Math 6 Notes:
Ratios and Proportional Relationships – PERCENTS

Prep for NVACS 6.RP.A.3

Percents

Percents are special fractions whose denominators are 100. The number in front of the percent symbol (%) is the numerator. The denominator is not written, but understood to be 100.

Examples $6\% = \frac{6}{100}$ $14\% = \frac{14}{100}$ $87\% = \frac{87}{100}$

Because a percent is a special fraction, then, just like with decimals, all the rules for percents come from the rules for fractions.

Adding & Subtracting Percents

Adding (or subtracting) percents is exactly the same as adding (or subtracting) fractions with like denominators. Add (or subtract) the numerators and keep the common denominator.

Example: Add $34\% + 15\%$

This is the same as $\frac{34}{100} + \frac{15}{100} = \frac{49}{100}$

$\frac{49}{100}$ can be written as 49%.

Example: Subtract $47\% - 23\%$

This is the same as $\frac{47}{100} - \frac{23}{100} = \frac{24}{100}$

$\frac{24}{100}$ can be written 24%.

Converting Percents to Fractions and Decimals

To convert a percent to a fraction, we just use the definition. The number in front of the percent symbol is the numerator, the denominator is 100, then simplify.

Example: Convert 53% to a fraction.

$\frac{53}{100}$

Example: Convert 53% to a decimal.

$53\% = \frac{53}{100}$, but that's a fraction. There is one more step, change $\frac{53}{100}$ to a decimal . To divide by 100 or simply move the decimal point 2 places to the left. $53\% = 0.53$.

Converting % to fraction to decimal

% to fraction--Remove % symbol and put 100 in the denominator.
% to decimal--Move decimal two places to the left.
Decimal to %--Move decimal two places to the right and put a % symbol at the end.
fraction to decimal--Divide numerator by denominator.
fraction to %--Convert fraction to a decimal; then move decimal two places to the right.

Example: Convert 3% to a decimal.

Remove the % symbol; then move the decimal two places to the left.
3% = .03

Example: Convert .34 to a percent.

Move the decimal point 2 places to the right and put a percent symbol at the end.
.34 = 34%

Hints

To convert a decimal, the loop on the "d" in decimal curves to the left, so move the decimal point to the left 2 places.

To convert to a percent, the loop on the "p" in percent curves to the right, so move the decimal point to the right 2 places.

Example: Convert 63% to a decimal.

The loop on the "d" curves left, move the decimal point 2 places in that direction. The answer is .63.

Example: Convert .42 to a percent.

The loop on the "p" curves to the right, move the decimal point 2 places in that direction. The answer is 42%.

Once students have these techniques, students need to work on fluency with these skills. Consider introducing a chart like the following. For each example students should complete the chart so each expression is written in fraction, decimal and percent form.

Equivalent Expressions – Fractions, Decimals and Percents

	Fraction	Decimal	Percent
1.	$\frac{1}{2}$	**0.50**	**50%**
2.		0.7	
3.			19%
4.	$\frac{1}{4}$		
5.		0.03	
6.			78%
7.	$\frac{3}{4}$		
8.		0.35	
9.			40%
10.	$\frac{2}{5}$		
11.		0.68	
12.			55%
13.	$\frac{1}{3}$		
14.		0.92	
15.			66%
16.	$\frac{7}{25}$		
17.		0.625	
18.			100%
19.	$\frac{17}{50}$		

Order the numbers from **least to greatest.**

Example: **44%, $\frac{21}{50}$, 0.43** convert to one form either **44%, 42%, 43%**

or

0.44, 0.42, 0.43

or

$\frac{44}{100}, \frac{42}{100}, \frac{43}{100}$

Then order from least to greatest - **42%, 43%, 44% or 0.42, 0.43, 0.44 or** $\frac{42}{100}, \frac{43}{100}, \frac{44}{100}$

Then revert back to the original number form $\frac{21}{50}$, 0.43, 44%

Order the numbers from **greatest to least.**

Example: $\frac{9}{20}$**, 13%, 0.125**

convert all to one format (fraction, decimal or percent) then order – 45%, 13%, 12.5%

0.125, 13%, $\frac{9}{20}$

Percent Proportion

NVACS 6.RP.A.3c Find the percent of a quantity as a rate per 100 (e.g., 30% of a quantity means 30/100 times the quantity; solve percent problems involving finding the whole, given a part and the percent.

A percent is nothing more than a way of interpreting information, writing a ratio, and then rewriting the ratio so that the denominator is 100.

For instance, let's say a student gets 8 correct out of 10 problems on a quiz. To determine the grade, the teacher would typically take that information and convert it to a percent. In other words, set up a proportion like this.

$$\frac{\#\,correct}{total} = \frac{?}{100}$$

Filling in the numbers:

$$\frac{8}{10} = \frac{n}{100} \rightarrow \frac{8}{10} = \frac{80}{100} \rightarrow 80\%$$

($\times 10$ above the middle fractions; $\times 10$ below the middle fractions)

Getting 8 out of 10 is equivalent to 80%.

Notice the right side of the proportion is a fraction whose denominator is 100 because that is the definition of a percent.

Example: Let's say Ashton made 23 out of 25 free throws playing basketball. How many shots would you expect Ashton to make at this rate if he were to shoot 100 free throws?

Again, begin with a proportion:

$$\frac{\text{attempts}}{\text{total}} = \frac{\quad}{100}$$

$$\frac{23}{25} \overset{\times 4}{=} \frac{n}{100} \rightarrow \frac{23}{25} = \frac{92}{100}$$

The proportion can be solved by making equivalent fractions or by cross-multiplying. Either way, the missing numerator is 92. Ashton is expected to make 92 free throws out of 100 tries.

These problems are just like the ratio and proportion problems from previous examples. The only difference is the denominator on the right side is 100 because we are working with percents.

A proportion that always has the denominator of the right side as 100 is called the **Percent Proportion.**

Percent Proportion

$$\frac{\text{part}}{\text{total}} = \frac{\%}{100}$$

Remembering that you have to describe the ratios the same way on each side of a proportion, we might think this should read:

$$\frac{\text{part}}{\text{total}} = \frac{\text{part}}{\text{total}}$$

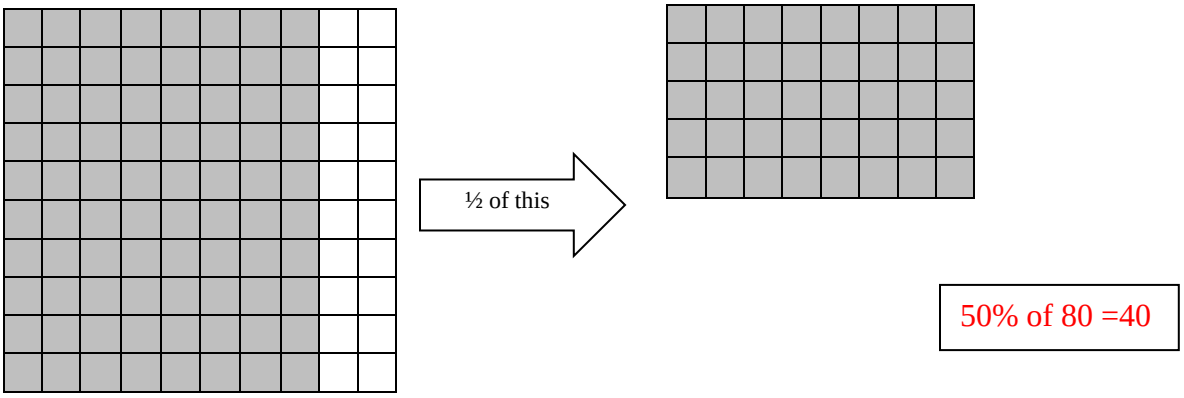
Well, the percent ratio actually does compare parts to total on both sides. For a percent, the total is always 100 and the percent is always the part you get.

