

7.5 Interest

One way of awarding interest is called *simple interest*. Before we provide the formula used in calculating simple interest, let's first define some basic terms.

Balance. The balance is the current amount in an account or the current amount owed on a loan.

Principal. The principal is the initial amount invested or borrowed.

Rate. This is the interest rate, usually given as a percent per year.

Time. This is the time duration of the loan or investment. If the interest rate is per year, then the time must be measured in years.

To calculate the simple interest on an account or loan, use the following formula.

Simple Interest. Simple interest is calculated with the formula

$$I = Prt,$$

where I is the interest, P is the principal, r is the interest rate, and t is the time.

You Try It!

How much simple interest is earned if \$2,500 is invested at 5% per year for 8 years?

EXAMPLE 1. How much simple interest is earned if \$1,200 is invested at 4% per year for 5 years?

Solution. Set up the formula for simple interest.

$$I = Prt$$

The principal is $P = \$1200$, the interest rate is $r = 4\% = 0.04$ per year, and the time or duration of the investment is $t = 5$ years. Substitute each of these numbers into the simple interest formula $I = Prt$.

$$\begin{aligned} I &= (1200)(0.04)(5) && \text{Substitute 1200 for } P, 0.04 \text{ for } r, \text{ and } 5 \text{ for } t. \\ &= 240 && \text{Multiply.} \end{aligned}$$

Answer: \$1,000

Hence, the interest earned in 5 years is \$240.

□

To find the balance, we must add the interest to the principal.

Calculating the Balance. To find the balance, add the interest to the principal. That is,

$$\text{Balance} = \text{Principal} + \text{Interest}.$$

You Try It!

EXAMPLE 2. A contractor borrows \$5,000 at 4.5% per year. The interest accrued is simple interest. The duration of the loan is 6 months. How much will the contractor have to pay back at the end of the 6-month loan period?

Solution. Set up the formula for simple interest.

$$I = Prt$$

The principal is $P = \$5000$, the interest rate is $r = 4.5\% = 0.045$ per year, and the time or duration of the loan is $t = 6$ months. Because the interest rate is per year, the time must be changed to years. That is,

$$\begin{aligned} 6 \text{ months} &= 6 \text{ months} \cdot \frac{1 \text{ yr}}{12 \text{ months}} && \text{Apply conversion factor.} \\ &= 6 \cancel{\text{ months}} \cdot \frac{1 \text{ yr}}{12 \cancel{\text{ months}}} && \text{Cancel common unit.} \\ &= \frac{6}{12} \text{ yr} && \text{Multiply numerators;} \\ & && \text{multiply denominators.} \\ &= \frac{1}{2} \text{ yr} && \text{Reduce.} \end{aligned}$$

Substitute these numbers into the simple interest formula $I = Prt$.

$$\begin{aligned} I &= (5000)(0.045) \left(\frac{1}{2} \right) && \text{Substitute 5000 for } P, 0.045 \text{ for } r, \text{ and } 1/2 \text{ for } t. \\ &= 112.50 && \text{Multiply.} \end{aligned}$$

Hence, the interest accrued in 6 months is \$112.50. Therefore,

$$\begin{aligned} \text{Amount owed} &= \text{Principal} + \text{Interest} \\ &= 5000 + 112.50 \\ &= 5112.50 \end{aligned}$$

That is, the amount owed at the end of the 6-month loan period is \$5,112.50. **Answer:** \$8,110

You Try It!

The owner of Alioto Motors takes out a 8-month loan at 4% per year simple interest. At the end of the 8-month loan period, the interest owed is \$80. What was the principal amount borrowed?

EXAMPLE 3. A business owner takes out a 4-month loan at 5.4% per year simple interest. At the end of the 4-month loan period, the interest owed is \$90. What was the principal amount borrowed?

Solution. Set up the formula for simple interest.

$$I = Prt$$

The interest owed is $I = \$90$, the interest rate is $r = 5.4\% = 0.054$ per year, and the time or duration of the loan is $t = 4$ months. Because the interest rate is per year, the time must be changed to years. That is,

$$\begin{aligned} 4 \text{ months} &= 4 \text{ months} \cdot \frac{1 \text{ yr}}{12 \text{ months}} && \text{Apply conversion factor.} \\ &= 4 \cancel{\text{ months}} \cdot \frac{1 \text{ yr}}{12 \cancel{\text{ months}}} && \text{Cancel common unit.} \\ &= \frac{4}{12} \text{ yr} && \text{Multiply numerators;} \\ & && \text{multiply denominators.} \\ &= \frac{1}{3} \text{ yr} && \text{Reduce.} \end{aligned}$$

Substitute these numbers into the simple interest formula $I = Prt$.

$$90 = P(0.054) \left(\frac{1}{3} \right) \quad \text{Substitute 90 for } I, 0.054 \text{ for } r, \text{ and } 1/3 \text{ for } t.$$

$$90 = \frac{0.054}{3} P \quad \text{Rearrange order of multiplication.}$$

$$90 = 0.018P \quad \text{Divide: } 0.054/3 = 0.018.$$

Solve the equation for P .

$$\frac{90}{0.018} = \frac{0.018P}{0.018} \quad \text{Divide both sides by } 0.018.$$

$$5000 = P \quad \text{Divide: } 90/0.018 = 5000.$$

Answer: \$3,000

Thus, the principal amount borrowed was \$5,000. □

You Try It!

