

Section 5.3 Percent applications (Part I)

For fractions, the key word “of” indicates multiplication when written between a fraction and a number such as $\frac{3}{4}$ of 12. Similarly for percentages, the key word “of” indicates multiplication when written between a percent and a number such as 75% of 12.

Fractional part **of** a number

$$\frac{3}{4} \text{ of } 12 = \frac{3}{4}(12) = 9$$

$$\frac{1}{2} \text{ of } 80 = \frac{1}{2}(80) = 40$$

Percentage **of** a number

$$75\% \text{ of } 12 = 75\%(12)$$

$$50\% \text{ of } 80 = 50\%(80)$$

To multiply a percent times a number

To multiply a percent times a number, first write the percent in decimal format by removing the percent symbol % and moving the decimal point two places to the left and then multiply the resulting decimal times the number.

Example 1 Evaluate the following: 75% of 12 50% of 80 3% of 170

Write each as a multiplication problem involving a percent times a number. To multiply the percent times the number, first write the percent in decimal format by removing the percent symbol % and moving the decimal point two places to the left and then multiply the resulting decimal times the number.

$$75\% \text{ of } 12 = 75\%(12) = 0.75(12) = 9$$

$$50\% \text{ of } 80 = 50\%(80) = 0.50(80) = 40$$

$$3\% \text{ of } 170 = 3\%(170) = 0.03(170) = 5.1$$

$$\begin{array}{r} \cancel{1} \\ 12 \\ \times .75 \\ \hline 60 \\ 840 \\ \hline 9.00 \end{array}$$

$$\begin{array}{r} 4 \\ 80 \\ \times .50 \\ \hline 40.00 \end{array}$$

$$\begin{array}{r} 2 \\ 170 \\ \times .03 \\ \hline 5.10 \end{array}$$

For multiplications involving 1%, 10%, 50%, 100% and 200% these products can be calculated mentally without having to show any multiplication steps.

1% of a number is equal to **one hundredth of** the number

To find 1% of a number multiply by 0.01 which moves the decimal point in the number two places to the left.

10% of a number is equal to **one tenth of** the number

To find 10% of a number multiply by 0.10 which moves the decimal point in the number one place to the left.

50% of a number is equal to **half of** the number

To find 50% of a number multiply by 0.50 which results in half of the number.

100% of a number is equal to **all of** the number

To find 100% of a number multiply by 1.00 which leaves the number unchanged.

200% of a number is equal to **double** the number

To find 200% of a number multiply by 2.00 which doubles the number.

Example 2 Evaluate the following mentally without showing steps.

1% of 80 10% of 80 50% of 80 100% of 80 200% of 80

$$1\% \text{ of } 80 = 0.80$$

*A hundredth of 80
Move decimal point 2 places to the left*

$$10\% \text{ of } 80 = 8.0$$

*A tenth of 80
Move decimal point 1 place to the left*

$$50\% \text{ of } 80 = 40$$

Half of 80

$$100\% \text{ of } 80 = 80$$

All of 80

$$200\% \text{ of } 80 = 160$$

Double 80

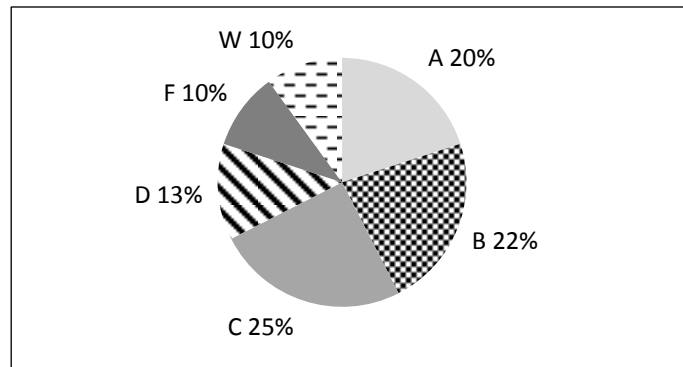
Example 3 Assuming that 10% of humans are left handed how many left handers are expected in a class with 30 students

Since 10% of 30 equals 3 as shown below, three left handed students are expected in a typical class of 30 students.

$$10\% \text{ of } 30 = 3.0$$

*A tenth of 30
Move decimal point 1 place to the left*

Example 4 The final grade distribution in an algebra class with 40 students is shown below. How many students earned an A grade? How many earned a C grade? How many students withdrew from the course? How many students were successful in this course?



