



DEPARTMENT OF EDUCATION

GRADE 10

MATHEMATICS

UNIT 2



MANAGING YOUR MONEY

Published by:



FLEXIBLE OPEN AND DISTANCE EDUCATION
PRIVATE MAIL BAG, P.O. WAIGANI, NCD
FOR DEPARTMENT OF EDUCATION
PAPUA NEW GUINEA

GRADE 10

MATHEMATICS

UNIT 2

MANAGING YOUR MONEY

TOPIC 1 PERCENTAGE AND MONEY

TOPIC 2 RATIO AND PROPORTION

TOPIC 3 RATES

TOPIC 4 BORROWING MONEY

Acknowledgements

We acknowledge the contribution of all Secondary teachers who in one way or another helped to develop this Course.

Special thanks are given to the staff of the Mathematics Department- FODE who played active role in coordinating writing workshops, outsourcing of lesson writing and editing processes involving selected teachers in NCD.

We also acknowledge the professional guidance and services provided through-out the processes of writing by the members of:

Mathematics Department- CDAD

Mathematics Subject Review Committee-FODE

Academic Advisory Committee-FODE

This book was developed with the invaluable support and co-funding of the GO-PNG/FODE World Bank Project.

MR. DEMAS TONGOGO

Principal-FODE



Flexible Open and Distance Education
Papua New Guinea

Published in 2017

@ Copyright 2017, Department of Education
Papua New Guinea

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means electronic, mechanical, photocopying, recording or any other form of reproduction by any process is allowed without the prior permission of the publisher.

ISBN 978 9980 89 704 6

National Library Services of Papua New Guinea

Written by: **Maseeve Joseph James Masule**, Mathematics Curriculum Writer - FODE

Printed by the Flexible, Open and Distance Education

CONTENTS

	Page
Secretary's Message	4
Unit Introduction	5
Study Guide	6
TOPIC 1: PERCENTAGE & MONEY	8
Lesson 1 Percentage & Money	9
Lesson 2 Earning Money	16
Lesson 3 Spending Money	30
Lesson 4 Hire Purchase	38
Lesson 5 Appreciation & Depreciation	47
Lesson 6 Profit & Loss	53
Lesson 7 Budget	60
Summary	71
Answers Practice Exercises 1-7	72
TOPIC 2 : RATIO & PROPORTION	78
Lesson 8 Ratios & Equivalent Ratios	79
Lesson 9 More Ratios	88
Lesson 10 Ratios With Three or More Terms	93
Lesson 11 The Meaning of Proportion	97
Lesson 12 Proportion Division	108
Summary	112
Answers Practice Exercises 8-12	113
TOPIC 3: RATES & RATE GRAPHS	
Lesson 13 The Meaning of Rates	118
Lesson 14 Uniform Rates and Average Rates	124
Lesson 15 Rates and Unitary Method	130
Lesson 16 More Rates	134
Lesson 17 Graphs of Rates	142
Summary	148
Answers Practice Exercises 13 – 17	149
TOPIC 4: BORROWING MONEY	153
Lesson 18 Simple and Compound Interest	154
Lesson 19 Types of Loan and Loan Interest Rates	163
Lesson 20 Most Suitable Term of the Loan	168
Lesson 21 Applying for a Loan	173
Summary	179
Answers Practice Exercise 18 - 21	180
Bibliography	185

SECRETARY'S MESSAGE

Achieving a better future by individuals students, their families, communities or the nation as a whole, depends on the curriculum and the way it is delivered.

This course is part and parcel of the new reformed curriculum – the Outcome Base Education (OBE). Its learning outcomes are student centred and written in terms that allow them to be demonstrated, assessed and measured.

It maintains the rationale, goals, aims and principles of the national OBE curriculum and identifies the knowledge, skills, attitudes and values that students should achieve.

This is a provision of Flexible, Open and Distance Education as a alternative pathway of formal education.

The Course promotes Papua New Guinea values and beliefs which are found in our constitution, Government policies and reports. It is developed in line with the National Education Plan (2005 – 2014) and addresses an increase in the number of school leavers which has been coupled with a limited of access to secondary and higher educational institutions.

Flexible, Open and Distance Education is guided by the Department of Education's Mission which is fivefold;

- to facilitate and promote integral development of every individual
- to develop and encourage an education system which satisfies the requirements of Papua New Guinea and its people
- to establish, preserve, and improve standards of education throughout Papua New Guinea
- to make the benefits of such education available as widely as possible to all of the people
- to make education accessible to the physically, mentally and socially handicapped as well as to those who are educationally disadvantaged

The College is enhanced to provide alternative and comparable path ways for students and adults to complete their education, through one system, many path ways and same learning outcomes.

It is our vision that Papua New Guineans harness all appropriate and affordable technologies to pursue this program.

I commend all those teachers, curriculum writers and instructional designers, who have contributed so much in developing this course.

Secretary for Education

Unit Introduction



This is the Second Unit of the grade 10 Mathematics Course titled Managing Your Money. It is based on the NDOE Lower Secondary Mathematics Syllabus and Curriculum Framework for Grade 10.

When we deal with money we earn, spend, borrow or invest. We earn in various forms of employment. We spend to sustain our life. We borrow to fill the shortfall in cash on demand and invest when we have savings and to increase wealth.

The topics provide you the concepts, skills and aptitude you require to manage your money. Each topic is sub-divided into lessons. Each lesson teaches you the specific attitude, knowledge and skills in computing various forms of earnings, spending or borrowing for personal use or for an investment purpose.

Topic 1 Percentage and Money

The topic covers Percentage and Money, Earning Money, Spending Money, Hire Purchase, Appreciation and Depreciation, Profit and Loss and Budget. Ways of computing your earnings and spendings are clearly laid out. It further discusses over-time rates, taxes, voluntary and compulsory deductions, net pay and forms of commission payment.

Topic 2 Ratio and Proportion

This topic covers Ratios and Equivalent Ratios, More Ratios, ratios with three or More terms, The meaning of Proportion and proportion Division. The sub-topics provide links to computations skills in earning and spending money.

Topic 3 Rates

Here the topic discusses Meaning of Rates, the Uniform and Average Rates, Rates and Unitary Method, More Rates and Graphs of Rates. Rates provide the basis to compute earnings . The graphs provide illustrative aspect of the problems.

Topic 4 Borrowing Money

This topic provides knowledge and examples of Simple and Compound Interest, the Types of Loans and Interest rates, the Suitable Terms of the Loan and Applying for a Bank Loan. It provides in addition the commercial application and knowledge you require to bid for a loan and manage your loan successfully by being able to repay the loan.

Order of Operations (BODMAS) is also an important skill you must acquire, so you can compute with confidence the wages, hire purchase and appreciation & depreciation problems. All these lessons are set to prepare you and provide to you as a tool to meet the daily challenges you will face while in school, and as well as after school in your village, workplace or at home.

STUDY GUIDE

Follow the steps given below as you work through the Unit.

- Step 1: Start with TOPIC 1 Lesson 1 and work through it.
Step 2: When you complete Lesson 1, do Practice Exercise 1.
Step 3: After you have completed Practice Exercise 1, check your work. The answers are given at the end of the TOPIC 1.
Step 4: Then, revise Lesson 1 and correct your mistakes, if any.
Step 5: When you have completed all these steps, tick the check-box for Lesson, on the Contents Page (page 3) like this:

Lesson 1: Percentage and Money

Then go on to the next Lesson. Repeat the same process until you complete all of the lessons in Topic 1.

As you complete each lesson, tick the check-box for that lesson, on the Content Page 3, like this . This helps you to check on your progress.

- Step 6: Revise the Topic using Topic 1 Summary, then, do Topic test 1 in Assignment 2.

Then go on to the next Topic. Repeat the same process until you complete all of the four Topics in Unit 2.

Assignment: (Four Topics and a Unit Test)

When you have revised each Topic using the Topic Summary, do the Topic Test in your Assignment. The Unit book tells you when to do each Topic Test.

When you have completed the four Sub-strand Tests, revise well and then do the Strand Test. The Assignment tells you when to do the Strand Test.

The Topic Tests and the Unit Test in the Assignment will be marked by your Distance Teacher. The marks you score in each Assignment will count towards your final mark. If you score less than 50%, you will repeat that Assignment.

Remember, if you score less than 50% in three Assignments, you will not be allowed to continue. So, work carefully and make sure that you pass all of the Assignments.

TOPIC 1

PERCENTAGE AND MONEY

Lesson 1: Percentage & Money

Lesson 2: Earning Money

Lesson 3: Spending Money

Lesson 4: Hire Purchase

Lesson 5: Appreciation & Depreciation

Lesson 6: Profit and Loss

Lesson 7: Budget

TOPIC 1: PERCENTAGE & MONEY

Introduction



This is the first Topic of the Grade 10 Mathematics Course under Unit 2, Managing Your Money.

Money enables us to trade goods and services. Money is the medium of exchange, here in Papua New Guinea and all other countries in the modern world.

This Topic 1 Percentage and Money covers 7 lessons from lesson 1 to lesson 7.

Lesson 1: Percentage & Money: This lesson includes percentage, estimation of money, and calculating percentages of money.

Lesson 2: Earning Money: This lesson includes pay rates and scales, wages, piece-work, salary and commission. It expands your knowledge on the computation of payments of these various forms of earnings. It further discusses over-time rates, taxes, deductions, net pay and forms of commission payment.

Lesson 3: Spending Money: This lesson includes discounts, sales, best-buys and estimating costs of living. It explains these through computation of cash price, selling price, sales and discount price.

Lesson 4: Hire Purchase: This lesson teaches you how to calculate hire purchase and defines and explains the parameters of hire purchase in initial deposit, balance outstanding, instalments and interest on balance outstanding.

Lesson 5: Appreciation & Depreciation: This lesson includes computation of appreciation and depreciation of asset and investment values.

Lesson 6: Profit & Loss: This lesson discusses computation of profit and loss.

Lesson 7: Budget: This lesson provides you an insight of a personal budget, family budget and business budget. It expands your knowledge on business budget through discussion of cash flow statement.

Lesson 1: Percentage & Money



You have learned percentages and calculating percentages of quantities, and expressing as percentage of a quantity.



In this lesson you will:

- identify the purpose of using money,
- estimate addition, subtraction, multiplication and division of money,
- find percentage of money.

Money makes exchange of goods and services easy. Money has value, is easy to carry around, and is accepted by everyone. Money can be used to buy food, clothes, shelter, transport, and anything you need and want.

Money is a standard medium of exchange.

Money has now become the centre of all activities. Whether it is business, politics, sports or social gathering, money will make things happen. Having enough money every fortnight is what every individual strives to achieve.

Percentage

Percent or Percentage is an amount or rate expressed as a ratio of 100.

Percent describes part or portion in every 100. For example, 'five per cent' (5%) means 5 per 100. We must note that it is for every one hundred (100) and not every hundred (200 or 600 etc.)

Estimation of Money

When estimating prices of goods and services or performing basic operation with money, round off the amount to one significant figure.

Look at the second significant digit of a figure, say in 2618, six (6) is the second significant digit, counting from left to the right. If it is less than 5, round off; if the digit is equal to or greater than 5, round the figure upward (the first significant digit increases by 1 each time). Then perform the basic operation.

Example

Find the estimate of the following:

a. $K9.37 + 74t$ $[3 < 5; 4 < 5 \text{ in the second}]$

$$= K9.00 + 70t$$

$$= K9.70$$

- b. $K62\,739.08 - K7\,909.62$ [2 < 5; 9 > 5 in the second]
= $K60\,000 - K8\,000$
= $K52\,000$
- c. $8 \times K4.53$ [8 is a single digit so it is unchanged; 5 is equal to 5]
= $8 \times K5.00$
= $K40.00$
- d. $K649 \div 13$ [4 < 5; 3 < 5]
= $K600 \div 10$
= $K60$
- e. $K0.70 + K2.42 - 85t$ [note that the first amount is in 1 significant digit form, 4 < 5; 5 = 5]
= $K0.70 + K2.00 - K0.90$
= $K1.80$

Calculating Percentage of Money

Money is a quantity. When we calculate percentage of money, we are actually calculating percentage of a quantity.

Example 1

Find 20% of K234.

Solution:

$$\begin{aligned} & 20\% \text{ of } K234 \\ &= \frac{20}{100} \times K234 \\ &= \frac{1}{5} \times 234 \\ &= \frac{234}{5} \\ &= K46.80 \end{aligned}$$

Example 2

Find 6% interest on K4000

Solution:

$$\begin{aligned} & 6\% \text{ of K4000} \\ &= \frac{6}{100} \times \text{K4000} \\ &= \frac{3}{5} \times 400 \\ &= \frac{1200}{5} \\ &= \text{K240.00} \end{aligned}$$

Example 3

Given 10% commission, how much will Mutu earn from K1836.00 worth of sales of PEPSI drinks?

Solution:

$$\begin{aligned} & 10\% \text{ of K1 836} \\ &= \frac{10}{100} \times 1836 \\ &= \frac{1}{10} \times 1836 \\ &= \frac{1836}{10} \\ &= \text{K183.60} \end{aligned}$$

Example 4

Calculate 10% of K2.8 million.

Solution:

$$\begin{aligned} & 10\% \times \text{K2.8 mil} \\ &= 10\% \times \text{K2 800 000} \\ &= 0.1 \times \text{K2 800 000} \quad [\text{Per cent can be expressed as a decimal fraction.}] \\ &= \text{K280 000} \end{aligned}$$

Example 5

When 30% of an amount of money was deducted, only K350 was paid to Sedrick. What is the total amount?

Solution:

$$100\% - 30\% = 70\%$$

And Sedrick received K350 = 70%

$$\frac{70}{100}A = 350$$

$$70A = 35000$$

$$A = \frac{35000}{70}$$

$$A = \text{K}500$$

Example 6

If 40% of an amount is K80, what is 60% of the amount?

Solution:

Let the amount be A.

$$\frac{40}{100}A = 80$$

$$40A = 8000$$

$$A = \frac{8000}{40}$$

$$A = 200$$

Since A = 200

$$\frac{60}{100} \times 200$$

$$= 0.6 \times 200$$

$$= 6 \times 20$$

$$= \text{K}120$$

Therefore 60% of the amount is K120

Example 7

Bedu has a 4% deduction from his salary as a member's contribution to Papua New Guinea Teacher's Association (PNGTA). Bedu's salary per fortnight is K946.17. How much is Bedu's contribution to PNGTA every fortnight?

Solution:

$$4\% \text{ of } K946.17$$

$$= 0.04 \times 946.17$$

$$= 4 \times 9.4617 \quad [\text{Multiply } 0.04 \text{ by } 100 \text{ and, divide } 946.17 \text{ by } 100]$$

$$= 37.8464$$

$$= K37.85$$

Therefore 4% of K946.17 is K37.85

NOW DO PRACTICE EXERCISE 1

**Practice Exercise 1**

1. Find the sum or difference of the following amounts of money.

a. $K12.43 + K3.89$

b. $K16.92 - K11.09$

2. Estimate the sums, differences and products of the given amounts of money.

a. $K8.36 + 42t =$

b. $59t + 71t =$

c. $K9.43 - 67t =$

d. $K912 - K235.74 =$

e. $K3.69 \times 10 =$

f. $14 \times 48t =$

3. What per cent of K3.00 is 20t?

4. Calculate percentages of money.

a. 5% of K2.80 =

b. 10% of K43 =

5. Estimate the percentages of money.

a. 10% of K43 =

b. 15% of K780 =

6. Tatai has to pay six of his helpers K69.30 each. Estimate the total amount Tatai needs to pay all six of his helpers.

7. Makun had to pay 10% of K18 649.76 to a business partner. Estimate the amount Makun pays her partner.

8. Ketur gets K230 in a fortnight. The following fortnight his pay increased by 8%. Calculate his new fortnightly wage.
-

9. A sum of K2800 was shared amongst Bansu, Ruthie and Schola. Ruthie got 30%, Schola got 50% and Bansu got the rest. Find how much each of the three received.
-

10. If 10% of an amount of money is K22, find the amount.
-

11. When an amount of money was reduced by 15%, K340 was left. Calculate the original sum of money.
-

12. If 20% of an amount is K3000, what is 80% of the amount?
-

CHECK YOUR WORK. ANSWERS ARE AT THE END OF TOPIC 1.

Lesson 2: Earning Money



You have learned to estimate and calculate percentages of money, and expressing as percentage of a quantity in the previous lesson.

In this lesson you will:

- calculate pay rates and scales
 - solve problems involving piece wages, wages and overtime, and salary
 - solve problems involving commission and piece-work
 - calculate income tax payable using taxation table.
-

Pay Rates and Pay Scales

Those that are paid salaries have pay scales set by the Minimum Wages Board and approved by the Labour Department. Public servants are paid using pay rates or pay scales.

Pay Scales is a range of pay. It is a pay range for a particular type of work or for all types of work within a particular organization.

Employees who are paid wages are given their basic rate of pay per hour. It is set as low as K3.36 per hour. Wage earners are paid over-time if they work more than 8 hours per day or 40 hours a week.

On the weekends, wage earners are paid at over-time rates.

Pay rate is the basic rate paid to wage earners for the time worked.

Piece wage

If a green copra picker is paid K4.00 per bag, or a cocoa picker is paid K2.50 per kilogram collected and etc., they are paid at a piece wage.

The K4.00 per bag and K2.50 per kilogram is the piece rate at which they are paid.

Piece wage is the pay received for every unit of work done.

Piece rate

Each bag of green copra and a kilogram of cocoa are each the unit of work done.

Piece rate is the amount of money paid for every unit of work produced.

Example 1

Yodik is a cocoa picker. He picks 12kg on Tuesday, 15kg on Wednesday and 18kg on Thursday. He is given piece-rate as K0.75/kg. How much does Yodik earn for his weeks work?

Solution: Money earned = total weight of cocoa collected x piece rate

$$\begin{aligned} \text{Yodik's total weight collected} &= 12\text{kg} + 15\text{kg} + 18\text{kg} \\ &= 55\text{kg} \end{aligned}$$

$$\begin{aligned} \text{Money earned} &= 55\text{kg} \times \text{K}0.75/\text{kg} \\ &= \text{K}41.25 \end{aligned}$$

Therefore Yodik earned K41.25 in that week.

Wage

If an employee has 7 hours per day, he has 35 basic hour-week and 70 hours a fortnight. An employee who works 8 hours a day has 40 basic hour-week and 80 hours in a fortnight.

Wage is the payment received for each hour of work done.

Wage earners are paid a **basic rate** of pay on a **basic hour-week**, and **over-time rate** for any hour worked over time.

Basic Wage = Basic rate of Pay x Basic hour- week x 2 weeks.

If in a fortnight, the employees work time does not exceed 70 hours when he or she has 70 basic hour-week, he or she will not be paid over-time pay.

Likewise, employees with 40 basic hour-week will not be paid over time if they clocked 80 hours or less in a fortnight.

An employee with 80 basic hour-week has to work 81 hours or more to earn overtime. Often after regular hours of work and on weekends, employees are paid at over-time rates for each hour of work done.

Overtime = Overtime Rate x Overtime of work .

Over-time rates are based on individual basic rate of pay. The overtime rates are often stated as:

- **Time-and-a-half for 1 ½ (1.5) times the basic rate**

- **Double-time for 2 times the basic rate**
- **Double-time-and- a-quarter for $2\frac{1}{4}$ (2.25) times basic rate**
- **Triple-time for 3 times the basic rate**
- **Triple-time-and-a- third for $3\frac{1}{3}$ x basic rate and etc.**

Take-home pay is the amount paid into the bank account of an employee or paid as cash or cheque.

Take-home Pay = Basic Wage per fortnight + Overtime Wage per fortnight.

Example 1

Yegat is paid a basic rate of K5.30 per hour for 35 hour-weeks work. How much does he receive in a fortnight?

Solution:

$$\begin{aligned}\text{Basic Pay} &= \text{Basic Rate} \times 35 \text{ hour-week} \times 2 \text{ weeks} \\ &= \text{K}5.30 \text{ per hour} \times 35 \text{ hour-week} \times 2 \text{ weeks} \\ &= \text{K}5.30/\text{h} \times 70 \text{ hours} \\ &= \text{K}371.00\end{aligned}$$

Example 2

Vince is paid at a basic rate of K4.20 per hour for 40 hour-weeks. He is paid time - and – half for over-time, and double - time on weekends. In a fortnight, Vince worked 90 hours and additional 12 hours over the weekend.

Calculate his:

- Normal pay for the fortnight.
- Overtime pay during the week.
- Overtime pay for the weekend.
- Total pay for the fortnight.

Solution:

- Normal pay for the fortnight.

$$\text{K}4.20/\text{h} \times 80\text{h} = \text{K}336$$

- (b) Overtime pay during the week.

$$K4.20/h \times 1.5 \times 10h = K63.00$$

- (c) Overtime pay for the weekend.

$$K4.20/h \times 2 \times 12h = K102.80$$

- (d) Total pay for the fortnight.

$$\begin{aligned} \text{Total Pay} &= \text{Normal pay} + \text{OT Week} + \text{OT Weekend} \\ &= K336.00 + K63.00 + K102.80 \\ &= K501.80 \end{aligned}$$

Example 3

Navu is paid a basic rate of K6.20 per hour for 35 hour-weeks work with a road construction company. On weekends he is paid at time-and-a-half on Saturdays, and double-time on Sundays.

In a fortnight he work 70 hours on weekdays, 10 hours on Saturday, and 3 hours on Sunday. What is his take-home pay?

Solution:

$$\text{Take-home Pay} = \text{Basic Pay} + \text{Over-time (OT) Pay}$$

$$\begin{aligned} \text{Basic wage} &= \text{Basic Rate} \times 35 \text{ hour- week} \times 2\text{weeks} \\ &= K6.20/h \times 70h \\ &= K434.00 \end{aligned}$$

$$\begin{aligned} \text{Saturday OT} &= \text{Basic rate} \times 1.5 \times \text{Time} \\ &= K6.20/h \times 1.5 \times 10h \\ &= K92.00 \end{aligned}$$

$$\begin{aligned} \text{Sunday OT} &= \text{Basic rate} \times 2 \times \text{Time} \\ &= K6.20/h \times 2 \times 3h \\ &= K37.20 \end{aligned}$$

$$\begin{aligned} \text{Take-home Pay} &= K434 + K92.00 + K37.20 \\ &= K520.20 \end{aligned}$$

Salary

Internationally recognized companies in PNG pay salaries in months. So to find monthly salary, divide annual salary by 12 months.

All other government employees or public servants are paid on fortnightly basis. So their annual salary is divided by 26 fortnights per year to work out their fortnightly salary.

Gross salary is the amount paid before tax or any other deductions are made.

Net Pay is the amount left after tax and other deductions have been made.

Deductions are money taken out from gross pay such as **tax** and **superannuation** which are compulsory. There may be **optional deductions** such as savings & loans scheme, life-insurance cover and house mortgage.

Tax is calculated based on pay total after deductions have been taken off.

Overtime is not paid because salary does not depend on the number of hours worked.

Calculating Salary

Salaries are fixed on annual basis.

Salary is fixed on yearly basis. It is divided by 12 months or 26 fortnights to get monthly or fortnightly pay respectively.

Example 1

Bera works for Canadian American Tobacco (CAT) receives an annual salary of K35 600. How much is she paid every month?

Solution:

$$\begin{aligned}\text{Monthly Salary} &= \text{Annual Salary} \div 12 \text{ months per year} \\ &= \text{K}35\,600 \div 12 \\ &= 2\,966.6667 \\ &= \text{K}2\,966.67\end{aligned}$$

Therefore Bera is paid K2 966.67 as a monthly gross pay.

Example 2

John Ram is paid an annual salary of K41 100p.a. On February 3rd, 2015 he got a pay rise of 6%. What is the cash difference on his pay per fortnight?

Solution:

$$\begin{aligned}\text{Old fortnight Salary} &= \text{Annual Salary} \div 26 \text{ fortnights per year} \\ &= \text{K}41\,100 \div 26 \\ &= 1580.7692\dots \\ &= \text{K}1\,580.76\end{aligned}$$

$$\begin{aligned}\text{New Annual Salary} &= \text{Old Annual Salary} + 6\% \text{ of Old Annual Salary} \\ &= \text{K}41\,100 + (6\% \times \text{K}41\,100) \\ &= \text{K}41\,100 + (0.06 \times \text{K}41\,100) \\ &= 41\,100 + (6 \times 411) \\ &= 41\,100 + 2466 \\ &= \text{K}43\,566.00\end{aligned}$$

$$\begin{aligned}\text{New fortnight Salary} &= \text{New Annual Salary} \div 26 \text{ fortnights per year} \\ &= \text{K}43\,566 \div 26 \\ &= \text{K}1\,675.61\end{aligned}$$

$$\begin{aligned}\text{Cash Difference} &= \text{New fortnight salary} - \text{Old fortnight salary} \\ &= \text{K}1\,675.61 - \text{K}1\,580.76 \\ &= \text{K}94.85\end{aligned}$$

John Ram will get cash difference of K94.85 as pay increase.

Deductions

The total amount you receive fortnightly is your fortnight **Gross** Pay. Pay Section makes some deductions. **Deductions** are money taken out from your gross pay.

After Tax and other deductions have been made on your pay, what is left is called **Net** Pay. Net Pay is often referred to as **Take-home** Pay.

$\text{Net Pay} = \text{Gross Pay} - (\text{Tax} + \text{Deductions})$
--

An example of a payslip.

SILIH BUILDERS		PAYROLL ADVICE	
Pay	K872.64		
Deductions:	SAV.LOAN 30	KWI 50	Medic.Ins 30
Name:	Peter TUL		Date: 10/07/2015
Address:	Po Box 2034, Madang 511, MP		
			Pay Centre: BSP, Mad
GROSS	TAX	DEDUCTIONS	NET
872.64	* 32.03	110	730.61

*4.2% tax is used for the purpose of tax calculation; tax was calculated on K762.64

Income Tax

Income tax is the money every employee worker pays to the government. It is calculated after all deductions have been made on the fortnightly **Gross Pay**.

Tax deducted is paid to the Taxation Office, the body which also sets the Taxation Table.

Dependants of an employee were always considered before tax is deducted from an employee. Every employee needs to fill in **Tax Declaration Form** in-order to be fairly taxed.

$$\text{Tax value} = n\% \times (\text{Gross Pay} - \text{Deductions})$$

Example 3

Makis teaches in a secondary school. He is paid K32 400 p.a. He pays 4% in tax and has the following other deductions as Savings and loans K50 and Brian Bell K61.90

Calculate Makis' net pay.

