Senior High School

Department of Education
National Capital Region
SCHOOLS DIVISION OFFICE
MARIKINA CITY

GENERAL MATHEMATICS

Quarter 2: Module 2
Solving Problems Involving Simple and Compound Interest

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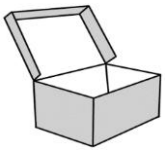


What I Need to Know

Hello Grade 11 learners! In this module, you will learn how to:

Solve problems involving simple and compound interest (**M11GM-IIb-2).**

The module is divided into two lessons, namely:

Lesson 1: Solving Problems Involving Simple Interest; and
Lesson 2: Solving Problems Involving Compounding Interest Computed More than Once a Year.

You can say that you have understood the lesson in this module if you can already:

1. solve problems involving simple interest;
2. define different terms on compound interest on compounding more than once a year;
3. compute interest, maturity value, and present value where interest is compounded more than once a year; and
4. solve problems involving compound interest when compound interest is computed more than once a year.

What I Know

Choose the correct letter that corresponds to the exact answer.

1. A bank offers 3.5% annual simple interest rate for a particular deposit. How much interest will be earned if ₱500,000.00 is deposited in this savings account for 2 years?
   A. ₱25,000.00 B. ₱35,000.00 C. ₱45,000.00 D. ₱55,000.00
2. Express the term in years if the term of a loan is 3 years and 9 months.
   A. 3.167 years B. 3.5 years C. 3. 75 years D. 8.83 years
3. How much money will you have after 6 years and 6 months if you deposited ₱18,000.00 in a bank that pays 0.8% simple interest?
   A. ₱18,036.00 B. ₱18,136.00 C. ₱18,636.00 D. ₱18,936.00

For item 4-5, please refer to the problem below.

Suppose you deposited ₱250,000.00 in a bank at annual simple interest rate of 2.5% for 3 years.

4. Compute for the simple interest in the given problem above.
   A. ₱8,750.50 B. ₱9,850.09 C. ₱14,204.76 D. ₱18,750.00
5. Find the maturity value in the given problem above.
   A. ₱268,750.00 B. ₱268,850.00 C. ₱300,000.00 D. ₱368,850.00

For item 6 – 8, please refer to the problem below.

Mr. Tolentino invested his money for the amount of ₱14,000.00 in a company at 4% compounded semi-annually for 7 years.

6. What is the total amount that Mr. Tolentino must receive after 7 years?
   A. ₱18,472.70 B. ₱20,472.70 C. ₱4,472.70 D. ₱4,272.70
7. Compute the interest gained by Mr. Tolentino.
   A. ₱18,472.70 B. ₱20,472.70 C. ₱4,472.70 D. ₱4,272.70
8. Find the present value of ₱35,000.00 due in 5 years if the money is invested at 12% compounded semi-annually.
   A. ₱15,045.06 B. ₱19,543.82 C. ₱20,000.00 D. ₱25,879.77
9. What is the present value of ₱30,000.00 due in 4 years if the money is worth 12% compounded quarterly?
   A. ₱11,304.99 B. ₱ 15,083.02 C. ₱16,862.72 D. ₱18,695.01
10. Compute the compound interest in item number 9.
   A. ₱11,304.99 B. ₱ 15,083.02 C. ₱16,862.72 D. ₱18,695.01

Lesson 1	**Solving Problems Involving Simple Interest**

What's In

Complete the table below by finding the unknown.

Principal (P)	**Rate (r)**	**Time (t)**	**Interest (I_s)**
a.)	1.5%	2 years	₱4,000.00
₱25,000.00	b.)	5 years	₱3,500.00
₱350,000.00	0.5%	C.)	₱1,800.00

What's New

Consider the problem below and answer the questions that follow.

Mr. Martin borrowed ₱50,000.00 and they both agreed with the lender that he pay after 9 months with an annual interest rate of 12%.

1. List the following given:
   Given: P = _____ r = _____ t = _____

2. How will you get the value of term/time when it is expressed in months?

3. How much is the interest that being charged to Mr. Martin?

What is It

In the previous lessons, you have learned how to calculate interest, maturity value and present value of a simple interest. In this lesson, you will focus on solving problems involving simple interest.