To determine the number of students that earned an A grade find 20% of the 40 total students as shown below which results with 8 students receiving an A grade.

$$20\% \text{ of } 40 = 20\%(40) = 0.20(40) = 8$$

$$\begin{array}{r} 40 \\ \times .20 \\ \hline 8.00 \end{array}$$

To determine the number of students that earned a C grade find 25% of the 40 total students as shown below which results with 10 students receiving a C grade.

$$25\% \text{ of } 40 = 25\%(40) = 0.25(40) = 10$$

$$\begin{array}{r} 40 \\ \times .25 \\ \hline 200 \\ 800 \\ \hline 10.00 \end{array}$$

To determine the number of students that withdrew find 10% of the 40 total students using the mental calculation shown below. Four students withdrew from the course.

$$10\% \text{ of } 40 = 4.0$$

*A tenth of 40
Move decimal point 1 place to the left*

Successful students are defined as those that earned an A, B or C grade, to find the success rate in this course add 20%, 22% and 25%. Then find 67% of the 40 total students as shown below which results with 27 students successful in this course.

$$67\% \text{ of } 40 = 67\%(40) = 0.67(40) = 26.8 \approx 27$$

$$\begin{array}{r} 40 \\ \times .67 \\ \hline 280 \\ 2400 \\ \hline 26.80 \end{array}$$

Example 5 In the third quarter of 2012, 75% of the 180 million smart phones shipped use the android operating system. How many android smart phones are shipped in the third quarter of 2012? How many non-android types of smart phones are shipped in that quarter?

To find the number of android smart phones shipped in the third quarter of 2012, evaluate 75% of the total 180 million smart phones shipped. As shown below, 135 million android cell phones are shipped in the third quarter of 2012.

$$75\% \text{ of } 180 = 75\%(180) = 0.75(180) = 135$$

$$\begin{array}{r} 5 \\ \cancel{4} \\ 180 \\ \times .75 \\ \hline 900 \\ 12600 \\ \hline 135.00 \end{array}$$

There are two different techniques to find the number of non-android smart phones shipped in this quarter. One method is to subtract the 135 million android smart phones shipped from the total 180 million shipped. A second technique is to subtract 75% from 100% which leaves 25% of the smartphone shipped being non-android and evaluating 25% of the total 180 million smart phones shipped. Both calculations are shown below which result with 45 million non-android phones shipped.

$$180 - 135 = 45$$

OR

$$25\% \text{ of } 180 = 25\%(180) = 0.25(180) = 45$$

$$\begin{array}{r} 1 \\ \cancel{4} \\ 180 \\ \times .25 \\ \hline 900 \\ 3600 \\ \hline 45.00 \end{array}$$

Example 6 In the 2012 presidential election nationwide approximately 51.0% voted for President Obama, 47.3% voted for Governor Romney, and 1.7% voted for other candidates. If approximately 128.3 million citizens cast votes in the presidential election, find how many voted for each candidate.

To find the votes that each candidate received multiply the percentage of voters each candidate received times the 128.3 million total voters. As shown below, Obama received approximately 65.4 million, Romney received 60.7 million, and other candidates received 2.2 million votes.

$$\text{Obama votes} \quad 51.0\% \text{ of } 128.3 = 51.0\%(128.3) = 0.510(128.3) \approx 65.4$$

$$\text{Romney votes} \quad 47.3\% \text{ of } 128.3 = 47.3\%(128.3) = 0.473(128.3) \approx 60.7$$

$$\text{Other votes} \quad 1.7\% \text{ of } 128.3 = 1.7\%(128.3) = 0.017(128.3) \approx 2.2$$

The discount, the markup, commission earned, and sale tax are all determined by a percent (discount rate, markup rate, commission rate, sales tax rate) of a corresponding quantity (regular price, wholesale cost, total sales, purchase price). Thus the discount, the markup, the commission earned, and the sale tax can be calculated by simply multiplying the appropriate percentage times the corresponding quantity as shown below.

$$\text{discount} = \text{discount rate \% of regular price}$$

$$\text{markup} = \text{markup rate \% of wholesale cost}$$

$$\text{sales tax} = \text{sales tax rate \% of purchase price}$$

$$\text{commission earned} = \text{commission rate \% of total sales}$$

When retailers have special sales they often mark down the price of items by a percentage. For an item that is on sale at a percentage off, the discount (the amount saved) is determined by a percent (the discount rate) of the regular or marked price.

