza banquet. There are 9 slices left of mushroom pizza, and 12 slices left of pepperoni pizza. A whole pizza has 8 slices.

Surprisingly, multiplying fractions can often be easier than adding them. This is because multiplying fractions does not involve finding a common denominator. To multiply two fractions, multiply both numerators together to get the new numerator, and then multiply both denominators to get the new denominator. For example, to multiply ½ by ½, first multiply 1 by 1 to get the new numerator of 1. Then, multiply 2 by 2 to get 4, the new denominator, so that the new fraction is ¼.

When multiplying a fraction by a whole number, just think of the whole number as a fraction, where the numerator is that number, and the denominator is one. The number 6 can also be expressed as the fraction 6/1. So, to multiply ½ by six, just multiply ½ by 6/1: 6 x 1 is 6, and 1 x 2 is 2, so the product is 6/2. Remembering to simplify, we reduce this fraction down to 3/1, or just 3. Just like a whole number can be expressed as a fraction by placing it over 1, any fraction over 1 can be expressed as just the whole number that is the numerator.

Dividing fractions is just as easy. There is only one more step in dividing fractions then there is with multiplying fractions: instead of multiplying both numerators and denominators together, you must cross multiply. The easiest way to do this is to flip fraction you are dividing by (the second fraction) so that the numerator is the denominator and vice versa. Then just multiply the numerators and denominators as if you were doing a multiplication problem. For example, when dividing ½ by 4, or 4/1, as we know, flip 4/1 over to make it ¼ and multiply to get 1/8.

In some cases, you will need to multiply mixed numbers. It may be easier to convert the mixed number to an improper fraction, and then convert back to a mixed number once you have completed the calculation. This will help reduce confusion, because you won't need to do to separate calculations for the fraction and whole number parts of the mixed number. Here are some practice problems for multiplying and dividing fractions.

Practice Problems

$\frac{1}{2}cup \times \frac{1}{16} =$	$\frac{5}{16}lb \times \frac{3}{4} =$	$\frac{3}{4}tsp \times 5 =$	$\frac{1}{4}lb \times \frac{4}{5} =$
$1\frac{1}{3}qt \times 2 =$	$2\frac{1}{4}tsp \times \frac{1}{2} =$	$3\frac{1}{2}oz \times \frac{1}{4} =$	$2\frac{1}{4}gal \times 1\frac{1}{2} =$
$3\frac{1}{4}pt \times \frac{1}{3} =$	$10lbs \times 5\frac{1}{2} =$	$2\frac{1}{10}kg \times 10 =$	$250\frac{1}{2}oz \times 2\frac{1}{2} =$

Chef needs to know how many pounds of shrimp to prepare for shrimp cocktail. Each cocktail uses ¾ cup of shrimp, and there are 5 orders for shrimp cocktail.

Chef is making quarter-pound burgers for a large cookout. How many pounds of burger meat should be ordered if he expects to make 120 burgers?

Chef needs to know how much broth to make for French Onion Soup. He plans on making 6 batches of soup, and each batch requires 5-$^{1}/_{3}$ cups of beef broth.

A casserole recipe calls for $^{2}/_{3}$ tsp of cumin. Chef needs to know how much cumin to set aside for 10 casseroles.

A roast takes 2-3/4 hours to cook in the oven. If Chef needs to cook 6 roasts and can only cook 1 at a time, how long will it take to cook all of the roasts?

Chef needs to marinade 45 steaks. Each steak takes up 1/8 of a storage container. How many containers will be needed to marinate all of the steaks?

There is only 2-5/8 of pie left after the picnic. Chef needs to know how many servings of pie there are. A single serving is equal to 1/8 of a pie.

There are ¾ lbs of ground sausage left over from lasagna. If a jumbo meatball needs 1/8 lb of ground sausage, how many meatballs can Chef make with the leftovers?

Chef is preparing 5 gallons of iced tea. If a serving of iced tea is equal to 1/16 of a gallon, how many servings of iced tea are there?