Problem 1: *How much interest is charged when ₱60,000.00 is borrowed for 1 year and 3 months at annual interest rate of 8%?*

Given: P = 60,000 r = 8% = 0.08 t = 1 year and $\frac{9}{12}$ = 1.75 years

Find: I_s

Solution:

$I_s = Prt$

$I_s = (60{,}000)(0.08)(1.75)$

$I_s = 8{,}400$

Hence, the simple interest charged is ₱8,400.00.

Note: When the term is expressed in months (M), it should be converted in years by t = $\frac{M}{12}$

Problem 2: *Mrs. Dela Cuesta avails a loan from Bank A amounting to ₱120,000.00 with an annual interest rate of 12% for 4 years. Compute for the interest and maturity value.*

Given: P = 120,000 r = 0.12 t = 4 years

Find: a.) I_s

b.) F

Solution: a. Simple Interest (I_s)

$I_s = Prt$

$I_s = (120{,}000)(0.12)(4)$

$I_s = 57{,}600$

b. Maturity Value (F)

$F = P + I_s$

$F = 120{,}000 + 57{,}600$

$F = 177{,}600$

Hence, the simple interest is ₱57,000.00 and the maturity value is ₱177,600.00.

Problem 3: *How much should you invest at the simple interest of 9.5% in order to have* ₱450,000.00 in 3 years and 6 months?

Given: F = 450,000.00 r = 0.095 t = 3.5 years

Find: P

Solution: Use the formula below to find P:

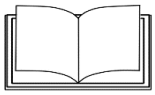
$$\mathbf{P} = \frac{F}{(1+rt)}$$

$$\mathbf{P} = \frac{F}{(1+rt)}$$

$$\mathbf{P} = \frac{450{,}000}{(1+(0.095)(3.5))}$$

$$\mathbf{P} = 337{,}711.07$$

Hence the principal amount is ₱337,711.07.



What's More

Solve the following problems:

1. What are the amounts of interest and maturity value of a loan amounting to ₱55,000.00 at 12% simple interest for 8 years?

2. How much money will you have after 5 years and 9 months if you deposited ₱15,000.00 in a bank that pays 2% simple interest?

What I Have Learned

Problem:

Mr. Ocampo avails a loan from Bank A amounting to ₱85,000.00 with an annual interest rate of 10.5% for 4 years and 10 months.

1. **Given**: P = _____ r =_____ t =_____ years
2. **Find:** a.) _____
   b.) _____
3. **Solution:** (Write your complete solution in the box)

What I Can Do

Problem: *Dexter wants to compare the simple interest on a* ₱30,000.00 investment. Which investment should Dexter choose and why?
1. Find the simple interest if funds earn 5% simple interest for 2 years.
2. Find the simple interest if funds earn 6% simple interest for 2.5 years.

Score	Description
15 points	Complete solutions and correct answer
10 points	Incomplete solutions and correct answer
5 points	Incomplete solutions and incorrect answer
No point earned	No output at all

Additional Activities

Problem: *Mikko borrowed ₱65,000.00 at 10% annual simple interest rate. How much should he pay after 6 years and 3 months?*

Lesson 2	Solving Problems Involving Compounding Interest Computed More than Once a Year

What's In

Complete the table below by finding the unknown.

Principal (P)	Rate (r)	Time (t)	Compound Interest	Maturity Value (F)
₱3,000.00	4%	8years	a.)	b.)
₱40,000.00	6%	1year and 2 months	c.)	d.)
e.)	2%	8 year	f.)	₱35,000.00

What's New

Consider the problem and answer the questions that follow:

Problem: *Given a principal of ₱6,000.00, which of the following options will yield greater interest after 3 years.*

OPTION A: Earn an annual interest rate of 3% at the end of the year, or
OPTION B: Earn an annual interest rate of 3% in two portions – 1.5% after 6 months, and 1.5% after another 6 months?