Example 7 For a holiday sale at a local retailer all shoes are 30% off of their regular prices. Find the discount and the sale price for shoes with a regular price of \$20.

Find the discount on the shoes by evaluating 30% of the \$20 regular price. As shown below the saving is \$6 and the sale price is \$14 which is determined by subtracting the \$6 savings from the \$20 regular price.

Discount	$30\% \text{ of } \$20 = 30\%(\$20) = 0.30(\$20) = \6.00	$\begin{array}{r} 20 \\ \times .30 \\ \hline 6.00 \end{array}$
Sale price	$\$20.00 - \$6.00 = \$14.00$	

Example 8 As part of a clearance sale a retailer in the April offers all their remaining sweaters at 50% off. Find the amount saved on a sweater with a regular price of \$48.

Find the discount on the sweater by evaluating 50% of the \$48 regular price which can be calculated mentally by taking half of the regular price. As shown below the saving is \$24 and the sale price is also \$24

Discount	$50\% \text{ of } \$48 = \text{Half of } \$48 = \$24.00$
Sale price	$\$48.00 - \$24.00 = \$24.00$

Retailers often set their list prices by marking up the cost of items by a percentage of their wholesale cost. For an item whose price is marked up by a percentage of the wholesale price, the markup amount is determined by a percent (the markup rate) of the wholesale cost.

Example 9 A campus bookstore has a markup rate of 25% on textbooks. Find the markup and list price of a textbook whose wholesale cost is \$90.

Find the markup on this textbook by evaluating 25% of the \$90 wholesale cost. As shown below, the markup is \$22.50 and the list price of the textbook is \$112.50 which is determined by adding the \$22.50 markup to the \$90 wholesale cost.

Markup amount	$25\% \text{ of } \$90 = 25\%(\$90) = 0.25(\$90) = \22.50	$\begin{array}{r} 90 \\ \times .25 \\ \hline 450 \\ 1800 \\ \hline 22.50 \end{array}$
List Price	$\$90.00 + \$22.50 = \$112.50$	$\begin{array}{r} 90 \\ + 22.50 \\ \hline 112.50 \end{array}$

To motivate sales some employers pay their workers using a commission system, in which the commission earned is determined by a percent (the commission rate) of the total sales by that employee.

Example 10 Jamille earns \$2500 per month plus 1% commission of her monthly sales. Find her monthly salary if her monthly sales are \$45,000.

First find the commission earned by evaluating 1% of the \$45,000 monthly sales which is calculated mentally by moving the decimal point two places to the left. As shown below, Jamille earned \$450 in commission and her monthly salary is \$2950 which is determined by adding the \$450 commission to her \$2500 base salary.

Commission earned

$$1\% \text{ of } \$45,000 = \$450.00$$

*A hundredth of 45,000
Move decimal point 2 places to the left*

Monthly salary

$$\$2500 + \$450 = \$2950$$

To generate tax revenues forty five of the fifty states have a sales tax. The sales tax on a purchase is determined by a percent (the sales tax rate) of the purchase price.

Example 11 The tax rate in Vallejo is 8% of the purchase. Sandy spends \$27.25 at a store in Vallejo. Find the sales tax on that purchase and find the total cost including tax.

To find the tax paid on a \$27.25 purchase, evaluate 8% of \$27.25 which results in a \$2.18 tax on this purchase. To find the total cost of \$29.43, add the \$2.18 sales tax to the \$27.25 purchase price.

