

Simple Interest

ApexMath

Notes

What Is Interest?

When you borrow money, or when you put money into a savings account, the bank charges or pays a fee for the use of that money. That fee is called **interest**. In this lesson, we study the simplest version of interest, where the fee is always calculated on the *original* amount — never on interest that has already built up.

Key Vocabulary

- **Principal** (P): The original amount of money borrowed or invested.
- **Interest Rate** (r): The percentage charged or earned per year. Always convert a percentage to a decimal before using it in a formula. For example, $5\% = 0.05$.
- **Time** (t): The length of time in *years*. If time is given in months, divide by 12 first.
- **Interest** (I): The fee earned or charged. This is the *extra* amount on top of the principal.
- **Amount** (A): The total value at the end — principal plus interest.

The Two Formulas

The interest earned or charged is:

$$I = Prt$$

The total amount (what you end up with or owe) is:

$$A = P + I \quad \text{which can also be written as} \quad A = P(1 + rt)$$

These two formulas are closely related. Once you find I , you can always find A by adding I back to P .

Rearranging the Formulas

Since $A = P(1 + rt)$, we can solve for any one variable if we know the other three:

- Solve for P :

$$P = \frac{A}{1 + rt}$$

- Solve for r :

$$r = \frac{A/P - 1}{t}$$

- Solve for t :

$$t = \frac{A/P - 1}{r}$$

Pro Tip

- Always convert the interest rate to a decimal before plugging it into the formula. Writing $r = 5\%$ directly into $I = Prt$ is one of the most common errors in this unit.
- Always convert time to **years**. If a problem says “18 months,” rewrite it as $t = 18 \div 12 = 1.5$ years before doing anything else.
- The formula $A = P(1 + rt)$ is the most powerful version because it finds the total amount in one step. Use $I = Prt$ only when the question specifically asks for the interest amount.
- When solving for P , r , or t , isolate the unknown the same way you would in any linear equation. Divide both sides by whatever is multiplied with the unknown.
- Label every value you identify ($P = \dots$, $r = \dots$, $t = \dots$) before substituting. This prevents confusion, especially in word problems.

Examples

Example 1 (Find the Interest and Total Amount): Jenna invests \$2,000 at a simple interest rate of 5% per year for 3 years. Find the interest earned and the total amount at the end.

Step 1: Identify the known values and convert the rate.

$$P = 2000, \quad r = 5\% = 0.05, \quad t = 3$$

Step 2: Use the formula $I = Prt$ to find the interest.

$$I = 2000 \times 0.05 \times 3$$

$$I = 300$$

Step 3: Find the total amount using $A = P + I$.

$$A = 2000 + 300$$

$I = \$300, \quad A = \$2,300$

Example 2 (Find the Total Amount Directly): Marcus borrows \$5,000 at a simple interest rate of 3% per year for 4 years. What is the total amount he owes at the end?

Step 1: Identify the known values and convert the rate.

$$P = 5000, \quad r = 3\% = 0.03, \quad t = 4$$

Step 2: Use $A = P(1 + rt)$ to find the total amount in one step.

$$A = 5000(1 + 0.03 \times 4)$$

Step 3: Simplify inside the brackets first.

$$A = 5000(1 + 0.12)$$

$$A = 5000 \times 1.12$$

$$\boxed{A = \$5,600}$$

Example 3 (Solve for the Principal): After 5 years at a simple interest rate of 4% per year, an account has grown to \$1,320. What was the original principal?

Step 1: Identify what is known and what is unknown.

$$A = 1320, \quad r = 4\% = 0.04, \quad t = 5, \quad P = ?$$

Step 2: Write the formula and rearrange to isolate P .

$$A = P(1 + rt) \quad \implies \quad P = \frac{A}{1 + rt}$$

Step 3: Find the value of $1 + rt$.

$$1 + rt = 1 + 0.04 \times 5 = 1 + 0.20 = 1.20$$

Step 4: Substitute and solve.

$$P = \frac{1320}{1.20}$$

$$\boxed{P = \$1,100}$$

Example 4 (Solve for the Time): Leon invests \$800 at a simple interest rate of 6% per year. How many years will it take for the account to reach \$1,040?