Option A: Interest is compounded *annually*

Time (t) in years	Principal = ₱6,000.00 Annual Interest rate = 3%, compounded annually
	Amount at the end of the year
1	6,000(1.03)= 6,180
2	6,180 (1.03) =6,365.40
3	6,365.40(1.03) = 6,556.362

Option B: Interest is compounded semi-annually, or every 6 months. Under this option, the interest rate every six months is 1.5% (3% divided by 2).

Time (t) in years	Principal = ₱6,000.00 Annual Interest rate = 3%, compounded semi-annually
	Amount at the end of the year
$\frac{1}{2}$	6,000(1.015) = 6,090
1	6,090 (1.015) = 6,181.35
$1\frac{1}{2}$	6,181.35(1.015) = 6,274.07
2	6,274.07(1.015) = 6,368.18
$2\frac{1}{2}$	6,368.18(1.015) = 6,463.70
3	6,463.70(1.015) = 6560.66

1. What have you noticed on the interest of Option A and Option B?
2. Since option B is compounded twice a year, what is the conversion period and frequency of conversion?
3. Option B gives a higher interest after 3 years. What conclusion can you draw from the given problem?

What is It

Definition of Terms

Frequency of conversion *(m)* – number of conversion periods in one year

Conversion or interest period – time between successive conversion of interest

Total number of conversion periods *(n):*

n = mt = (frequency of conversion) x (time in years)

Nominal rate *(i^m)* – annual rate of interest

Rate *(j)* of interest for each conversion period

$$j = \frac{i^m}{m} = \frac{annual\ rate\ of\ interest}{frequency\ of\ conversion}$$

Note on rate notation: *r, i^m, j*

In earlier lessons, r was used to denote the interest rate. Now that an interest rate can refer two rates (either nominal rate or rate per conversion period), the symbols i^m and j will be used instead.

Examples of nominal rates and corresponding frequencies of conversion and interest rate for each period:

i^m = Nominal rate(annual Interest rate)	m = frequency of conversions	j = Interest rate per conversion period	One conversion period
2% compounded annually; $i^1 = 0.02$	1	$\frac{0.02}{1} = 0.02 = 2\%$	1 year
2% compounded semi-annually; $i^2 = 0.02$	2	$\frac{0.02}{2} = 0.01 = 1\%$	6 months
2% compounded quarterly; $i^3 = 0.02$	4	$\frac{0.02}{4} = 0.005 = 0.5\%$	3 months
2% compounded monthly; $i^{12} = 0.02$	12	$\frac{0.02}{12} = 0.0016 = 0.16\%$	1 month
2% compounded daily; $i^{365} = 0.02$	365	$\frac{0.02}{365}$	1 day

From the previous lesson, the formula for the maturity value F when principal is invested at annual rate interest j compounded annually is
F = P(1 + j)^t.
Because the rate for each conversion period is $j = \frac{i^m}{m}$, then in t years, interest is compounded mt times. The following formula is obtained.

Maturity Value, Compounding m time a year

$$\mathbf{F} = P(1 + \frac{i^m}{m})^{mt}$$

Where: F = maturity (future) value
P = principal
i^m = nominal rate of interest (annual rate)
m = frequency of conversion
t = term/time in years

Example 1: Find the maturity value and interest if ₱15,000.00 is invested in a bank that pays 3% compounded quarterly for 4 years.
Given: P = 15,000.00 i^4 = 0.03 t = 4 years m – 4
Find: a. Maturity value (F)
b. Compound Interest
Solution:
Compute for the interest rate in a conversion period by

$$j = \frac{i^4}{4} = \frac{0.03}{4} = 0.0075$$

Compute for the total number of conversion periods given by
n = mt = (4)(4) = 20 conversion periods
Compute for the maturity value using
$F = P(1 + j)^n$
$F = (15{,}000)(1+0.0075)^{16}$
F = 15,455.09
Thus, the maturity value is ₱15,455.09.

The compound interest is given by
$I_c = F - P$
I_c = 15,455.09 – 15,000
I_c = 455.09
Thus, the compound interest is ₱455.09.