Solution:

$$\begin{aligned} \text{Fortnight Salary} &= \text{Annual Salary} \div 26 \text{ fortnights per year} \\ &= \text{K}32\,400 \div 26 \\ &= 1\,246.1538\dots \\ &= \text{K}1\,246.15 \end{aligned}$$

$$\begin{aligned}
 \text{Deductions} &= \text{Savings \& Loans + Brian Bell} \\
 &= \text{K50 + K61.90} \\
 &= \text{K111.90}
 \end{aligned}$$

$$\begin{aligned}
 \text{Tax} &= 4\% \text{ of } [(\text{Annual Salary} \div 26) - \text{Deductions}] \\
 &= \frac{4}{100} \times ((\text{K}32\,400 \div 26) - \text{K}111.90) \\
 &= (0.04 \times ((32400 \div 26) - 111.90)) \\
 &= 0.04 \times (1\,246.15 - 111.90) \\
 &= 0.04 \times 1134.25 \\
 &= \text{K}45.37
 \end{aligned}$$

Subtract total deduction from gross pay then, calculate **tax payable**.

$$\begin{aligned}
 \text{Total Deductions} &= \text{Tax + Savings \& Loans + Brian Bell} \\
 &= \text{K}45.37 + \text{K}50 + \text{K}61.90 \\
 &= \text{K}157.27
 \end{aligned}$$

$$\begin{aligned}
 \text{Net Pay or Take-home Pay} &= \text{fortnight gross} - \text{fortnightly deductions} \\
 &= \text{K}1\,246.15 - \text{K}157.27 \\
 &= \text{K}1\,088.88
 \end{aligned}$$

Therefore, Makis' net pay is K1088.88 per fortnight.

Commission

Commission is a fixed percentage of the value of goods sold or value of services provided paid to salesperson or service provider.

Commission is an additional pay given to a salesperson if the salesperson is paid a basic wage. If the basic wage is not paid, the salesperson's earning depends entirely on the commission he or she earns. That is, if the salesperson sells goods he or she earns; if not, he or she does not receive any pay.

For a salesperson, commission is paid to encourage the salesperson to work hard and sell more of the products for the company. For a service provider, he or she generally makes claim for 10% of the value of service.

Example 1

A motor vehicle spare parts salesperson receives a basic fortnight of K16 120 per annum. His commission rate is 3.5%. In a fortnight the spare parts salesperson sold K18 000.00 worth of car parts. What is the total earning for the salesperson in that fortnight?

Solution:

$$\text{Fortnight Salary} = \text{Annual Salary} \div 26 \text{ fortnights}$$

$$= \text{K}16\,120 \div 26$$

$$= 620$$

$$= \text{K}620$$

$$\text{Commission} = 3.5\% \text{ of Sales Value}$$

$$= \frac{3.5}{100} \times \text{K}18\,000$$

$$= 0.035 \times 18\,000$$

$$= 35 \times 18$$

$$= \text{K}630$$

$$\text{Total Earnings} = \text{Fortnight Salary} + \text{Fortnights Commission}$$

$$= \text{K}620 + \text{K}630$$

$$= \text{K}1\,250$$

Therefore, the salesperson is paid a total of K1 250.00

Self-Employment

When you work for yourself to earn a living, you are self-employed.

You are self-employed when you operate your own trade store, sell 'buai', sell market produce, operate a PMV service, or sell plantation produce such as copra collected from your own plantation. Money you make is your own.

Example 1

Goba bought a bag of betel nut for K60. He sold the betel nut for K2.00 each. He sold 98 betel nut from the bag he bought. How much money did he make?

Solution:

$$\begin{aligned}
 \text{Money Earned} &= \text{Total Earning} - \text{Cost of a Bag of betel nut} \\
 &= (98 \times K2) - K60 \\
 &= 196 - 60 \\
 &= K116
 \end{aligned}$$

Therefore, Goba earned K116.00.

Goba's earning may be lower if he gave a free mustard seed to his customers. The cost of mustard seed is to be subtracted from K116.00. Goba did the buying and selling of betel nut once every fortnight, so he had a regular income fortnightly.

Example 2.

Saya sold 15 lime pots at K2.00 each, 68 betel nuts at 20t each, 46 mustard seeds at 10t each and 100 tobaccos at K1.00 each.

- (a) What is his total earning for the day?
- (b) If he spent K3.00 on mustard to sell along with his betel nut, what is the profit made on mustard seed?
- (c) He bought 20 lime pots at 50t each. Was he able to make a profit on the lime pots?

Solution:

$$\begin{aligned}
 \text{(a) Total Earning} &= \text{lime pot} + \text{betel nuts} + \text{mustard} + \text{tobacco} \\
 &= 15 \times K2 + 68 \times K0.20 + 46 \times K0.10 + 100 \times K1 \\
 &= K30 + K13.60 + K4.60 + K100 \\
 &= 148.20 \\
 &= K148.20
 \end{aligned}$$

$$\begin{aligned}
 \text{(b) Profit} &= \text{Income on Mustard} - \text{Cost on Mustard} \\
 &= K4.60 - K3.00 \\
 &= K1.60
 \end{aligned}$$

$$\begin{aligned} \text{(c) Profit on Lime Pot} &= \text{Earning from lime pots sold} - \text{Total Cost of lime pots} \\ &= 15 \times \text{K}2.00 - 20 \times \text{K}0.50 \\ &= \text{K}30 - \text{K}10 \\ &= \text{K}20.00 \end{aligned}$$

Example 3

Steven sold 10 cabbages at K2.00 each, 20 heaps of kaukau at K5 each, and 10 heaps of potato at K3.00 each.

What is Steven's total earning?

Solution:

$$\begin{aligned} \text{Total Earning} &= \text{cabbages} + \text{kaukau} + \text{potato} \\ &= 10 \times \text{K}2 + 20 \times \text{K}5 + 10 \times \text{K}3 \\ &= \text{K}20 + \text{K}100 + \text{K}30 \\ &= \text{K}150 \end{aligned}$$

Therefore, Steven's total earning is K150.

NOW DO PRACTICE EXERCISE 2

**Practice Exercise 2**

1. Tere is a cocoa picker. She is paid a piece-rate of K1.20 per kg. Tere picked the following weights from Monday to Saturday as 89kg, 70kg, 69kg, 58kg, 72kg and 64kg .
 - (a) What is the total weight of cocoa Tere picked in that week?

 - (b) How much will Tere earn in that week?

2. Veni's annual salary is K42 300.

Find:

 - (a) his fortnight gross salary.

 - (b) his take-home pay when the following deductions are taken out: TSL 30, KWI 20, Tax 7.93.

3. Pama is paid K0.63 for every shirt pocket he sews. In a fortnight he sewed 500 shirt pockets. How much did he earn in that fortnight?

4. Landi is paid a basic rate of K3.36 per hour for 40 hour-week. Find his wage for the fortnight.

5. Petter sold K7 300 worth of Coca Cola. He gets 6% of his sales as a commission. How much will Petter receive as a commission?

6. Ngang receives K67 432 per year. He pays 7.4% as tax, K43.68 to Nambawan Super, K40 to Welfare Fund, K39.70 to Brian Bell and K50 to Savings & Loans.

Calculate:

- (a) Ngang's total deductions.
 - (b) fortnight salary.
 - (c) tax he pays.
 - (d) his Net Pay.
 - (e) his bank balance if the previous bank balance before the pay was credited was K4 006.73.
-

7. Kini spent K2 000 on transport, K3 000 on 100 bags of betel nut, K500 on other travel costs. Kini sold each bag of betel nut at K600 each.

- (a) Calculate Kini's total expenses.
 - (b) Calculate his total earnings.
 - (c) Did he make a profit or loss and by how much?
-

8. David is paid a basic rate of K4.70 per hour for a 35 hour- week. He is paid time-and-a-half for overtime, and double-time on Saturdays. In a fortnight David worked 80 hours and 6 hours on Saturdays.

Calculate his:

- (a) normal wage.
- (b) overtime pay during the week.
- (c) pay received for Saturday's work.
- (d) fortnight's Wage.
- (e) his available bank balance if the bank takes out K67.00 for school fee loan.

9. Jane sold 22 cabbages at 50t each, 8 heaps of kaukau at K3.00 each, 5 heaps of potato at K2.00 each, and 50 sugar fruits at 20t each.

(a) Calculate her total earning.

(b) Tepu gave K50 and got a heap each of kaukau and potato, and a cabbage. How much change does Jane give Tepu?

(c) What is her new total earning?

10. Ronan is paid a basic rate of K9.00 per hour for a 40 hour - week. He is paid double-time for overtime worked. In a fortnight Ronan worked 100 hours.

Calculate:

(a) normal wage.

(b) his over-time pay

(c) fortnight's Wage.

CORRECT YOUR WORK. ANSWERS ARE AT THE END OF TOPIC 1

Lesson 3: Spending Money



You have learned about the processes of calculating four main different ways of earning an income.

In this lesson you will:

- apply percentage to calculate specials such as discounts buying at sales and best buys
- estimate cost
- calculate cost of living in a village or town
- appreciate the concept of living and be able to spend wisely.

Discounts and Sales

One way to save money is to shop when there is **sales**, buy goods in shops that offer **discounts**, and being able to pick the **best-buy** when you have an option to buy a certain item.

Sale is a period of time where stores sell items at reduced price to clear stock

Mastering the skills in estimating sums, differences, quotients and products in dealing with numbers and money will help you in this topic.

Discount is the reduction of prices of goods

Cash discount is the difference between the marked price and the selling price. If so, then we can say that the Marked Price is the sum of the Selling Price and the Cash Discount.

Selling Price = Marked Price – Cash Discount
Cash Discount = Marked Price – Selling Price
Discount Price = Marked Price – Cash Discount

Percentage discount is the ratio of the cash discount and marked price, multiplied by 100%.

And cash discount is found by finding certain a percentage (n %) of a marked price. Cash discount is a percentage of a quantity.

% Discount = cash discount/marked price x 100%
Cash Discount = n % x Marked Price

Example 1

Mary Pina is a member and Nasfund card holder. Nasfund members are given 10% discount by Brian Bell. Mary Pina decided to buy a rice cooker priced at K137.

- (a) How much is taken off?
(b) How much did Pina pay?

Solution:

$$\begin{aligned} \text{(a) } 10\% \text{ of K137} &= \frac{10}{100} \times \text{K137} \\ &= 0.1 \times 137 \\ &= 13.7 \\ &= \text{K13.70} \end{aligned}$$

$$\begin{aligned} \text{(b) Discount Price} &= \text{Marked Price} - \text{Cash Discount} \\ &= \text{K137} - \text{K13.70} \\ &= \text{K123.30} \end{aligned}$$

Therefore, Pina will pay K123.30.

When a shop advertises on daily paper or on a bill board with a placard as given below, there is a sale taking place.



When a shop advertises a sale at say 30% off on all goods or items, add prices of all items, then calculate 70% of the total value of items. Because when 30% is taken out, 70% is left. This is possible because the same percentage is taken out on each of the items.

$$\text{Amount Spent} = 70\% \times \text{Total Goods Value}$$

Example 2

Chemica Shop in Madang had a sale during Easter holidays. The shop announced that all prices were slashed by 40%. Talo chose to buy a spade marked at K17.30, an axe priced at K25.80, a bush knife at K18.60, and a digging fork for K22.50. How much money did Talo pay?

Solution:

$$\begin{aligned} \text{i. Sum of all prices} &= \text{spade} + \text{axe} + \text{b/knife} + \text{fork} \\ &= \text{K}17.30 + \text{K}25.80 + \text{K}18.60 + \text{K}22.50 \\ &= \text{K}84.20 \end{aligned}$$

ii. 40% is taken out so 60% of items value left.

$$\begin{aligned} \text{iii. 60\% of K}84.20 &= \frac{60}{100} \times \text{K}84.20 \\ &= 0.6 \times 84.20 \\ &= \text{K}50.52 \end{aligned}$$

Therefore, Talo will pay in cash K50.50 only.

Best-Buy

Best-buy is getting the most from your money. We pay more attention to how much an item cost per millimetre or per gram or per unit etc. Sometimes it is much easier to use per 100mL or per 100g or per 100units.

It depends on the type of item. The item may have volume, mass, length or none of the metric units. When no unit is associated with an item, we generalize by saying units.

Save!!!

 <p>Save K3.60 Get 3 for K18</p>	 <p>K9.60 3 for k25</p>	 <p>Price K7.90 Buy 2 at K14 only</p>
---	--	---

You spend K18 to get 3 Tulip meat, but if you buy one each day you will spend a total of K21.60. You spend K28.80 for 3 Ox & Palm tin of meat if you buy one at a time. For 777 tin of fish, you save K1.80 if you buy two.

Example 1

Paul's milk was sold at a shop in Port Moresby as follow:

1Litre	K5.90
250 mL	K2.30
200 mL	K1.80

Which is the best-buy?

Solution:

Divide each price by its unit to get cost in toea per millimetre.

- i. $590t \div 1000 \text{ mL} = 0.0059t/\text{mL}$
- ii. $230t \div 250 \text{ mL} = 0.0092t/\text{mL}$
- iii. $180t \div 200 \text{ mL} = 0.009t/\text{mL}$

Here we can see that the cost of buying a millilitre of Paul's milk in 1Litre packet is cheapest. So the best buy is 1Litre at K5.90

We can also work out the amount of milk per toea. However, in the example used it will take a lot of time to compute.

Living in a Town

When living in a town, you have certain costs which are unavoidable and are essentials. These costs cover your basic needs to live in a town.

They are: rent, electricity bill, water bill, sewerage bill, food, transport, clothes and cleaning agents. Among these essential costs, rent and transport costs are often fixed for a fortnight.

The others you can have control over them, and it depends on your own lifestyle.

Your earning should be enough to meet all these expenses every fortnight. If so, then you may have a chance to save some money.

If not, you may end up living in debts. This is where you have to watch out where sales are taking place. Which shop can offer you a discount? Which store offers best-buy?

Example

Rex rents a room at 4-mile, National Capital District and travels to FinCorp House to work daily.

He pays K200 as rent. It costs him K2 per day to go to work and return. For food he bought 12 tins of fish at K2.40 each, 12 packets of trukai rice at K2.90 a packet, K1 aibika or kango over 12 days and 4 bulbs of onion at 50t a piece.

He also bought 2 packets of coffee at K5.60 a packet, 1 large packet of Ramu sugar at K5.90 and 12 packets of Snax biscuit at K1.00.

For cleaning agents he purchased a bottle of bleach costing K4.90 and 2 small packets of Omo at K2.20 each.

Find his:

- total expenses,
- savings if he shopped at Stop 'n' Shop which offered 20% discount on all food items.

Solution:

a. Total expenses

1 x Rent	1 x K200	= K200.00
10 x Transport	10 x K2.00	= K20.00
12 x Tin of Fish	12 x K2.40	= K28.80
12 x Trukai Rice	12 x K2.90	= K 34.80
1 x packet of Ramu sugar	1 x K5.90	= K5.90
2 x coffee	2 x K5.60	= K11.20
12 x Snax biscuit	12 x K1.00	= K12.00
1 x bleach	1 x K5.20	= K5.20
2 x Omo	2 x K2.20	= K4.40
<u>12 x aibika/kango</u>	<u>12 x K1.00</u>	<u>= K12.00</u>
	Total	= K334.30

b. Savings = 20% of Total cost on Food Items

$$= 0.2 \times K92.70$$

$$= K18.54$$

Estimating Costs

Your ability to estimate accurately enables you to work out rough total cost of items you intend to buy.

It also guides you as to whether you are over spending or not, in one sector of your budget.

In estimating costs, always round to one significant figure, then perform the operation.

Example 1

Add K3.49, K26.43, K7.92 and K0.63

Solution:

$$\begin{aligned} \text{K3.49} + \text{K26.43} + \text{K7.92} + \text{K0.63} &= \text{K3.00} + \text{K30} + \text{K8} + \text{K0.6} \\ &= \text{K41.60} \end{aligned}$$

Example 2

Subtract K68.70 from K100.

Solution:

$$\begin{aligned} \text{K100} - \text{K68.70} &= \text{K100} - \text{K70} \\ &= \text{K 30.00} \end{aligned}$$

Example 3

Estimate the cash change received for payment of the following goods with K50 cash:

Ox & Palm for K9.30, a packet of rice for K4.60, onions at K2.80, oil at K3.20 and 3 drinks at K2.00.

Solution:

$$\begin{aligned} \text{K50} - [\text{K9.30} + \text{K4.60} + \text{K2.80} + \text{K3.20} + (3 \times \text{K2.00})] \\ &= \text{K50} - [\text{K9} + \text{K5} + \text{K3} + \text{K3} + (\text{K6})] \\ &= \text{K50} - \text{K36} \\ &= \text{K14.00} \end{aligned}$$

NOW DO PRACTICE EXERCISE 3

**Practice Exercise 3**

1. Estimate Sam Kumil's expenses in a fortnight if he spends as follows,

- i. Rent K100
 - ii. Water K27
 - iii. Food K254.64
 - iv. Transport K20
 - v. Others K160
-

2. State which is the better buy and by how much for each of the following pairs of options.

- a. 5 guavas for K3.00 or 6 guavas for K4.00?

 - b. 2kg of potato for K3.50 or 10kg of potato for K6?

 - c. 250mL milk for K2.80 or 1L milk for K6.00?
-

3. Estimate the cost of Muga's spending in a day's shopping:

2 packets of nails	at K2.15 each
1 spade	at K15.49 each
1 Pinch Bar	at K340.00 each
2 Hammers	at K12.70 each

4. Tuna steak is down from K8.00 per kg to K7.00 per kg. What is the percentage of price reduction?

5. Paul needs to buy 16 sheets of iron roofing at K32.80 per sheet. Estimate the total amount he needs to pay.

6. Find the discount price if 10% discount is offered on a bed-set marked at K1360.
-

7. If a discount price is K158.40 when a 10% discount was given, find the marked price.
-

8. Bedu owns 200 000 shares and was paid a dividend of 37t per share. Estimate the total dividend he gets.
-

9. Stores A, B and C have their prices of specific items as given:

Item	Store A	Store B	Store C
Tin of fish 777 (150oz)	K7.50	K7.20	K7.55
Packet of Rice (1kg)	K4.55	K4.70	K4.00

Which store, store A, store B or store C offers the best buy?

10. Calculate cash discounts on goods as given below.
- 20% on a good which normally sold for K418.
 - 50% on an item marked at K4.50
 - a 10% discount on an article marked at K394.
 - 5% discount on goods worth K769.80
-

CORRECT YOUR WORK . ANSWERS ARE AT THE END OF TOPIC 1

Lesson 4: Hire Purchase



You have learnt about estimating money and percentages of money.

In this lesson you will:

- define hire purchase,
- state examples of hire purchase,
- calculate hire purchase.

Hire Purchase is a form of purchasing items in instalments in trading of goods. This method of payment enables low wage earners to obtain certain goods or items.

Items such as fridge, washing machine, four-burner stove are often hard to purchase in a fortnights salary earning. So Hire Purchase enables a customer to own and use the item, even before paying for it in full. It is a lease purchase.

Hire purchase is a purchase arrangement whereby a customer pays initial deposit and uses the item, and pays the balance outstanding with interest regularly in instalments.



Items like sofa and digital camera can be bought on hire purchase. You pay a certain amount as specified by the shop. It is called **initial deposit**. When the initial deposit is paid, you are then allowed to take the item home.

After the initial deposit has been paid, the amount is subtracted from the **Cash Price** or **Marked Price**. The difference is called **Balance Outstanding**.

Balance Outstanding = Cash Price – Initial Deposit

From the balance outstanding, a certain percentage is calculated and added to the balance outstanding, called **interest** on balance outstanding.

Interest = n% of Balance Outstanding

The sum of the interest and the balance outstanding gives you the total amount to be repaid.

$$\text{Repayment Amount} = n\% \text{ of Balance Outstanding} + \text{Balance Outstanding}$$

Once the repayment amount is known, it is then divided by 26 fortnights to obtain **fortnightly instalment** amounts to be paid by you.

$$\text{Fortnightly Instalment} = \text{Repayment Amount} \div 26 \text{ Fortnights}$$

If you receive monthly salaries or wages, the repayment amount is divided by 12 months. So you will be given monthly instalment amounts that you have to pay. The repayment amount you owe is a loan you have with the shop.

$$\text{Monthly Instalment} = \text{Repayment Amount} \div 12 \text{ months per year}$$

In some arrangements, there is no need for initial deposit. You may be asked to pay the first instalment payment and walk away with the item. The interest has been added. So when you multiply the instalment amount by the number of instalment payments, you will realize that the product is more than the cash price. See example 2 below.

The interest can be worked out when you find the difference of hire purchase price and the cash price, often referred to as 'savings if paid cash' or 'cash savings'.

$$\text{Interest} = \text{Hire Purchase Price} - \text{Cash Price}$$

To find interest rate you divide the interest by balance outstanding and multiply by 100%.

$$\text{Interest rate} = \frac{\text{interest}}{\text{balance outstanding}} \times 100\%$$

When you are given an instalment amount, either it be fortnightly or monthly, the interest had been added onto the balance outstanding before it is being divided accordingly.

And what you owe is not only the balance outstanding, but the sum of the interest and the balance outstanding.

$$\text{Hire Pur. Price} = \text{Initial Dep.} + \text{Bal/ Outstanding} + \text{Interest on Bal/Outstanding}$$

Example 1

An item was sold for K2 100 cash. Or it can be obtained by a K500 deposit, and pay K67.70 instalments for 26 fortnights. What is the balance outstanding?

Solution:

$$\begin{aligned}\text{Balance Outstanding} &= \text{Cash Price} - \text{Initial Deposit} \\ &= \text{K}2\,100 - \text{K}500 \\ &= \text{K}1\,600\end{aligned}$$

Example 2

An item was sold for K2 100 cash. Or it can be obtained by paying K88.85 instalments for 26 fortnights. What is the hire purchase price?

Solution:

$$\begin{aligned}\text{Hire purchase price} &= \text{Instalments amount} \times \text{Number of instalments} \\ &= \text{K}88.85/\text{fn} \times 26\text{fn} \\ &= \text{K}2\,310.10\end{aligned}$$

In this example, the initial deposit was not required. The cash price is the same. But you pay a bit more in example 2 than in example 1.

In example 1, 10% is calculated on K1600, whereas in example 2, the outstanding balance is the same as the cash price.

Example 3

A white good was sold at K1 700 marked price. It can be obtained by paying 20% as deposit, and pay K57.50 in instalments for 26 fortnights. Find the:

- initial deposit
- balance outstanding

Solution:

$$\begin{aligned}\text{a. Initial deposit} &= 20\% \text{ of Marked Price} \\ &= \frac{20}{100} \times \text{K}1\,700 \\ &= 20 \times 17 \\ &= \text{K}340 \\ \text{b. Balance outstanding} &= \text{cash price} - \text{initial deposit} \\ &= \text{K}1\,700 - \text{K}340 \\ &= \text{K}1\,360\end{aligned}$$

Example 4

A power generator was sold for K3 600 cash. It can be obtained by paying $\frac{1}{4}$ of cash price as initial deposit, and pay K247.50 in instalments for 12 months.

Find the:

- initial deposit
- balance outstanding
- outstanding loan
- hire purchase price
- savings if paid in cash
- interest rate charged

Solution:

$$\begin{aligned} \text{a. Initial deposit} &= \frac{1}{4} \text{ of Marked Price} \\ &= \frac{1}{4} \times \text{K3 600} \\ &= \text{K900} \end{aligned}$$

$$\begin{aligned} \text{b. Balance outstanding} &= \text{cash price} - \text{initial deposit} \\ &= \text{K3 600} - \text{K900} \\ &= \text{K2700} \end{aligned}$$

$$\text{c. Outstanding loan} = \text{outstanding balance} + \text{interest on outstanding balance.}$$

But since interest rate is not given, we use total instalments paid. Since each monthly instalment amount was obtained from the total repayment amount divided by 12 months.

$$\begin{aligned} \text{Outstanding loan} &= \text{total instalment paid} \\ &= \text{K247.50/month} \times 12 \text{ months} \\ &= \text{K2 970} \end{aligned}$$

- d. Hire purchase price = initial deposit + total instalments paid
= K900 + K2 970
= K3 870
- e. Savings if paid in cash = Hire purchase price - Cash price
= K3 870 - K3 600
= K270
- f. Interest Rate Charged = Savings/balance outstanding x 100%
= $\frac{270}{2700} \times 100\%$
= 0.1 x 100%
= 10%

Example 5

Study the advertisement and answer the questions that follow.

<p>Camping Tent Cash K1200 Or K200 Deposit K42.30/fn for 26 fortnights</p>	
---	--

- (a) What is the balance outstanding?
(b) What is the repayment amount?
(c) Find the interest charged.
(d) What is the cash savings?
(e) Calculate the interest rate.

Solution:

- a. Balance outstanding = cash price – initial deposit
= 1200 – 200
= K1000
- b. Repayment amount = instalments payment x number of instalments
= K42.30 x 26
= K1 099.80
- c. Interest (on balance o/s) = hire purchase price – cash price
= K1 299.80 - K1200
= K99.80
- d. Cash savings = interest on balance outstanding
= K99.80
- e. Interest rate = $\frac{\text{cash savings}}{\text{balance outstanding}} \times 100\%$
= $\frac{99.8}{1000} \times 100\%$
= 0.0998 x 100%
 $\approx 10\%$

NOW DO PRACTICE EXERCISE 4



Practice Exercise 4

1. Calculate the interest charged on the balance outstanding based on the rates given and then find the hire purchase price.

	Item	Cash price	Initial deposit	8% interest	Hire purchase price
A	Bed	K683.00	K183.00		
B	Garden Tools	K1 342.60	K342.60		
C	Chairs	K2 000.00	K200.00		

2. Study the advertisement and state the balance outstanding.



Cash K1 860
Or
 $\frac{1}{5}$ **Deposit**
K136.40 in 12 monthly

3. A shop has a fridge marked at K800. It can be purchased with a deposit of K300 followed by fortnightly instalments of K21.15.

(a) Find the balance outstanding.

(b) What is the total amount paid for the item?

4. An item was marked at K600 in cash. It can also be obtained with down payment of the first monthly installment of K55. What is the
- initial deposit?
 - interest charged?
-

5. Calculate the hire purchase price in each of the following cases:
- deposit of K60 plus 12 monthly installment of K15.00.
 - deposit of K26.80 plus 52 fortnightly installment of K8.50.
 - deposit of K417 plus quarterly installment of K69.30 for three years.
-

6. The cash price of a hot water urn is K869. Hire purchase terms require K220 deposit together with K29.95 fortnight payments over a year. Calculate the amount saved by paying cash.
-

7. A rice cooker can be bought for K148 cash or for a deposit of K56 plus 12 monthly instalment of K8.43.
- How much more does the rice cooker cost if bought on the instalment plan compared with the cash price?
 - Express the additional cost as a percentage of the cash price.

8. The marked price of a lawn-mover is K1 380. A 10% off is offered for cash sale, but if bought on hire purchase, the initial deposit is $\frac{1}{4}$, followed by 18 monthly instalments of K63.25.

Find the cash difference in the two ways of purchasing and express the difference as a percentage of cash price. State your final answer correct to two decimal places.

-
9. A certain shop calculates hire purchase price as follows:

- Cash deposit 25%
- Interest $12\frac{1}{2}\%$
- Monthly payments

Using the given information calculate the

- a. installments on a good marked at K1 748.

- b. total cost of a house furniture set, the list price of which is K1 464 if it is to be paid in 8 months.

- c. difference of the two forms of payments if marked price of music instruments is K9 600 to be paid in 12 monthly payments.

CORRECT YOUR WORK. ANSWERS ARE AT THE END OF TOPIC 1

Lesson 5: Appreciation & Depreciation



You have learnt about the processes of calculating hire purchase.

In this lesson you will:

- define appreciation and depreciation
- identify assets that appreciate and depreciate in value,
- calculate appreciation and depreciation in asset values.