Step 1: Identify what is known and what is unknown.

$$P = 800, \quad A = 1040, \quad r = 6\% = 0.06, \quad t = ?$$

Step 2: Use $A = P(1 + rt)$. Divide both sides by P first.

$$\frac{A}{P} = 1 + rt$$

$$\frac{1040}{800} = 1 + rt$$

$$1.3 = 1 + rt$$

Step 3: Subtract 1 from both sides.

$$1.3 - 1 = rt$$

$$0.3 = 0.06t$$

Step 4: Divide both sides by r to isolate t .

$$t = \frac{0.3}{0.06}$$

$$\boxed{t = 5 \text{ years}}$$

Example 5 (Solve for the Rate): Sara borrows \$3,000. Three years later she owes \$3,450 in total. What was the annual simple interest rate?

Step 1: Identify what is known and what is unknown.

$$P = 3000, \quad A = 3450, \quad t = 3, \quad r = ?$$

Step 2: Divide both sides of $A = P(1 + rt)$ by P .

$$\frac{A}{P} = 1 + rt$$

$$\frac{3450}{3000} = 1 + rt$$

$$1.15 = 1 + rt$$

Step 3: Subtract 1 from both sides.

$$0.15 = rt = 3r$$

Step 4: Divide both sides by $t = 3$.

$$r = \frac{0.15}{3} = 0.05$$

$$\boxed{r = 5\%}$$

Common Mistakes

- **Forgetting to convert the percentage to a decimal.** The formula requires a decimal, not a percentage. Using $r = 5$ instead of $r = 0.05$ will give an answer 100 times too large.
- **Leaving time in months instead of years.** The rate r is per year, so t must be in years. Always divide months by 12 before substituting.

- **Confusing I and A .** The question may ask for the interest earned (I) or the total amount (A). These are different. $A = P + I$, not $A = I$.
- **Multiplying $P \times r$ and forgetting to multiply by t .** All three values — P , r , and t — must be multiplied together to get I .
- **Using $A = P(1 + rt)$ but adding incorrectly inside the brackets.** Always finish the multiplication rt before adding 1. The order of operations requires multiplication before addition.

Worksheet

1. You invest \$1,500 at a simple interest rate of 4% per year for 2 years. How much interest do you earn? What is the total amount in the account?
2. A loan of \$4,000 is taken out at a simple interest rate of 3.5% per year for 5 years. Find the interest charged and the total amount owed.
3. After 4 years at a simple interest rate of 5% per year, an account contains \$1,800. What was the original principal?
4. Priya invests \$1,200 at a simple interest rate of 6% per year. How many years will it take for her account to reach \$1,560?

5. A savings account holds \$5,000. After 3 years, the total amount is \$5,750. What is the annual simple interest rate?
6. A \$900 loan is taken out for 18 months at a simple interest rate of 8% per year. Find the interest charged and the total amount owed.
(*Hint: Convert 18 months to years first.*)
7. You invest \$2,500 for 30 months at a simple interest rate of 4% per year. What is the total amount at the end of the investment?
(*Hint: Convert 30 months to years first.*)
8. (Challenge) A simple interest account earned \$360 in interest over 4 years at a rate of 6% per year. What was the original principal?
(*Hint: Use $I = Prt$ and solve for P .*)

Answer Key

1. You invest \$1,500 at 4% per year for 2 years.

Step 1: Identify the values and convert the rate.

$$P = 1500, \quad r = 4\% = 0.04, \quad t = 2$$

Step 2: Find the interest using $I = Prt$.

$$I = 1500 \times 0.04 \times 2$$

$$I = 120$$

Step 3: Find the total amount.