Speaking mathematically, the 100 always goes on the bottom right side. That's a constant. The only thing that can change is the part, total or percent. This information is obtained by reading the problem and placing the numbers in the correct spot, and then solving.

There are only 3 different problems: we can look for a part, a total or a percent.

NVACS **requires** the use of models. A few samples are shown below.

50% of 80 is what?

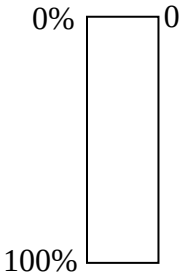


80

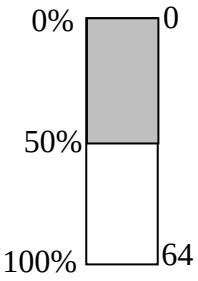
50% of 80 =40

Example *50% of 64 is what?*

Students begin by creating a rectangle and mark on one side 0% to 100%.

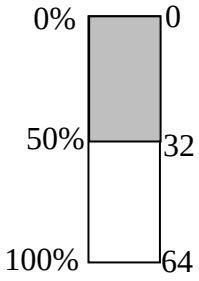


Since 50% is given, we subdivide the model to show 50% or $\frac{1}{2}$.



Next, the total given is 64 we indicate that on the model.

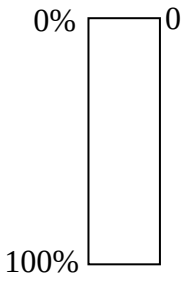
Lastly, we find ½ of 64 and indicate that it is 32.



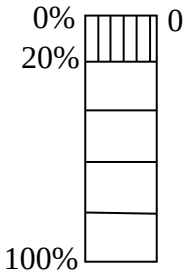
50% of 64 = 32

Example *20% of what is 5?*

Students begin by creating a rectangle and mark on one side 0% to 100%.

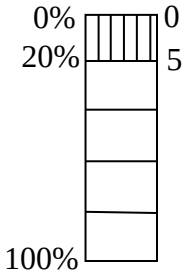


Since 20% is given we subdivide the rectangle to indicate 20%.



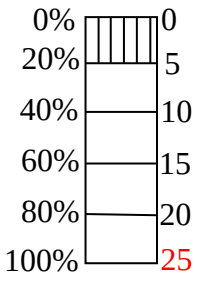
Since we were given 20% of something is 5, we indicate that on our model.

In this case, we are trying to find the number value that corresponds to 100%.

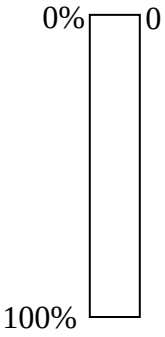


Looking at the model on the percent side, we see the divisions are increments of 20%. On the number side the increments are of 5. Counting down we get that 100% is 25.

So, 20% of 25 = 5.

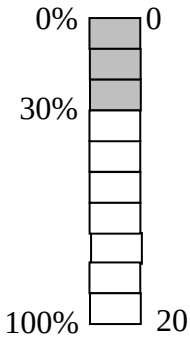


Example 30% *of* 20 *is what*?



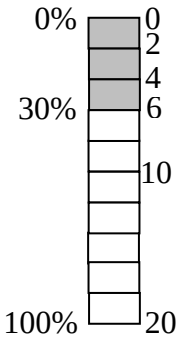
Begin with the basic model.

Since % given is 30% divide the rectangle into tenths.



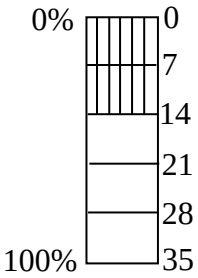
We are given the total is 20. We need to find increments that total 20 that can be divided into 10 equal parts, so 2's.

The shaded region tells us the 30 % of 20 is 6.

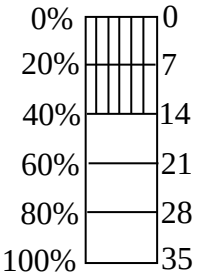


Example: *What % of 35 is 14?*

Beginning with the basic model, I must determine the increments to divide my model into. Since both 35 and 14 are divisible by 7, I will make increments of 7. Since 35 ÷ 7 = 5, I will divide the rectangle into fifths. I will also shade my model to represent 14 out of the 35.



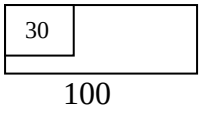
Finally I need to determine the increments from 0% - 100% with 5 equal parts …so by 20's. As I label my increments I can see, 40% of 35 is 14.



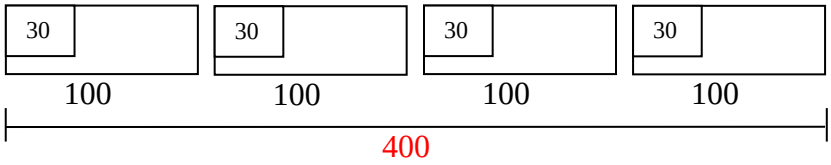
Example: *A sporting goods store received a shipment of 400 baseball gloves and 30% were left-handed. How many left-handed gloves were in the shipment?*

Solutions may include:

You can draw a diagram to solve this problem. Since 30% means 30 out of every 100, we can begin with this model.



Since there were 400 gloves in the shipment, the diagram is repeated (iterated) 4 times.

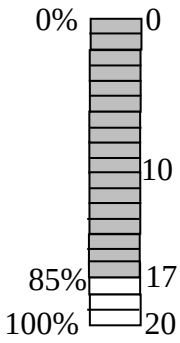


So 30 + 30 + 30 + 30 = or $30 \times 4 = 120$.

120 left-handed gloves were in the shipment.