Example 2: Compute for the maturity value and interest if ₱12,000.00 is deposited in a bank at 5% compounded monthly for 6 years.
Given: P = 12,000.00 i^{12} = 0.02 t = 6 years m = 12
Find: a. Maturity Value (F)
b. Compound Interest

Solution:

Compute for the interest rate in a conversion period by

$$j = \frac{i^{12}}{12} = \frac{0.05}{12} = 0.004167$$

Compute for the total number of conversion periods given by

$$n = mt = (12)(6) = 72 \text{ conversion periods}$$

Compute for the maturity value using

$$F = P(1 + j)^n$$
$$F = (12{,}000)(1+0.004167)^{72}$$
$$F = 16{,}188.60$$

Thus, the maturity value is ₱16,188.60.

The compound interest is given by

$$I_c = F - P$$
$$I_c = 16{,}188.60 - 12{,}000$$
$$I_c = 4{,}188.60$$

Thus, the compound interest is ₱4,188.60.

The formula for the present value (P) at compound interest is given below.

Present Value (P) at Compound Interest

$$\mathbf{P} = \frac{F}{(1+j)^n}$$

Where: F = maturity (future) value
P = principal
i^m = nominal rate of interest (annual rate)
m = frequency of conversion
t = term/time in years

Example 3: Find the present value of ₱40,000.00 due in 6 years if the money is invested at 10% compounded semi-annually.

Given: F = 40,000.00 t = 6 $i^2 = 0.10$

Find: Principal

Solution:

First, compute for the interest rate per conversion period given by

$$j = \frac{i^2}{m} = \frac{0.10}{2} = 0.05$$

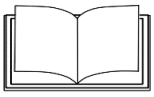
The total number of conversions is given by

$$n = mt = (2)(6) = 12$$

Compute for P, by substituting these values in the formula

$$\mathbf{P} = \frac{F}{(1+j)^n}$$
$$\mathbf{P} = \frac{40{,}000}{(1+0.05)^{12}}$$
$$\mathbf{P} = 22{,}273.50$$

Thus, the present value is ₱22,273.50.



What's More

A. Complete the table by computing the interest rate per period and total number of conversion periods.

Nominal rate i^m	**Interest compounded**	**Frequency of conversion (m)**	**Interest rate for each conversion period**
12%	Semi-annually	a.)	b.)
c.)	Quarterly	d.)	0.015
12%	Monthly	e.)	f.)

B. Solve the following problems.

1. Mr. Lim lends ₱65,000.00 for 4 years at 6% compounded semi-annually. Find the maturity value and interest of this amount.

2. How much should you deposit in a bank paying 2% compounded quarterly to accumulate an amount of ₱80,000.00 in 5 years and 9 months?

What I Have Learned

Given the problem below, answer the questions that follow. Write your answers on the space provided.

Problem: *Mr. De Guzman deposited ₱25,000.00 in a bank that pays 4% compounded quarterly for 8 years.*

1. List the following values of the given:
   P = _____ i^4 = _____ t= _____ m = _____
2. Compute for the value of j. Answer: _____
3. Find the value of n. Answer: _____
4. Compute for the maturity value. Answer: _____
5. Solve for the compound interest. Answer: _____

What I Can Do

Problem: *Debbie wants to compare the simple interest and the compound interest of* ₱80,000.00 investment.

1. Find the simple interest if it earns 8% interest in 1 year.
2. Find the interest if it earns 8% compounded annually for 1 year.

3. Find interest if it earns 8% compounded semi-annually for 1 year.

4. Find the interest if it earns 8% compounded quarterly for 1 year.

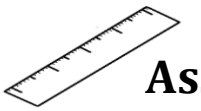
5. Which is the best investment? Why?

Score	Description
15 points	Complete solutions and correct answer
10 points	Incomplete solutions and correct answer
5 points	Incomplete solutions and incorrect answer
No point earned	No output at all

Additional Activities

Solve the problem below:
Mr. Joaquin aims to accumulate 1 million for 10 years. Which investment will require the smallest present value?