Assets are items of value such as a building, a machine, motor vehicle, land, shares, savings in bank account, mural paintings, gold plated necklace and etc.

Assets like buildings, land, savings, share prices can **appreciate** in value. When a building gets tiles, furniture, air condition, they increase the value of the building.

When land rates increase or a building is built on a land, the specified land will increase in value.

When an interest is paid on your savings, your savings will increase it's bank balance.

If you buy a share at K2.50, and the following year the price per share is K2.70, the next year the price is K3.10 per share then the share value has appreciated over three years.

Appreciation is increase in value of an asset, item or quantity.

Other assets such as a bulldozer, a car, power generator, wear and tear due to continuous use. Their parts get worn down and they do not work like when they were brand new so their value **depreciate**. Some depreciate at a small rate while others depreciate at a large rate.



Loader/Backhoe



Airplane

Depreciation is decrease in value of an asset, item or quantity.

Calculating Appreciation

We can use the multiplier to calculate annual value every time for the number of years or we can use the formula as given. The **Multiplier** is $100\% \pm \text{Percentage Change (n\%)}$ is one, and formula is another method that we can use.

$$\text{Multiplier} = 1 + n\%$$

The **n** is the percentage change. The multiplier is greater than 1 but less than 2.

The appreciation formula.

$$A = P(1 + r)^t$$

A = accrued value, P = Principal value, r = percentage increase p.a., t = period of time in years.

Example 1

A house was purchased for K150 000 and it increased in value by 5% per year. What will be its value after 3 years?

Solution:

Method 1	Multiplier = $100\% + 5\% = 105\% = 1.05$
	After Year 1 $150\,000 \times 1.05 = \text{K}157\,500$
	After Year 2 $157\,500 \times 1.05 = \text{K}165\,373$
	After Year 3 $165\,373 \times 1.05 = \text{K}173\,643.75$

Method 2	Formula
	$P = 150\,000, r = 5\%, t = 3$
A	$= P(1 + r)^t$
	$= 150\,000(1 + 5\%)^3$
	$= 150\,000(1 + 0.05)^3$
	$= 150\,000(1.05)^3$
	$= 150\,000(1.157625)$
	$= \text{K}17\,364.75$

Therefore, after 3 years the value of the house will be K17 364.75

The same formula can be used for population increase and compound interest problems.

Calculating Depreciation

Again we can use the multiplier to calculate annual value every time for the number of years or we can use the formula as given.

$$\text{Multiplier} = 1 - n\%$$

The n is the percentage change. The multiplier is less than 1 but greater than 0.

The depreciation formula.

$$A = P(1 - r)^t$$

A = accrued value, P = Principal value, r = percentage decrease per annum, and t = period of time in years.

The same formula can be used for population decrease and decreases when time matters.

Example 1

A washing machine was bought for K768 when new and depreciates at 7% per annum. Find its value after 5 years.

Solution:

Method 1	Multiplier = 100% - 7% = 93% = 0.93
After Year 1	768.00 x 0.93 = K714.24
After Year 2	714.24 x 0.93 = K664.24
After Year 3	664.24 x 0.93 = K617.75
After Year 4	617.75 x 0.93 = K574.50
After Year 5	574.54 x 0.93 = K534.29

Method 2 Formula

$$P = 768, r = 7\%, t = 5$$

$$\begin{aligned} A &= P (1 - r)^t \\ &= 768 (1 - 7\%)^5 \\ &= 768 (1 - 0.07)^5 \\ &= 768 (0.93)^5 \end{aligned}$$

same as $[768 (0.93 \times 0.93 \times 0.93 \times 0.93 \times 0.93)]$

$$= 768 (0.695\ 688\ 369)$$

$$= 534.288\ 667\ 6\dots$$

$$= \text{K}534.29$$

Therefore the value of the washing machine will be K534.29 after 5 years.

NOW DO PRACTICE EXERCISE 5



Practice Exercise 5

1. Given that $P = 1000$, $r = 10\%$ and $t = 2$ find the value of the accrual (A).

2. Given that $P = 12\ 000$, $r = 5\%$, $t = 3$, find the depreciated value (A).

3. Complete the table. Use the appreciation formula.

	Principal (P)	Rate (r)	Time (t)	Accrual (A)
A	2 000	5%	5	
B	5 000	6%	4	
C	15 000	4%	3	

4. Complete the table. Use depreciation formula.

	Principal (P)	Rate (r)	Time (t)	Accrual (A)
A	5 000	5%	4	
B	20 000	10%	2	
C	25 000	10%	3	

5. A house appreciates in value by 8 % per annum. It was bought for K150 000, what will be its value in 3 years' time?

6. An investment of K20 000 appreciates in value by 6% per annum. Find the investment value after two years.
-

7. Property values in a certain town appreciate by 3% per annum. Find the value of a property after 4 years if the current property value is K12 000.
-

8. A truck bought for K64 000 depreciates by 10 % per annum. If it is to be resold after 3 years use, what will be the price at which the truck will be sold at?
-

9. A certain principal depreciated to K4 374 after 3 years. Its depreciation rate was 10% per annum. Find the principal.
-

10. An amount kept for 3 years in a bank account increased in value to K13 310. Find the amount if the interest rate was 10% per annum.
-

CORRECT YOUR WORK. ANSWERS ARE AT THE END OF TOPIC 1

Lesson 6 Profit & Loss



You have learned about appreciation and depreciation.

In this lesson you will:

- define profit and loss
- calculate profit and loss
- evaluate applied profit and loss problems
- calculate percentage profit and percentage loss

For any business to be successful, the business must be able to identify whether it is going to make a profit or a loss. The aim of running any business or any trade is to make a profit.

Profit

To be able to make profit, money coming in (income) must always be more than the money going out (expense).

Profit is the extra money made after all expenses have been met.

Profit = Revenue – Expenses.

In symbol

$$P = R - E$$

In any trading, profit is determined by the mark-up on the item. Hence, we can say that

Profit = Selling Price – Cost Price.

In symbol

$$P = SP - CP$$

Example1

Sam operates a trade store. In a year, his operational cost was K28 439.26. Sam made a total of K36 093.38 in that year. What is Sam's profit?

Solution:

$$R = \text{K}36\,093.38, E = \text{K}28\,439.26$$

$$P = R - E$$

$$= \text{K}36\,093.38 - \text{K}28\,439.26$$

$$= \text{K}7654.12$$

Example 2

Anne bought 20 fish for K10 and sold them at K2 each at the market.

- What is the cost of 1 fish?
- What is her profit made on one fish?

Solution:

$$\begin{aligned} \text{a. Cost of 1 fish} &= \text{K}10 \div 20\text{fish} \\ &= \text{K}0.50/\text{fish} \end{aligned}$$

$$\begin{aligned} \text{b.} \quad P &= \text{SP} - \text{CP} \\ &= 2.00 - 0.50 \\ &= \text{K}1.50 \end{aligned}$$

Therefore, Anne made K1.50 profit on 1 fish. Her profit made on the entire sale is 20 x K1.50, which is K30

Loss

When the income or revenue made is less than the cost of all items bought and sold, a loss is made. In any trading involving money, if you don't make profit, you are likely to make a loss.

Loss is the shortfall in cash made when expenses are more than the revenue.

$$\text{Loss} = \text{Expenses} - \text{Revenue}$$

In symbol

$$L = E - R.$$

$$\text{Loss} = \text{Cost Price} - \text{Selling Price}$$

In symbol

$$L = \text{CP} - \text{SP}$$

Example1

Temi bought 24 mangoes at K0.50 each. The next day, Temi sold the mangoes for K1.00 each at the market. However, she was only able to sell 11 mangoes. What is Temi's profit or loss?

Solution:

$$CP = K0.50 \times 24$$

$$= K12$$

$$SP = K1.00 \times 11 \text{ mangoes}$$

$$= K11.00$$

(Since Temi got less amount than what she had spent she made a loss.)

$$L = CP - SP$$

$$= K12.00 - K11.00$$

$$= K1.00$$

Percentage Profit

Sometimes percentage profit is given or is necessary instead of the profit.

Percentage Profit is the percentage of ratio of profit over expense

The profit can be said as the difference of the Revenue and Expenditure.

$$\text{Percentage Profit} = \frac{\text{Profit}}{\text{Expense}} \times 100\%, \text{ PP} = \frac{P}{E} \times 100\%$$

The profit can also be said as the difference of the Selling Price and the Cost Price.

$$\text{Percentage Profit} = \frac{\text{Profit}}{\text{Cost Price}} \times 100\%, \text{ PP} = \frac{P}{CP} \times 100\%$$

Governance issues such as gross sales tax (GST), mortality rate and population increase are often given as a percentage.

Example1

A paper company made K10 000 in paper sales in a month. If its operating cost was K8 000 in that month, what is the paper company's percentage profit?

Solution:

$$R = \text{K}10\,000, E = \text{K}8\,000 \text{ therefore } P = \text{K}2\,000$$

$$\begin{aligned} P &= \text{K}10\,000 - \text{K}8\,000 \\ &= \text{K}2\,000 \end{aligned}$$

$$PP = \frac{2\,000}{8\,000} \times 100\%$$

$$= \frac{1}{4} \times 100\%$$

$$= 25\%$$

Example 2

Nagod sold lobsters at K16 each to Madang Resort Hotel. If she bought the lobsters for K10 each, what is her percentage profit made on each lobster?

Solution:

$$SP = 16, CP = 10$$

$$\text{So } P = 16 - 10$$

$$= 6$$

$$PP = \frac{P}{CP} \times 100\%$$

$$= \frac{6}{10} \times 100\%$$

$$= 0.6 \times 100\%$$

$$= 60\%$$

Therefore, Nagod's percentage profit is 60%.

Percentage Loss

Sometimes a percentage loss is given or is necessary instead of the loss.

Percentage Loss is the percentage of ratio of loss over expense

The loss can be said as the difference of the Expenditure and Revenue.

$$\text{Percentage Loss} = \frac{\text{Loss}}{\text{Expense}} \times 100\%, \text{ PL} = \frac{L}{E} \times 100\%$$

The loss can also be said as the difference of the Cost Price and the Selling Price.

$$\text{Percentage Loss} = \frac{\text{Loss}}{\text{Cost Price}} \times 100\%, \text{ PL} = \frac{L}{\text{CP}} \times 100\%$$

Example1

A chair made at a cost of K60 was marked at K80. It was sold at K50 a year later. What is the percentage loss?

Solution:

$$\text{CP} = \text{K}60, \text{ SP} = \text{K}50, \text{ Therefore } L = \text{K}10$$

$$\begin{aligned} \text{PL} &= \frac{10}{60} \times 100\% \\ &= \frac{1}{6} \times 100\% \\ &= 16\frac{2}{3}\% \end{aligned}$$

Example 2

A car bought for K8 000 was sold for K6 000. What is the percentage loss?

Solution:

$$\text{Loss} = \text{K}8\,000 - \text{K}6\,000$$

$$= \text{K}2\,000$$

$$\text{PL} = \frac{2000}{8000} \times 100\%$$

$$= \frac{1}{4} \times 100\%$$

$$= 25\%$$

NOW DO PRACTICE EXERCISE 6

**Practice Exercise 6**

1. In each of the following write down the factor by which the cost price must be multiplied by to give the selling price.
 - a. Profit 10%
 - b. Profit 5%
 - c. Loss 10%
 - d. Loss 6%

2. In each of the following, find the selling price.
 - a. CP K12, profit 20%
 - b. CP K43, profit 12%
 - c. CP 20, loss 5%
 - d. CP K92, loss 25%

3. A chair made at a cost of K47.80 was sold at K60. What is the profit made?

4. Find the percentage profit or percentage loss in the following:
 - a. CP K6, profit 60t
 - b. CP K28, profit K2
 - c. CP K60, loss K4
 - d. CP K368, loss K4

5. A shop keeper buys 200 items for K180 and sells each for K1.30. Find the percentage profit or percentage loss.
-

6. Herbal juice made at K30 per litre was sold for K12 per 300mL. Find the
- percentage profit.
 - total profit on 10L made.
-

7. A second hand car dealer bought a car for K6 200 and resold it at a loss of 15% per annum. How much does the second hand car dealer sold the car for?
-

8. Peter Paul made a loss of 10% by selling cabbages for K4 each. Find the total loss if there was a total of 30 cabbages sold.
-

9. Pairs of shorts had a mark-up of 12% which includes profit and GST at a price of K14.56. Find the cost price.
-

10. A bag bought for K19 had a 10% mark-up. After 6 months the bag was offered at 10% discount. Does the shop make a profit or loss, and by how much?
-

CORRECT YOUR WORK. ANSWERS ARE AT THE END OF TOPIC 1

Lesson 7: Budget



You have learned about profit and loss in lesson 6.



In this lesson you will:

- define and explain what a budget is
- record basic income and expenditure
- estimate monthly expenses and incomes
- interpret and draw up personal and family budgets
- explain basic ideas of cash flow.

A budget provides a plan describing ways of incomes and expenses. Carefully following the budget ensures a business to make a profit, and a family or an individual to be able to cover all expenses for the fortnight or a month. A Business would draw an annual budget.

A budget is a plan on how money will come in and how money will be spent.

A Budget has two main columns. On the left it shows ways money will come in. On the right it depicts ways the money will be spent.

Incomes	K	Expenses	K
Total:		Total:	

There are three types of a budget.

1. Personal Budget
2. Family Budget
3. Business Budget

The government budget falls under business budget.

Personal Budget

Often there is only one means of income for those working and living in towns. Personal budget is made for one person, yourself.

The expenses should be divided into essential items and non-essential items sections. Essentials are things that ought to be done or expenses needed to be made in-order to survive. Then there is savings as the third section.

In towns, essential items are food, rent, clothes, power, water bill, transport. Others are non-essential items.

Savings is very important because this money can cater for medical bills and emergencies.

Creating a culture of saving money prevents one from borrowing from 'money markets' and creating unnecessary debts for young people. 'Money market' is eating away a large portion of personal budget in PNG today.

Young people need to save as much as possible while young to be in sound financial position in the future. And a budget can guide you to achieve that aim.

Example

SEBASTIAN'S BUDGET

Income	K	Expenses	K
Salary	1 373.68	<u>Essentials</u>	
		Food	300
		Rent	550
		Clothes	80
		Easy Pay Power	20
		Water Bill	30
		Transport	20
		<u>Non-Essentials</u>	
		Entertainment	170
		Others	50
		<u>Savings</u>	130.69
Total	1 373.68	Total	1 373.68

- What per cent of essential items is spent on clothes?
- What is the total amount spent on essential items?
- How much is spent on entertainment?
- How much could Sebastian save in a month?
- If Sebastian intends to increase savings by K50, which item should have a cut in spending?
- If his take-home pay increases by 10%, and he does not increase spending on budgeted items, what will be his new savings?

Solution:

- $\frac{50}{1000} \times 100\% = 5\%$
- K1 000
- K170
- $K130.69 \times 2 = K261.38$
- Others
- $10\% \times K1\,373.68 = K137.37$
 New Savings = $K130.69 + K137.37$
 = K268.06

Family Budget

A Family Budget can have two sources of income. Family budget will have additional items under essentials and additional items under non essentials than a Personal Budget.

Example

REX FAMILY BUDGET

Income	K	Expenses	K
Father's Salary	1 738.72	<u>Essentials</u>	
Mother's Wage	863.97	Food	_____
		Rent	600.00
		Easy Pay Power	60.00
		Water Bill	40.00
		Garbage	20.00
		Transport	100.00
		Clothes	200.00
		School Fee	100.00
		Child Sports	100.00
		<u>Non-Essentials</u>	
		Entertainment	300.00
		Others	200.00
		Savings	182.69
Total	2 602.69	Total	2 602.69

- How much is spent on food?
- If Rex's employer pays the rent, what will be the new savings for the family?
- If BSP deducts K20 for bank charge on accounts keeping, which item in the budget will cater for that?
- Water bill increased to K50, transport to K120 and electricity to K80, what will be the savings?
- If savings remain the same, what will be the total savings, after 5 fortnights?

Solution:

$$\begin{aligned}
 \text{(a)} \quad & [K2\ 602.69 - (\text{known essentials} + \text{non-essentials} + \text{savings})] \\
 & = 2\ 602.69 - (1\ 120 + 500 + 182.69) \\
 & = 2\ 602.69 - 1\ 902.69 \\
 & = K700
 \end{aligned}$$

- (b) $K182.69 + K600$
 $= K782.69$
- (c) Others
- (d) $K182.69 - K(10 + 20 + 20)$
 $= K182 - K50$
 $= K132.69$
- (e) $5 \times K182.69$
 $= K913.45$

Business Budget

A business budget gives the company a general impression on how the manager should manage business' spending. Businesses aim to make a profit every year.

Businesses can have one or many ways of earning income. It depends on the type of business in operation. For example, a copra exporter has only one form of earning while a stationary shop has several things like biros, papers, exercise books and etc.

Example

BUSINESS BUDGET

Revenue	Amount (K)	Expenditure	Amount (K)
Sales (Paper)	12 144 000	Transport	10 000
Others	6 086 000	Electricity	20 000
		Water	5 000
		Rent	60 000
		Land Rates	5 000
		Taxes	3 060 000
		Wages	241 800
		Workers Tea	5 000
		Cleaning	10 000
		Freight	48 000
		Maintenance	50 000
		Insurance	20 200
		Stock	700 000
		Company Expansion	2 000 000
		Dividends	12 000 000
Total Revenue	18 230 000	Total Expenditure	18 230 000

- (a) If 10% is paid as wage increase, what will be the new wages total figure?

- (b) Share Holders A, B and C are to share the dividend in the ratio 2 : 3 : 5. How much will the Share Holder B get?
- (c) How much money is spent on new stock, their core business?
- (d) Rewrite a new budget and include 10% increase on wages, 5% increase on insurance, and K5 000 increase for workers tea. All these will affect dividends only. Total revenue and expenditure is the same.

Solution:

(a) $10\% \times \text{K}241\,800 = \text{K}24\,180$

$$\begin{aligned} \text{New wage total} &= \text{K}241\,800 + \text{K}24\,180 \\ &= \text{K}265\,980 \end{aligned}$$

(b) $\frac{3}{10} \times 12\,000\,000 = 0.3 \times \text{K}12\,000\,000$

$$= \text{K}3\,600\,000$$

(c) K700 000

(d)

Revenue	Amount (K)	Expenditure	Amount (K)
Sales(Paper)	12 144 000	Transport	10 000
Others	6 086 000	Electricity	20 000
		Water	5 000
		Rent	60 000
		Land Rates	5 000
		Taxes	3 060 000
		Wages	265 980
		Workers Tea	10 000
		Cleaning	10 000
		Freight	48 000
		Maintenance	50 000
		Insurance	21 210
		Stock	700 000
		Company Expansion	2 000 000
		Dividends	11 969 810
Total Revenue	18 230 000	Total Expenditure	18 230 000

For all the three types of budgets, the expenses should never be more than the income. When the expenses exceed the income, there will be a debt, loss or deficit.

Cash Flow

Budget alone does not give a clear indication of the flow of cash. The flow of cash into and out of a company bank account must show that the expenses are kept below income or revenue level. Businesses need to write cash-flow statements to guide them through in their operations and spending every month.

Cash flow is incomings and outgoings of cash, representing the operating activities of an organization.

The cash flow statement tells the management how much money is coming in and how much money is going out every month. As some clients do not make payments immediately on delivery, cash at bank may not be equal to the anticipated cash balance.

Cash flow statement and cash flow analyses of the month can guide the company either to make payment immediately or to pay later.

Cash flow statement and cash flow analyses of the month can guide the company as to how much the company needed to loan from the bank to keep it's operations flowing, when cash balance at bank is low.

It is easy to operate simple cash flow statement for a village trade store however, business cash-flow statement requires accountants.

Sample Cash Flow Forecast (Business)

Business Name: **Aine Clothing**

Business Start Date: **February 1,2015**

Business Type: **Women's Retail Store Business** End date: **November 31,2015**

Money Business Receives (Revenue)

Cash Receipts	February forecast	March Forecast	April Forecast	May Forecast	Total Forecast
Estimated Sales	K1 100	K2 500	K10 000	K10 000	K23 600
Easter Company Award	K3 500				K3 500
Owner cash Contribution	K100				K100
Total Receipts	K4 700	K2 500	K10 000	K10 000	K27 200

Money Business Pays Out (Expenses)

ADVERTIZING/MARKETING EXPENSE	February forecast	March Forecast	April Forecast	May Forecast	Total Forecast
Business Cards	K200				K200
Flyers	K500				K500
Total	K700				K700

EQUIPMENT EXPENSES	February forecast	March Forecast	April Forecast	May Forecast	Total Forecast
Mannequin	K500				K500
Display rack	K300				K300
Total	K800				K800

BANK FEES AND LICENCES	February forecast	March Forecast	April Forecast	May Forecast	Total Forecast
Bank Fees	K50	K50	K50	K50	K200
Business Registration	K300				K300
Total	K350	K50	K50	K50	K500

INSURANCE EXPENSES	February forecast	March Forecast	April Forecast	May Forecast	Total Forecast
Business Insurance	K400				K400
Total Receipts	K400				K400

OTHER EXPENSES	February forecast	March Forecast	April Forecast	May Forecast	Total Forecast
Inventory	K1 000	K1 000	K1 000	K1 000	K4 000
Cash	K2 000				K2 000
Fees to Events	K500	K100	K300	K500	K1 400
Total Receipts	K3 500	K1 100	K1 300	K1 550	K7 400

Total Expenditures	K5 750	K1 150	K1 350	K1 550	K9 800
--------------------	--------	--------	--------	--------	--------

Net Cash and Net Profit

Net Cash	February forecast	March Forecast	April Forecast	May Forecast	Total Forecast
Monthly Surplus or Deficit	(K1 050)	(1 150)	K8 650	K8 450	K17 400
Cumulative (to date)	-K1 050	-K2 200	K6 450	K14 900	K16 500
Personal Drawings (subtract)			K2 000		K2 000
Net Profit/Loss	-K1 050	-K1 150	K4 650	K14 900	K12 900

If you operate a Chicken Sales Business, the operating expenses many not be many and you may have your cash flow statement as:

Cash Flow

Business Name: Mete Chickens Business Start Date: February 2,2015
 Business Type: Farm Chicken Sale End date: December 31,2015

Money Business Receives (Revenue)

Cash Receipts	February forecast	March Forecast	April Forecast	May Forecast	Total Forecast
Estimated Sales	K1 200		K1 200		K2 400
Owner cash Contribution					
Total Receipts	K1 200		K1 200		K2 400

Money Business Pays Out (Expenses)

OPERATIONAL EXPENSE	February forecast	March Forecast	April Forecast	May Forecast	Total Forecast
Day Old Chicks		K50		K50	K100
Labour	K100				K100
Transport	K50				K50
Feeds	K800				K800
Total	K950	K50		K50	K1 050

Net Cash	February forecast	March Forecast	April Forecast	May Forecast	Total Forecast
Monthly Surplus or Deficit	K250	-K50	K1 200	-K50	K1 350
Cumulative (to date)	K250	K200	K1 400	K1 350	K1 350
Personal Drawings (subtract)				-K500	K850
Net Profit/Loss	K250	K200	K1 400	K850	K850

There is no separate table for Total Expenses as you have only one table for all expenses under OPERATIONAL EXPENSE.

NOW DO PRACTICE EXERCISE 7



Practice Exercise 7

1. A company sells a ream of paper for K17.45. In a box, there are five reams of papers. If the company sells sixty-two boxes of papers in one week, estimate the total earnings made on sale of papers for one year.

2. Pere Family spend their money as follow:

School K200, clothes K300, water bill K50, garbage K20, electricity bill K100, others k300, Savings K300, rent K500, entertainment K300, transport K150, and food K600.

With an earning of K3 020.00, draw up Pere Family budget based on the information given, ensuring that items are correctly placed under essentials and non-essentials.

3. Complete Kavin's Personal Budget.

Income	K	Expenses	K
Wage	_____	<u>Essentials</u>	(450)
		Food	_____
		Rent	150
		Clothes	80
		Power	30
		Transport	40
		<u>Non-Essentials</u>	(100)
		Entertainment	50
		Others	_____
		<u>Savings</u>	50
Total		Total	600

4. Find the total cost for the following purchases:

2 tins of fish at K2.45 each, 8 packets of rice at K4.90 each, 3 cans of Ox & Palm at K7.20 each, cooking oil at K4.80 each, 2 bath soap at K2.10 each and 5 toilet tissues at K1.80 each.

5. Find Mary's expenses for the fortnight if she paid K750 on rent, K600 on food, K36 on water bill, K60 on 'easy pay' electricity, K20 on transport, K60 on cleaners & toiletries, and K200 on entertainment.

6. When Peter Salu paid K69.50 for an electric drill and an electric hammer at sales, he paid 80% of the total. What would be the price of the two items at a usual price?

7. Complete the car rental business annual budget.

Revenue	K	Expenditures	K
Rental	800 000	Dividends(50%)	
		Advertising & Marketing (2%)	
		Spare Parts (5%)	
		Bank Fees & Licences (5%)	
		Insurance (2%)	
		X-mas Awards (6%)	
		Other Expenses (35%)	
Total		Total (100%)	

CORRECT YOUR WORK. ANSWERS ARE AT THE END OF TOPIC 1

TOPIC 1: SUMMARY



This summarizes some of the important ideas and concepts to remember.

- Percentage is a ratio of a quantity out of one hundred.
- Money is a medium of exchange.
- PNG's currency is the kina and toea.
- Ten toea can be expressed as 10t or K0.10
- Four main ways of earning through **employment** are salary, wages, piece-wage and commission.
- Salary is a payment received annually based on class of the position held and is paid fortnightly. **Fortnight Salary = Annual Salary ÷ 26 Fortnights**
- Wage is a payment received for time worked. **Basic Wage = Basic Rate x Basic Hour-week**. Basic Hour-week is the minimum hours to be worked in a week.
- Piece-wage is payment received for every article or unit produced.
- Commission is a payment received as a fraction of total value of items sold.
- If one works for himself to earn a living then he or she is self-employed. Self-employment can be managing a small business or marketing.
- Overtime is paid on wages. It is the additional hours worked over basic hour-week.
- Overtime rate is higher than basic rate of pay. Overtime rate is **time - and - a - half** (basic rate x $1\frac{1}{2}$), **double - time** (basic rate x 2) or higher.
- When spending money, look for discounts, sales or best - buy to save money.
- Hire purchase is a lease purchase with parameters of **initial deposit**, **balance outstanding** and **interest** on balance outstanding.
- Asset values can either appreciate over time ($A = P(1 + r)^T$) or depreciate over time ($A = P(1 - r)^T$).
- Aim to make a profit in any trade of good or service.
- Always follow your budget in your spending to avoid debts.

