SIMPLE AND COMPOUND INTEREST

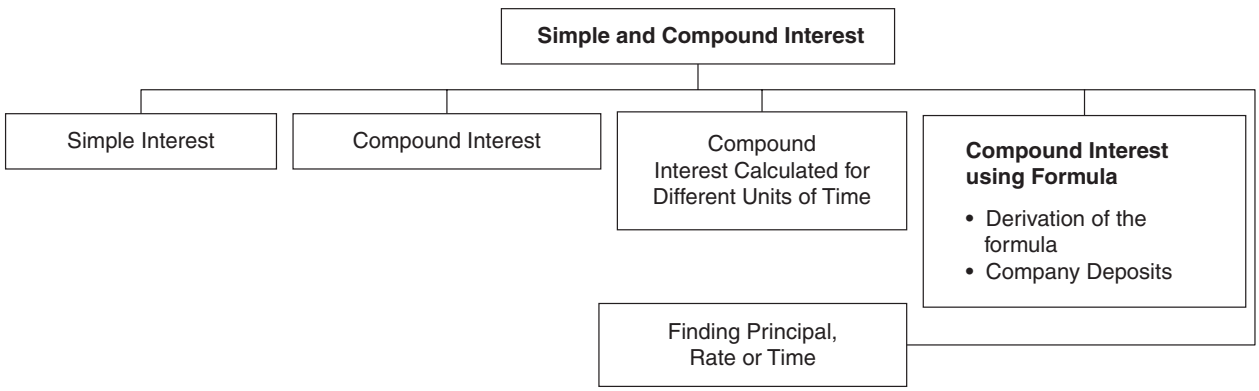
Learning objectives

Students will learn:

- To calculate simple interest
- To differentiate between simple and compound interest
- To calculate compound interest with interest compounded annually, half-yearly and quarterly
- To understand and use formula for calculating compound interest

Prior knowledge

- Banking and the terms associated with banking: deposit, rate of interest, time period, amount, simple interest
- Converting fractions and ratios to decimal and vice versa



Guidelines to teach

Rewind:

- Review the simple interest formula and ask students to work out the sums in the Rewind section.

Warm Up:

- Use the Warm Up to emphasise the benefits of saving money in banks as banks provide interest.

Simple interest:

- Revise the terms associated with banking.
- Ask students to complete the statements:
  - The money we deposit in a bank is called the _____. (*principal*)
  - The amount is the sum of the principal and _____. (*interest*)
  - The interest is calculated at a specific _____. (*rate per annum*)
  - $I =$ _____ $\left(\frac{PTR}{100}\right)$

- $A =$ _____ $(P + I)$

- Use the course book to explain the calculation of simple interest using the formula.
- Ask students to complete the statements:
- If time is given in days, divide the number of days by _____. (*365*)
- If time is given in months, divide the number of months by _____. (*12*)
- If time is given in weeks, divide the number of weeks by _____. (*52*)
- Instruct students to study the solved examples in the Guided Learning section for simple interest before attempting the Tryout.

1. Extension activity for simple interest:

- On five quarter sheets of chart paper, write the letters I, P, T and R and the number 100 prominently, using marker pens of different colours.
- Choose a place in the school ground or any other spacious area for demonstrating the activity.
- Using powdered lime (white powder used to mark tracks for athletic events), mark the RHS and the LHS. Draw an equal to sign between the RHS and the LHS.
- Also draw a line each on the LHS and the RHS for the vinculum or fraction/division bar.
- Make students stand in a circle around this space.
- Ask five students to volunteer for the activity. Give each of these students a quarter sheet of chart paper marked with the letters/number.
- Instruct the student with the letter 'I' to stand above the fraction bar on the LHS.
- Instruct the students with the letters 'P', 'T' and 'R' to stand above the fraction bar on the RHS and the student with the number 100 to stand below the fraction bar on the RHS.
- Ask the remaining students to say what the arrangement represents. (*The formula for Simple Interest:* $\boldsymbol{I = \frac{PTR}{100}}$)
- Ask them to say what *P*, *T* and *R* represent.
- Tell the student volunteers that you will say a letter P, R' or 'T'. To demonstrate the formula for finding P/R/T they will have to rearrange themselves on the LHS and RHS correctly.
- Suppose you say 'T'. Check if the students rearrange themselves as:

LHS RHS

$$\frac{\mathbf{I\ 100}}{\mathbf{PR}} = \mathbf{T}$$

- Correct them if necessary.
- Ask the class to say the formula for finding 'T' aloud.
- Ask the volunteers to rearrange themselves as per the original equation.
- Repeat the process to demonstrate the formula for finding 'R' and 'P'.
- Check if the formulas are represented correctly.