Sales Tax 8% of \$27.25 = 8%(\$27.25) = 0.08(\$27.25) = \$2.18

Total cost \$27.25 + \$2.18 = \$29.43

$$\begin{array}{r} 524 \\ 27.\underline{2}5 \\ \times \quad \underline{.08} \\ \hline 2.\underline{1}8\underline{0}\underline{0} \end{array}$$

$$\begin{array}{r} 27.25 \\ + \quad 2.18 \\ \hline 29.43 \end{array}$$

Exercises 5.3

1-9 Evaluate the following. (Show steps)

- | | | | | | |
|----|-------------|----|-------------|----|-------------|
| 1. | 35% of 120 | 2. | 40% of 60 | 3. | 25% of 30 |
| 4. | 8% of 125 | 5. | 3.5% of 280 | 6. | 38% of 45 |
| 7. | 1.20% of 90 | 8. | 125% of 48 | 9. | 16.7% of 36 |

10-21 Evaluate the following mentally.

- | | | | | | |
|-----|------------|-----|------------|-----|------------|
| 10. | 10% of 140 | 11. | 1% of 140 | 12. | 50% of 140 |
| 13. | 100% of 24 | 14. | 200% of 24 | 15. | 10% of 24 |
| 16. | 1% of 35 | 17. | 10% of 35 | 18. | 100% of 35 |
| 19. | 50% of 8 | 20. | 10% of 8 | 21. | 200% of 8 |

22-40 Solve the following application problems. Show the calculations.

22. A multivitamin tablet contains 50% of the daily recommended value of zinc which is 15 milligrams. How many milligrams of zinc are in one tablet of this multivitamin?
23. A multivitamin tablet contains 125% of the daily recommended value of vitamin D which is 400 IU (international units). How many IU of vitamin D are in one tablet of this multivitamin?
24. Approximately 60% of the 8000 total shoppers surveyed indicated that they preferred receiving a gift card as a present. Estimate the number of shoppers surveyed that preferred receiving a gift card.
25. As a class project 60 students were surveyed and asked if they preferred online to regular classes. If 35% preferred online course, how many of the students surveyed responded that they preferred online courses.
26. 71% of the total earth's surface area of 510 million square kilometers is covered by water. How many million square kilometers of the earth are covered by water? How many million square kilometers of the earth are covered by land? *Round the final answers to the nearest million*
27. Assuming the current world population is 7 billion people. If approximately 17% of the world's population lives in India, estimate how many people live in India. *Round the final answer to one decimal place*

28. If 75% of 200 customers surveyed were satisfied with their purchase, how many of the customers surveyed responded that they were satisfied. How many of the customers surveyed responded that they were not satisfied.
29. If approximately 65% of the total students passed a course. If there were a total of 34 students in the class, estimate how many students passed the course. Estimate how many students did not pass the course.
30. A basketball player scores approximately 22% of his team's total points. If the team averages 105 points per game during the season, find how many points this player averages per game during the season.
31. A dishwasher is on sale at 10% off the regular price. If the regular price is \$420, find the discount and the sale price of the dishwasher.
32. A bed is on sale at 25% off the regular price. If the regular price is \$350, find the discount and the sale price of the bed.
33. A 28 inch television regularly priced at \$300 is marked down 18%. Find discount and the sale price of this television.
34. At a clearance sale, clothes are marked down 40%. Find the discount and the sale price of a dress with a \$28 regular price.
35. A grocer markups up cereal by 45%. If the wholesale cost of a box of cereal is \$3.00, find the markup and the price of a box of this this cereal.
36. A jeweler gets a ring wholesale for \$400 and marks it up by 250%. Find the markup and list price of this ring.
37. Lilly earns a base salary of \$2500 per month plus 1.5% commission on her total monthly sales. If her total monthly sales are \$40,000 in June, find her totally monthly earning in June.
38. Kelli earns a base salary of \$500 per week plus 1% commission on her total sales. If Kelli's total sales weekly sales are \$18,500 find her weekly earning that week.
39. A laptop computer is advertised for \$630. If the sales tax rate is 8.5%, find the sales tax amount and the total cost of the laptop including sales tax.
40. At a fast food restaurant for lunch Eduardo orders some menu items for \$7.35. If the sales tax rate is 6% find the sales tax amount and the total cost for the lunch including the sales tax.