ANSWERS TO PRACTICE EXERCISES 1-7

Practice Exercise 1

1. a. K16.32 b.K5.83
2. a. K8.40 b. K1.30 c. K8.30 d. K700.00 e. K40.00
f. K7.00
3. $6\frac{2}{3}\%$
4. a. 14t b. K4.30
5. a. K4.00 b. K120
6. K420
7. K2 000
8. K284.40
9. Bansu K560 Ruthie K840 Schola K1 400
10. K220
11. K400
12. K12 000

Practice Exercise 2

1. a.422kg b.K506.40
2. a.K1626.92 b.K1568.99
3. K315
4. K268.80
5. K438
6. a.K173.38 b.K2593.54 c. K179.09 d. K2241.07 e. K6 247.53
7. a.K5500 b.K60 000 c. Profit, K54 500
8. a.K329 b.K70.50 c. K56.40 d.K455.90 e.K387.10

9. a. K55 b. K44.50 c. K60.50
10. a. K720 b. K360 c. K1080

Practice Exercise 3

1. K650
2. a. 5 guavas at K3 b. 10 kg of potato for K6
c. 1L Pauls milk for K6
3. K344
4. 12.5%
5. K480
6. K1224
7. K176
8. K80 000
9. Store C
10. a. K83.60 b. K2.25 c. K39.40 d. K38.49

Practice Exercise 4

1.

	Item	Cash price	Initial deposit	8% interest	Hire purchase price
A	Bed	K683	K183	40	K723
B	Garden Tools	K1342.60	K342.60	80	K1422.60
C	Chairs	K2000	K200	144	K2144

2. K1488
3. (a) K500 (b) K849.90
4. (a) nil (b) 10%
5. (a) K240 (b) K468.80 (c) K1248.60
6. K129.70

7. (a) K9.16 (b) 6%
8. K241.50
9. (a) K122.91 (b) K1601.25 (c) K900

Practice Exercise 5

1. K1 210
2. K10 288.50
3. 3. A.K2552.56 B.K6312.38 C.K16 872.96
4. 4. A.K4072.53 B.K16 200 C.K18 225
5. K188 956.80
6. K22 472
7. K13 506.11
8. K46 656
9. K6 000
10. K10 000

Practice Exercise 6

1. (a) 1.1 (b) 1.05 (c) 0.9 (d) 0.94
2. (a) K14.40 (b) K48.16 (c) K19.00 (d) K69.00
3. K12.20
4. 4. (a) 10% (b) 7% (c) 7% (d) 1%
5. 44%
6. 6. (a) 20% (b) K366
7. K5270
8. K13.30
9. K13.00
10. Loss, K0.19

Practice Exercise 7

1. K322 400
2. Pere Family Budget

Income	K	Expenses	K
Wage	3020	<u>Essentials</u>	
		Food	600
		Rent	500
		Clothes	300
		Easy Pay Power	100
		Water Bill	50
		Transport	150
		School	200
		Garbage	20
		<u>Non-Essentials</u>	
		Entertainment	500
		Others	300
		<u>Savings</u>	300
Total	3020	Total	3020

3.

Income	K	Expenses	K
Wage	600	<u>Essentials</u>	
		Food	150
		Rent	150
		Clothes	80
		Power	30
		Transport	40
		<u>Non-Essentials</u>	
		Entertainment	50
		Others	50
		<u>Savings</u>	50
Total	600	Total	600

4. K83.70
5. K1 726
6. K86.88

7.

Revenue	K	Expenditures	K
Rental	800 000	Dividends (50%)	400 000
		Advertising & Marketing (2%)	16 000
		Spare Parts (5%)	40 000
		Bank Fees & Licences (5%)	40 000
		Insurance (2%)	16 000
		X-mas Awards (6%)	48 000
		Other Expenses (35%)	280 000
Total	800 000	Total (100%)	800 000

TOPIC 2

RATIO AND PROPORTION

Lesson 8: Ratios & Equivalent Ratios

Lesson 9: More Ratios

Lesson 10: Ratios With Three or More Terms

Lesson 11: The Meaning of Proportion

Lesson 12: Proportion Division

TOPIC 2: RATIO AND PROPORTION

Introduction



This is the second Topic of the grade 10 Mathematics Course under Unit 2, Managing Your Money.

Understanding Ratio and Proportion enables you to find portion of quantities according to a given ratio, solve proportional problems, draw scale diagrams, read and sketch maps and deal with foreign exchange of currencies.

In chemistry, it enables you to mix chemicals. In agriculture ratio and proportion skills guide us as to how much fertilizer needs to be used.

Your knowledge in ratio and proportion will enable you to visualize problems in order to solve them.

This Unit 2- covers 5 lessons from lesson 8 to lesson 12.

Lesson 8: Ratio and Equivalent Ratio: This lesson includes writing ratio in its notation, simplifying ratios, solving terms of equivalent ratios and finding quantities of given ratios.

Lesson 9: More Ratios: This lesson includes simplifying ratios with same units and simplifying ratios with varying units.

Lesson 10: Ratios With Three or More Terms: This lesson includes writing and simplifying ratios with more than two terms and solving problems with three or more terms.

Lesson 11: Proportion: This lesson includes deriving, writing and solving terms in given proportion statements or equations.

Lesson 12: Proportion Division: This lesson includes finding parts in a given quantity when their ratios are given, and dividing quantities in a given ratio.

Lesson 8: Ratios and Equivalent Ratios



You have learned about personal, family and business budgets in lesson 7.



In this lesson you will:

- explain and define ratio
- write ratio notation in a given problem
- compare one quantity with another of the same kind
- express ratio in its simplest form.

Ratio is a comparison between quantities of the same kind.

Ratio is a comparison between two or more quantities expressed in the same unit of measurement.

Each part of the ratio is known as the term of the ratio. In the ratio $p : q : r$, the first term is p , the second term is q , and the third term is r .

Ratio Notation

Ratio can be expressed in colon notation form as $a : b$ and $a : b : c$ or as a fraction as $\frac{a}{b}$. The ratio, 'a' full colon 'b' ($a : b$) is read as 'a is to b'.

When we make a statement as $a : b$, we are comparing one quantity with another quantity. We do not state the units in any given measurement because we express the all terms in the ratio in the same unit.

Example

A bag contains 7 red marbles and 5 blue marbles.

- a. Write the ratio of blue marbles to red marbles.
- b. Write the ratio of red marbles to the total number of marbles.

Solution:

a. $b : r$

$$= 5 : 7$$

b. blue + red = total, hence $5 + 7 = 12$

$$r : t$$

$$= 5 : 12$$

Simplifying Ratios

A ratio is at its simplest form when all terms of the ratio do not have a common factor. We simplify ratios just like we simplify common fractions. When simplifying ratios:

1. **Find the Highest Common Factor (HCF)**
2. **Divide into the ratios by the HCF if the terms are whole numbers.**
3. **Multiply the terms by their HCF if the terms are fractions (or decimals) to make them whole numbers.**
4. **Multiply the terms by powers of 10 if the terms are decimals to make them whole numbers.**
5. **Simplify further if a common factor exists.**

Example 1

Simplify by first finding the HCF in 18 : 63

Solution:

$$18 : 63 = 2 : 7 \quad (\div 9)$$

Example 2

Simplify the fractional ratio $\frac{5}{6} : \frac{2}{3}$

Solution:

$$\frac{5}{6} : \frac{2}{3}$$

$$\frac{5}{6} : \frac{2}{3}$$

$$\frac{30}{6} : \frac{12}{3} \quad (\text{numerator} \times 6) \quad \text{OR} \quad \frac{5}{6} : \frac{4}{6} \quad (\text{express in terms of } 6^{\text{th}})$$

$$5 : 4$$

$$5 : 4$$

Example 3

$0.4 : \sqrt{16}$

Solution:

$$\begin{aligned} 0.4 : \sqrt{16} &= 0.4 : 4 \\ &= 4 : 40 && (\times 10) \\ &= 1 : 10 && (\div 4) \end{aligned}$$

Example 4

Simplify the ratio $7pqr : 21pr$

Solution:

$$7pqr : 21pr = q : 3r \quad (\div 7pr)$$

Example 5

Simplify the ratio in index form $15^2 : 5^3$

Solution:

$$\begin{aligned} 15^2 : 5^3 \\ &= 225 : 125 && \text{(exponent)} \\ &= 9 : 5 && (\div 25) \end{aligned}$$

Three Forms of a Simplified Ratio

Ratio can be expressed as $m : n$, $1 : n$ or $n : 1$, where m and n are positive integers (1, 2, 3, 4,...) and 1 is an integer positive one.

When a ratio is simplified, the ratio is expressed in one of the three ways.

The ratio **3 : 2** is expressed in the form $m : n$. Where, m and n are two positive integers (whole numbers) that have a common factor of 1, so the terms cannot be reduced further.

The ratio **1 : 8** is expressed in the form $1 : n$. This is when the first term is 1 and the second is any whole number or a positive integer. It is often used in map scale and scale diagrams.

The ratio **5 : 1** is expressed in the form $n : 1$. The first term is a positive integer and the second term is 1. It is used in rates and scale diagrams.

But expressing the ratio in the form $n : 1$ and $1 : n$ may not always give a whole number n . It may give a decimal number like $2.5 : 1$ or $1 : 4.2$ etc.

Example 1

Simplify the ratio of K140 : K200 and express in the form $m : n$.

Solution:

$$K140 : K200 = 7 : 10 \quad (\div 20)$$

Example 2

Express the ratio of K500 : 20 people in the form $n : 1$.

Solution:

$$K500 : 20 = 25 : 1 \quad (\div 20)$$

Example 3

Simplify the ratio of K30 : K40.80 and express in the form $1 : n$.

Solution:

$$K30 : K40.80 = 1 : 1.36 \quad (\div 30)$$

Equivalent Ratio

Ratios are equivalent when their corresponding terms increase or decrease by the same factor.

The ratios $3 : 2$, $15 : 10$ and $0.6 : 0.4$ are equivalent ratios. The ratio $3 : 2$ is the simplest form of the three ratios.

$$\begin{array}{ccc}
 (\div 5) & & (x 5) \\
 \curvearrowright & & \curvearrowright \\
 15 : 10 = 3 : 2 & & 0.6 : 0.4 = 3 : 2 \\
 \curvearrowleft & & \curvearrowleft \\
 (\div 5) & & (x 5)
 \end{array}$$

In the ratio $15 : 10$, we divided both terms by 5 to get $3 : 2$. And in the ratio $0.6 : 0.4$, we multiplied both terms by 5 to get $3 : 2$.

The order of the terms is important especially, when we make a statement of equality or statement of proportionality. That is say $\mathbf{a : b = p : q}$, we must maintain the order as

$$\frac{\mathbf{a}}{\mathbf{b}} = \frac{\mathbf{p}}{\mathbf{q}}$$

Example

From above,

$$\frac{15}{10} = \frac{3}{2} \text{ order maintained, BUT } \frac{15}{10} \neq \frac{2}{3} \text{ order not maintained.}$$

When we say the ratio of girls to boys in a class is $3 : 2$, we translate as $G : B = 3 : 2$. We have maintained the order girls : boys, followed by $3 : 2$.

When the order of one ratio is changed, the order of the corresponding ratio should be changed to maintain a relationship.

Solving Equivalent Ratio

Ratios with two terms can easily be solved by either **Factor Method** or **Cross-Multiplication Method**.

Factor Method

The ratios 3 : 8 and 21 : x are equivalent so we equate 3 : 8 = 21 : x . Therefore we write as a fraction to help us identify the common factor.

$$\frac{3}{8} = \frac{21}{x} \quad \begin{array}{l} \text{So } x \text{ is } 8 \text{ multiplied by } 7, \text{ which is equal to } 56. \\ \text{Corresponding terms increase by same factor.} \end{array}$$

x 7

Another example.

$$\frac{33}{121} = \frac{x}{11} \quad \begin{array}{l} \text{So } x \text{ is } 33 \text{ divided by } 7, \text{ which is equal to } 3. \\ \text{Corresponding terms decrease by same factor.} \end{array}$$

÷ 7

÷ 11

Factor method can be used on three or more terms ratio or proportion problems.

Cross-Multiplication Method

The ratio a : b = c : d are equivalent, or are in proportion. We re-write as fraction we get

$$\frac{a}{b} = \frac{c}{d}$$

By cross multiplication we get $ad = bc$. The value of the **cross-product 'ad'** equals value of the **cross-product 'bc'**. Then divide by d, c, b or a to solve for the letters a, b, c or d respectively (in that order).

$$a = \frac{bc}{d}$$

$$b = \frac{ad}{c}$$

$$c = \frac{ad}{b}$$

$$d = \frac{bc}{a}$$

Cross-multiplication method is very useful when it is not easy to work out the highest common factor quickly. However, cross – multiplication is only convenient with two term proportion statement.

Example 1

Find the value of 't' in $t : 4 = 27 : 36$ using factor method.

Solution:

$$\begin{array}{c} \div 9 \\ \curvearrowright \\ \frac{t}{4} = \frac{27}{36} \\ \curvearrowleft \\ \div 9 \end{array}$$

$$27 \div 9 = 3, \text{ Therefore } t = 3$$

Example 2

Solve for k in $k : 8 = K5100 : K2400$

Solution:

$$k : 8 = 5100 : 2400$$

$$\frac{k}{8} = \frac{5100}{2400} \quad (2400 \div 8 = 300, \text{ HCF} = 300, \text{ thus } k = 5100 \div 3)$$

$$k = 17$$

Example 3

Solve for p in $4 : p = 6 : 9$ by using cross-multiplication method.

Solution:

$$4 : p = 6 : 9$$

$$\frac{4}{p} = \frac{6}{9}$$

$$4 \times 9 = 6 \times p$$

$$\frac{4 \times 9}{6} = \frac{6 \times p}{6}$$

$$6 = p$$

$$p = 6$$

Steps:

1. Equate as vulgar fractions
2. Take cross-products
3. Divide by numerical coefficient
4. Solve for unknown

In the above example, 4×9 and $6 \times p$, are the **cross-products** of the ratio. It is easier to simplify if the cross-products are left in factor form as laid out in the examples.

Example 4

Solve for 'm' in the proportion $12 : 32 = 60 : m$.

Solution:

$$12 : 32 = 60 : m$$

$$\frac{12}{32} = \frac{60}{m}$$

$$12 \times m = 60 \times 32$$

$$\frac{12 \times m}{12} = \frac{60 \times 32}{12}$$

$$m = 5 \times 32$$

$$m = 160$$

Example 5

Simplify the ratio $m - n : 2n - 2m$

Solution:

$$m - n : 2n - 2m = -1(n - m) : 2(n - m)$$

$$= \frac{-1(n - m)}{n - m} : \frac{2(n - m)}{n - m}$$

$$= -1 : 2$$

$$= 1 : 4$$

Since we get negative 1, we square both terms to make them positive because ratio is always positive.

NOW DO PRACTICE EXERCISE 8

**Practice Exercise 8**

1. Simplify the following ratios

a. $9 : 15$

c. $18 : 12$

b. $20 : 48$

d. $51 : 17$

2. Express the following ratios as fractions.

a. $5 : 11$

c. $9 : 28$

b. $21 : 6$

d. $25 : 40$

3. Simplify the following ratios.

a. $\frac{1}{5} : \frac{3}{10}$

c. $0.2 : 0.02$

b. $\frac{4}{15} : \frac{3}{5}$

d. $3.5 : 7$

4. Simplify

a. $2p : 6p^3 =$

c. $2^2 : 4^2 =$

b. $\sqrt{64} : \sqrt[3]{8} =$

d. $abc : bcd =$

5. Express the ratios in the form $n : 1$

a. $8 : 4 =$

c. $\frac{3}{4} : \frac{1}{4} =$

b. $3.6 : 0.6 =$

d. $100 : 20 =$

6. Express the ratios in the form 1 : n

a. $12 : 36 =$

c. $\sqrt{16} : 16$

b. $13 : 52 =$

d. $0.3 : 2.7$

7. Express the ratios in the form m : n

a. $300 : 400 =$

c. $K8 : 60t$

b. $300\text{mL} : 1\text{L} =$

d. $6\text{hr} : 40\text{min}$

8. Use factor method to find unknowns.

a. $3 : p = 6 : 16$

c. $7 : 11 = 63 : r$

b. $q : 8 = 15 : 40$

d. $5 : s = 30 : 12$

9. Use cross-multiplication method to solve.

a. $17 : 3 = v : 12$

c. $\frac{x}{12} = \frac{40}{96}$

b. $9 : 5 = 54 : w$

d. $15 : y = 120 : 160$

10. Express the ratio 20cm : 8cm in the form

a. $m : n$

b. $n : 1$

c. $1 : n$

CORRECT YOUR WORK. ANSWERS ARE AT THE END OF TOPIC 2

Lesson 9 More Ratios



You have learned about ratio and equivalent ratio in lesson 8.

In this lesson you will:

- use ratio notation to compare quantities with measurements that have the same unit
 - use ratio notation to compare quantities with measurements with different units.
-

Ratios with Units

Ratio is often given in units, when comparisons are made as to which class has greater or less quantity.

But a ratio is a comparison between quantities of the same kind. So when units are that of differing scale say, 4km : 100m, we need to express them in the same scale of units as 4000m : 100m in-order to simplify.

Often we express both terms in smaller units in-order to simplify. Expressing in smaller units enables us to avoid using decimals.

A ratio is at its simplest form when all terms of the ratio do not have a common factor. We simplify ratios just like we simplify common fractions.

When simplifying ratios:

1. **Express the ratios in the same unit.**
2. **Find the Highest Common Factor (HCF)**
3. **Divide into the ratios by the HCF**
4. **Write your answer without units.**

When expressing two terms in the same unit, always take into account the conversion factor.

Generally, when converting one term to a lesser unit, multiply. When converting a term to a larger unit, divide.

In our examples and exercises, we will use other measurement units along with money units.

Example

- a. Express 2.5 L in millilitres
- b. Express 1200mg in grams

Solution:

$$\begin{aligned} \text{a. } 2.5\text{L} &= 2.5\text{L} \times 1000\text{mL/L} \\ &= 2500\text{mL} \end{aligned}$$

Conversion from larger unit to smaller unit

$$\begin{aligned} \text{b. } 1200\text{mg} &= 1200\text{mg} \div 1000\text{mg/g} \\ &= 1200\text{mg} \times \frac{\text{g}}{1000\text{mg}} \\ &= 1.2\text{g} \end{aligned}$$

Conversion from a smaller unit to a larger unit

The boxed conversion keys can be used as a guide in the examples that follow.

Metric Measurements			
<u>Distance</u>	<u>Capacity</u>	<u>Mass</u>	<u>Time</u>
10mm = 1 cm	1000mL = 1L	1000mg = 1g	60s = 1min
100cm = 1m	1000L = 1kL	1000g = 1kg	60min = 1h
1000m = 1km		1000kg = 1t	24h = 1d
<u>Area</u>	<u>Volume</u>		
10 000cm ² = 1m ²	1000mm ³ = 1 cm ³		
10 000m ² = 1ha	1000 000cm ³ = 1m ³		

Example1

Simplify the ratio 2cm : 4mm

Solution:

$$\begin{aligned} 2\text{cm} : 4\text{mm} \\ &= 20\text{mm} : 4\text{mm} \\ &= \frac{20}{4} : \frac{4}{4} \\ &= 5 : 1 \end{aligned}$$

Example 2

Simplify 700mL : 1400

Solution:

$$\begin{aligned}700\text{mL} : 1400\text{mL} &= 700 : 1400 \\ &= \frac{700}{700} : \frac{1400}{700} \\ &= 1 : 2\end{aligned}$$

Example 3

Express the ratio K400 : K1000 in the form m : n

Solution:

$$\begin{aligned}\text{K400} : \text{K1000} \\ &= \frac{400}{200} : \frac{1000}{200} \\ &= 2 : 5\end{aligned}$$

Example 4

Express the ratio 20cm : 400cm in the form 1: n

Solution:

$$\begin{aligned}20\text{cm} : 400\text{cm} &= 20 : 400 \\ &= 1 : 20\end{aligned}$$

Example 5

Express the ratio 360g : 60g in the form n : 1

Solution:

$$\begin{aligned}360\text{g} : 60\text{g} &= \frac{360}{60} : \frac{60}{60} \\ &= 6 : 1\end{aligned}$$

NOW DO PRACTICE EXERCISE 9

**Practice Exercise 9**

1. Simplify the following ratios expressed in the same units.

a. $2\text{mL} : 10\text{mL} =$

f. $500\text{g} : 250\text{g} =$

b. $10\text{kg} : 15\text{kg} =$

g. $240\text{t} : 80\text{t} =$

c. $\text{K}100 : \text{K}120 =$

h. $\frac{3}{4}\text{L} : \frac{3}{8}\text{L}$

d. $30\text{cm}^3 : 180\text{cm}^3 =$

i. $\text{K}1.20 : \text{K}1.80 =$

e. $64\text{cm}^2 : 16\text{cm}^2 =$

j. $2\text{mm} : 4000\text{mm} =$

2. Simplify the following ratios expressed in different units.

a. $250\text{g} : 2\text{kg} =$

f. $400\text{kg} : 4000\text{g} =$

b. $10\text{m} : 10\text{cm} =$

g. $0.8\text{g} : 16\text{mg} =$

c. $200\text{cm} : 20\text{mm} =$

h. $60\text{sec} : 2\text{min} =$

d. $2\text{L} : 500\text{mL} =$

i. $3\text{hr} : 5\text{min} =$

e. $\text{K}2.00 : 40\text{t} =$

j. $1.5\text{d} : 12\text{hr} =$

3. Simplify the ratios

a. $\frac{1}{4}$ L : 300mL =

f. $2\frac{1}{2}$ hr : 30min =

b. 60km/hr : 80km/hr =

g. 2.5ha : 250m² =

c. 4m : $\frac{1}{2}$ m =

h. 60cm² : 60mm² =

d. 200cm³ : 200mm³ =

i. 12hr : $\frac{1}{4}$ day =

e. 2days : 2weeks =

j. $\frac{1}{2}$ t : 200kg =

-
4. Sam contributed K800 000 and Saul contributed K60 000 to start a business. Write the ratio of their contribution.

-
5. Maureen runs two laps and Sarah runs 5 laps every morning on a 300m track. What is the ratio of distance run by Maureen to distance run by Sarah?

-
6. Hicks fetched 10L of water while the husband Paul fetched 10 lots of 500mL containers. What is the ratio of water fetched by Hicks to Paul?

CORRECT YOUR WORK. ANSWERS ARE AT THE END OF TOPIC 2

Lesson 10 Ratios With Three Or More Terms



You have learned more about ratios in lesson 9.

In this lesson you will:

- workout problems involving ratios with three or more terms in any practical situation.

Ratios can have more than two terms. When dealing with division of a quantity, we may be faced with a situation that discusses three, four or more people.

We can simplify ratios with 3 or more terms using the same approach as we did for two term ratios.

When dealing with measurement units, always express each term in the lowest scale of units of measurement. Then disregard the units, and further simplify if a common factor exists.

Remember that simplified ratios have no measurement units.

Example

Simplify $2\text{m} : 3\text{m} : 400\text{cm} : 8\,000\text{mm}$

Solution:

$$\begin{aligned} 2\text{m} : 3\text{m} : 400\text{cm} : 8\,000\text{mm} \\ &= 200\text{cm} : 300\text{cm} : 400\text{cm} : 8\,000\text{mm} \\ &= 2000 : 3000 : 4000 : 8000 \\ &= 2 : 3 : 4 : 8 \end{aligned}$$

Dividing a Quantity

When dividing a quantity by a given ratio, add the ratios and write the corresponding ratio out of the total of ratios, then multiply by the quantity.

Example 1

Tom, James, Sandy and Maria are to share K400 in the ratio $2 : 3 : 4 : 7$ in that order. How much does Sandy receive?

Solution:

$$\begin{aligned} \text{Sum of ratios} &= 2 + 3 + 4 + 7 \\ &= 16 \end{aligned}$$

$$\begin{aligned}\text{Sandy's Share} &= \frac{4}{16} \\ &= \frac{4}{16} \times 400 \\ &= \frac{1}{4} \times 400 \\ &= \text{K}100\end{aligned}$$

Example 2

Mom, Yami, Dong, Dal and Pana are to share 25kg of rice in the ratio 2 : 3 : 4 : 5 : 6 respectively. How much more kilogram of rice does Pana get than Mom?

Solution:

$$\begin{aligned}\text{Sum of ratios} &= 2 + 3 + 4 + 5 + 6 \\ &= 20\end{aligned}$$

$$\begin{aligned}\text{Pana's Share} &= \frac{6}{20} \times 25 \\ &= \frac{3}{10} \times 25 \\ &= 3 \times 2.5 \\ &= 7.5\text{kg}\end{aligned}$$

$$\begin{aligned}\text{Mom} &= \frac{2}{20} \times 25 \\ &= \frac{1}{10} \times 25 \\ &= 1 \times 2.5 \\ &= 2.5\text{kg}\end{aligned}$$

$$\text{Difference } 7.5 - 2.5 = 5\text{kg more}$$

NOW DO PRACTICE EXERCISE 10



Practice Exercise 10

1. Simplify the ratios.

a. $20 : 60 : 100 =$

f. $250\text{mL} : 1000\text{mL} : 1500\text{mL} =$

b. $45 : 15 : 135 : 225 =$

g. $10\text{kg} : 20\text{kg} : 25\text{kg} =$

c. $3 : \frac{1}{4} : 2 : \frac{3}{4} =$

h. $100\text{m} : 200\text{m} : 400\text{m} : 800\text{m} =$

d. $0.4 : 1.2 : 2.4 =$

i. $\text{K}80 : \text{K}100 : \text{K}40 : \text{K}200 =$

e. $\sqrt{400} : \sqrt[3]{8000} : \sqrt[4]{16} =$

j. $10\text{ha} : 15\text{ha} : 15\text{ha} : 20\text{ha} : 30\text{ha} =$

2. Simplify ratios with different units.

a. $\text{K}300 : \text{K}400 : \text{K}500 : \text{K}600 =$

f. $250\text{mL} : 1\text{L} : 2.5\text{L} =$

b. $5\text{cm} : 12\text{cm} : 0.13\text{m} =$

g. $500\text{g} : 1\text{kg} : 5\text{kg} : 10\text{kg} =$

c. $500\text{mL} : 1\text{L} : 2\text{L} =$

h. $100\text{m} : 200\text{m} : 400\text{m} : 800\text{m} =$

d. $1000000\text{mm}^3 : 1\ 000\ 000\text{cm}^3 : 1\text{m}^3 =$

i. $80\text{kg} : 1000000\text{mg} : 4000\text{g} : 2\text{kg} =$

e. $100000\text{mm}^2 : 10\ 000\text{cm}^2 : 10\ 000\text{m}^2 =$

j. $30^\circ : 60^\circ : 90^\circ : 180^\circ : 360^\circ =$

3. Share K30 000 in the ratio 2 : 3 : 4 : 6 among Tim, Pana, Greg and Mileng in that order.
-

4. Divide 25kg of rice in the ratio 1 : 2 : 3 : 4 among Susie, Mary, Kerry and Tammy in that order.
-

5. Divide K50 000 amongst Kelly, Paul and John in the ratio 2 : 3 : 5. How much more does John get than Kelly?
-

6. Care Centres A, B, C, D and E are to share 30 000 bags of 20kg rice in the ratio 3 : 3 : 4 : 5 : 5 in that order. How many more bags of 20kg rice is given to Care-Centre D than Care-Centre A?
-

7. A packet contains 100 lollies. It is to be shared among Ronan, Isha and Sasha in the ratio 5 : 2 : 3. Find how many lollies will each get?
-

8. If 6 000 library books were distributed to schools A, B, C, D, E and F in the ratio 5 : 4 : 1 : 3 : 2. How many more library books will school A get more than school C?
-

CORRECT YOUR WORK. ANSWERS ARE AT THE END OF TOPIC 2

Lesson 11 The Meaning of Proportion



You have learned about ratios with three or more terms in lesson 10.