LHS RHS

$$\frac{I\ 100}{PT} = R$$

LHS RHS

$$\frac{I\ 100}{RT} = P$$

Compound interest:

- Explain the term compound interest with the help of the course book.
- Explain the calculation of compound interest with the help of the example given in the course book.
- Help students compare this interest with the simple interest for the same principal, deposited for the same period of time and at the same rate of interest. Help them conclude that compound interest gives better returns on an investment compared to simple interest.
- Explain what accumulated interest is. (*It is the interest of the previous period that is due but not paid. It is added to the principal for calculating the interest that is due in the current period.*)
- Ask students to complete the solved examples in the Guided Learning section in the course book.

2. Extension activity for comparison of simple interest and compound interest:

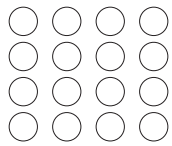
- Cut out around 60 small disc-shaped counters from a sheet of chart paper and keep them ready for the activity.
- Draw two tables like the one given here, on two half sheets of chart paper (of a different colour) and pin them to a display board that faces the class, one below the other. (In the absence of a display board, you may also draw the tables on a Thermocol sheet and tape the sheet to a wall facing the class.)

1st year	2nd year	3rd year

- Direct the attention of the class to Table 1.

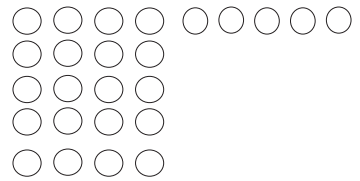
- Pin 16 counters to the 1st year column. Ask students to imagine that the counters represent money deposited in a bank. Tell them that this money earns simple interest at the rate of 25%.
- Instruct them to consider 10 seconds as 1 year. Time 10 seconds with the help of a stopwatch. At the end of 10 seconds, pin 4 counters to the 2nd row of the 1st year column.
- Ask students: What is 25% of 16? (*4*) What do the 4 counters represent? (*the interest earned in the first year*)
- Leave these 4 counters in the same row. Shift the 16 counters to the 2nd year column.
- At the end of 10 seconds, pin 4 more counters to the 2nd row of the 2nd year column.
- Leave these 4 counters there and shift the 16 counters to the 3rd year column.
- At the end of 10 seconds, ask students to say the number of counters to be pinned in the 2nd row of the 3rd year column. (*4 counters*).
- Pin 4 counters there. Ensure that your table looks like this:

Table 1

1st year	2nd year	3rd year 
		

- Ask students to add the counters in all the three columns. *(28 counters*)
- Help them conclude that the 28 counters represent the amount at the end of 3 years that includes the principal and the simple interest calculated at 25%.
- Next, direct the attention of the class to Table 2.
- Repeat what you did for the two rows of the 1st year column in Table 1.
- After pinning the 4 counters that represent interest earned in the first year, shift all the counters to the 2nd year column.
- Ask students: What do these 20 counters represent? (*principal + interest earned in the first year*)
- Ask them to calculate interest for this new principal at the rate of 25%. $\left(\frac{20 \times 1 \times 25}{100} = 5\right)$
- Pin 5 counters to the 2nd row in the 2nd year column.
- Again, shift all the counters to the 3rd year column. (You have 25 counters now.)
- Ask students to calculate the interest for this new principal. $\left(\frac{25 \times 1 \times 25}{100} = 6.25 \text{ or } 6\frac{1}{4}\right)$
- Pin 6 counters to the 2nd row of the 3rd year column. Take one more counter and cut it into 4 parts. Pin just 1 part to represent $\frac{1}{4}$ th.

Table 2

1st year	2nd year	3rd year
		
		

- Ask students to add all the counters in the 3rd column. (*31.25 counters*)
- Help them conclude that compound interest was calculated in Table 2.
- Instruct them to compare the number of counters in the two tables.
- Help them conclude that compound interest yields more returns than simple interest does.

Compound interest calculated for different units of time:

- Explain that compound interest can be calculated not only annually, but also for different time periods such as half-yearly, quarterly and monthly.
- Explain that the rate of interest given per annum changes according to the specified unit of time. Otherwise, the formula for calculating the compound interest remains the same.
- Instruct students to study the solved examples in the Guided Learning section to understand how compound interest for an amount compounded half yearly and quarterly is calculated.
- Ask students to attempt the Quick Check exercise.

Compound interest using formula:

- Tell students that we use a formula which serves as a shortcut for calculating compound interest. This is because the method of calculating compound interest year by year or period by period is very cumbersome.

Derivation of the formula

- Help students derive the formula for calculating compound interest with the help of the course book.
- Instruct them to study the solved examples in the Guided Learning section for calculating the amount payable and the compound interest using the formula.