A manufacturer borrows \$10,000 for 4 years. At the end of the 4-year loan period, the interest owed is \$3,200. What was the simple interest rate?

EXAMPLE 4. A pet shop owner borrows \$8,000 for 6 months. At the end of the 6-month loan period, the interest owed is \$200. What was the simple interest rate?

Solution. Set up the formula for simple interest.

$$I = Prt$$

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The principal is $P = \$8,000$, the interest owed is $I = \$200$, and the duration of the loan is $t = 6$ months. As we saw in Example 2, 6 months equals $1/2$ year. Substitute these numbers into the simple interest formula $I = Prt$.

$$200 = (8000)(r) \left(\frac{1}{2} \right) \quad \text{Substitute 8000 for } P, 200 \text{ for } I, \text{ and } 1/2 \text{ for } t.$$

$$200 = \frac{8000}{2}r \quad \text{Rearrange order of multiplication.}$$

$$200 = 4000r \quad \text{Divide: } 8000/2 = 4000.$$

Solve this last equation for r .

$$\frac{200}{4000} = \frac{4000r}{4000} \quad \text{Divide both sides by 4000.}$$

$$\frac{1}{20} = r \quad \text{Reduce: Divide numerator and denominator by 200.}$$

We need to change r to a percent. This is easily accomplished by creating an equivalent fraction with a denominator of 100.

$$\begin{aligned} \frac{1}{20} &= \frac{1 \cdot 5}{20 \cdot 5} \\ &= \frac{5}{100} \\ &= 5\% \end{aligned}$$

Thus, the simple interest rate is 5%.

Answer: 8%

□

Extending the Simple Interest Formula

In Example 2, we had to add the interest to the principal to discover the balance owed at the end of the loan. That is,

$$\text{Balance} = \text{Principal} + \text{Interest},$$

or in symbols,

$$A = P + I,$$

where A is the balance, P is the principal, and I is the simple interest. Because $I = Prt$, we substitute Prt for I in the last equation to get

$$A = P + Prt.$$

Use the distributive property to factor P from each term on the right.

$$A = P \cdot 1 + P \cdot rt$$

$$A = P(1 + rt).$$

Balance Formula Using Simple Interest. If simple interest is applied, then the balance is given by the formula

$$A = P(1 + rt),$$

where A is the balance, P is the principal, r is the simple interest rate, and t is the duration of the loan or investment.

You Try It!

If \$8,000 is invested at 4.25% simple interest, what will be the balance after 4 years?

EXAMPLE 5. If \$4,000 is invested at 6.25% simple interest, what will be the balance after 2 years?

Solution. Start with the balance formula for simple interest.

$$A = P(1 + rt)$$

The principal is $P = \$4,000$, the rate is $r = 6.25\% = 0.0625$ per year, and the time is $t = 2$ years. Substitute these numbers in the balance formula $A = P(1 + rt)$.

$$A = 4000(1 + (0.0625)(2)) \quad \text{Substitute 4000 for } P, 0.0625 \text{ for } r, \text{ and } 2 \text{ for } t.$$

$$A = 4000(1 + 0.125) \quad \text{Order of Ops: } 0.0625 \cdot 2 = 0.125.$$

$$A = 4000(1.125) \quad \text{Order of Ops: } 1 + 0.125 = 1.125.$$

$$A = 4500 \quad \text{Multiply: } 4000 \cdot 1.125 = 4500.$$

\$9,360

Hence, the balance at the end of two years is $A = \$4,500$. □

You Try It!

The balance due on a 4-year loan is \$6,300. If the simple interest rate is 10%, what was the principal borrowed?

EXAMPLE 6. The balance due on a 2-year loan is \$3,360. If the simple interest rate is 6%, what was the principal borrowed?