In this lesson you will:

- define proportion
- explain and give examples of proportion
- identify and apply the rule to find ratio in proportion.

Proportion is a statement of equality in corresponding terms of two ratios. When we state that one ratio is equal to another, we are saying that the two ratios are in proportion.

Two ratios are in direct proportion when they increase or decrease by the same factor.

As a fraction, we express as

$$\frac{a}{b} = \frac{c}{d}$$

The statement $a : b = c : d$ is a proportional statement. That is, $a : b$ is in direct proportion to $c : d$. So when **a** increases by a factor to get **c**, **b** increases by the same factor to get **d**. That occurs as the product of the **mean** is equal to the product of the **extremes**.

$$\begin{array}{c} \text{mean} \\ \text{---} \\ \mathbf{a : b = c : d} \\ \text{---} \\ \text{extremes} \end{array}$$

If we represent the proportion statement with figures as such as $2 : 5 = 6 : 15$, we can demonstrate that the product of the mean is equal to the product of the extremes.

$$\begin{array}{c} \text{---} \\ \mathbf{2 : 5 = 6 : 15} \\ \text{---} \end{array}$$

This indicates that $2 \times 15 = 5 \times 6$. And if we express as a fraction, we write as below and get their cross products which will yield 30.

$$\begin{array}{c} \text{---} \\ \mathbf{2} \quad \mathbf{6} \\ \text{---} \\ \mathbf{5} \quad \mathbf{15} \\ \text{---} \end{array}$$

Based on this **postulate** (accepted fact), we can solve related problems if we know the values of at least three terms of the proportion statement.

We can say that two ratios are in direct proportion when they increase or decrease at the same rate or by the same factor.

Study the given table.

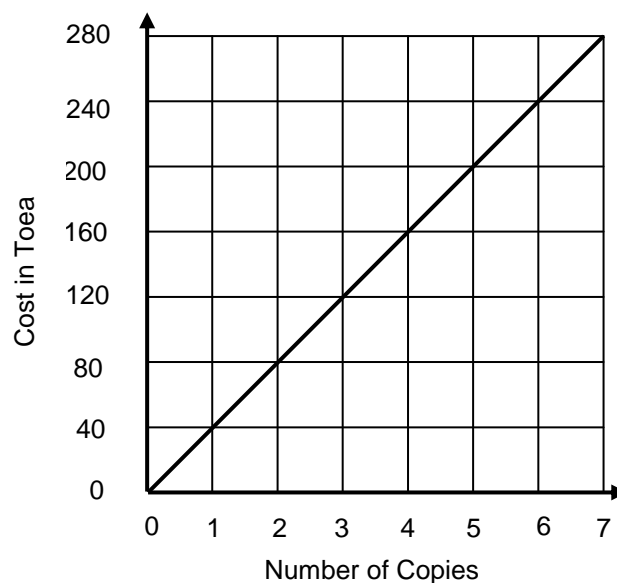
Number of Copies	Cost in Toea
1	40
2	80
3	120
4	160
5	200
6	240
7	280

The table shows that $1 : 4 = 40t : 160t$ and $2 : 5 = 80t : 200t$. The ratio of the number of copies is directly in proportion to the ratio of their corresponding cost in toea. That is, when the number of copies is multiplied by 4, the cost is also multiplied by 4.

If we write $4 : 1 = 160t : 40t$, again the ratio of copies is in direct proportion to the corresponding ratio of the cost in toea. That is when the number of copies is divided by 4, the cost in toea is also divided by 4.

We can illustrate direct proportion with a graph. The graph below shows the cost of photocopying. Such a graph is referred to as a ready-reckoner.

Ready-Reckoner : Cost of Photocopies



To read the graph, say 3 copies, we start from 3 and go up. When we meet the diagonal line, we go across left and read the scale.

From 3 up, then across, we meet the scale of 120t.

We can also go the reverse order if we are given the amount of money and to find number of copies.

What is the rate (gradient of the graph)? (40t/copy)

What is the cost of 5 copies? (K2.00)

What is the cost of 10 copies? (K4.00)

With K2.00 (200t) how many copies can you make? (5 copies)

Is the charge of K3.20 for 8 copies correct? (Yes)

Direct Proportion

Direct Proportion can be expressed as a proportion statement or an equation containing two fractions.

$$\begin{aligned} a : b &= c : d \\ \frac{a}{b} &= \frac{c}{d} \end{aligned}$$

When the product of the **mean** is equal to the product of the **extremes**, or the **cross products** are equal, there exists a direct proportion in the comparison of the two ratios.

Example 1

Find x in $4 : x = 32 : 40$

Solution:

$$4 : x = 32 : 40$$

$$\frac{4}{x} = \frac{32}{40}$$

$$160 = 32x$$

$$\frac{160}{32} = x$$

$$x = 5$$

We can also say 40 divided by 8 equals 5, because 8 is the factor.

Example 2

Distance (d) is directly proportional to time (t). If a car travelled 250km in 2 hours, how far will it travel in 5 hours?

Solution:

$$d_1 : t_1 = d_2 : t_2 \text{ Where } d_1 = 250\text{km}, t_1 = 2 \text{ hrs}, t_2 = 5 \text{ hrs}$$

$$\frac{d_1}{t_1} = \frac{d_2}{t_2}$$

$$\frac{250}{2} = \frac{d_2}{5}$$

$$d_2 = \frac{250 \times 5}{2}$$

$$d_2 = \frac{1250}{2}$$

$$= 625\text{km}$$

Example 3

The cost of 3 mobile phones is K381. Calculate the cost of 8 mobile phones.

Solution:

$$p_1 : c_1 = p_2 : c_2 \text{ where } p_1 = 3, c_1 = 381, p_2 = 8$$

$$\frac{p_1}{c_1} = \frac{p_2}{c_2}$$

$$\frac{3}{381} = \frac{8}{c_2}$$

$$3c_2 = 8 \times 381$$

$$c_2 = \frac{8 \times 381}{3}$$

$$c_2 = \frac{3048}{3}$$

$$c_2 = 1016$$

Therefore, the cost of 10 mobile phones is K1016.

Factor Method and Cross-Multiplication Method can also be used in Direct Proportion problems.

Factor Method

Example

Tamar, Samor and Loma share a sum of money in the ratio 4 : 1 : 3 in that order. If Tamar got K280 and Samor got K70, how much did Loma get?

Solution:

The ratio 4 : 1 : 3 = 280 : 70 : L are in direct proportion.

$$\begin{array}{c}
 \begin{array}{ccc}
 & \times 70 & \times 70 \\
 \curvearrowright & & \curvearrowright \\
 4 : 1 : 3 = 280 : 70 : L & &
 \end{array} \\
 \begin{array}{ccc}
 & & \curvearrowleft \\
 & & \times 70
 \end{array}
 \end{array}$$

So L is 3 multiplied by 70, which is equal to 210.

Corresponding terms increase by same factor.

Therefore, Loma gets K210.

Cross-Multiplication Method

Example

A certain distance along a road is to be divided in the ratio 7:13 between groups A and B to do the clean-up. If group A covers 42m:

Find

- the distance group B cleans up.
- the total distance covered

Solution:

$$\begin{array}{l}
 \text{a. } A : B \\
 7 : 13 = 42 : B
 \end{array}$$

$$\frac{7}{13} = \frac{42}{B}$$

$$7B = 42 \times 13$$

$$B = \frac{42 \times 13}{7}$$

$$B = 78$$

Therefore, Group B cleaned 78m in length

b. Total distance

$$42\text{m} + 78\text{m} = 120\text{m}$$

Inverse Proportion

When one term of a ratio increases by a factor, and the second term decreases by the same factor, they are said to be inversely proportional.

Two ratios are inversely proportional when a term of one ratio increases by a factor, and the corresponding term of another ratio decreases by the same factor.

If we use the alphabetical letters a, b, c and d, we express as $ab = cd$. The proof is as given hereafter.

$$a : \frac{1}{b} = c : \frac{1}{d}$$

$$\frac{a}{1} = \frac{c}{\frac{1}{d}}$$

$$a \times \frac{b}{1} = c \times \frac{d}{1} \quad (\text{when dividing by fraction, multiply by its inverse})$$

$$ab = cd$$

We can now see that the direct proportion is a **statement of division**, and inverse proportion is a **statement of multiplication**.

Suppose we substitute c and d with a_2 and b_2 in that order, the above statement of inverse proportion can be rewritten as $a_1 b_1 = a_2 b_2$. We can illustrate inverse proportion with the statement below.

$$a_1 b_1 = a_2 b_2$$

$$5 \times 12 = 10 \times z.$$

$$z = \frac{5 \times 12}{10}$$

$$z = 6$$

Remember that $a_1 = 5$, $b_1 = 12$, $a_2 = 10$ and $b_2 = z$. So if 5 increases by multiplying by factor **k** to get 10, then z is a number we multiply 12 by $\frac{1}{k}$.

And $\frac{1}{k}$ is the inverse (multiplicative inverse) of k . Likewise, if 5 is multiplied by 2 to get 10, then z is a number we multiply 12 by half to obtain, which is 6.

The use of $ab = cd$ or $a_1b_1 = a_2b_2$ eases the calculation process in inverse proportion.

And inverse proportion can be used in the following situations:

Present Situation	Arising Situation
A quantity of food supply for 'a' people for 'b' days	When people increase or decrease to a_2 or days increase or decrease to b_2 but quantity of food supply does not increase or decrease
Given a volume of work or task to accomplish to 'a' people for 'b' days	If 'a' increases to a_2 , b decreases to b_2 but work to be done is the same
Time taken at 'a' speed for 'b' distance	When either 'a' changes to a_2 or 'b' changes to b_2 but time remains the same

Example 1

The number of days a water tank can last a village is inversely proportional to the village population. With 500 people, the water tank can last the village 14 days. If 100 people leave the village, how long will the water tank last them?

Solution:

$$a_1b_1 = a_2b_2$$

where $a_1 = 500$, $b_1 = 14$, $a_2 = 400$, b_2 is the unknown

$$500 \times 14 = 400 \times b_2$$

$$\frac{500 \times 14}{400} = \frac{400 \times b_2}{400}$$

$$\frac{5 \times 7}{2} = b_2$$

$$17 \frac{1}{2} = b_2$$

$$b_2 = 17 \frac{1}{2} \text{ days}$$

Therefore, it will last them $17 \frac{1}{2}$ days.

Example 2

The number of weeks a water pipe drain can be dug to lay pipes to run water from a tank to a village is inversely proportional to the village manpower provided. With 100 men, the water pipe drain can be dug and pipe laid in 2 weeks.

If 40 men show up for work on the drain, how long will the task take the men?

Solution:

$$a_1 b_1 = a_2 b_2 \text{ where } a_1 = 100, b_1 = 2, a_2 = 40, b_2 = \text{the unknown}$$

$$100 \times 2 = 40 \times b_2$$

$$\frac{100 \times 2}{40} = b_2$$

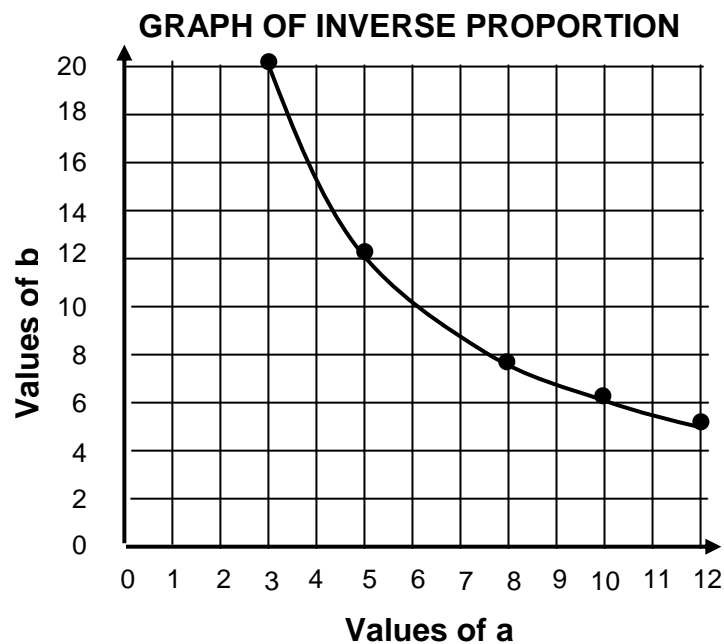
$$b_2 = \frac{200}{40}$$

$$b_2 = 5 \text{ weeks}$$

Below is a table of values for an inverse function.

a	3	5	8	10	12
b	20	12	7 ½	6	5

Graph of inverse function when $x \geq 0$ and $y \geq 0$ or when x is positive, y is positive.



When given such a graph, the following questions may be asked.

Example

- (a) When 'a' value is 6, what is b value?
- (b) When b value is 5, what is 'a' value?

Solution:

(a) $b = 8$

(b) $a = 9$

NOW DO PRACTICE EXERCISE

**Practice Exercise 11**

1. Solve for x in the following.

a. $2 : 9 = x : 27$

c. $x : 100 = 49 : 50$

b. $21 : 8 = 84 : x$

d. $40 : x = 5 : 3$

2. Solve for the unknown in the following:

a. $2 \times 18 = m \times 9$

c. $k \times 27 = 15 \times 9$

b. $20 \times d = 4 \times 25$

d. $3 \times 2 = 30 \times p$

3. The cost of text books is directly proportional to the quantity purchased. If 80 Geometry text books were bought for K4960, what is the cost for 100 Geometry text books?

4. If 9 men were paid a total of K3240 in wages, K5400 budgeted for wages can cater for how many workers?

5. A 20kg bag of trukai rice can feed 30 students for 3 days at a camp. If 5 students did not make it to the camp, how long will the bag of rice last them?

6. Two rectangles, Rectangle A and Rectangle B are in proportion to each other in the ratio of $2 : 5$. If the length of Rectangle B is 40cm, find the length of Rectangle A?

7. The ratio of money loaned to repayment from a money lender is 10 : 13. Terry got K200, how much will Terry pay the money lender?
-

8. Sapo, Mogo and Sogi share a certain amount of money in the ratio 2 : 3 : 4. If Sogi gets K400, how much each will Sapo and Mogo get?
-

9. Speed is inversely proportional to time. Mula travelled 2 hours at 80 km per hour. On the return trip, Mula drove at 100 km/hr, how long will it take him to travel?
-

10. The amount of money to be paid to each individual is inversely proportional to the number of individuals working. 25 men can be paid K200 each.

How much each will 40 men be paid, and what is the total money to be paid out?

11. A cubic metre can hold 1000 L of water. A Village built 5 m x 3 m x 3 m cement water tank. How much water in litres can the cement tank hold for the village?
-

CORRECT YOUR WORK ANSWERS ARE AT THE END OF TOPIC 2

Lesson 12 Proportion Division



You have learned about direct proportion and inverse proportion in lesson 11.



In this lesson you will:

- define and explain proportional division
- solve problem based on proportional division.

Proportional Division

Some books use the phrase **finding a quantity**.

Proportion division is finding a portion of a quantity from the given ratio.

The quantity can be given in units of mass, time, volume, distance or numeric etc. The answer is given in the unit of the quantity used in the problem.

Let the terms of the ratio be 'a' and 'b' and the quantity to be shared be Q. Then a : b gives a total of a + b. Hence the fractions or portions are $\frac{a}{a+b}$ and $\frac{b}{a+b}$.

So the two parts are

$$\text{First Part} = \frac{a}{a+b} \times Q, \text{ and the Second Part} = \frac{b}{a+b} \times Q$$

The total can be as a + b + c if there are three terms in a ratio, etc.

In proportion division, the answer is given in units of the quantity used.

This unit focuses on money, however in the exercise, other quantities are also provided for the purpose of practice. That is because the application of the quantities may involve the use of money.

Example 1

Divide 2.7 ha of land in the ratio 2 : 3 : 4 among Max, John and Peto respectively. Find the area of land each of the three will own.

Solution:

$$Q = 2.7\text{ha} = 27000\text{m}^2, \quad a = 2, \quad b = 3, \quad c = 4, \quad a + b + c = 9$$

$$\begin{aligned}\text{First Piece} &= \frac{a}{a+b+c} \times Q \\ &= \frac{2}{9} \times 27\,000 \\ &= 6\,000\text{m}^2\end{aligned}$$

$$\begin{aligned}\text{Second Piece} &= \frac{b}{a+b+c} \times Q \\ &= \frac{3}{9} \times 27\,000 \\ &= 9\,000\text{m}^2\end{aligned}$$

$$\begin{aligned}\text{Third Piece} &= \frac{c}{a+b+c} \times Q \\ &= \frac{4}{9} \times 27\,000 \\ &= 12\,000\text{m}^2\end{aligned}$$

Therefore, Max will own 0.6 ha, John 0.9 ha and Peto 1.2 ha

Example 2

Omar, Tom, Andy and Jim are to share amongst themselves K16 000. It is shared in the ratio 2 : 5 : 3 : 6 in that order. Find the difference between the largest amount and the least amount received.

Solution:

$$Q = 16\,000, \quad a = 2, \quad b = 5, \quad c = 3, \quad d = 6 \quad a + b + c + d = 16$$

$$\text{Largest Amount} = \frac{6}{16} \times 16\,000$$

$$= 6 \times 1000$$

$$= \text{K}6000$$

$$\text{Least Amount} = \frac{2}{16} \times 16\,000$$

$$= 2 \times 1000$$

$$= \text{K}2000$$

$$\text{Difference} = \text{Largest Amount} - \text{Least Amount}$$

$$= 6000 - 2000$$

$$= \text{K}4000$$

Therefore the difference is K4000

NOW DO PRACTICE EXERCISE 12

**Practice Exercise 12**

1. Divide

- a. K1500 in the ratio 2 : 3 : 4 : 6
- b. 300ha in the ratio 4 : 5
- c. 20kg in the ratio 3 : 7 : 10
- d. 2L in the ratio 9 : 1
- e. 12m timber in the ratio 3 : 5
- f. 333mL in the ratio 1 : 2
- g. 800 bags of rice in the ratio 2 : 3 : 4 : 5 : 6
- h. 60 marbles in the ratio 3 : 4 : 5
- i. 2000 text books in the ratio 4 : 3 : 2 : 1
- j. 40 mangoes in the ratio 2 : 1 : 1

-
2. James and Ken are business partners. Their investment into the business is in the ratio 3 : 5. If they make a profit of K40 000, how much will Ken get?

3. Jan, Kim and Lau are to share K9million profit in the ratio 1 : 2 : 3 in that order. How much more does Lau get than Jan?
-

4. The population of women to men in a village is 500 and 300 respectively. If 800 treated mosquito nets are to be distributed in the ratio of women to men, how many more treated mosquito nets will women receive than men?
-

5. Divide 5L of water in the ratio 1 : 2 : 3 : 4 among Susie, Mary, Kerry and Tammy in that order.
-

6. Divide K200 000 amongst Andy, Raul and John in the ratio 5 : 2 : 3. How much more does Andy get than Raul?
-

7. Five villages A, B, C, D and E are to share 6 000 bags of 20kg rice in the ratio of 2 : 3 : 6 : 5 : 4 in that order based on their population. How many bags of 20kg will village B and village C get?
-

CORRECT YOUR WORK ANSWERS ARE AT THE END OF TOPIC 2

Topic 2 Summary



This summarizes some of the important ideas and concepts to remember.

- Ratio is a comparison of 2 or more quantities of the **same** kind.
- Ratios have **no unit**.
- Each part of a ratio is called a **term**.
- **HCF** is used for Highest Common Factor. Some books may use **GCF** for Greatest Common Factor. They mean the same thing.
- Equivalent ratios are in proportion, such that **$a : b = c : d$** .
- To simplify ratios, multiply or divide each term by the highest common factor.
- **Proportion** is a statement of equality of two ratios such that their corresponding terms are in proportion, or increase or decrease by the same factor (**k**) e.g,
 $ka : kb = c : d$ (increase) and $\frac{1}{k}a : \frac{1}{k}b = c : d$ (decrease).
- **Proportion Division** is dividing a quantity in the given ratio. The division of the quantity may be made in a two or more term ratio.
- **Direct Proportion** is a statement of equality of two ratios such that as one term increases by a factor, the other term increases by the same factor (**k**).
- **Inverse Proportion** is a statement of equality of two ratios such that as one term increases by a factor, the other term decreases by the same factor (**k**), thus **$ab = cd$** .
- **Ready-reckoner** is a linear graph of ratio or rates. The graph provides quick solution by interpolating.

ANSWERS TO PRACTICE EXERCISES 8 - 12

Practice Exercise 8

1. (a) 3:5 (b) 5:12 (c) 3:2 (d) 3:1
2. (a) 5/11 (b) 21/6 (c) 9/28 (d) 25/40
3. (a) 2:3 (b) 4:9 (c) 10:1 (d) 1:2
4. (a) $1:3p^2$ (b) 4:1 (c) 1:4 (d) a:d
5. (a) 2:1 (b) 6:1 (c) 3:1 (d) 5:1
6. (a) 1:3 (b) 1:4 (c) 1:4 (d) 1:9
7. (a) 3:4 (b) 3:10 (c) 40:3 (d) 9:1
8. (a) $p = 8$ (b) $q = 3$ (c) $r = 99$ (d) $s = 2$
9. (a) $v = 68$ (b) $w = 30$ (c) $x = 5$ (d) $y = 20$
10. (a) 5 : 2 (b) 2.5 : 1 (c) 1 : 0.4

Practice Exercise 9

1. (a) 1 : 5 (b) 2 : 3 (c) 5 : 6 (d) 1 : 6 (e) 4 : 1 (f) 2 : 1
(g) 3 : 1 (h) 2 : 1 (i) 2 : 3 (j) 1 : 2000
2. (a) 1 : 8 (b) 100 : 1 (c) 100 : 1 (d) 4 : 1 (e) 5 : 1 (f) 100 : 1
(g) 50 : 1 (h) 1 : 2 (i) 36 : 1 (j) 3 : 1
3. (a) 5 : 6 (b) 3 : 4 (c) 8 : 1 (d) 1000 : 1 (e) 1 : 7 (f) 5 : 1
(g) 100 : 1 (h) 100 : 1 (i) 2 : 1 (j) 5 : 2
4. 40 : 3
5. 2 : 5
6. 2 : 1

Practice Exercise 10

1. (a) 1 : 3 : 5 (b) 3 : 1 : 9 : 15 (c) 12 : 1 : 8 : 3 (d) 1 : 3 : 6
(e) 10 : 10 : 1 (f) 1 : 4 : 6 (g) 2 : 4 : 5 (h) 1 : 2 : 4 : 8
(i) 4 : 5 : 2 : 10 (j) 2 : 3 : 3 : 4 : 6
2. (a) 3 : 4 : 5 : 6 (b) 5 : 12 : 13 (c) 1 : 2 : 4 (d) 1 : 1000 : 1000
(e) 1 : 10 : 10 (f) 1 : 4 : 10 (g) 1 : 2 : 10 : 20 (h) 1 : 2 : 4 : 8
(i) 80 : 1 : 4 : 2 (j) 1 : 2 : 3 : 9 : 12
3. Tim K4 000, Pana K6 000, Greg K8 000, Mileng K12 000
4. Susie 2 $\frac{1}{2}$ kg, Mary 5 kg, Kerry 7 $\frac{1}{2}$ kg, Tammy 10 kg
5. John K25 000, Kelly K10 000. K40 000 more
6. Care Centre D = 7500 bags, Care Centre A = 4500bags. 3000 bags more
7. Ronan = 50 lollies, Isha = 20 lollies, Sasha = 30 lollies
8. School A = 2000 books, School D = 400 books. School A gets 1600 more.

Practice Exercise 11

1. a. $x = 6$ b. $x = 32$ c. $x = 98$ d. $x = 24$
2. a. $m = 4$ b. $d = 5$ c. $k = 5$ d. $p = \frac{1}{5}$ or 0.2
3. K6 200
4. 15 men
5. $3\frac{3}{5}$ days
6. 16cm
7. K260
8. Sapo K200, Mogo K300
9. 1hour 36 min or 1.6 hours
10. K125, K5 000
11. 45 000L or 4.5kL

Practice Exercise 12

1. (a) K200, K300, K400, K600 (b) $133\frac{1}{3}$ ha, $266\frac{2}{3}$ ha
(c) 3kg, 7kg, 10kg (d) 1800mL, 200mL
(e) $4\frac{1}{2}$ m, $7\frac{1}{2}$ m (f) 111mL, 222mL
(g) 80 bags, 120 bags, 160bags, 200 bags , 240 bags
(h) 15 marbles, 20 marbles, 25 marbles
(i) 800 books, 600 books, 400 books, 200 books
(j) 20 mangoes, 10 mangoes, 10 mangoes
2. Ken gets K25 000
3. K3million more (K3 000 000)
4. 200 more nets
5. Susie $\frac{1}{2}$ L, Mary 1L, Kerry $1\frac{1}{2}$ L, Tammy 2L
6. K60 000 more
7. 2 700 bags of 20kg rice

TOPIC 3

RATES

Lesson 13: The Meaning of Rates

Lesson 14: Uniform Rates and Average Rates

Lesson 15: Rates and Unitary Method

Lesson 16: More Rates

Lesson 17: Graphs of Rates

Topic 3 Rates

Introduction



This is the third Topic of the Grade 10 Mathematics Course under Unit 2, Managing Your Money.

There are different definitions for rates. Rates can be value of an asset, it can be the charge on a land or building, a charge as a cost as in wages and it can be a comparison of two different quantities expressed in the form $n : 1$.

This topic is more concerned with comparison of two different quantities expressed in the form $n : 1$. Reproducing quantities by direct proportion enables us to plot the graph of rates problem.

When expressed in the form $n : 1$ in ratio, there are no units and are expressed purely as numerals. However, in rates there are units attached.



This topic has 5 lessons covering lessons 8 to 12.

Lesson 13 : Rates - This lesson includes definition, writing and solving rate problems.

Lesson 14 : Uniform Rates and Average Rates - This lesson includes reading, interpreting and graphing uniform and average rates.

Lesson 15 : Rates and Unitary Method - This lesson includes usage of unitary method to solve rate problems.

Lesson 16 : More Rates - This lesson includes skills in converting currencies using Currency Exchange Rate and skills to determine total Postal Charges.

Lesson 17 : Graphs of Rates - This lesson includes reading and interpreting rate graphs and plotting rate graph.

Lesson 13 Rates



You have learned about proportion division in lesson 12. This is your first lesson about rates.

In this lesson you will:

- define and identify the purpose of using rates
- state practical examples of rates
- identify the units of rates
- solve practical problems using rates.

Rate enables us to make predictions when we know that similar situation exists and are in direct proportion with the given rate.

Rates can also help us to solve problems involving what we consume and what we use in our everyday lives. Rate helps us to solve or make judgement on health, educational, social and political issues.

Rate is a comparison between quantities of the different kind.

Because rates compare quantities of different kinds, units are necessary. Rates are always expressed in the simplified form $n : 1$, with its units maintained.