Example (looking for a percent): *Bob got 17 correct on his history exam that had 20 questions. What percent grade did he receive?*

Solutions may include:



$$\frac{\text{part}}{\text{total}} = \frac{\%}{100}$$

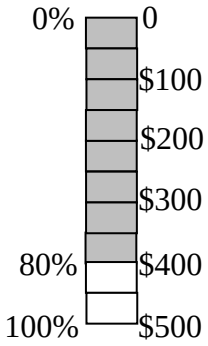
Filling in the numbers, $\frac{17}{20} = \frac{n}{100}$ (x5 above, x5 below)

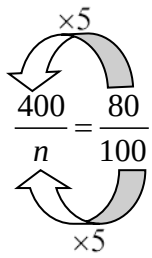
$n = 85$

85%

Example (looking for a total): *A company bought a used typewriter for $400, which was 80% of the original cost. What was the original cost?*

Does the $400 represent the total or part?





$$\frac{400}{n}=\frac{80}{100}$$

$$80n = 400\times 100.$$

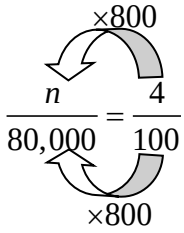
$$80n = 40,000$$

$$n = 500$$

The original cost of the typewriter is $500.00.

Example (looking for a part): *If a real estate broker receives 4% commission on an $80,000 sale, how much would he receive?*

Does $80,000 represent the part or total?



$$\frac{n}{80,000}=\frac{4}{100}$$

$$100n = 4\times 80,000$$

$$100n = 320,000$$

$$n = 3,200$$

He would receive $3,200 in commission.

While the first three examples were all percent problems, percent proportions were used to solve them. In each case the unknown was something different. That's the beauty of the percent proportion: it can be used for any situation.
In this next example, everything stays the same, but there is a slight variation in how the problem is written. To do this problem, how proportion problems are set up must be understood.

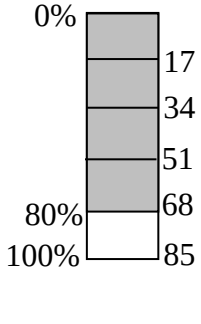
Example: *Dad purchased a radio that was marked down 20% for $68.00. What was the original cost of the radio?*

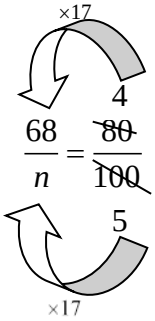
Setting up the proportion, does $68 represent the part or total?
Filling in the proportion,

$$\frac{\text{paid}}{\text{total}}=\frac{\%}{100}$$

If the $68 represents the part you paid, what does the 20% represent? It represents the percentage saved or the percentage off the total price.

A proportion with **paid is to total** as **amount off is to total** is not correct!! The same ratio must be on both sides. That is <u>paid to total</u> as <u>paid to total</u>. If dad got 20% off, what percent did he pay? Well, 100% - 20% = 80%





$$\frac{68}{n} = \frac{80}{100}$$

$$80n = 6{,}800$$

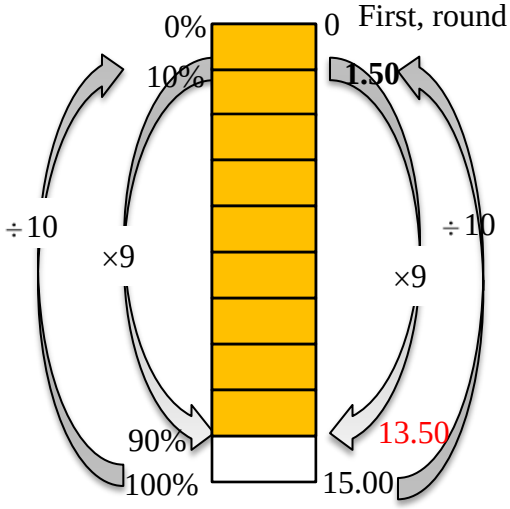
$$n = 85$$

The original cost of the radio is $85.

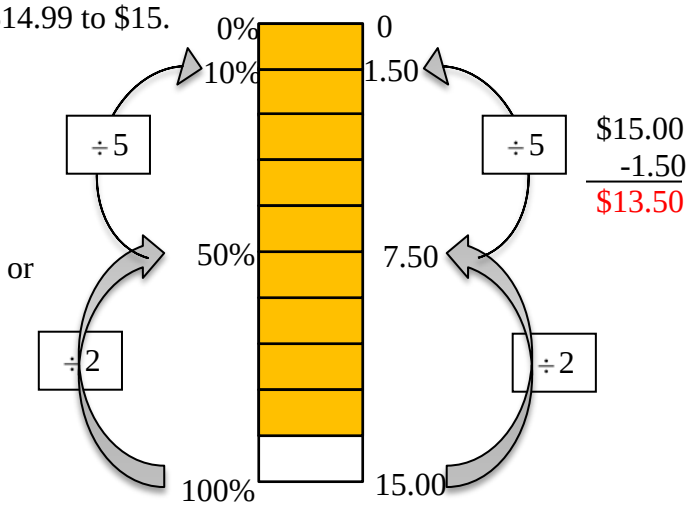
Common uses of percents involve discounts, tips and sales tax.

Example (discount): *A store sign reads "10% off the regular price." If Nick wants to buy a CD whose regular price is $14.99, about how much will he pay for the CD after the discount?*

First, round $14.99 to $15.

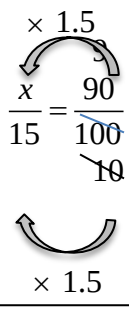


or



or

100% - 10% = 90%



or

Find 10% of $15 by multiplying 0.10 • $15. That is,
10% of 15 → 0.10 • 15 → $1.50
The approximate discount if $1.50.

Next, subtract $1.50 from $15.00 to get the estimated cost:
$15.00 − $1.50 = $ 13.50

Nick will pay about $13.50 for the CD.

or

× 1.5

$x = 1.5 = \$1.50$

$\frac{x}{15} = \frac{10}{100}$

1

10

$15.00

-1.50

$13.50

× 1.5

or

or

100% - 10% =90%

Find 90% of $15 by multiplying 0.90 • $15. That is,

90% of 15 → 0.90 • 15 → $13.50

Nick will pay about $13.50 for the CD.

Example (tip): *The total bill for lunch is $13.95. About how much is a tip of 15%?*

Mental Math

First, round $13.95 to $14.

Next, think 10% + 5%.

10% of $14 = $1.40. 5% is half or $.70.

So the tip would be $1.40 + $0.70 or

or by proportion equation

$\frac{x}{14} = \frac{15}{100}$

3

20

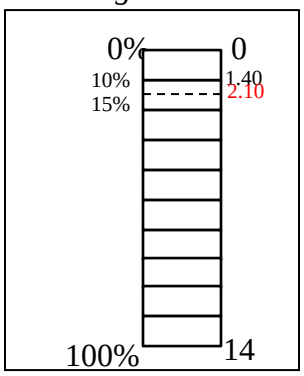
$20x = 3 \cdot 14$

$20x = 42$

$x = 2.10$

or

Using a model



$2.10

Example (sales tax): *Arnold is buying a skateboard for $79.85. The sales tax rate it 8%. About how much will the total cost of the skateboard be?*

First, round $79.85 to $80.

Next, think 1% of $80 is $0.80, so 8% will be 8 • $0.80 or $6.40.

So the approximate total cost will be $80 + $6.40 or $86.40.

Example: In one game a quarterback completed 13 out of 25 passes. What % of the passes were completed?