1. 8% simple interest
2. 8% compounded annually
3. 8% compounded semi-annually
4. 8% compounded quarterly
5. 8% compounded monthly



Assessment

Choose the letter that corresponds to the exact answer.

1. A bank offers 5.5% annual simple interest rate for a particular deposit. How much interest will be earned if ₱750,000.00 is deposited in this savings account for 3 years and 10 months?
   A. ₱158.111.25 B. ₱158,222.26 C. ₱158.333.27 D. ₱158.444.28

2. Express the term in years, if the term of a loan is 5 years and 5 months.
   A. 5.167 years B. 5.42 years C. 5. 75 years D. 5.83 years

3. How much money will you have after 10 years and 6 months if you deposit ₱12,000.00 in a bank that pays 0.6% simple interest?
   A. ₱12,650.00 B. ₱12,756.00 C. ₱12,636.00 D. ₱12,936.00

For item 4-5, please refer to the problem below.

Suppose you deposited ₱150,000.00 in a bank at an annual simple interest rate of 4.5% for 5 years.

4. What is the simple interest?
   A. ₱11,750.00 B. ₱22,750.00 C. ₱33,750.00 D. ₱44,750.00

5. What is the maturity value?
   A. ₱168,750.00 B. ₱178,567.00 C. ₱181,230.00 D. ₱183,750.00

For item 6 – 8, please refer to the problem below.
Mr. Tolentino invested his ₱14,000.00 in a company at 8% compounded quarterly for 8 years.

6. What is the total amount that Mr. Tolentino must receive after 8 years?
   A. ₱26,383.57 B. ₱25,472.70 C. ₱24,472.70 D. ₱23,272.70

7. What is the interest gained by Mr. Tolentino?
   A. ₱18,472.70 B. ₱12,383.57 C. ₱14,999.70 D. ₱4,272.70
8. Find the present value of ₱20,000.00 due in 5 years if it is invested at 12% compounded semi-annually.
   A. ₱11,167.90 B. ₱11,764.82 C. ₱12,000.00 D. ₱12,844.01

9. What is the present value of ₱80,000.00 due in 2 years if it is invested at 12% compounded quarterly?
   A. ₱50,778.99 B. ₱ 55,645.06 C. ₱63,152.73 D. ₱78,008.53

10. What is the compound interest in item number 9?
   A. ₱11,304.99 B. ₱ 15,083.02 C. ₱16,847.26 D. ₱18,695.01

References

General Mathematics Leaner's Materials: Published by Department of Education

Answer Key

Assessment:

1. A 2. B 3. B 4. C 5.D 6. A 7. B 8. A 9. C 10. C

What I Know:

1. A 2. C 3. D 4. D 5. A 6. A 7. C 8. B 9. D 10. A

Lesson 1:

What's In

Principal (P)	Rate (r)	Time (t)	Compound Interest	Maturity Value (F)
3,000	4%	8years	a.) 1,105.71	b.) 4,105.71
40,000	6%	1year and 2 months	c.) 2,812.12	d.) 42,812.12
e.) 29,872.16	2%	8 year	f.) 5,127.84	35,000

What's More

A.

Nominal rate i^m	**Interest compounded**	**Frequency of conversion (m)**	**Interest rate for each conversion period**
12%	Semi-annually	a.) 2	b.) 0.06
c.) 6%	Quarterly	d.) 4	0.015
12%	Monthly	e.) 12	f.) 0.01

B. 1. a. 82,340.06 b. 17,340.06

2. 77,738.32

What I Have Learned

1. P = 25,000 i^4 = 0.04 t = 8 m = 4
2. j = 0.01 3. n = 32 4. 34,373.52 5. 9,373.52

What I can DO

1. 6,400 2. F = 86,4000, I_c = 6,400 3. F = 86,528, I_c = 6,528
4. F = 86,594.57, I_c = 6,594.57
5. The highest interest is the one that earns 8% compounded quarterly

Additional Activity

1. 555,555.55 2. 463,193.49 3. 456,386.95
4. 452,890.42 5. 450,523.46

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