Both the **Factor Method** and **Cross - Multiplication Method** can be used to solve rate problems.

Below are some rates and their abbreviations that are often used.

Rate	Unit	Abbreviation
Speed	Kilometres per hour	km/h
Wage	Kina per hour	K/h
Fuel	Kina per litre	K/L
Fuel Consumption	Litres per kilometre	L/km
Dosage	Kilogram per millilitre	Kg/mL
Salary	Kina per annum	Kp.a
Interest	Per cent per annum	%p.a.
Items	Kina per item	K/item
Land/building rates	Kina per m ²	K/m ²
Rental	Kina per week	K/wk

Example 1

Kamo is paid at a rate of K9.50 per hour. How much will Kamo receive for 80 hour-weeks work?

Solution:

$$\begin{aligned}
 \text{Fortnight wage} &= \text{rate} \times \text{time} \\
 &= \text{basic rate} \times \text{basic hour-week} \times 2\text{wk} \\
 &= \text{K}9.50/\text{h} \times 80\text{h} \\
 &= \text{K}760
 \end{aligned}$$

Basic hour- week is often 40 hours, that is, working 8 hours in a day.

Example 2

A car travels at 6km per litre over 100km. How much fuel will the car use over the distance?

Solution:

$$\begin{aligned}
 \text{Fuel used} &= \text{consumption rate} \times \text{distance} \\
 &= 6\text{L}/\text{km} \times 100\text{km} \\
 &= 600\text{L}
 \end{aligned}$$

There are so many different **consumption rates**. If the first term of the rate involves using or being spent, then it is a consumption rate.

Example 3

A landlord pays K300 per month for the rental he gets from a business that rent his area of 20m^2 . What is the rates in that town area?

Solution:

$$\begin{aligned}
 \text{Monthly Rates} &= \frac{\text{Cost Per Month}}{\text{Land Area}} \\
 &= \frac{\text{K}300}{20\text{m}^2} \\
 &= \text{K}15.00/\text{m}^2
 \end{aligned}$$

The **product** of Monthly rates and Land area yields Cost Per Month. We can also say Land Area is the **quotient** of Cost Per Month and Monthly Rates.

Example 4

A dose of 1mL is given per 20kg to a child who is advised to take panadol for fever relief. How many millilitres of panadol syrup can be given to a child weighing 70kg?

Solution:

$$\text{Dose} = 20\text{kg/mL}$$

$$70\text{kg Child } \frac{20\text{kg}}{1\text{mL}} = \frac{70\text{kg}}{x}$$

$$20x\text{kg} = 70\text{mLkg}$$

$$x = \frac{70\text{mLkg}}{20\text{kg}}$$

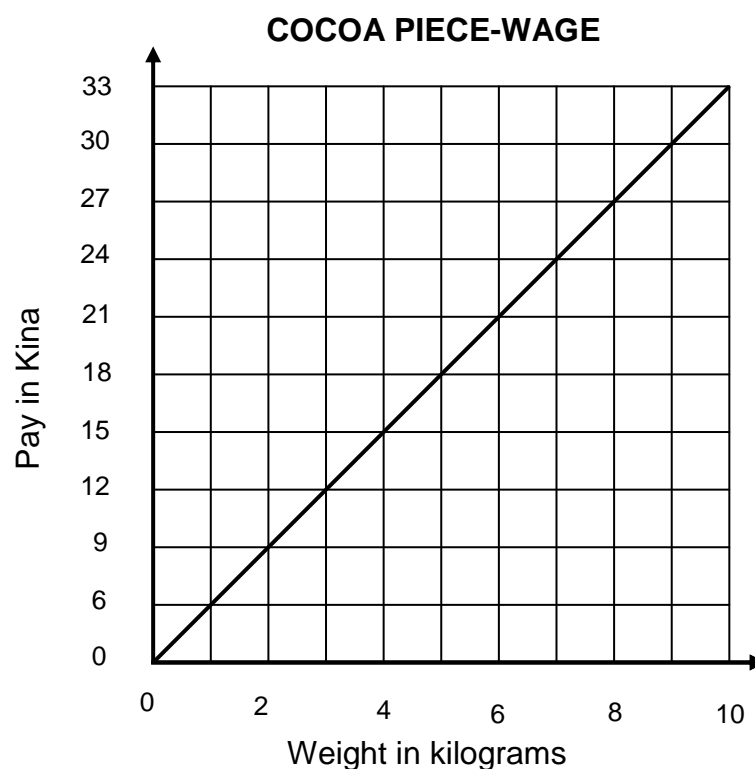
$$x = 3 \frac{1}{2} \text{ mL.}$$

Therefore a 70kg child will be given 3 ½ mL of panadol.

If a **Ready-reckoner** is drawn then a graph can be used to solve rate problem. To know the rate from a given graph, we find the **gradient** or **slope** of the graph.

Example

Below is a ready - reckoner graph of Piece-wage.



- a. How much is paid for 4kg?
- b. K18 is paid for what weight of cocoa?
- c. What is the piece-rate?
- d. If August collects 20kg, how much pay would he get?

Solution:

a. K15

b. 5 kg

c. rate = $\frac{\text{rise}}{\text{run}}$

= K3.30 per kilogram

d. Piece-wage = piece - rate x units

= K3.30/kg x 20kg

= K66

For questions a - c, we read within the graph. It is called **interpolation**. So we interpolated to solve questions a to c.

For question d we read beyond or outside the graph. It is called **extrapolation**.

In extrapolation we use the rate (gradient) of the graph to multiply by weight (horizontal axis) to find the amount of payment, or we divide into payment to find the weight.

NOW DO PRACTICE EXERCISE 13



Practice Exercise 13

1. A car is travelling at a speed of 80km/hr travelled for 5 hours. How far had it gone from where it started?
-

2. A bag of 10kg rice can feed 10 students in a week. If there are 320 students, how many bags of 10kg rice is needed?
-

3. The minimum wages rate is K3.60 per hour. If a person worked for 8 hours a day for 5 days a week, how much will he be paid in a fortnight?
-

4. Sam is paid at a piece-rate of K4.20/kg of green coffee beans collected. If Sam picks 200kg, how much will he be paid?
-

5. Bola was given 6mL of cough syrup as he weighs 90kg. What is the prescription rate of the cough syrup?

6. Mr. Bush travelled 45km in half an hour. What must have been the speed of the car Mr. Bush travelled at?
-

7. Peter travelled 80km with 20L of petrol. He needs more fuel to travel another 240km. How many litres of petrol does he need to cover the whole journey?
-

8. 5 men are required to dig 14m long, half a metre by 30cm drain in a day. If 42m long drain is to be dug in a day, how many men are required?
-

9. A contractor charges K200 per square metre for tiling. If the contractor tiled 2 rooms of 3m x 4m, how much will the contractor be paid?
-

10. Express 2m per second as speed in kilometres per hour.
-

CORRECT YOUR WORK ANSWERS ARE AT THE END OF TOPIC 3

Lesson 14 Uniform Rates and Average Rates



You have learned about rates in lesson 13. This lesson expands your knowledge about rates.

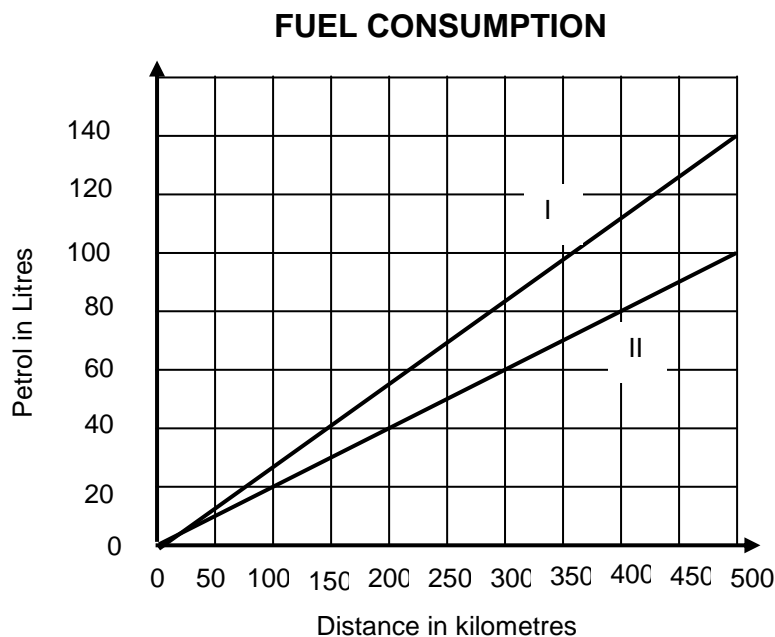
In this lesson you will:

- define and identify the purpose of using uniform rate
- define and identify the purpose of using average rate
- differentiate between uniform and average rates
- solve problems using uniform and average rates.

The rates can be steady, remains the same, or the rates can change one or more times. When the rate remains steady we call it **Uniform Rate**.

When the rate is the same throughout time, it is known as uniform rate.

We can illustrate by a graph.



Graph I and Graph II of two different models of cars have uniform rates of fuel consumption. Car in Graph I uses more fuel than car in Graph II. Car in Graph I uses 0.28L per kilometre whilst car in Graph I uses 0.2L per kilometre.

The steeper the graph is, the larger the rate of consumption. The sloppier the graph is, the lesser the rate of consumption.

Land rates, rental rates and taxation rates often remain the same over two years. So that is when the rate is uniform. It makes businesses able to predict their expenses, and make plans for future.

When various rates are uniform over a period of time, it makes it easy for planners to make predictions and make informed plans for the future.

Example 1

A car is travelling at 80km per hour for 5 hours. A motor bike is travelling at 40km per hour for 5 hours. If they start at the same point, how far away is the car from the motor bike after 5 hours?

Solution:

Both the car and the motor bike were travelling at uniform speed.

$$\begin{aligned}\text{Distance of Car} &= \text{Speed} \times \text{time} \\ &= 80\text{km/h} \times 5\text{hr} \\ &= 400\text{km}\end{aligned}$$

$$\begin{aligned}\text{Distance of Motor bike} &= \text{Speed} \times \text{time} \\ &= 40\text{km/h} \times 5\text{hr} \\ &= 200\text{km}\end{aligned}$$

$$\begin{aligned}\text{Distance Apart} &= \text{Distance of Car} - \text{Distance of Motor bike} \\ &= 400\text{km} - 200\text{km} \\ &= 200\text{km}\end{aligned}$$

Example 2

Agmark is paying K500 per bag of cocoa. Arjay can make 5 bags of cocoa in a month. How much money can Arjay earn from cocoa in a year?

Solution:

$$\begin{aligned}\text{Earning per month} &= \text{K}500/\text{bag} \times 5 \text{ bags} \\ &= \text{K}2500\end{aligned}$$

$$\begin{aligned}\text{Earnings per year} &= \text{Earnings per month} \times 12 \text{ months} \\ &= \text{K}2500/\text{month} \times 12\text{months} \\ &= \text{K}30\,000.00/\text{yr}\end{aligned}$$

When the rates change one or more times, we can only work out the average rate and use the average rate for the purpose of discussion.

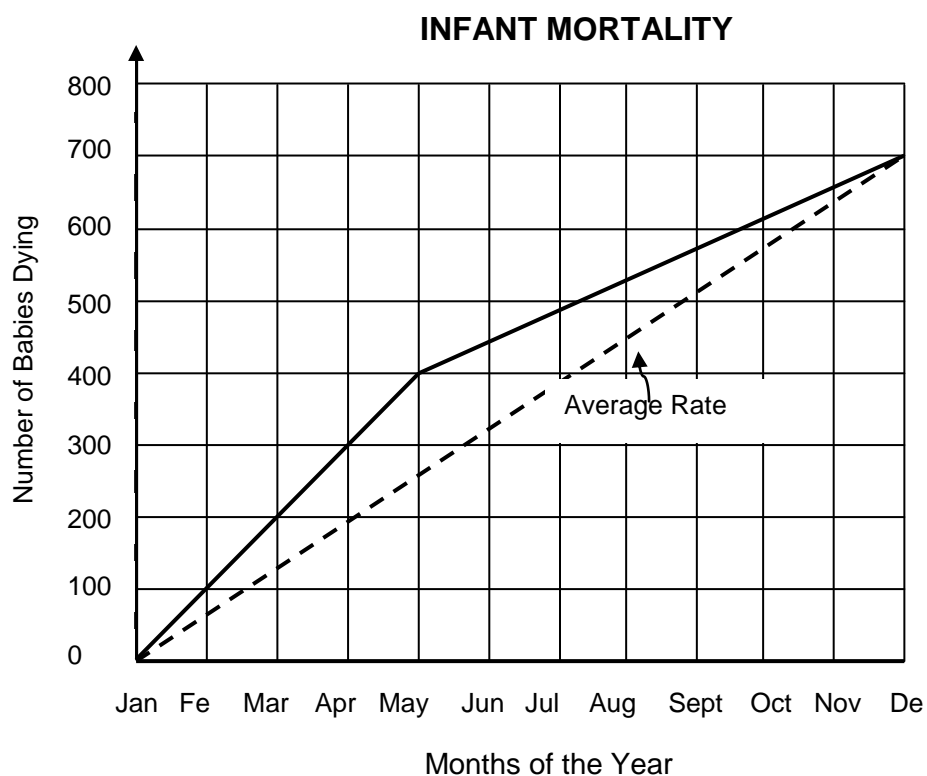
Average Rate is the average of two or more rates.

Governments and researchers base their report on average rates. Issues like GST, population growth, export volume and more do not have constant rates or uniform rates in a given year.

The average rate is the mid value of the rates often over several years. It provides the planners the general impression of the trend of the issue in discussion.

Doctors cannot diagnose a patient based on the exact age or exact weight of the patient as medicines have fixed weights. So doctors diagnose patients based on average age and weight.

Example 1



- What is the death rate between January and May?
- How many babies died by the month of April?
- After which month of the year the number of dead infants reached 500?
- What is the death rate between May and December?
- What is the average death rate for the whole year?

Solution:

- a. January-May = $400 \div 5$ months
= 80 babies per month
- b. Up to April = 300 infants
- c. In July.
- d. $700 - 400 = 300$
 $300 \div 7 = 43$ babies per month
- e. Average Rate = $(\text{Rate 1} + \text{Rate 2}) \div 2$
= $(80 + 43) \div 2$
= $123 \div 2$
= 62 infants per month

Example 2

Heni spends K50 per day for bus fare and lunch. After 3 months he was spending K60 per day. Then he could spend only K30 per day for the rest of the year. What is Heni's average daily spending for that year?

Solution:

$$\begin{aligned}\text{Average Daily Spending} &= (K50/d + K60/d + K30/d) \div 3 \text{ months} \\ &= K140/d \div 3 \\ &= K46.70 \text{ per day}\end{aligned}$$

NOW DO PRACTICE EXERCISE 14

**Practice Exercise 14**

1. An employer pays workers K5.60 per hour. Is the rate uniform or average?

2. Find average rate given the following rates:

(a) 4 exercise books per child, 6 exercise books per child

(b) 6 mangoes/child, 10 mangoes/child, 11 mangoes/child.

(c) 12mL/d, 18mL/d, 12mL, 14mL/d

(d) 60km/h, 80km/h, 100km/h

(e) K600/cubic, K750/cubic, K650/cubic, K600/cubic

3. Betty sold 24 dozen eggs on Monday, 36 dozen eggs on Tuesday, 30 dozen eggs on Wednesday, 36 dozen eggs on Thursday and 30 dozen eggs on Friday. Which rate, the daily sales or the weekly sales rate is the average rate?

4. A ship was travelling at 60knots per hour then 80knots for the next two hours before berthing. What was the average speed of the ship?

5. Madang Division of Education paid Tuition Fee Free (TFF) funds to school A with 782 students K391 000, School B with 840 students K420 000 and school C with 1200 students K600 000. Calculate and state if the rate of Kina per child is uniform.
-

6. Car A travelled 280km in $3\frac{1}{2}$ hours and Car B travelled 480km in 6 hours.
- (a) Find if their speed is uniform.
- (b) If they travel in the opposite directions and both departed at 10am, when will they meet?
- (c) How far from point A will they meet?
-

7. Car A travels at 60km/hr for 3 hours then to 100km/hr for the next three hours. Car B travelled at 80km per hour for 6 hours. Both cars are heading the same direction. Will they arrive at the same time or at different times, and why. Give your reason.
-

8. A company pays the following rates to the company workers according to years of service:

Class A K12.80 per hour

Class B K8.30 per hour

Class C K5.60 per hour

What is the companies' average rate of pay?

CORRECT YOUR WORK ANSWERS ARE AT THE END OF TOPIC 3

Lesson 15 Rates and Unitary Method



You have learned about uniform rate and average rate in lesson 14.

In this lesson you will:

- define Unitary Method with examples
- use Unitary Method to solve rate problems.

Unitary Method is expressing the rates in the form n per unit. The process is the same as expressing ratio in the form $n : 1$. However, rates have units.

Unitary Method is a method of finding the value of an article by division and then using that to find values of more articles by multiplication.

Your success in using Unitary Method effectively depends on your ability to divide accurately to obtain the unit rate.

Example 1

James bought 2000 shares with K4500. If he bought 5000 shares, how much would James have paid for them?

Solution:

$$\begin{aligned} \text{Price of 1 share} &= \text{Cost of shares} \div \text{number of shares} \\ &= \text{K}4500 \div 2000\text{shares} \\ &= \text{K}2.25/\text{share} \end{aligned}$$

$$\begin{aligned} \text{Cost of 5000 shares} &= \text{Cost per share} \times \text{number of shares} \\ &= \text{K}2.25/\text{share} \times 5000\text{shares} \\ &= \text{K}13\,250.00 \end{aligned}$$

Example 2

Constance bought 15 T-shirts for K192.00. What will be the cost for 24 of the same T-shirts?

Solution:

$$\begin{aligned} \text{Price of one T- shirt} &= \text{Amount Spent} \div \text{number of T- shirts} \\ &= \text{K}192 \div 15 \text{ T-shirts} \\ &= \text{K}12.80 \end{aligned}$$

Therefore, a T-shirt costs K12.80

$$\begin{aligned} \text{Cost of 24 T- Shirts} &= \text{Cost per T- shirts} \times \text{number of T- shirts} \\ &= \text{K12.80/T-shirt} \times 24 \text{ T- shirts} \\ &= \text{K307.20} \end{aligned}$$

Example 3

Fifty men cut grass and cleared a 600m stretch of a road. If there are 62 of them from the start of work to be done, how far on the stretch of the road would they have cut?

Solution:

$$\begin{array}{r} \div 50 \\ \curvearrowright \\ \frac{600}{50} = \frac{x}{1} \\ \curvearrowleft \\ \div 50 \end{array} \quad x = 12 \text{ m}$$

Each man clears 12m of road.

$$\begin{aligned} \text{Total stretch cut by 62 men} &= 12\text{m per men} \times 62 \text{ men} \\ &= 744\text{m} \end{aligned}$$

NOW DO PRACTICE EXERCISE 15

**Practice Exercise 15**

1. Twenty bags of dried coffee earned K13 800. What will be the earning for 8 bags of dried coffee?
-

2. 30 biros cost K24.00. How much will 42 biros cost?
-

3. 40 students require 20m^2 of land to set up their garden plots. If there are 62 students, how many square metres of land is needed?
-

4. A house $20\text{m} \times 8\text{m}$ requires 86 pieces of $2'' \times \frac{1}{2}''$ timber. If the house is extended to $24\text{m} \times 8\text{m}$, how many more $2'' \times \frac{1}{2}''$ timber will be needed?
-

5. If 200km will require 25L of petrol, find the rate of fuel consumption and the amount of fuel need to travel 84km and return.
-

6. It cost K1080 for 6 men a night per room at a Guest House in Port Moresby. What is the cost per person per room for 5 nights for 10men?

7. Kile hired 30 women to help her weed a garden area of 20m x 30m in a day. Maui has garden spanning 25m x 40m. How many women will she need to weed the garden within a day?
-

8. The earnings for a day's match between SP Hunters and Jets was K202 650 watched by 8 106 fans. Sir John Guise stadium can hold 15 000 people. How much can be made if the stadium was filled to capacity?
-

9. PMIZ can export 800 000 tonnes of tuna in 5 years. How much can PMIZ make in a year if tuna export earns K2 500 per tonne?
-

10. The 2015 el nino drought cost K90000 to feed 200 people for a month. Find the cost of feeding 0.8million people in July and August.
-

CORRECT YOUR WORK. ANSWERS ARE AT THE END OF TOPIC 3

Lesson 16 More Rates



You have learned about rates unitary method in lesson 15.

In this lesson you will:

- explain foreign exchange rate and postal rates
- identify the current exchange rate of PNG currency to foreign exchange countries
- identifies the current postal rate Nationally and Internationally
- solve practical problems using foreign exchange rate and postal rate.

Foreign Exchange Rate is provided daily during week days by daily papers like The National and Post Courier. The exchange rate is supplied by Bank of Papua New Guinea (BPNG) to the commercial banks and published by the daily papers.

The Exchange Rate provides the currency conversion key unit from kina to foreign currency or foreign currency to kina.

The BPNG Exchange Rate as July 31, 2015 is as given below. It shows the conversion rate per kina for the 14 main trading partners of Papua New Guinea.

WHAT YOUR KINA IS WORTH

USD	0.3615	PHP	16.46
AUD	0.4943	JPY	44.75
CAD	0.4689	NZD	0.5476
CHF	0.3486	SGD	0.4955
GBD	0.2310	SDR	0.2585
HKD	2.7946	KRW	421.90
EUR	0.3297	FJD	0.7663

Example

Sasha sold her 2000 Marengo shares at CA\$1.20 each so she earned a total of CA\$2400. What is the kina equivalent using the rates above?

Solution:

$$1 : 0.4689 = x : 2400$$

$$\frac{1}{0.4689} = \frac{x}{2400}$$

$$2400 = 0.4689x$$

$$\frac{2400}{0.4689} = \frac{0.4689x}{0.4689}$$

$$5118.36 = x$$

$$x = \text{K}5118.36$$

The commercial banks and financial institutions develop Telegraphic Transfer (T/T) Rates based on Exchange Rates provided by BPNG. BPNG regulates the Fiscal Policy of PNG. The T/T Rate provides buying and selling rates.

When we go with foreign currency, the banks and financial institutions will buy foreign currency from us. So banks will use buying rates to do the transaction.

If we want to get foreign currency, they will sell foreign currency to us. So banks will use selling rates to do the transaction.

The sample of T/T Rates is as given below.

	ANZ		BSP		FIFL		MAYBANK		MONI PLUS		WESTPAC	
	<i>sell</i>	<i>buy</i>	<i>sell</i>	<i>buy</i>	<i>sell</i>	<i>buy</i>	<i>sell</i>	<i>buy</i>	<i>sell</i>	<i>buy</i>	<i>sell</i>	<i>buy</i>
US\$	0.3530	0.3680	0.3530	0.3680	0.3530	0.3680	0.3530	0.3680	0.3545	0.3695	0.3530	0.3680
AU\$	0.4771	0.4921	0.4774	0.4922	0.4739	0.4887	0.4776	0.4929	0.4833	0.4983	0.4765	0.4915
Pound	0.2191	0.2341	0.2237	0.2386	0.2225	0.2373	0.2224	0.2374	0.2256	0.2406	0.2241	0.2391
Euro	0.3187	0.3337	0.3200	0.3349	0.3202	0.3350	0.3208	0.3358	0.3212	0.3362	0.3197	0.3347
Sing\$	0.4848	0.5084	0.4864	0.5163	0.4852	0.5000	0.4858	0.5008	0.4879	0.5029	0.4870	0.5020
Peso	15.75	16.80	16.08	17.40	15.64	17.12	15.18	16.68	15.78	NA	16.14	17.64
INR	21.98	23.41	22.06	23.90	----	----			21.53	NA	22.48	23.98

To maximise earning, choose which bank or financial institution you should go to, to convert foreign currency into kina or kina into foreign currency.

Example 1

Pana has US\$368 and intends to convert them to kina. Find how much Pana will get if he goes to one of the following financial institutions to do the exchange.

- BSP bank.
- Moni Plus

Solution:

$$\text{a.} \quad \text{K1} : \$0.368 = \text{Kn} : \$368$$

$$\frac{1}{0.368} = \frac{n}{368}$$

$$368 = 0.368n$$

$$\frac{368}{0.368} = n$$

$$1000 = n$$

$$n = \text{K}1000$$

$$\text{b.} \quad \text{K1} : \$0.3695 = \text{K}n : \$368$$

$$\frac{1}{0.3695} = \frac{n}{368}$$

$$368 = 0.3695n$$

$$\frac{368}{0.3695} = n$$

$$995.9 = n$$

$$n = \text{K}995.90$$

Since there is no circulation of 1t and 2t in PNG, Pana loses K4.10 by going to Moni Plus.

When you go to the bank with a foreign currency the bank will use the buying rate to exchange the currency.

Example 2

Dupa would like to buy used lap top computers from Australia at a price of AU\$476.50 each. She went to Westpac bank to make payment for 10 used lap top computers. How much will she pay in kina for the 10 lap tops?

Solution:

$$1: 0.4675 = K n : 476.50$$

$$\frac{K1}{\$0.4675} = \frac{Kn}{\$476.50}$$

$$\frac{467.50}{0.4675} = n$$

$$n = K1000$$

She has to buy 10 of the lap tops so 10 x K1000 equals K10 000 which she gives to the bank for the telegraphic transfer to be made to the seller in Australia.

Note: We used selling rate instead of buying rate as in example 1.

When you go to the bank to get a foreign currency the bank will use selling rate to exchange the currency.

Example 3.

Raka arrived from the Phillipines with P338 and would like to change them into kina. How much in kina will Raka get if he goes to ANZ bank?

Solution:

$$K_1 : P_1 = K_2 : P_2 \text{ hence the ratio } 1:16.8 = n:336$$

$$\frac{1}{16.8} = \frac{n}{336}$$

$$\frac{336}{16.8} = n$$

$$20 = n$$

$$n = 20$$

Generally, to convert kina into a foreign currency, multiply. To convert foreign currency into kina, divide.

Postal Rate

Sealed envelopes do not weigh exactly the same. But it is inconvenient to charge for every gram weight.

So Post Offices set a range of weight for a unit of stamp. In PNG, the range of 0g to 50g weight will need a K1.35 stamp. And 51g to 150g will cost a K5.00 stamp as given in the table below.

So 50g or 'part-there-of' costs K1.35, and 150g or part-there-of costs K5.00.

POSTAL RATES IN PNG

Weight	Domestic (K)	International (K)
0g - 50g	1.35	6.20
51g - 150g	5.00	15.00
151g - 250g	8.00	25.00
251g - 500g	15.00	40.00
501g - 1kg	40.00	90.00

Note:

1. All important documents should be sent by express mail.
2. All parcels weighing more than 1kg should be sent by express mail.

Example 1

Iamo has the following mails to post to different parts of PNG.

- i. A 105g letter to Alotau,
- ii. A 152g letter to Kavieng,
- iii. A 300g parcel to Queensland, Australia.

Find Iamo's total postage cost.