$\frac{13}{25} = \frac{x}{100}$ (×4 above, ×4 below)

$13 \bullet 4 = 52$ 52%

Example: On a 75 question test, Maureen got 84% correct. How many questions did she answer correctly?

$\frac{x}{75} = \frac{84}{100} = \frac{21}{25}$ (×3 above, ×3 below)

$21 \bullet 3 = 63$ 63 questions correct

Example: 15% of the contents of a 450 gm can is protein. How many grams of protein are in the can?

$\frac{x}{450} = \frac{15}{100}$ ($\times 4\frac{1}{2}$ above, $\times 4\frac{1}{2}$ below)

$15 \bullet 4\frac{1}{2} = 67\frac{1}{2}$ $67\frac{1}{2}$ grams of protein

Example: The selling price of a bicycle that had sold for $220 last year was increased 15%. What is the new selling price of the bicycle?

100%
+ 15% increase
115%

$\frac{x}{220} = \frac{115}{100} = \frac{23}{20}$ (×11 above, ×11 below)

$23 \bullet 11 =$ $253

Example: The Eagles have won 6 out of 8 games they have played this season. What % of this season's games have they lost?

8 games
- 6 wins
2 losses

$\frac{2}{8} = \frac{1}{4} = \frac{x}{100}$ (×25 above, ×25 below)

25%

Example: All the students in 11 classes are going on a field trip. There are exactly 23 students in each class. The students will ride school buses to the field trip location. Exactly 48 students can ride each school bus. Which is the **best** ESTIMATE of the percent of all the students going on the field trip who will be riding each of the school buses?

A.	5%
B.	20%
C.	50%
D.	90%

Prep for NVACS 6.RP.A.3d

The *customary system* is the measurement system we use in the United States (and Liberia and Burma). The *metric system* is used everywhere else in the world.

Measurement –the metric system in particular—is embedded in the science program at the middle school level. Measurement is an objective is to be addressed repeatedly throughout the science course. Be sure to collaborate with your science department!

If you do not have a measurement tool, like a ruler, measuring cup or a scale, it is good to have a "benchmark" or estimate that you can use. It will also help you to choose the appropriate measurement when asked to measure an object, as well as make a comparison between the two systems of measurement. You may want to make an exercise having students determine their own benchmarks.

Customary Units: LENGTH		
Unit	***Abbr.***	***Benchmark***
inch	in	width of your thumb
foot	ft	spread fingers-touch thumbs**
yard	yd	length of baseball bat
mile	mi	12 city blocks or 20 football fields

**

Customary Units: WEIGHT/MASS		
Unit	***Abbr.***	***Benchmark***
ounce	oz	a slice of bread
pound	lb	a loaf of bread
ton	T	a small car

Metric Units: LENGTH		
Unit	***Abbr.***	***Benchmark***
millimeter	mm	thickness of a CD (or dime)
centimeter	cm	width of the tip of your "pinky" finger
meter	m	about the distance from the floor to your belly button (for an average 6th grader)
kilometer	km	about half a mile

Customary Units: CAPACITY		
Unit	***Abbr.***	***Benchmark***
fluid ounce	fl oz	a tablespoonful
quart	qt	large bottle of water
gallon	gal	large plastic milk jug

Metric Units: CAPACITY		
Unit	***Abbr.***	***Benchmark***
liter	g	About a quart of milk

Metric Units: WEIGHT/MASS		
Unit	***Abbr.***	***Benchmark***
gram	g	large paper clip
kilogram	kg	hardcover textbook

Listed below are a few websites with more information:

http://www.aaamath.com/mea.html
http://www.nist.gov/public_affairs/kids/metric.htm
http://www.edhelper.com/metric_system.htm

Customary Conversions that should be known, learned and/or able to be computed .

Time	
60 seconds	*1 minute*
60 minutes	*1 hour*
3600 seconds	*1 hour*
24 hours	*1 day*
1440 minutes	*1 day*
7 days	*1 week*
12 months	*1 year*
52 weeks	*1 year*
$365\frac{1}{4}$ *days*	*1 year*
Weight	
16 ounces	*1 pound*
2,000 pounds	*1 ton*
Linear Measure	
12 inches	*1 foot*
3 feet	*1 yard*
36 inches	*1 yard*
5,280 feet	*1mile*
1,760 yards	*1 mile*
Liquid Measure	
8 fluid ounces	*1 cup*
2 cups	*1 pint*
2 pints	*1 quart*
4 quarts	*1 gallon*

Metric System

You can use both conversion factors and proportions to convert metric units. However, since the system is based on factors of 10, you are multiplying or dividing by powers of 10. All we need to know is how to multiply or divide by moving the decimal point—what direction and how many places.

We need to start with the meaning of the metric prefixes. Again, note that to move from one unit to another is simply multiplying or dividing by 10.

kilo-	1000
hecto-	100
deka- or deca-	10
base or unit (meter, liter, gram)	1
deci-	.1
centi-	.01
milli-	.001

A way to remember the order of these units is to think:

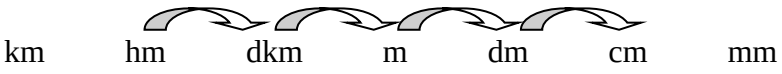
King **H**enry **D**oesn't (**U**sually) **D**rink **C**hocolate **M**ilk

Or

King **H**enry **D**ied (**B**y) **D**rinking **C**hocolate **M**ilk

where the first letter matches the first letter of the prefix, and the "U" refers to the unit or the "B" refers to the base (meter, liter or gram).

If you memorize them in this order, you will know the answer to our questions of how to move the decimal point. For example, let's convert 24 hectometers to centimeters. We would list: km, hm, dkm, m, dm, cm and mm. Then we need to determine, how many "jumps" I would make from hectometers to get to centimeters.



I would "jump" four places, to the right. I will move my decimal that way, filling in zeros as place holders:

24 → 24.0 → 24 0 0 0 → 0

240000

Therefore, 24 hm = 24,000 cm.

Example: Convert 54,653 m to km.

Let's determine the number of jumps and the direction to move.

km hm dkm m dm cm mm

We need to move the decimal 3 places to the left.

54,653 → 54653.0 → 5 4 6 5 3 . 0 → 54.653

Therefore, 54,653 m = 54.653 km.

Example:

Which of these is the **least** weight?

A 1 gram
B 1 milligram
C 1 ounce
D 1 pound

Example:

The height of a man is about 2 yards. Which measure is **closest** to 2 yards?

A 80 centimeters
B 200 centimeters
C 800 centimeters
D 2000 centimeters

NVACS 6.RP.A.3d Use ratio reasoning to convert measurement units; manipulate and transform units appropriately when multiplying or dividing quantities.