Company deposits:

- Explain why companies invite the public to deposit money with them for a certain period of time. Explain how they attract investments. (*by paying interest higher than that paid by banks*)

- Ask students to study the solved examples in the Guided Learning section in the course book. Clarify doubts if any.
- Ask students to complete the Tryout for compound interest.

Finding Principal, Rate or Time

- Explain how the compound interest formula is used to find an unknown quantity when the other quantities are given.
- Instruct students to study the solved examples in the Guided Learning section to compute principal, rate of interest and time.
- Ask students to complete the Tryout for finding principal, rate or time.

More suggestions for extension activities

3. Activity (*Compound interest calculated for different units of time*):

- Instruct students to complete the table.

S. No.	Principal	Period	Interest	Rate of interest	Amount
1	P	1 year	compounded half-yearly	$\frac{R}{2}\%$	$P\left(1+\frac{R}{200}\right)^2$
2	P	1 year	compounded quarterly		
3	P	$1\frac{1}{2}$ years	compounded half-yearly		
4	P	2 years	compounded quarterly		
5	P	2 years	compounded annually		
6	P	2 years	compounded half-yearly		

[Answer key: **2**. Rate: $\frac{R}{4}\%$, Amount: $P\left(1+\frac{R}{400}\right)^4$ **3.** Rate: $\frac{R}{2}\%$, Amount: $P\left(1+\frac{R}{100}\right)^3$ **4.** Rate: $\frac{R}{4}\%$, Amount: $P\left(1+\frac{R}{400}\right)^8$ **5.** Rate: $R\%$, Amount: $P\left(1+\frac{R}{100}\right)^2$ **6.** $\frac{R}{2}\%$, Amount: $P\left(1+\frac{R}{200}\right)^4$]

4. Activity (*Comparison of simple interest and compound interest*):

- Situation 1: A deposit of ₹12,000 with a bank for 5 years earned simple interest at the rate of 10%.
- Situation 2: A deposit of ₹12,000 with a bank for 5 years earned compound interest at the rate of 10%.

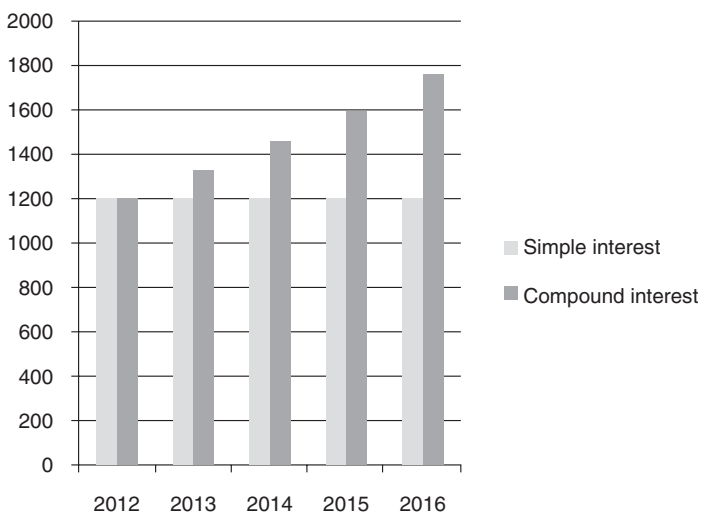
Year	Principal	Rate of interest	Simple interest
2012			
2013			
2014			
2015			
2016			

Year	Principal	Rate of interest	Compound interest
2012			
2013			
2014			
2015			
2016			

- Make as many copies of the data and the tables given as there are students in the class.
- Give each student a copy.
- Instruct them to complete the two tables and draw bar graphs to show the simple interest and compound interest earned each year. (*x*-axis — the years, *y*-axis—the interest)
- Help them verify that compound interest yields better returns on investments than simple interest does.

(Answer key: *2012: SI—1200, CI, 1200; 2013: SI—1200, CI—1320; 2014: SI—1200, CI—1452; 2015: SI—1200, CI—1597.20; 2016: SI—1200, CI—1756.92*)

- Check if students have drawn the bar graph like this:



Question Bank

1. Choose the correct answer.

a. The simple interest on an amount of ₹100 at 1% rate of interest for a period of one year is:

i. ₹1 ii. ₹10 iii. ₹100 iv. ₹0.1

b. A man lends ₹100 on a compound interest of 10%, interest compounded annually. The amount at the beginning of the second year is:

i. ₹100 ii. ₹110 iii. ₹200 iv. ₹121

c. For the loan mentioned in the previous question, what is the amount at the end of the second year?