Solution:

$$105g = K5.00$$

$$152g = K8.00$$

$$\underline{300g = K40.00}$$

$$\text{Total} = K53.00$$

Example 2

What is Ben's total charge for sending the following mail weighing 101g, 300g and 1kg to Buka from Port Moresby?

Solution:

101g costs K5

300g costs K15

1kg costs K40

Total cost K60

Example 3

Kila has the following mails to post overseas. A 55g mail to Australia, 140g mail to New Zealand and 150g mail to Italy. What is his total postage cost?

Solution:

55g costs K15

140g costs K15

150g costs K15

Total cost K45

For mails weighing more than 1kg, they have to be sent by express mail. The cost depends on the distance between ports.

The cost for sending express mail from Port Moresby to Madang would cost more than from Port Moresby to Lae.

NOW DO PRACTICE EXERCISE 16



Practice Exercise 16

1. What is the value of K20 in USD using Moni Plus rates using table on page 121?

2. Find peso equivalent of K174 using BSP rates.

3. Express K1000 equivalent in the following currencies using BPNG rates.

USD	\$
AUD	\$
Euro	€
British Pound	£
Peso	P

4. Express the following in kina using BPNG rates.

USD	\$100	
AUD	\$100	
Euro	€100	
Pound	£100	
Peso	100	

5. Calculate total charge of the following domestic mails posted from Lae.

600g mail to Madang, 780g mail to Goroka, 390g mail to Wewak, and 670g mail to Kundiawa.

6. Find the total charge of the following international mails:

A 48g mail to Japan, 100g mail to Australia, 260g mail to New Zealand and a 800g mail to Indonesia.

7. Convert 10 000 pesos to kina using Westpac rates.
-

8. Convert AU\$3000 to kina using ANZ rates.
-

9. Calculate the total cost of sending the following mails from Alotau:

520g mail to Singapore, 520g mail to Port Moresby, 520g mail to Australia and 600g mail to Fiji.

10. Goba came from the USA with \$900 and converted the dollars to kina at the Jacksons International Airport. If he was given K2000, what must have been the rate of exchange?
-

CORRECT YOUR WORK. ANSWERS ARE AT THE END OF TOPIC 3

Lesson 17 Graphs of Rates



You have learned about more rates in lesson 16.

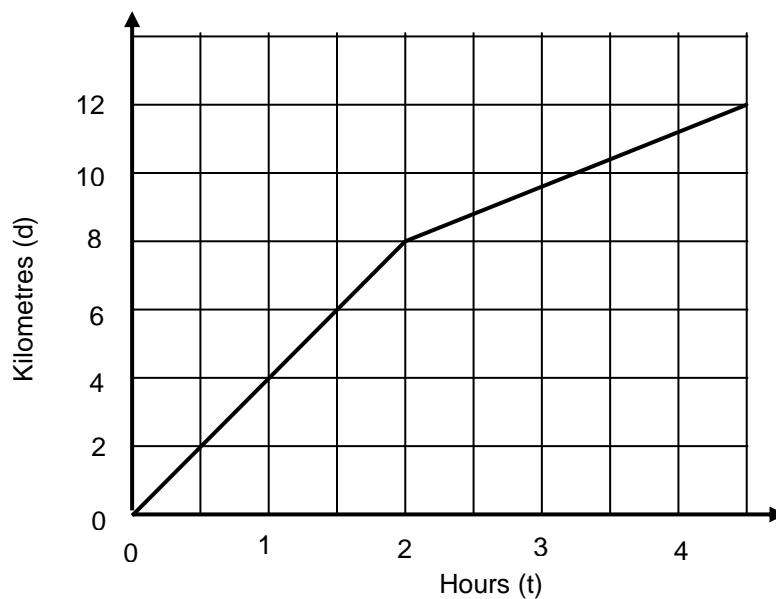
In this lesson you will:

- identify different types of rate graphs
- read rate graphs
- solve problems using rate graphs.

Graphs of Rate or Rate Graph eases problem of computation and saves time. Rate Graphs do not only provide information on rates but also provides all corresponding proportional quantities. It provides information within the working range so we can interpolate to find a quantity given another quantity.

Example 1

DISTANCE-TIME GRAPH



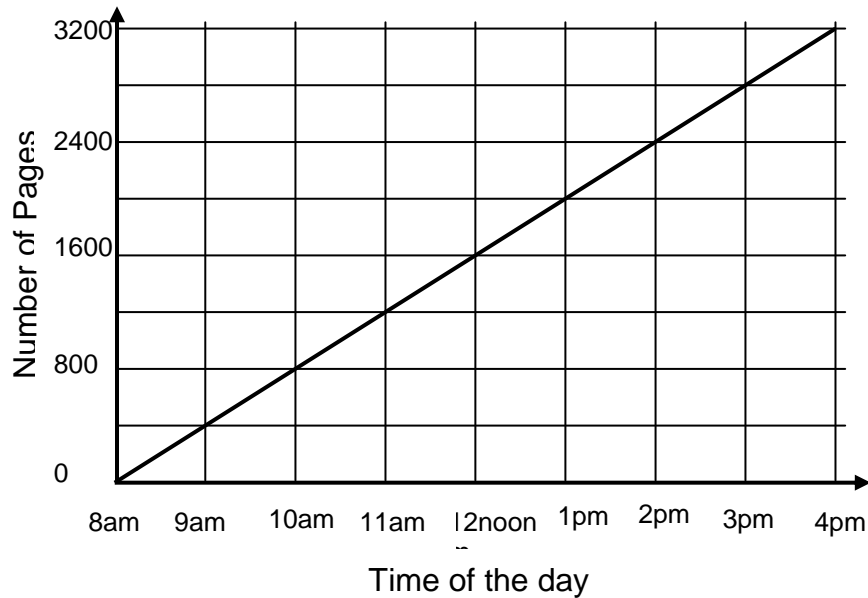
- (a) How many kilometres is covered in 2 hours of walk from the start?
- (b) How long did it take to walk 6 km?
- (c) What is the gradient?
- (d) What is the speed of the walk?
- (e) What is the speed of walk after 2nd hour to the 4th hour?
- (f) What is the average speed of the whole journey?

Solution:

- (a) 8km
- (b) 1 ½ hours
- (c) Rise/run = $\frac{8}{2} = 4$
- (d) 4km/hr
- (e) 2km/hr
- (f) 3km/hr

Example 2

GRAPH OF PRINTING



When we interpret the graph, we can say that:

1. 3200 pages can be printed in a day.
2. The rate of printing is 400pg/hr
3. By 11am (3hrs) 1200 pages can be printed.
4. In 7 hours (3pm) 2800 will be printed.

Example 3

Plot the rate graph of the given data below.

Time in Hours (t)	0	8	16	24	32	40
Pay in Kina (K)	0	28.80	57.60	86.40	115.20	144.00

Time in Hours (t)	48	56	64	72	80
Pay in Kina (K)	172.80	201.60	230.40	259.20	288.00

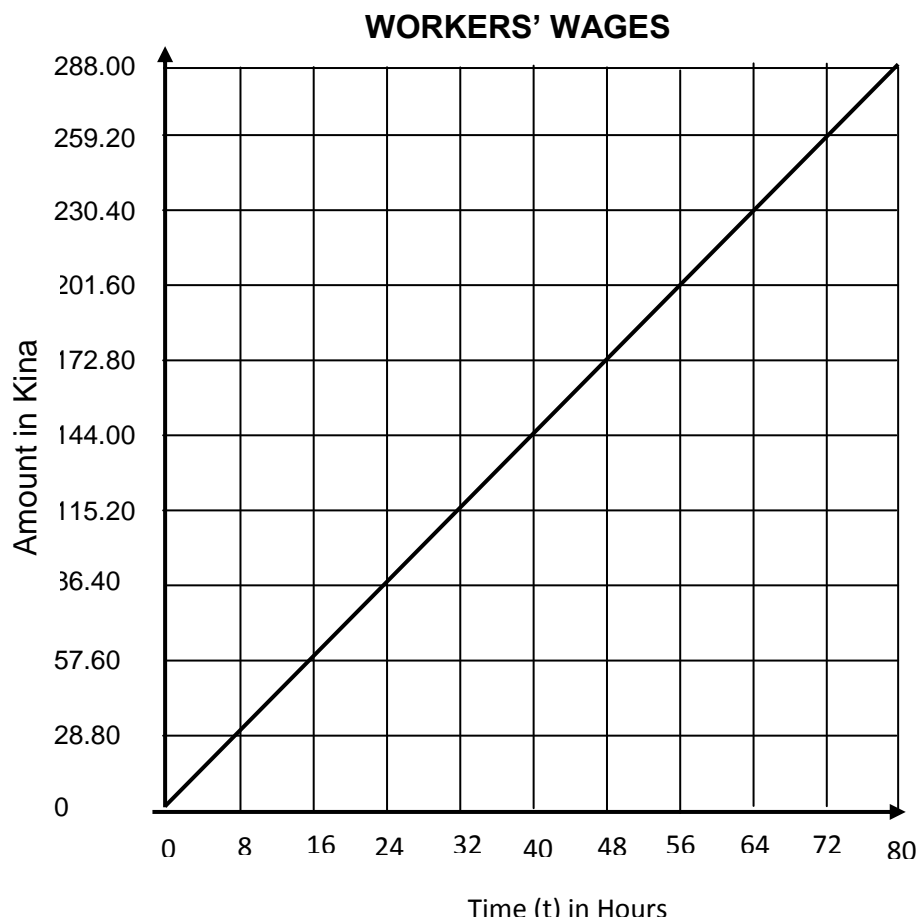
(both tables of data give one set of information)

Solution:

Scales:

Vertical axis- pay in kina **1: 28 . 80**

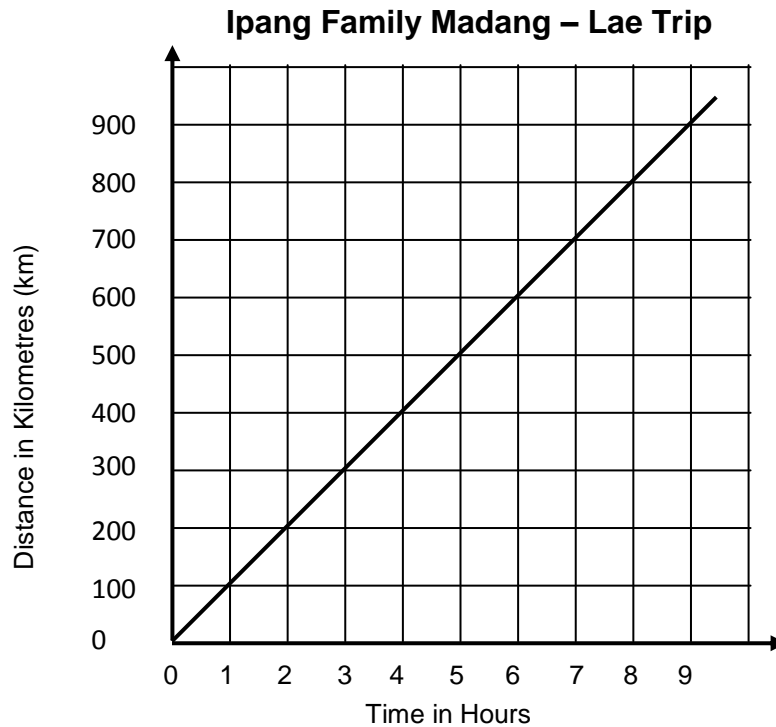
Horizontal axis - time in hours **1: 8**



NOW DO PRACTICE EXERCISE 17

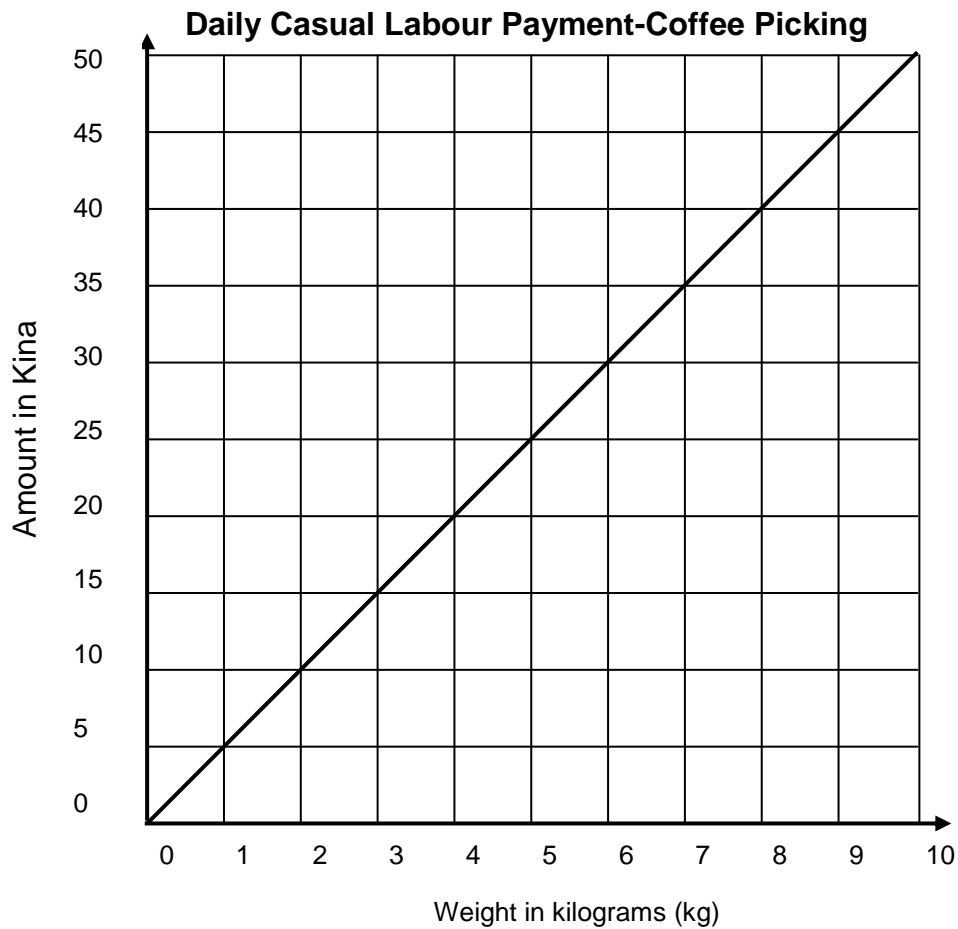
**Practice Exercise 17**

1. Study the graph and answer questions below.



- (a) The trip started at 9am from Madang. How far were they from Madang after 3 hours of travelling?
- (b) How far from Madang were they at 12 noon?
- (c) How far from Madang were the family after $4\frac{1}{2}$ hours of travel?
- (d) How long did it take them to cover 550km?
- (e) What was the Ipang Family's speed?

2. Below is a graph of Piece-Wage.

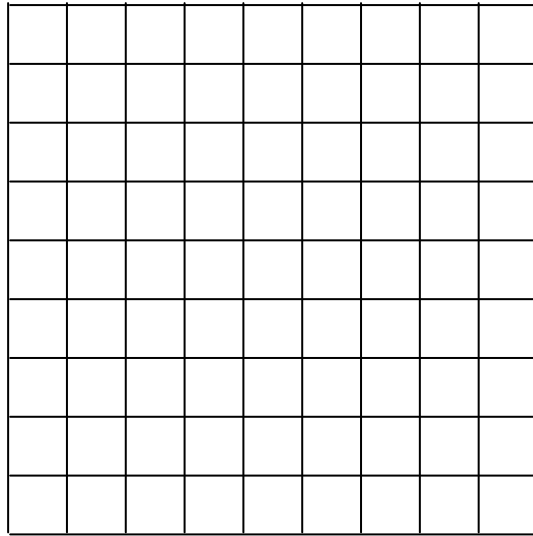


- Mari collects 6kg of coffee beans. How much would she be paid?
- Koi collects 8.5kg, how much would he be paid?
- If Poli was paid K20, how many kilograms of coffee did he pick?
- What is the rate of pay per kilogram?
- Extrapolate payment received for 15kg picked.

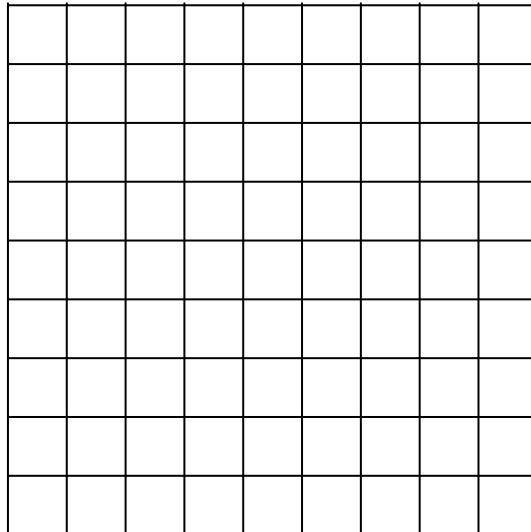
3. Draw a rate graph of the given table of values. Use the grid on the next page.

Baby weight (kg)	2	2.5	3	3.5	4	4.5	5
Dose (mL)	4	5	6	7	8	9	10

Use the grid to plot the graph in question 3.



-
4. Draw a distance – time graph of a car travelling at 80km/hr .Will the car reach a town 406km away in 5 hours?



CORRECT YOUR WORK. ANSWERS ARE AT THE END OF TOPIC 3

Summary



This summarizes some of the important ideas and concepts to remember.

- Rate is a comparison of quantities of different kinds expressed in the form **$n : 1$** .
- When the rate is the same over a period of time it is called **Uniform Rate**.
- When the sum of different rates are added and divided by the number of different rates, it is called **Average Rate**.
- **Unitary Method** is a method of first finding the value of an article by division and then finding the value of more articles by multiplication.
- Exchange Rate provides a price at which a unit of one currency can be exchanged for a unit of another currency.
- **Buying Rate** is the rate used to exchange foreign currency into kina.
- **Selling Rate** is the rate used to exchange kina into foreign currency.
- **Postal Rates** are unit charges per gram or **part-there-of** for mail delivery services.
- **Part-there-of** means part of it for a defined range. E.g., 0g – 50g i.e., 50g or part-there-of.
- Rate Graph is a linear graph of two different quantities.
- **Interpolation** is interpreting a linear graph within the given domain and range.
- **Extrapolation** is interpreting the linear graph beyond the given domain and range, based on the rate.
- **Domain** is the x-axis values of a graph
- **Range** is the y-axis values of a graph.

ANSWERS TO PRACTICE EXERCISES 13 – 17

Practice Exercise 13

1. 400km
2. 32 bags
3. K288.00 per fortnight
4. K840
5. 15kg/mL
6. 90km/hr
7. 60L
8. 15 men
9. K4 800.00
10. 7.2km/hr

Practice Exercise 14

1. Uniform rate. There is no other rate for workers.
2. (a) 5 exercise books per child.
(b) 9 mangoes/child
(c) 14L /d
(d) 80km/hr
(e) K650/cubit
3. Weekly sales rate.
4. 70 knots /hr
5. Uniform. K500/student
6. (a) Uniform speed of 80km/hr
(b) 1:15 pm
(c) 260km
7. Same time. Both have speed of 80km/hr
8. K8.90/hr

Practice Exercise 15

1. K5 520
2. K33.60
3. 31m²
4. 103 pieces
5. 21L
6. K9000
7. 50 women
8. K375 000
9. K400 000 000
10. K720 000 000

Practice Exercise 16

1. \$7.09
2. 2 797.92

3. K1000 equivalents in foreign currency.

USD	\$361.50
AUD	\$494.30
Euro	€392.70
Pound	£231
Peso	P16464

4. Foreign currency 100 units equivalent in kina.

USD	\$100	K276.63
AUD	\$100	K202.31
Euro	€100	K303.31
Pound	£100	K432.90
Peso	P100	K6.08

5. K135

6. K151.20

7. K566.89

8. K6 096.32

9. K310

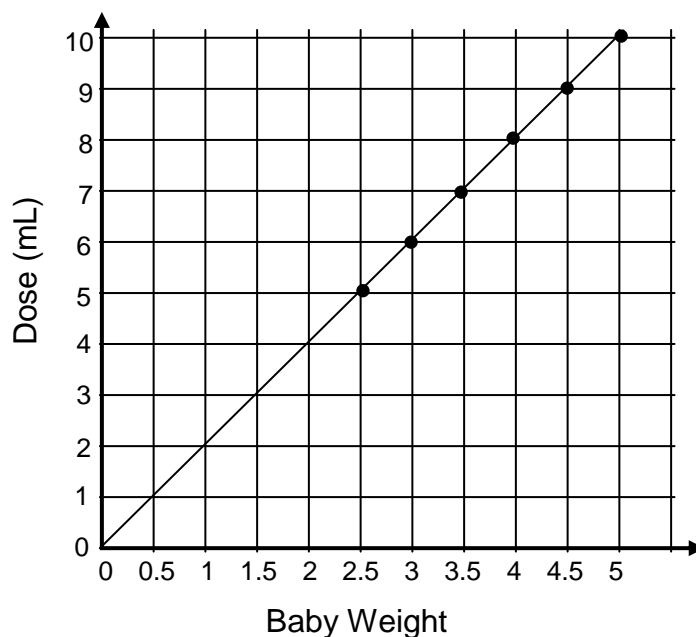
10. K1 = \$0.45

Practice Exercise 17

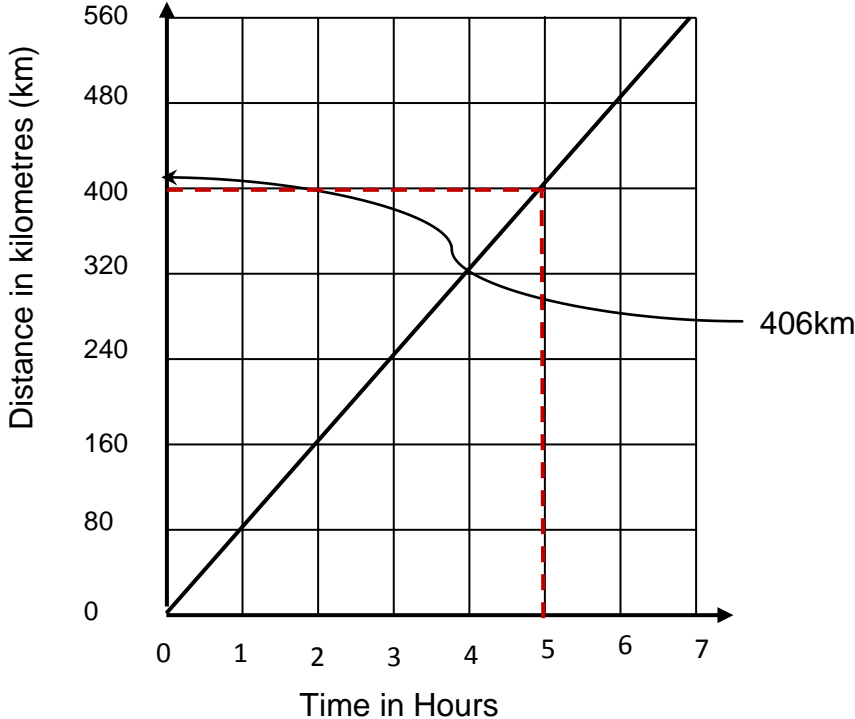
1. (a) 300km (b) 300km (c) 450km (d) 5 ½ hrs (e) 100km/hr

2. (a) K30 (b) K42.50 (c) 4 kg (d) K5/kg (e) K75

3. Graph of Dosage



4. Graph of Speed



No. Not possible

TOPIC 4

BORROWING MONEY

Lesson 18: Simple and Compound Interest

Lesson 19: Types of Loan and Interest Rates

Lesson 20: The Most Suitable Term of the Loan

Lesson 21: Applying for a Loan

Topic 4 Borrowing Money



This is the fourth Topic of the Grade 10 Mathematics Course under Unit 2, Managing Your Money.

Borrowing money is taking cash from someone else for personal or other expenses and repaying the money sometimes later.

Borrowing money includes money market offered outside of regulated system, and loans offered by financial institutions and commercial banks.

Secondary banks offer loans for investment and asset finance.

Tertiary bank like Bank of Papua New Guinea (BPNG), among other responsibilities, regulates the flow of cash and terms of loans offered by commercial banks and financial institutions.

When money is given as a loan, interest is charged. So when the borrower repays, the borrower pays additional amount to the lender.

Lesson 18 : Simple and Compound Interest - This lesson includes definition, and calculation of simple interest and compound interest problems. Rates, principle and time to be evaluated in simple interest.

Lesson 19 : Types of Loan and Interest Rates - This lesson includes personal loans, type of rate be it simple or compounded, instalment payments and loan balance.

Lesson 20 : Most Suitable Terms of the Loan - This lesson includes terms and conditions of loans and repayment schedule.

Lesson 21: Bank Loan - This lesson includes skills converging required documents as terms and predicting total loan value.

Lesson 18 Simple and Compound Interest



You have learned about graphs of rates in lesson 17.

In this lesson you will:

- distinguish between simple and compound interest
- calculate simple and compound interest
- apply the concept of simple and compound interest in real life situations.

Simple Interest

Simple interest is a flat rate interest. The interest is charged on the principal amount borrowed or the capital. And interest is not charged on interest accumulated on the principal or capital over the previous years.

Simple interest is the flat rate of interest charged once in a year on the principal over time.

The formula is $I = Prt$, where I is simple interest, P is the principal amount in kina, t is time in years and r is rate per cent.

In $I = Prt$, I is the subject. P , t and r can be transposed or made the subject to give

$$P = \frac{I}{rt}, t = \frac{I}{Pr} \text{ and } r = \frac{I}{Pt}$$

Example 1

If $P = 10\,000$, $t = 3$, $r = 4\%$ per annum, then find the simple interest.

Solution:

$$\begin{aligned} I &= Prt \\ &= 10\,000 \times 4\% \times 3 \\ &= 30\,000 \times 0.04 \\ &= 300 \times 4 \\ &= K1200 \end{aligned}$$

Example 2

Find time in years if $P = K800$, $r = 10\%$ per annum. and $I = K160$.

Solution:

Since $I = Prt$, $t = \frac{I}{Pr}$ (transposition)

Substituting for I , P and r we get

$$t = \frac{160}{800 \times 10\%}$$

$$= \frac{160}{800 \times 0.1}$$

$$= \frac{160}{80}$$

$$= 2 \text{ years}$$

Therefore, the time (t) is 2 years.

Example 3

Thelma earned K1800 as simple interest on K20 000 after two years. What is the interest rate she was paid at?

Solution:

$P = K20\,000$, $t = 2$, $I = K1800$. Transpose r in $I = Prt$ we get $r = \frac{I}{Pt}$

$$r = \frac{1800}{20000 \times 2}$$

$$= \frac{1800}{40000}$$

$$= \frac{18}{400}$$

$$= \frac{4.5}{100}$$

$$= 4.5\%$$

Example 4

Find the principal if a total of K6 300 interest is paid after 3 years at a rate of 21%p.a.

Solution:

$$t = 3, r = 21\%, I = 6\,300. \text{ Since } I = Prt, \text{ then } P = \frac{I}{rt}$$

$$P = \frac{6\,300}{3 \times 21\%}$$

$$= \frac{6\,300}{3 \times 0.21}$$

$$= \frac{6\,300}{0.63}$$

$$= \frac{630000}{63}$$

$$= \text{K}10000$$

Therefore, the principal is K10 000.