Solution. Start with the balance formula for simple interest.

$$A = P(1 + rt)$$

The balance is $A = \$3360$, the rate is $r = 6\% = 0.06$ per year, and the time is $t = 2$ years. Substitute these numbers in the balance formula $A = P(1 + rt)$.

$$3360 = P(1 + (0.06)(2)) \quad \text{Substitute 3360 for } A, 0.06 \text{ for } r, \text{ and } 2 \text{ for } t.$$

$$3360 = P(1 + 0.12) \quad \text{Order of Ops: } 0.06 \cdot 2 = 0.12.$$

$$3360 = P(1.12) \quad \text{Order of Ops: } 1 + 0.12 = 1.12.$$

$$3360 = 1.12P \quad \text{Change order of multiplication.}$$

Solve this last equation for P .

$$\frac{3360}{1.12} = \frac{1.12P}{1.12} \quad \text{Divide both sides by 1.12.}$$

$$3000 = P \quad \text{Divide: } 3360/1.12 = 3000.$$

Hence, the principal borrowed was $P = \$3,000$.

Answer: \$4,500

You Try It!

EXAMPLE 7. The balance due on a 2-year loan is \$2,200. If the principal borrowed was \$2,000, what was the rate of simple interest?

The balance due on a 2-year loan is \$4,640. If the principal borrowed was \$4,000, what was the rate of simple interest?

Solution. Start with the balance formula for simple interest.

$$A = P(1 + rt)$$

The balance is $A = \$2,200$, the principal is $P = \$2,000$, and the time is $t = 2$ years. Substitute these numbers in the balance formula $A = P(1 + rt)$.

$$2200 = 2000(1 + (r)(2)) \quad \text{Substitute 2200 for } A, 2000 \text{ for } P, \text{ and } t = 2.$$

$$2200 = 2000(1 + 2r) \quad \text{Change the order of multiplication.}$$

Solve this last equation for r .

$$2200 = 2000 + 4000r \quad \text{Distribute 2000.}$$

$$2200 - 2000 = 2000 + 4000r - 2000 \quad \text{Subtract 2000 from both sides.}$$

$$200 = 4000r \quad \text{Simplify both sides.}$$

$$\frac{200}{4000} = \frac{4000r}{4000} \quad \text{Divide both sides by 4000.}$$

$$\frac{1}{20} = r \quad \text{Reduce: } 200/4000 = 1/20.$$

Of course, r must be changed to a percent. In Example 4, we encountered this same fraction.

$$r = \frac{1}{20} = \frac{5}{100} = 5\%$$

Hence, the rate of simple interest is $r = 5\%$.

Answer: 8%

 Exercises 

1. How much simple interest is earned if \$7,600 is invested at 8% per year for 7 years?
2. How much simple interest is earned if \$2,500 is invested at 5% per year for 6 years?
3. How much simple interest is earned if \$5,800 is invested at 3.25% per year for 4 years?
4. How much simple interest is earned if \$2,000 is invested at 8.5% per year for 6 years?
5. How much simple interest is earned if \$2,400 is invested at 8.25% per year for 5 years?
6. How much simple interest is earned if \$4,000 is invested at 6.5% per year for 6 years?
7. How much simple interest is earned if \$4,000 is invested at 7.25% per year for 6 years?
8. How much simple interest is earned if \$8,200 is invested at 8% per year for 6 years?
9. A business owner borrows \$3,600 for 2 months at a 4.5% per year simple interest rate. At the end of the 2-month loan period, how much interest is owed?
10. A business owner borrows \$3,200 for 4 months at a 9% per year simple interest rate. At the end of the 4-month loan period, how much interest is owed?
11. A business owner borrows \$2,400 for 6 months at a 2% per year simple interest rate. At the end of the 6-month loan period, how much interest is owed?
12. A business owner borrows \$2,200 for 4 months at a 3% per year simple interest rate. At the end of the 4-month loan period, how much interest is owed?
13. A business owner takes out a 6-month loan at a 8% per year simple interest rate. At the end of the 6-month loan period, the interest owed is \$68. What was the principal amount borrowed?
14. A business owner takes out a 4-month loan at a 6% per year simple interest rate. At the end of the 4-month loan period, the interest owed is \$194. What was the principal amount borrowed?
15. A business owner borrows \$3,600 for 3 months at a 8% per year simple interest rate. At the end of the 3-month loan period, how much interest is owed?
16. A business owner borrows \$2,400 for 4 months at a 8.25% per year simple interest rate. At the end of the 4-month loan period, how much interest is owed?
17. A business owner takes out a 2-month loan at a 8.5% per year simple interest rate. At the end of the 2-month loan period, the interest owed is \$85. What was the principal amount borrowed?