i. ₹100 ii. ₹110 iii. ₹200 iv. ₹121

d. If the compound interest is 12% per annum and it is compounded quarterly, what is the value of R to be used in the formula $A = (1 + R/100)^n$?

i. 3 ii. 12 iii. 4 iv. 6

e. In the previous question, what is the value to be substituted for n to calculate the amount at the end of 18 months?

i. $\frac{3}{2}$ ii. 6 iii. 18 iv. 2

2. Answer the following.

a. Calculate the simple interest on ₹3400 for 3 years at the rate of 9% per annum.

b. Calculate the simple interest on ₹3650 at the rate of $12\frac{1}{2}$% per annum, from 1 March to 20 May. (Hint: Count the day of deposit but do not count the last day).

c. At what rate of simple interest will ₹3000 earn ₹900 of interest in 2 years?

d. Find the time in which ₹2000 will become ₹2600 at 9% simple interest per annum.

e. For a principal of ₹2500, calculate
(i) simple interest for 1 year at the rate of 10%
(ii) compound interest for 1 year at the rate of 10% per annum, if the interest is compounded half yearly. Use only the simple interest formula.

f. Using only the simple interest formula, calculate the compound interest on ₹4000 for 9 months at the rate of 12% per annum, interest compounded quarterly. (Round your answer to nearest paise).

g. Calculate the compound interest on ₹12,000 for 18 months at 8% compound interest, compounded every six months.

h. Calculate the amount payable on ₹6000 at the rate of 8% p.a. compound interest, compounded quarterly, at the end of 9 months.

i. A man borrows ₹15,000 from a bank at 14% interest per annum compounded half-yearly. Calculate the amount he has to repay after 5 years. $(1.07)^{10} = 1.9672$.

j. In what time will ₹3000 amount to ₹5184 at compound interest of 20%?

k. Find the principal if the amount at the end of 2 years at 10% compound interest is ₹9680.

l. Find the rate of compound interest at which a principal of ₹1000 will become ₹1210 in 2 years.

Answer Key to the Question Bank

1. a. i b. ii c. iv d. i e. ii **2.** a. ₹918 b. ₹100 c. 15% d. 3.33 years e. i. ₹250 ii. ₹ 256.25 f. ₹370.91 g. ₹1,498.37 h. ₹6,367.25 i. ₹29,508 j. 3 years k. ₹8000 l. 10%

Answer Key—Simple and Compound Interest Worksheet

A. 1. a 2. d 3. d 4. b 5. a **B.** 1. d 2. f 3. c 4. e 5. a 6. b

SIMPLE AND COMPOUND INTEREST — Worksheet

A. Choose the correct answer.

1. The relationship between the simple interest and the compound interest for one year is
   a. simple interest = compound interest
   b. simple interest < compound interest
   c. simple interest : compound interest = 2 : 1
   d. simple interest : compound interest = 3 : 2
2. The simple interest on ₹13000 for 3 years at 10% per annum is
   a. ₹3000 b. ₹3300 c. ₹3600 d. ₹3900
3. The compound interest on a sum of money for a fixed rate of interest
   a. remains constant for each year for which it is calculated
   b. decreases every year for which it is calculated
   c. increases by the same amount every year for which it is calculated
   d. increases by different amounts every year for which it is calculated
4. The compound interest on ₹100 for 2 years at 10% per annum is
   a. ₹20 b. ₹21 c. ₹120 d. ₹121
5. The difference between the compound interest and the simple interest for 2 years on ₹100 at 2% per annum is
   a. ₹0.04 b. ₹4 c. ₹4.04 d. ₹4.40

B. Match the formula with the information.

Let A be the amount, P be the principal, n be the number of years and r, q, s be the rate of interest/increase/decrease as the case may be.

1. $A = P\left(1 + \frac{r}{100}\right)^n$
2. $A = P\left(1 - \frac{r}{100}\right)^n$
3. $A = P\left(1 + \frac{r}{100}\right)\left(1 + \frac{q}{100}\right)\left(1 + \frac{s}{100}\right)$
4. $A = P\left(1 + \frac{r/4}{100}\right)^{4n}$
5. $A = P\left(1 - \frac{r}{100}\right)\left(1 - \frac{q}{100}\right)\left(1 - \frac{s}{100}\right)$
6. $A = P\left(1 + \frac{r/2}{100}\right)^{2n}$

a. Amount at compound interest for varying rates of depreciation
b. Amount at compound interest for interest compounded half yearly
c. Amount at compound interest for varying rates of growth
d. Amount at compound interest for constant rate of growth
e. Amount at compound interest for interest compounded quarterly
f. Amount at compound interest for constant rate of depreciation