$$A = P + I = 1500 + 120$$

$I = \$120, \quad A = \$1,620$

2. A \$4,000 loan at 3.5% per year for 5 years.

Step 1: Identify the values and convert the rate.

$$P = 4000, \quad r = 3.5\% = 0.035, \quad t = 5$$

Step 2: Find the interest using $I = Prt$.

$$I = 4000 \times 0.035 \times 5$$

$$I = 700$$

Step 3: Find the total amount.

$$A = 4000 + 700$$

$I = \$700, \quad A = \$4,700$

3. After 4 years at 5% per year, the account holds \$1,800. Find P .

Step 1: Identify what is known. P is unknown.

$$A = 1800, \quad r = 5\% = 0.05, \quad t = 4$$

Step 2: Write the rearranged formula.

$$P = \frac{A}{1 + rt}$$

Step 3: Compute $1 + rt$.

$$1 + rt = 1 + 0.05 \times 4 = 1 + 0.20 = 1.20$$

Step 4: Substitute and divide.

$$P = \frac{1800}{1.20}$$

$$\boxed{P = \$1,500}$$

4. Priya: $P = \$1,200$, $A = \$1,560$, $r = 6\%$. Find t .

Step 1: Convert the rate.

$$r = 6\% = 0.06$$

Step 2: Divide both sides of $A = P(1 + rt)$ by P .

$$\frac{A}{P} = 1 + rt \quad \implies \quad \frac{1560}{1200} = 1 + rt$$

$$1.3 = 1 + rt$$

Step 3: Subtract 1 from both sides.

$$0.3 = 0.06t$$

Step 4: Divide both sides by $r = 0.06$.

$$t = \frac{0.3}{0.06}$$

$$\boxed{t = 5 \text{ years}}$$

5. $P = \$5,000$, $A = \$5,750$, $t = 3$ years. Find r .

Step 1: Divide both sides of $A = P(1 + rt)$ by P .

$$\frac{5750}{5000} = 1 + rt$$

$$1.15 = 1 + rt$$

Step 2: Subtract 1 from both sides.

$$0.15 = rt = 3r$$

Step 3: Divide both sides by $t = 3$.

$$r = \frac{0.15}{3} = 0.05$$

$$\boxed{r = 5\%}$$

6. \$900 loan at 8% per year for 18 months.

Step 1: Convert time to years.

$$t = \frac{18}{12} = 1.5 \text{ years}$$

Step 2: Identify all values and convert the rate.

$$P = 900, \quad r = 8\% = 0.08, \quad t = 1.5$$

Step 3: Find the interest.

$$I = 900 \times 0.08 \times 1.5$$

$$I = 108$$

Step 4: Find the total amount.

$$A = 900 + 108$$

$$\boxed{I = \$108, \quad A = \$1,008}$$

7. \$2,500 invested at 4% per year for 30 months.

Step 1: Convert time to years.

$$t = \frac{30}{12} = 2.5 \text{ years}$$

Step 2: Identify all values and convert the rate.

$$P = 2500, \quad r = 4\% = 0.04, \quad t = 2.5$$

Step 3: Use $A = P(1 + rt)$.

$$A = 2500(1 + 0.04 \times 2.5)$$

Step 4: Simplify inside the brackets.

$$A = 2500(1 + 0.10)$$

$$A = 2500 \times 1.10$$

$$A = \$2,750$$

8. (Challenge) $I = \$360$, $r = 6\%$, $t = 4$ years. Find P .

Step 1: Write the formula for interest and identify the unknown.

$$I = Prt$$

P is unknown. All other values are given.

Step 2: Convert the rate and substitute.

$$r = 6\% = 0.06$$

$$360 = P \times 0.06 \times 4$$

Step 3: Simplify the right side.

$$360 = 0.24 P$$

Step 4: Divide both sides by 0.24.

$$P = \frac{360}{0.24}$$

$$P = \$1,500$$

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