Example: *The length of a sheet of paper is 11 inches. What is the length in centimeters?*
Note: 1 inch ≈2.54 cm

$$\frac{inch}{cm} = \frac{1}{2.54} = \frac{11}{x} \quad (\times 11) \qquad or \qquad \frac{in}{in} = \frac{cm}{cm} \quad \frac{1}{11} = \frac{2.54}{x} \quad (\times 2.54)$$

Solution: **27.94 cm long**

***Example*:** *Alex's bedroom is 12 feet long by 10 feet wide. He wants to replace the carpet. The new carpet costs $16 per square meter. What will be the total cost of the new carpet?*
Note: 1 foot ≈0.305 meters

Solution:

Length: $\frac{feet}{meters}$ $\frac{1}{0.305}=\frac{12}{x}$ (×12 above, ×12 below) x=3.66 meters

Width: $\frac{feet}{meters}$ $\frac{1}{0.305}=\frac{10}{x}$ (×10 above, ×10 below) x=3.05 meters

Area: Area= length $\times$ width 3.66 meters $\times$ 3.05 meters=11.163square meters

Cost: Total Cost = Square meters $\times$ cost per square meter
Total Cost = 11.163square meters $\times$ \$16 = **\$178.61**

***Example*:** Convert 6 weeks to days.

$\frac{week}{days}=\frac{1\,week}{7\,days}=\frac{6\,weeks}{x\ days}$

$7\bullet 6=42\,days$

or

$\frac{week}{week}=\frac{day}{day}\rightarrow\frac{6\,weeks}{1\,week}=\frac{x}{7\,days}$

$x=42\ days$

***Example*:** Convert 4 hours to minutes. Use a proportion to solve. Show your work.

$\frac{hour}{minutes}=\frac{1\,hour}{60\,minutes}=\frac{4\ hours}{x\ minutes}$

$x=240\,minutes$

or

$\frac{4\,\cancel{hours}}{1\,\cancel{hour}}=\frac{x}{60\,minutes}$

$4\bullet 60\,minutes=x$

$240\,minutes$

***Example*:** What is 54 inches converted into feet?

$\frac{inches}{foot}=\frac{12\ inches}{1\ feet}=\frac{54\ inches}{x}$

$x=4.5\,feet$

or

$\frac{54\,\cancel{inches}}{12\,\cancel{inches}}=\frac{x}{1\ foot}=$

$12x=54\,feet$

$x=\frac{54}{12}\,feet=4\frac{6}{12}\,feet=4\frac{1}{2}\,feet$

***Example*:** Convert 1,549 mL to L. Use a proportion to solve. Show your work.

$$\frac{mL}{L}=\frac{1{,}000}{1}=\frac{1549}{x}$$

$$x=1.549\,L$$

or

$$\frac{1{,}549\ mL}{1{,}000\,mL}=\frac{x}{1L}$$

$$1{,}000x=1{,}549\,L$$

$$x=\frac{1{,}549}{1{,}000}L\ =\ 1.549\,L$$

Example: The distance Beta must run in PE class is 174 yards. So far she has run 48 feet. How many yards does she have left to run?

$$\frac{feet}{yards}=\frac{3}{1}=\frac{48}{x}$$

($\times 16$ on the top, $\times 16$ on the bottom)

$$x=16\,yards$$

or

$$\frac{48\,feet}{3}$$

$$\frac{48\,\cancel{feet}}{3\,\cancel{feet}}=\frac{x}{1\,yard}$$

$$48=3x$$

$$\frac{48}{3}=\frac{3x}{3}$$

$$16=x$$

$$16\,yards$$

But the question asks how many <u>more yards</u> does she have to run, so we must subtract the amounts.

$$\begin{array}{r} 174 \\ -16 \\ \hline 158 \end{array}$$

Beta has 158 yards left to run

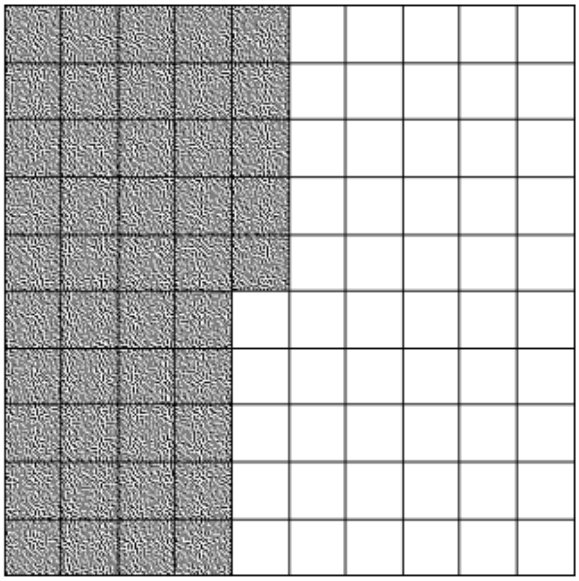
OnCore Examples

23. A set of trading cards sells for $8.95 before tax. After sales tax, it costs $9.60. What is the sales tax rate?
    a. 0.65%
    b. 6.77%
    c. 7.26%
    d. 13.77%

30. Sarah missed 9 questions on a quiz with 60 questions. What percent of questions did she get wrong?
    a. 10%
    b. 12%
    c. 15%
    d. 20%

31. What percent of 80 is 14?
    a. 0.175%
    b. 5.7%
    c. 17.5%
    d. 175%

66. Write the percent modeled by the grid.



    a. 45%
    b. 55%
    c. 0.55%
    d. 0.45%

67. Find 30% of 70.
    a. 2100
    b. 21
    c. 233.33
    d. 16.6

68. Find 70% of 90.
    a. 63
    b. 128.57
    c. 6300
    d. 59.4

70. A jar is filled with buttons of various colors. If the jar has a total of 420 buttons and 85% of the buttons are green, how many green buttons are in the jar?
    a. 335 green buttons
    b. 35,700 green buttons
    c. 63 green buttons
    d. 357 green buttons

71. Alberto is a waiter. He waits on a table of 4 whose bill comes to $110.05. If Alberto receives a 15% tip, about how much will he receive?
    a. $16.50
    b. $126.55
    c. $16.05
    d. $5.50

72. A watch cost $75.99. If the sales tax rate is 6.25%, what is the amount of sales tax?
    a. $0.48
    b. $2.19
    c. $4.75
    d. $474.94

74. In a survey, 10% of the people said they live in a city. If 60 people said they live in a city, how many people were surveyed?
    a. 15 people
    b. 25 people
    c. 240 people
    d. 600 people

75. Regina went out for breakfast. The bill came to $7.12. If Regina has a discount coupon for 20%, how much will be taken off the bill?
    a. $0.40
    b. $0.70
    c. $1.00
    d. $1.40

77. Frank's Sports store has a 20% off sale on all of its merchandise. How much is the discount on a baseball glove that originally costs $25?
    a. $0.05
    b. $5.00
    c. $20.00
    d. $30.00

81. Leslie's bookstore has a 48% off sale on all of its merchandise. How much is the discount on a book that originally costs $36.45?
    a. $11.55
    b. $17.50
    c. $18.95
    d. $53.95

87. If Nathan saves 35% on a $22.50 dress shirt, how much did he save?
    a. $7.78
    b. $7.88
    c. $12.38
    d. $14.63