18. A business owner takes out a 3-month loan at a 2% per year simple interest rate. At the end of the 3-month loan period, the interest owed is \$45. What was the principal amount borrowed?
 19. A business owner borrows \$4,000 for 3 months. At the end of the 3-month loan period, the interest owed is \$35. What was the simple yearly interest rate (as a percent)?
 20. A business owner borrows \$4,200 for 4 months. At the end of the 4-month loan period, the interest owed is \$63. What was the simple yearly interest rate (as a percent)?
 21. A business owner takes out a 6-month loan at a 7% per year simple interest rate. At the end of the 6-month loan period, the interest owed is \$287. What was the principal amount borrowed?
 22. A business owner takes out a 6-month loan at a 2% per year simple interest rate. At the end of the 6-month loan period, the interest owed is \$40. What was the principal amount borrowed?
 23. A business owner borrows \$7,300 for 2 months. At the end of the 2-month loan period, the interest owed is \$73. What was the simple yearly interest rate (as a percent)?
 24. A business owner borrows \$5,600 for 6 months. At the end of the 6-month loan period, the interest owed is \$182. What was the simple yearly interest rate (as a percent)?
 25. A business owner borrows \$3,200 for 6 months. At the end of the 6-month loan period, the interest owed is \$96. What was the simple yearly interest rate (as a percent)?
 26. A business owner borrows \$5,700 for 4 months. At the end of the 4-month loan period, the interest owed is \$133. What was the simple yearly interest rate (as a percent)?
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27. Suppose that \$6,700 is invested at 9% simple interest per year. What will the balance be after 4 years?
 28. Suppose that \$5,200 is invested at 3.5% simple interest per year. What will the balance be after 2 years?
 29. Suppose that \$1,600 is invested at 2% simple interest per year. What will the balance be after 3 years?
 30. Suppose that \$8,100 is invested at 8.25% simple interest per year. What will the balance be after 4 years?
 31. Suppose that \$8,900 is invested at 2.5% simple interest per year. What will the balance be after 2 years?
 32. Suppose that \$9,800 is invested at 2.75% simple interest per year. What will the balance be after 6 years?
 33. Suppose that \$5,400 is invested at 4.25% simple interest per year. What will the balance be after 2 years?
 34. Suppose that \$8,400 is invested at 4.5% simple interest per year. What will the balance be after 4 years?
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- 35.** The balance on a 6-year loan is \$10,222. If the principal borrowed was \$7,600, what was the simple interest rate (as a percent)?
- 36.** The balance on a 8-year loan is \$12,264. If the principal borrowed was \$8,400, what was the simple interest rate (as a percent)?
- 37.** The balance on a 5-year loan is \$4,640. If the simple interest rate is 9% per year, what was the principal borrowed?
- 38.** The balance on a 6-year loan is \$6,838. If the simple interest rate is 5.25% per year, what was the principal borrowed?
- 39.** The balance on a 9-year loan is \$9,593. If the simple interest rate is 9% per year, what was the principal borrowed?
- 40.** The balance on a 8-year loan is \$10,032. If the simple interest rate is 4% per year, what was the principal borrowed?
- 41.** The balance on a 3-year loan is \$5,941. If the principal borrowed was \$5,200, what was the simple interest rate (as a percent)?
- 42.** The balance on a 2-year loan is \$9,589. If the principal borrowed was \$8,600, what was the simple interest rate (as a percent)?
- 43.** The balance on a 5-year loan is \$5,400. If the principal borrowed was \$4,000, what was the simple interest rate (as a percent)?
- 44.** The balance on a 6-year loan is \$12,635. If the principal borrowed was \$9,500, what was the simple interest rate (as a percent)?
- 45.** The balance on a 5-year loan is \$11,550. If the simple interest rate is 7.5% per year, what was the principal borrowed?
- 46.** The balance on a 8-year loan is \$3,160. If the simple interest rate is 7.25% per year, what was the principal borrowed?
- 47.** The balance on a 4-year loan is \$5,720. If the principal borrowed was \$4,400, what was the simple interest rate (as a percent)?
- 48.** The balance on a 8-year loan is \$4,422. If the principal borrowed was \$3,300, what was the simple interest rate (as a percent)?
- 49.** The balance on a 8-year loan is \$9,768. If the simple interest rate is 4% per year, what was the principal borrowed?
- 50.** The balance on a 2-year loan is \$8,322. If the simple interest rate is 7% per year, what was the principal borrowed?


Answers


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| <p>1. \$4,256</p> <p>3. \$754</p> <p>5. \$990</p> <p>7. \$1,740</p> <p>9. \$27</p> | <p>11. \$24</p> <p>13. \$1,700</p> <p>15. \$72</p> <p>17. \$6,000</p> <p>19. 3.5%</p> |
|---|--|

21. \$8,200

23. 6%

25. 6%

27. \$9,112

29. \$1,696

31. \$9,345

33. \$5,859

35. 5.75%

37. \$3,200

39. \$5,300

41. 4.75%

43. 7%

45. \$8,400

47. 7.5%

49. \$7,400