Lesson 2-3:

Quantities by Percent

Being able to compute quantities by percent is just as important in a kitchen as fractional calculations. Recipes may seldom use percentages, but often a head chef will ask for a certain percentage of a recipe to be prepared; it is in these cases that calculating percentages comes in handy. A percentage is a value above zero that relates the state of fullness or wholeness, where 100% is equal to 1. 50% then is half of a whole, and 200% is equal to twice a whole, or 2. A percentage can easily be converted to a decimal value by dividing it by 100—100% becomes 1.00 and 50% becomes 0.5. Once you have converted a percentage to a decimal value, you can use that value to do regular calculations, as if it were any other number.

To find a percentage of a number, just multiply the percentage's decimal value by the number. For example, to find 25% of 60, just multiply 0.25 by 60 to get 15. To find a percentage, divide the number that you want to convert by the total number and multiply by 100. For example, if you wanted to find the percentage of chocolate doughnuts in your doughnut shop, you would need to know the total number of doughnuts, and the number of chocolate donuts. Let's say there were 10 chocolate doughnuts and 50 total doughnuts. 10/50 is 0.20, which, multiplied by 100, is 20%. So, 20% of the doughnuts are chocolate. Here are some RKE's relating to percentile quantities

Practice Problems

Chef only needs 50% of a red sauce prepared. The original sauce recipe calls for 6 cups of cream.

Chef added 4 liters of water to a pot to boil pasta. The recipe requires that he reserve 15% of the pasta water to use later in the sauce.

Chef needs to increase a recipe for hollandaise sauce by 350%. The original recipe requires 1 cup of clarified butter.

Of the 30 chicken breasts cooked in the oven, 6 were not the correct temperature after 30 minutes. Chef wants to know the percentage of undercooked chicken breasts.

Two 20-lb bags of potatoes yielded 66 potatoes. After the potatoes were skinned and chopped, the potatoes weighed 18.5 lbs. Chef wants to know the percentage of waste from the potatoes.

Chef prepared 10 quarts of soup for dinner. 3.5 quarts of soup were left over after. What percentage of the soup was served?

Lesson 2-4:
Chapter Review

Name the 4 steps to solving a Real Kitchen Exercise

1. ______________________________
2. ______________________________
3. ______________________________
4. ______________________________

Chef needs to know how many cups of green beans are able to be cooked. One chef cut 2-3/4 cups of beans, and another cut 1-2/3 cups of beans.

A pizza recipe calls for 3 cups of cheese to be added before it is baked, and then ¾ cup added after it comes out of the oven. Chef needs to know how many cups of cheese to grate for 6 pizzas.

60% of the pasties were served for breakfast. Originally, 380 pastries were prepared. Chef wants to know how many pastries are left over.

Each side salad needs ¼ cups of croutons. There are 13 cups of croutons. Chef needs to know how many side salads can be prepared.

After roasting a turkey, Chef would like to make gravy with the drippings. He only needs 4 cups of gravy. 1 cup of drippings yields 1-1/4 cups of gravy. If there are a total of 6 cups of drippings, what percentage of the drippings should he reserve for the gravy?

After skinning and pitting 10 lbs of avocados, 6.65 lbs of avocado meat is left to make guacamole. What percentage of the 10 lbs was waste?

A tomato soup calls for 2-1/2 cups of crushed tomatoes, 1-1/2 cups of cream, 1-1/3 cups of chicken broth, and 1/3 cup of olive oil. Chef wants to know how many 1-1/2 cup servings of soup he will have if he makes 3 batches of tomato soup.

A steak spends 4 hours marinating, 8 minutes searing on the grill, and 15 minutes in the oven to reach its minimum internal temperature. What percentage of the total time did it spend in each of these three stages?

4 cups of raw, sliced mushrooms are sautéed, yielding 1-2/3 cups of cooked mushrooms. What is the percentage yield, and how many cups of cooked mushrooms can Chef expect to get from 10 cups of raw, sliced mushrooms?