89. A DVD movie sells for $29 and the sales tax is 5.5%. What is the total cost of the movie to the nearest penny?
    a. $30.60
    b. $27.40
    c. $29.95
    d. $30.45

90. A sweater is on sale for 30% off the ticketed price of $42. How much will the sweater cost after the discount?
    a. $12.60
    b. $25.60
    c. $29.40
    d. $54.60

92. Iris wants to buy two necklaces, one for her sister and one for herself. The necklace for her sister costs $42.00, and the necklace for herself costs $28.00. The sales tax on the purchases is 8%. Find the total cost of Iris's purchases, including sales tax. If necessary, round your answer to the nearest cent.
    a. $64.40
    b. $5.60
    c. $75.60
    d. $70.00

93. The Quick Slide Skate Shop sells the Ultra 2002 skateboard for a price of $54.85. However, the Quick Slide Skate Shop is offering a one-day discount rate of 30% on all merchandise. About how much will the Ultra 2002 skateboard cost after the discount?
    a. $16.50
    b. $71.50
    c. $38.50
    d. $53.90

94. An airline is trying to promote its new Boston to Atlanta flight. The usual price of this flight is $315. However, the airline is offering a 40% discount until the end of the month. How much will the flight cost after the discount?
    a. $126
    b. $441
    c. $189
    d. $567

95. Hisako sells dolls at her doll store. If she sells a doll for $35, and there is 6% sales tax, what is the total cost of the doll? Round your answer to the nearest cent.
    a. $37.10
    b. $41.55
    c. $32.90
    d. $2.10

96. Sara wants to buy a necklace. The necklace has a list price of $41, and the sales tax is 6%. What will be the cost of the necklace after tax is added? Round your answer to the nearest cent.
    a. $43.46
    b. $38.54
    c. $2.46
    d. $54.06

1. Thomas has been offered two jobs. The first job pays $880.00 per week. The second job pays $790.00 per week plus 12% commission on his sales. How much will he have to sell in order for the second job to pay as much as the first job?

2. A new CD player costs $71.00. Minny waits until it is 25% off to buy it. Find the amount that Minny pays for the new CD player before tax.

3. Erica's family is moving away from California. They decided to have a moving sale and sell each item for 70% off the price they originally paid for it. The sofa had an original price of $799, and the love seat had an original price of $549. What is the total cost of both items after the discount?

3. The students in grades 6, 7, and 8 are raising money to benefit the Community Youth Center. The goals for each grade and the amounts of money raised so far are shown in the chart. Determine how much money the students in each grade have raised so far and how much more money they must raise to reach their goals.

Grade 6	**Grade 7**	**Grade 8**
Goal: $2,000	**Goal: $1,800**	**Goal: $1,600**
100%	100%	100%
10%	10%	10%

73. Orin's Sports store has a 40% off sale on all of its merchandise. How much is the discount on a soccer ball that originally costs $30?

78. Rick's Clothing store has a 45% off sale on all of its merchandise. How much would a jacket cost that was originally priced at $27.35?

84. A flower store sells carnations for $18.50 per dozen. The sales tax is 6%.
Part A: How much is the sales tax on a dozen carnations? Show your work.
Part B: What will be the total cost of a dozen carnations? Show your work.

97. Convert 6 yards to feet.
a. 18 yards
b. 18 feet
c. 216 feet
d. 3 yards

98. Convert 17 gallons to cups.
a. 16 cups
b. 136 cups
c. 286 cups
d. 272 cups

99. Convert 0.78 meters to millimeters.
a. 0.000078 millimeters
b. 780 millimeters
c. 78 millimeters
d. 0.00078 millimeters

100. Convert 7 cups to liters.
a. 1.6576 L
b. 7 L
c. 1657.6 L
d. 142.8571 L

101. Convert 108 feet to yards.
a. 1296 yd
b. 3888 yd
c. 324 yd
d. 36 yd

102. Convert 19 miles to yards.
a. 57 yards
b. 33,440 miles
c. 1,760 miles
d. 33,440 yards

103. Convert 73 kg to grams.
a. 0.073 g
b. 0.73 g
c. 7,300 g
d. 73,000 g

104. Convert 4 hours to minutes.
a. 0.07 minutes
b. 2,400 minutes
c. 24 minutes
d. 240 minutes

105. Convert 54 m to kilometers.
a. 0.0054 km
b. 0.054 km
c. 540 km
d. 54,000 km

106. Convert 300 mL to L.
a. 0.3 L
b. 3 L
c. 30 L
d. 300 L

107. Convert 704 oz to pounds.
a. 16 pounds
b. 11 pounds
c. 44 pounds
d. 22 pounds

108. Which gives 1600 m in km?
a. 16,000 km
b. 1600 km
c. 16 km
d. 1.6 km

109. Which measurement is equivalent to 880 cm?
a. 88 mm
b. 0.88 km
c. 8.8 m
d. 8,800 km

110. What is 16 fluid ounces converted into cups?
a. 2 cups
b. 4 cups

111. An infant drinks about 22 ounces of milk per day. About many quarts of milk does the baby drink in 4 weeks?
a. 38.5 qt
b. 25 qt
c. 5.5 qt
d. 19.25 qt

112. A whitewater kayak is 2 m long. Convert this measure to cm.
a. 2 cm
b. 20 cm
c. 200 cm
d. 2,000 cm

113. Working as a salesman, James visits 10 cities per week. At this rate, about how many cities would he visit in one year?
a. 62 cities
b. 3640 cities
c. 520 cities
d. 120 cities

114. How many liters are equivalent to 8,000 mL?
a. 8 L
b. 800 L

115. A large mixing bowl has a capacity of 5 quarts. How many fluid ounces is this?
a. 16 fl oz
b. 40 fl oz
c. 80 fl oz
d. 160 fl oz

116. A house is 1,928 cm long. Convert this measure to m.
a. 1.928 m
b. 19.28 m
c. 192. 8
d. 192,800 m

117. How many feet are there in 7 miles?
a. 3,696 ft
b. 5,280 ft
c. 7.040 ft
d. 36,960 ft

118. Sandra needs 180 feet of purple ribbon to prepare wedding decorations. How many yards of ribbon is this?
a. 30 yd
b. 45 yd
c. 60 yd
d. 540 yd

119. A damaged tugboat is leaking 2 gallons of fuel per minute. At this rate, how many liters of fuel will the tugboat lose per hour?
a. 31.66 L/hr
b. 0.13 L/hr
c. 113.52 L/hr
d. 454.8 L/hr

120. Gloria is selling orange juice during halftime at a basketball game. If she has 18 pints of juice, how many 1-cup servings can she sell?
a. 9 servings
b. 144 servings
c. 72 servings
d. 36 servings

121. Rachel is 1.35 m tall. Her friend, Pita, is 179 cm tall. Who is taller, and by how much? Give your answer in centimeters.
a. Rachel; 165.5 cm
b. Pita; 44 cm
c. Rachel; 44 cm
d. Pita; 165.5 cm

122. Jenny drank a 15-fluid-ounce bottle of water before tennis practice. After practice, she drank 4 cups of water. What is the total amount of water Jenny drank?
a. 7 c and 9 fl oz
b. 7 c and 7 fl oz
c. 5 c and 9 fl oz
d. 5 c and 7 fl oz

123. A new type of liquid is gathered from the Moon. If one kiloliter of the liquid has a mass of 5 kilograms, what is the mass of 7 liters of the liquid?
a. 35 g
b. 35 mg
c. 35 kg
d. 35 L

124. Alicia runs for exercise. If Alicia runs 30 miles in six days, how many feet does she run per day?
a. 8,800 ft
b. 22,629 ft
c. 26,400 ft
d. 158,400 ft

125. Alsea Bay Bridge in Oregon is about 970 yards long. About how many feet is this?
a. 2,910 ft
b. 81 ft
c. 11,640 ft
d. 323 ft

126. When Amy roller-skates, she moves 110 yards per minute. What is her speed in miles per hour? Round your answer to the nearest hundredth.
a. 3.75 mi/hr
b. 1.25 mi/hr
c. 3226.67 mi/hr
d. 0.42 mi/hr

127. Evan's car gets approximately 20 miles per gallon. How many feet can he drive with 1 pint of gas?
a. 26,400 ft
b. 13,150 ft
c. 13,200 ft
d. 4,400 ft

128. A damaged tugboat is leaking 1.5 gallons of fuel per minute. At this rate, how many quarts of fuel will the tugboat lose in 1 hour?
a. 180 qt
b. 360 qt
c. 720 qt
d. 22.5 qt

129. Derek's Great Dane puppy is growing quickly. He gains an average of 40 ounces per week. At this rate, about how many pounds will he gain in 1 year?
a. 173 lb
b. 240 lb
c. 130 lb
d. 120 lb

130. Raquel uses 13 oranges to make 1 cup of orange juice. How many oranges would she use to make 1 gallon of juice?
a. 416 oranges
b. 208 oranges
c. 36 oranges
d. $\frac{13}{16}$ orange

131. Use a unit conversion factor to convert 105 miles per hour to miles per second. If necessary, round your answer to the nearest hundredth.
a. 0.29 miles per second
b. 378,000 miles per second
c. 37,800 miles per second
d. 0.03 miles per second

4. Convert 644 centimeters to yards. Round your answer to the nearest hundredth.

5. The distance Beya must run in Physical Education class is 174 yards. So far she has run 48 feet. How many yards does she have left to run?

6. Find the cost of 1 pint of ice cream when 3 quarts of ice cream cost $3.60. Round your answer to the nearest cent.

4. A drink mix label states that 2 tablespoons of mix should be added to every 5 cups of water. If a container has 40 cups of water in it, how much mix should be added to the water? Use a proportion to solve. Show your work.

5. A gas pipe company is laying gas pipe through some mountains. Due to the uneven landscape, the workers must lay approximately 6500 feet of pipe for every mile of land they cover. If the workers must cover 8 miles through the mountains, how many feet of pipe will they need? Use a proportion to solve. Show your work.

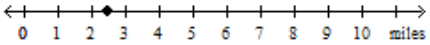
12. Jake grew an average of 0.5 cm per month last year. How many inches did he grow in the year? (Use 2.5 cm = 1 inch.)

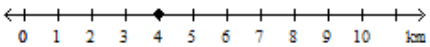
13. One and three-fourths pounds of green beans cost $1.98.

Part A: What is the cost of 3 pounds of green beans?

Part B: The cost of each $\frac{1}{4}$ pound of beans increases by $0.10. How does this affect the cost per pound? Explain.

15. The points graphed on each number line show equivalent distances measured in kilometers and in miles.





The distance from New York City, NY, to San Diego, CA, is approximately 2,800 miles. Explain how you could use the number lines to estimate the distance between the two cities in kilometers.

18. Johanna uses 40 sheets of paper every 4 days.

Part A: Make a table to show the number of sheets of paper Johanna will use in 12, 24, and 48 days.
Part B: How many sheets of paper does Johanna use per day?
Part C: Johanna's sister uses twice as much paper as Johanna uses in half the number of days that Johanna does. How many times more paper does Johanna's sister use each day than Johanna?

62. Melissa read a 384-page book in 37,440 seconds. Determine her page-per-minute reading rate. Round to the nearest hundredth.

85. Convert 1,549 mL to L.

86. Convert 22 miles to yards. Use a proportion to solve. Show your work.

87. The average teenager spends about 57 hours per month in a car. How many minutes per day is this? Show your work, or explain in words how you determined your answer. (Assume a 30-day month.)

88. What is 54 inches converted into feet?

89. What is 112 inches converted into feet?

90. What is 44 pints converted into gallons?

91. A large milk jug has a capacity of 128 fl oz. How many quarts is this?

92. A box of crackers has a mass of 340 g. How many kg is this?

93. A box of cereal weighs 450 grams.

Part A: How many kilograms does it weigh? Show your work.
Part B: How many milligrams does it weigh? Show your work.

94. A bag of rice has a mass of 1.2 kg. How many grams is this?

4. A 2-inch tall wooden box is 8 inches long by 4 inches wide. Hedo wants a 5-inch tall box that is similar in shape. Find the dimensions of Hedo's box. Show your work, and justify your response.

9. Why is it easier to convert within metric units than it is within customary units?

Standard 6.RP.3 *DOK: 2* *Answer: C*

7. A set of trading cards sells for $5 before tax. After sales tax, it costs $5.50. What is the sales tax rate?

a. 5%
b. 8%
c. 10%
d. 90%

Standard 6.RP.3 *DOK: 2* *Answer: 6%* *Short Answer*

9. A graphic novel sells for $14.95 before tax. After sales tax, it costs $15.85. What is the sales tax rate?

Standard 6.RP.3c *DOK: 1* *Answer: A*

19. A DVD movie sells for $29 and the sales tax is 5.5%. What is the total cost of the movie to the nearest penny?

a. $30.60
b. $27.40
c. $29.95
d. $30.45

Standard 6.RP.3c *DOK: 2* *Answer: $750* *Numeric Response*

20. Thomas has been offered two jobs. The first job pays $880.00 per week. The second job pays $790.00 per week plus 12% commission on his sales. How much will he have to sell in order for the second job to pay as much as the first job?

Standard 6.RP.3c *DOK: 2* *Answer: B*

21. Alaska is the largest state in the United States and has a surface area of approximately 588,000 square miles. Indiana has a surface area that is approximately 6% of the surface area of Alaska. What is the approximate surface area of Indiana?

a. 3,528,000 square miles
b. 35,280 square miles
c. 9,800 square miles
d. 98 square miles

Standard 6.RP.3c *DOK: 2* *Answer: C*

22. An airline is trying to promote its new Boston to Atlanta flight. The usual price of this flight is $315. However, the airline is offering a 40% discount until the end of the month. How much will the flight cost after the discount?

a. $126
b. $441
c. $189
d. $567

Write your answer to Question 11 on a separate sheet of paper. Be sure to answer Parts A and B.

11 The ratio of the number of girls to the number of boys at Michael's school is 4:5 . There are 351 students at the school.

A How many students at Michael's school are girls? Show your work or explain your thinking.

B At Sally's school, 28% of the students are in 6th grade. There are 49 students in 6th grade. What is the total number of students at Sally's school? Show your work or explain your thinking.

SBAC Examples

Standard: 6.RP.A.3c ***DOK:2*** ***Question Type: Equation/Numeric***

TM7
Stimulus: The student is presented with a part and a percent.

Enter the unknown value that makes this statement true:

30% of ☐ is 60.

Rubric: (1 point) Student enters the correct numeric value representing the total amount (e.g., 200).

Response Type: Equation/Numeric

Standard: 6.RP.A.3c ***DOK:2*** ***Question Type: Equation/Numeric***

TM8a
Stimulus: The student is presented with a part and a whole.

Example Stem 1: Janet correctly answers 45 questions on her science test. There are 50 questions on the test.

Enter the percent of the questions Janet answers incorrectly.

Example Stem 2: Enter the unknown value that makes this statement true:

45 is ☐ % of 50.

Rubric: (1 point) Student enters the correct numeric value representing the percent (e.g., 90; 90) and 0.90 is not an acceptable answer. Percent symbol (%) is not required for a correct response.

Response Type: Equation/Numeric

Standard: 6.RP.A.3c ***DOK:1*** ***Question Type: Multiple Choice Multiple Correct Response***

TM8b
Stimulus: The student is presented with a real-world or mathematical percent problem.

Example Stem 1: In a school with 200 students, 45% are males.

Select **all** expressions that demonstrate a correct method to calculate the total number of male students.

A. $\frac{45}{100} \bullet 200$

B. $\frac{0.45}{100} \bullet 200$

C. $0.45 \bullet 200$

D. $\frac{45}{10} \bullet 200$

Example Stem 2: Select **all** expressions that demonstrate a correct method to calculate 45% of 200.

E. $\frac{45}{100} \bullet 200$

F. $\frac{0.45}{100} \bullet 200$

G. $0.45 \bullet 200$

H. $\frac{45}{10} \bullet 200$

Answer Choices: At least two expressions must be correct.

Rubric: (1 point) Student selects all the correct mathematical expressions (e.g., A and C; A and C).

Response Type: Multiple Choice, multiple correct response

Grades 6-8, Claim 2

Task Model 1

DOK Levels 2, 3

Target A: Apply mathematics to solve well-posed problems in pure mathematics and arising in everyday life, society, and the workplace.

Example Item 3 (Grade 6):
Primary Target 2A (Content Domain RP), Secondary Target 1A (6.RP.3c), Tertiary Standard 2C

Katie and Becca each bought a new book for $50.

- Katie sold her book to the used bookstore for 25% less than the original price.
- Becca sold her book to the used bookstore for 40% less than the original price.

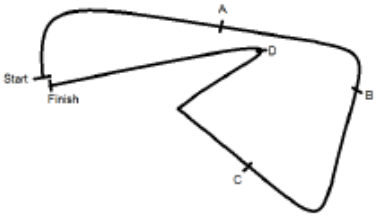
Enter how much more money, in dollars, Katie received for her book than Becca received for her book.

Rubric: (1 point) The student computes the correct difference (e.g., 7.50).

Response Type: Equation/Numeric

Example Item 4 (Grade 6):
Primary Target 2A (Content Domain RP), Secondary Target 1A (CCSS 6.RP.3), Tertiary Target 2D

It takes Shaun 90 minutes to complete a 15 mile race. The route, with four checkpoints (labeled A, B, C, and D), is shown.



Assume Shaun runs at a constant rate during the race.

Complete the table to show Shaun's time, in minutes, and distance, in miles, at each checkpoint.

Checkpoint	A	B	C	D	Finish
Number of minutes	6			60	90
Number of miles		$2\frac{3}{4}$	7.5		15

Rubric: (2 points) The student correctly determines all four missing values.
(1 point) The student correctly determines both minutes (e.g., 16.5, 45) or both miles (e.g., 1, 10) or three out of four values correct.

Response Type: Fill-in Table

Example Item 3 (Grade 6):
Primary Target 2A (Content Domain RP), Secondary Target 1A (6.RP.3c), Tertiary Standard 2C

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- Becca sold her book to the used bookstore for 40% less than the original price.

Enter how much more money, in dollars, Katie received for her book than Becca received for her book.

Rubric: (1 point) The student computes the correct difference (e.g., 7.50).

Response Type: Equation/Numeric

Standard: 6.RP.A.3d ***DOK: 2*** ***Question Type: Multiple Choice, single correct response***

Prompt Features: The student is prompted to use ratio reasoning to determine the missing measurement.

Stimulus Guidelines:

- Units of measurement should be rational numbers appropriate for the given situation.
- Item difficulty can be adjusted via these example methods:
  - All numbers used in conversion are whole numbers.
  - Some numbers used in conversion are decimals.
  - All numbers used in conversion are decimals.

TM9

Stimulus: The student is presented with a measurement ratio with a missing equivalent ratio value.

Example Stem: Select the value that will complete this expression for converting 10 yards to inches.

$$\left(\frac{10 \text{ yards}}{1}\right)\left(\square\right)\left(\frac{12 \text{ inches}}{1 \text{ foot}}\right)$$

A. $\frac{1 \text{ yard}}{36 \text{ inches}}$

B. $\frac{3 \text{ feet}}{1 \text{ yard}}$

C. $\frac{360 \text{ inches}}{10 \text{ yards}}$

D. $\frac{120 \text{ feet}}{10 \text{ inches}}$

Rubric: (1 point) Student selects the correct mathematical expressions (e.g., B).

Response Type: Multiple Choice, single correct response

Stimulus Guidelines:

- If used, context should be familiar to students 11 to 13 years old.
- Units of measurement should be rational numbers appropriate for the given situation.
- Specify measurement relationship when needed (e.g., 1 inch ≈ 2.54 cm).
- Item difficulty can be adjusted via these example methods
    - All numbers used in conversion are whole numbers and problems only require a single-unit conversion.
    - Some numbers used in conversion are decimals and problems only require a single-unit conversion
    - All numbers used in conversion are whole numbers and problems require multi-unit conversions.
    - Some numbers in conversions are decimals and problems require multi-unit conversions.

TM10
Stimulus: The student is presented with a measurement and is asked to convert it to an equivalent measurement.

Example Stem 1: Mary runs 800 yards in 4 minutes at a constant rate.

Enter the number of **feet** Mary runs in 20 **seconds**.

Example Stem 2: An object moves at a constant rate of 800 yards in 4 minutes.

Enter the distance, in **feet**, the object moves in 20 **seconds**.

Rubric: (1 point) Student enters the correct numeric value for the converted unit of measurement (e.g., 200; 200). Unit of measurement should be assumed from the stem.

Response Type: Equation/Numeric