Compound Interest

Interest charged on Principal and accumulated interest on the principal. Every year the interest is calculated on the previous years' principal and accrued interest.

Compound interest is the interest calculated on the combined total on the principal and interest, accrued in the previous year.

Unlike simple interest, we cannot calculate compound interest directly. We use the idea of multipliers to find cumulative value of principal and interest.

Value After 1 Year = Principal x multiplier

We continue the process according to the number of years. Then, we subtract the principal from the final cumulative value of principal and interest.

**Compound Interest = Final Cumulative Value of Principal and Interest
– Original Principal**

We will use the multiplier to find the total of the principal and the interest all at once.

The multiplier is the sum of 1 and the interest rate per annum charged. Digit 1 represents the principal, which is 100%.

Say, if 8.5% per annum is the interest rate, then the multiplier is the sum of 1 and 8.5% (0.085) which is **1.085**.

Example 1

Find the compound interest if $P = 10\,000$, $t = 2$, $r = 4\%$ per annum.

Solution:

$$P = 10\,000, t = 3, r = 4\% \text{ p.a}$$

$$\begin{aligned}\text{After Year 1} &= P \times \text{multiplier} \\ &= 10\,000 \times 1.04 \\ &= \text{K}10\,400\end{aligned}$$

$$\begin{aligned}\text{After Year 2} &= P \times \text{multiplier} \\ &= 10\,400 \times 1.04 \\ &= \text{K}10\,816\end{aligned}$$

$$\begin{aligned}\text{After Year 3} &= P \times \text{multiplier} \\ &= 10\,816 \times 1.04 \\ &= \text{K}11\,248.64\end{aligned}$$

Thus, the final cumulative value of principal and interest is K11 248.64

$$\begin{aligned}\text{Therefore, Compound Interest} &= \text{Value after Year 3} - \text{Original Principal} \\ &= \text{K}11\,248.64 - \text{K}10\,000 \\ &= \text{K}1\,248.64\end{aligned}$$

We can see that comparing example 1 in simple interest with this example, here we get K48.64 more than in the simple interest payment.

We can also use the appreciation formula to find compound interest. But first we have to calculate the appreciated value, then we subtract the principal amount to obtain the compound interest (CI) as shown on the next page.

$$A = P (1 + r)^t \quad \text{and} \quad CI = P (1 + r)^t - P$$

$$= A - P$$

Where A is Accumulated value, P is Principal, r is the rate of interest and t is time (period).

Now let us use the formula to solve the example given in the preceding example.

Since $P = 10\,000$, $t = 3$, $r = 4\%$

$$A = P (1 + r)^t$$

$$A = 10\,000 (1 + 4\%)^3 \text{ (Substitute)}$$

$$= 10\,000 (1.04)^3$$

$$= 10\,000 \times (1.04 \times 1.04 \times 1.04)$$

$$= 10\,000 (1.124864)$$

$$= K11\,248.64$$

Finally,

$$CI = A - P$$

$$= 11\,248.64 - 10\,000$$

$$= K1\,248.64$$

The process of using the **multiplier** is the shorter version of the formula itself.

When we determine the multiplier, we actually find the **sum** or **difference** of what is enclosed in the **parenthesis** in the formula.

Calculating Compound Interest (CI) by the Formula

$$CI = P (1 + r)^t - P$$

In this formula, we are able to find the appreciated value $[P (1 + r)^t]$ based on the given rate (%) and the given time (years) and subtract the principal simultaneously to obtain the compound interest.

Example 2

Find the compound interest, given that $P = K20\,000$, $t = 2$, $r = 10\%$ p.a.

Solution:

$$P = 20\,000, t = 2, r = 10\% \text{ p.a}$$

$$CI = P(1 + r)^t - P$$

$$= K20\,000(1 + 10\%)^2 - K20\,000 \text{ (Substitute)}$$

$$= K20\,000(1.1)^2 - K20\,000$$

$$= (K20\,000 \times 1.21) - K20\,000$$

$$= K24\,200 - K20\,000$$

$$= K4\,200$$

Therefore, the compound interest is K4 200.

NOW DO PRACTICE EXERCISE 18

**Practice Exercise 18**

1. $P = 1200$, $t = 3$, $r = 21\%$. Find simple interest.

2. Complete the table by finding the simple interest.

	Principal (K)	Time (t)	Rate (%)	Interest
a	300	3	6.5	
b	800	4	4.5	
c	2 000	2	21	
d	12 000	3	11.5	
e	20 000	5	10	

3. Calculate interest on a principal of K3 000, repaid after 3 years at 8% per annum compounded annually.

4. Complete the table by finding compound interest (CI).

	Principal (K)	Time(t)	Rate (r)	Interest (CI)
a	40 000	3	10	
b	12 000	4	5	
c	7 000	2	8	
d	5 000	3	5	
e	600	4	12	

-
5. Find the rate if a principal of K10 000 earned K6000 in simple interest in 6 years.

-
6. Calculate the time (t) taken for an investment of K3000 producing K3378 paid at 4.2% per annum simple interest.

-
7. Find the principal when it earned K6000 in simple interest at a rate of 10% per annum in two years.

-
8. If the interest of 6% per annum, compounded annually is paid on a principal of K7000.00, what will be its total value after 4 years?

9. Which is larger a principal of K800 earning compound interest of 10% per annum or a principal of K1000 earning a simple interest of 15% per annum over 2 years.
-

10. Treasury Bills is paying 13% per annum simple interest . If Akua deposited K100 000.00, how much will he get in interest alone over 4 years?
-

11. What is the total amount repaid after 3 years on a loan of K5 000.00 at the rate of 12% per annum compound annually?
-

12. Find the total investment value from these two different investments:

- i. K2000 deposit for 3 years paid at simple interest rate of 4.5% per annum.

 - ii. K2000 is deposit for 3 years paid at rate of 4.5% per annum compound interest compounded annually.
-

CORRECT YOUR WORK. ANSWERS ARE AT THE END OF TOPIC 4

Lesson 19 Types of Loan and Rates



You have learned about compound and simple interest in lesson 18.

In this lesson you will:



- explain the types of loan and interest rates
- identify how interest and capital is repaid by simulating the starting of a small business project.

Loan and Rate

Loan is money given (P) by one entity (lender) to another entity (borrower) with an understanding that it will be repaid over time (t) with interest (I) at a specified rate (r)

Rate as an interest is expressed in the form $n\% \left(\frac{n}{100} \right)$.

Rate is a comparison of quantities per 100 parts expressed as per cent.

Example

Peter takes a loan of K800 and has to repay at a fixed rate of 12% over two years. How much does Peter pay to repay the loan?

Solution:

$$P = K800, t = 2, r = 12\%, I = Prt$$

$$\begin{aligned} \text{Total Repaid} &= P + I \\ &= P + Prt \\ &= 800 + 800 \times 2 \times 12\% \\ &= 800 + 1600 \times 0.12 \\ &= 800 + 192 \\ &= K992 \end{aligned}$$

Unsecured loans attract large interest rates while secured loans have low interest rates.

Personal Loans

Often personal loans are unsecured so such loans attract high interest rates from 16%pa to 31% per annum fixed rate.

Example

Mete obtained a personal loan of K4000 with a bank. The bank charges fixed interest at 31% per annum. How much does Mete repay in full after 2 years?

Solution:

$$\begin{array}{ll}
 I = Prt & \text{Repayment} = P + I \\
 = 4000 \times 31\% \times 2 & = 4000 + 2480 \\
 = 8000 \times 0.31 & = \text{K}6\,480 \\
 = 80 \times 31 & \\
 = \text{K}2480 &
 \end{array}$$

Mortgage is a loan agreement by which somebody borrows money from a lending organization such as bank or savings and loan association and gives that organization the right to take possession of property given as security if the loan is not repaid.

Example

Sally took out a mortgage loan of K120 000. She repaid the loan in 5 years at 8% per annum compound interest.

Find her outstanding loan balance after 1 year.

Solution:

$$\begin{array}{l}
 \text{Total Repaid (A)} \\
 A = P(1+r)^t \\
 = 120\,000(1+8\%)^5 \text{ (Substitution)} \\
 = 120\,000(1+\frac{8}{100})^5 \\
 = 120\,000(1+0.08)^5 \\
 = 120\,000(1.08 \times 1.08 \times 1.08 \times 1.08 \times 1.08) \\
 = \text{K}176\,319.36
 \end{array}$$

Therefore the accumulated amount is K176 319.36

$$\begin{aligned}\text{Repayment Installment} &= \text{Total Repaid (A)} \div \text{No.of fortnights in 5 years} \\ &= 176\,319.36 \div 130 \\ &= \text{K}1\,356.30\end{aligned}$$

$$\begin{aligned}\text{Payment made in 1 year} &= \text{Repayment installment} \times \text{No.of fortnights in 1 year} \\ &= \text{K}1\,356.30 \times 26 \\ &= \text{K}35\,263.80\end{aligned}$$

$$\begin{aligned}\text{Outstanding Loan Balance} &= \text{Total repaid} - \text{Payment made in 1 year} \\ &= 176\,319.36 - 35\,263.80 \\ &= \text{K}141\,055.56\end{aligned}$$

Therefore, the outstanding loan balance after 1 year is K141 055.56

NOW DO PRACTICE EXERCISE 19

**Practice Exercise 19**

1. Conan took a K6 000 personal loan from BSP and had to pay the loan plus simple interest at 16% per annum in two years. He repays K50 application fee and K50 GST. Find his total loan value.

2. Toole obtained an unsecured school fee loan of K4000 and paid fixed interest at 21% per annum in one year. Find his loan balance after 13 fortnights.

3. Dan took out a mortgage loan from the bank worth K120 000. He has to repay the loan in 5 years at 8% per annum, compounded annually. Find his outstanding loan balance after 1 year.

4. A loan of K200 000 was obtained by John. He mortgaged his car, and paid the loan in 5 years at 6% per annum. fixed rate. Calculate his monthly installment payment.

5. A loan of K300 000 was obtained by Kila. He used his house as collateral, and paid the loan in 3 years at 6% per annum compounded annually. Calculate his monthly installment payment.

6. What is the total amount repaid on a personal loan of K1000 earning 31% per annum simple interest in one year?

7. Draw a loan repayment schedule (table) for the first 5 fortnights on a loan of K2000 earning 31% per annum fixed interest.
-

8. Ray took a bank overdraft (loan) of K2000 and repays with 18% per annum simple interest in 4 months. How much does Ray repay the bank? Time in years is $\frac{4}{12} = \frac{1}{3}$.
-

9. Niugini Papers Ltd sought a commercial loan of K600 000. The company repays in 4 installment payments with 12% per annum fixed interest in one year.

Find:

(a) Interest paid on the loan.

(b) Total amount repaid.

(c) Quarterly installment amount.

CORRECT YOUR WORK. ANSWERS ARE AT THE END OF TOPIC 4

Lesson 20 The Most Suitable Term of the Loan



You have learned about types of loan and interest rates in lesson 19.

In this lesson you will:

- determine the terms of the loan
- determine how much each loan repayment will be
- identify total interest to be paid.

Bank Loan is a loan obtained from a commercial bank.

Loan is money lent; an amount of money given by the bank to a borrower on condition that it will be repaid with interest.

When you lodge a loan application to a bank or a financial institution, you need to meet certain requirements set by the lender called terms of the loan.

Terms of Loans

Terms of the loan are conditions attending a loan; a certain agreement expressed besides the actual loan approval.

Terms of the loan may include tax to be charged on the borrower and mortgage for a large sum to be borrowed.

Loan Repayment Schedule

The loan repayment schedule defines the fixed installment to be paid and on regular basis until the total value of loan and interest charged on loan is paid. The installment depends on the number of years the loan is to be paid. A year has 26 fortnights.

The longer the number of years it takes, the lesser the installment payment on fixed interest. The shorter the number of years it takes, the larger the installment payment on fixed interest. An example of loan repayment schedule is given below.

Client: Isha Toto Loan Repayment: K2342.00			
PMT No	Date	Installment payment	Reducing Balance
1	16 – 09 - 15	90.08	2251.92
2	30 – 09 - 15	90.08	2161.84
3	14 – 10 - 15	90.08	2071.76
4	28 – 10 - 15	90.08	1981.68
5	11 – 11 - 15	90.08	1891.60

Interest on Loan

Interest charged on a loan provided, often are expressed in percentage.

Example 1

Kay obtained a personal K5000 loan from BSP. She is to repay the loan within one year with 16% per annum simple interest.

Calculate

- (a) the total amount she has to repay.
- (b) the installment payment.
- (c) her repayment schedule for the first 2 fortnights.

Solution:

$$(a) \quad P = \text{K}5000, r = 16\%, t = 1$$

$$I = Prt$$

$$= 5000 \times 1 \times 16\%$$

$$= 5000 \times 0.16$$

$$= 50 \times 16$$

$$= \text{K}800$$

$$\text{Total amount} = \text{Loan} + \text{interest on loan}$$

$$= 5000 + 800$$

$$= \text{K}5800$$

(b)

$$\text{Installment} = \frac{(\text{Loan} + \text{Interest on Loan})}{26 \text{ Fortnights}}$$

$$= \frac{5800}{26}$$

$$= \text{K}223.08$$

(c) Repayment Schedule

Client: Susie Kay Loan Repayment: K5800			
PMT No	Date	Installment payment	Reducing Balance
1	21-08-15	223.08	5576.92
2	04-09-15	223.08	5353.84
3	18-09-15	223.08	5130.76
4	01-10-15	223.08	4907.68

Example 2

Lender A charges 16% on personal loans and Lender B charges 12% on school fee loans. Which lender offers a better deal?

Solution:

Neither. These are two different loans. Lender B is better if lender A also charges 16% on school fee loans.

Example 3

Sera took a loan of K6000. She has to pay 8% simple interest, K50 GST and K150 tax as terms of the loan. Find the total amount she had to repay in a year and the installment she pays per fortnight.

Solution:

Since $I = Prt$

$$\begin{aligned}
 6000 \times 6\% \times 1 &= 6000 \times 0.06 \\
 &= 60 \times 6 \\
 &= K360
 \end{aligned}$$

$$\begin{aligned}
 \text{Total Repaid} &= \text{Loan} + \text{interest} + \text{GST} + \text{tax} \\
 &= 6000 + 360 + 50 + 150 \\
 &= K6560
 \end{aligned}$$

$$\begin{aligned}
 \text{Fortnightly Payment} &= \text{Total Repaid} \div 26 \text{ fortnights} \\
 &= 6560 \div 26 \\
 &= K252.31
 \end{aligned}$$

Therefore the amount she had to repay is K252.31

NOW DO PRACTICE EXERCISE 20

**Practice Exercise 20**

1. Find the total amount to be repaid on a loan of K5000 if the rate of interest is 10% per annum, compounded annually and is to be repaid in two years.

2. Daniel has an option either to take a loan of K2000 with Lender A which charges 12.5% per annum simple interest or from Lender B which charges 6% per annum compounded annually over two years. Which of the two loans costs less?

3. Samson obtained a loan worth K400 000 under home ownership scheme with a bank. The bank charges 4% per annum simple interest over 20 years. What will be his outstanding balance after 2 years if he pays K500 per fortnight?

4. Ronan takes a loan of K20 000 .He repays the loan with 16% per annum simple interest in one year. Draw his repayment schedule for up to 8 fortnights.

5. Schola took a loan of K2500. She has to pay 16% simple interest per annum, K50 GST and K150 tax as terms of the loan. Find the total amount she had to repay.

-
6. Shelly obtained a loan worth K200 000 under home ownership scheme with a bank. The bank charges 4% simple interest per annum on the reducing balance every year. No interest is charged in the first year.

What will be his outstanding balance after 1 year if he pays K1000 per fortnight?

-
7. Calculate the fortnightly installment on a loan of K4000 earning 10% interest per annum, compounded annually and to be repaid in two years.

-
8. Boni takes a loan of K10 000 .She repays the loan within a year with 6% per annum simple interest. Draw repayment schedule for up to 6 fortnights.

CORRECT YOUR WORK. ANSWERS ARE AT THE END OF TOPIC 4

Lesson 21 Applying for a Bank Loan



You have learned about most suitable terms of the loans in lesson 20.

In this lesson you will:

- identify the terms and conditions for applying for a loan.
-

The commercial banks in Papua New Guinea that provide bank loans are BSP, Westpac, ANZ, MiBank, Peoples Micro Bank and Kina Bank.

Banks will not lend you money unless you hold a bank savings account with the particular bank.

You have an option to seek loan from financial institutions like FinCorp Ltd, Yuwa Finance and others. Look for a lender which charges the least interest rates.

Terms and Conditions

There are requirements to be met by client in-order for the loan application to be approved. And there are other aspects you need to meet such as regular installment payment, over the period of loan.

Example 1

Isha is a teacher. She went to BSP bank to obtain a bank loan as a personal loan. What are the requirements she needs to meet in-order for her loan to be approved?

Solution:

Isha was given a loans application form and was advised as:

To get a loan, a bank will require you to do the following:

- Fill in loan application form
- Provide 3 latest payslips
- Present a confirmation letter from employer
- Provide superannuation ID and statement
- Present Quotation or Invoice for the purpose of loan
- Present Receipts of assets owned

When all these requirements are met, the bank will approve and pay the loan into Isha's savings account within 24 hours.

National Development Bank (NDB) was set up purposely by the government to assist and promote local business entrepreneurs. NDB manages the governments Small-Medium Enterprise (SME) project. Villagers and farmers can seek loan from NDB under SME scheme.

Example 2

Issac is a villager. He went to the NDB to obtain a bank loan through the government small-medium enterprise (SME) scheme. What are the terms he was given?

Solution:

Issac was given a loans application form and was advised as:

To get a SME loan:

- Fill loan application form
- Bank Statement of account held with Peoples Micro Bank
- Provide a letter from Parish Priest or Pastor
- Present a confirmation letter from Ward Member or Councilor
- Present Quotation or Invoice for the purpose of loan

With these requirements met, the bank will approve and pay the loan into Issac's savings account within 24 hours.

When your SME loan is approved, you need to sign an agreement with NDB before the money is transferred to your personal savings account with Peoples Micro Bank.

Example 3

Kaers is a wage earner. He went to Moni Plus Finance to obtain a loan. What are the terms he was given?

Solution:

Kaers was advised as:

To get a loan we will assist you fill loan application form, provided you provide the following:

- Bank Statement
- a letter from your employer
- 3 copies of latest pay-slips
- A signed salary deduction order form
- ID card or drivers' License

If all these terms are met, the Moni Plus will approve and pay the loan into Kaers' savings account within 24 hours.

Example 4

Mola is paid a salary. On obtaining a loan he provided:

- A bank statement
- Bank Mini-statement (ATM)
- Copies of 3 latest payslips

He signed a document stating deductions of K3 per K10 for K2000 he needed. Find the total repaid and installment amount if Mola intends to offset the loan in 6 fortnights.

Solution:

$$\begin{aligned}\text{Interest Charged} &= \frac{3}{10} \times 2000 \\ &= 0.3 \times 2000 \\ &= \text{K}600\end{aligned}$$

$$\begin{aligned}\text{Total Repayment} &= \text{Principal} + \text{interest} \\ &= 2000 + 600 \\ &= \text{K}2600\end{aligned}$$

$$\begin{aligned}\text{Installment Amount} &= \text{Total Repayment} \div \text{Number of fortnights} \\ &= 2600 \div 6 \\ &= \text{K}433.33\end{aligned}$$

Mola can pay K433.30 per fortnight. Then offset the toea difference in the final fortnight if he pays cash.

NOW DO PRACTICE EXERCISE 21



Practice Exercise 21

1. Jacob took a SME loan from NDB worth K5000. He has to repay the loan at 6.5% simple interest in two years. He intends to sell drinks and do money market. From the profit made Jacob will seek a larger loan to buy a PMV bus within the 5 years.

He collected prices of cartons of soft drinks and recorded them as:

500mL coke at K47, 333mL Can coke at K37, Orange at K37, Mirinda at K25, Mountain Dew at K25 and 7Up at K25.

Jacob also did a research on Money Market and secured a client base of 12 people who assured him that they will be his client.

- (a) Find the interest on the loan that Jacob had to pay.
- (b) What is the total amount to be repaid?
- (c) What would be the total cost for drinks if he buys a carton each of 500mL coke, 333mL can coke, Mountain Dew and Mirinda?
- (d) Jacob sells Mirinda and Mountain Dew and 333mL can coke for K2.00, and 500mL coke at K3.00. Calculate the total profit made from drinks.
- (e) He sells 3 cartons of each type of drink per week. How much profit can he make on drinks in a week?
- (f) Calculate total profit for a fortnight.
- (g) He pays installments of K150 fortnightly. What will be his outstanding loan balance after a year?

- (h) The difference of the profit on drinks is saved with BSP bank account. How much can he save in BSP account in a year?
- (i) Jacob set aside K3000 for Money Market. He charges K2 for every K10 borrowed. On average he gives out K1800 fortnightly. How much profit does Jacob make on Money market fortnightly?
- (j) He saves profit of Money market in a Dream Account held with Peoples Micro Bank. How much can he save in a year?
- (k) What will be his savings balance in Dream account after 5 years?
- (l) What will be his savings balance in BSP bank account after 5 years?
- (m) If NDB requires 10% equity, does Jacob have 10% of K90 000 loan to purchase a 15-seater PMV bus?

-
2. Ruthie operates a saw mill business. In a fortnight she pays K4000 in wages, K300 on food, K2000 on freight, K2000 on operational costs (fuel, oil, machine servicing).

She delivered two containers each of soft wood and hard wood at a price of K9000 and K13000. And she has 2 containers of soft wood and a container of hard wood to be delivered soon.

Ruthie had not received payment for the first two containers sold. She opted to obtain a refinancing loan so she can continue her operations whilst awaiting payment before she delivers the next three containers.

Ruthie needs to do the following calculations to apply for approximately the exact amount she required to operate for two months.

Expenditure

No	Item	Unit Cost	Total
1	Wages		
2	Food		
3	Freight		
4	Operational Cost		

Revenue

No	Item	Unit Price	Total
1	Hardwood		
2	Softwood		

Profit/Loss

Revenue	Expenditure	Profit/Loss

- (a) Complete the tables above.
- (b) How much loan should she apply for?
- (c) The bank charges 6%. How much does she repay the NDB?
- (d) Will she have enough money to operate for another month when she repays the bank loan on receiving payment within two months?

CORRECT YOUR WORK. ANSWERS ARE AT THE END OF TOPIC 4

Topic 4 Summary



This summarizes some of the important ideas and concepts to remember.

- **Simple interest** is interest charged on the principal over the years. $I = Prt$
- **Compound interest** is interest charged on combined principal and acquired interest over the years. $CI = A - P = P(1 + r)^T - P$
- **Loan** is money obtained from a person or an organization by a person or organisation with an understanding that it will be repaid with interest.
- **Interest Rate** is the ratio per 100 on the amount borrowed which is paid in addition to the amount borrowed.
- **Bank loan** is money lent by a bank and is repaid over time with interest.
- Every financial institution has its terms and conditions to be met before the loan applied for by a client is approved.
- **Terms** are conditions to be met by a client.
- **Condition(s)** is something or things that must exist in-order for the loan to be approved.
- Banks and financial institutions offer different types of loan products such as personal loan, overdraft, asset finance and etc.
- **Unsecured loans** attract large interest rates; secured loans such as mortgage are charged low interest rates.
- The **instalment** is an equal amount of money repaid regularly on the period of the loan.
- **Loan Repayment Schedule** is a record of instalment payment, date, and balance outstanding.
- **Balance Outstanding** is the amount remaining to be repaid after subtracting all previous instalment payments made.
- **Enterprise** is a new and often risky business that involves confidence and an initiative aimed at growth and profit.

ANSWERS TO PRACTICE EXERCISES 18 – 21

Practice Exercise 18

1. K756
2. (a) K58.50 (b) K144 (c) K840 (d) K4140 (e) K10000
3. K779.14
4. (a) K13240 (b) K2586.08 (c) K1164.80 (d) K788.13 (e) K344.11
5. 10%
6. 3 years
7. K30 000
8. K8 837.33
9. 15% simple interest on K1000
10. K63 047.36
11. K7024.64
12. K4 552.33

Practice Exercise 19

1. K8 052
2. K2 420.05
3. K141 055.51
4. K4 333.33
5. K9 925.13
6. K1 310

7. Repayment Schedule

Client: _____			
Loan Repayment: K2620			
PMT No	Date	Installment payment	Reducing Balance
1		100.78	2519.22
2		100.78	2418.44
3		100.78	2317.66
4		100.78	2216.88
5		100.78	2116.10

Note: all values in the table are in kina.

8. K2120

9. (a) K72 000 (b) K672 000 (c) K168 000

Practice Exercise 20

1. K6050

2. Lender B

3. K694 000

4. K16 061.52

5. K3100

6. K1809.60

7. K93.08

8. K8153.86

Practice Exercise 21

1. Jacob SME Loan $P = K5000$. $r = 6.5\%$ p.a., $t = 2$ years.

(a) $I = Prt$

$$= 5000 \times 0.065 \times 2$$

$$= K5000 \times 0.13$$

$$= K650$$

(b) Total repaid = $P + I$

$$= K5000 + K650$$

$$= K5650$$

(c) Total Cost = Sum of cost for each Carton of Drink

$$= 47 + 37 + 25 + 25$$

$$= K134$$

(d) Coke 500mL = $3 \times 24 = K72$ Profit = $72 - 47 = K25$

Coke 333mL = $2 \times 24 = K48$ Profit = $48 - 37 = K11$

Mount. Dew = $2 \times 24 = K48$ Profit = $48 - 25 = K23$

Mirinda = $2 \times 24 = K48$ Profit = $48 - 25 = K23$
 Total Profit/ sale = K82

(e) Profit per Week = Profit per Sale \times 3 sales per week

$$= K82 \times 3$$

$$= K246$$

(f) Profit per fortnight = Profit Per Week \times 2 weeks

$$= K246 \times 2$$

$$= K492$$

(g) K150 per fortnight \times 26 fortnights = K3 900

Outstanding Loan Balance = Loan value – Total Installment Paid

$$= K5650 - K3900$$

$$= K1750$$

(h) Difference of Profit on Drink Sales = $K492 - K150$

$$= K342 \text{ per fortnight}$$

$$\begin{aligned}\text{Deposit Per Year BSP} &= \text{Difference} \times 26 \text{ fortnights} \\ &= \text{K}342 \times 26 \\ &= \text{K}8892\end{aligned}$$

$$\begin{aligned}\text{(i) Profit} &= \text{Average Cash Sales} \times \frac{\text{K}2}{\text{K}10} \\ &= \text{K}1800 \times \frac{2}{10} \\ &= \frac{3600}{10} \\ &= \text{K}360 \text{ Interest per fortnight}\end{aligned}$$

$$\begin{aligned}\text{(j) Dream Account Savings Per Annum} &= \text{Interest per fortnight} \times 26 \text{ fortnights} \\ &= \text{K}360 \times 26 \\ &= \text{K}9360\end{aligned}$$

$$\begin{aligned}\text{(k) 5 Years Savings Dream Account} &= 1 \text{ Year Savings} \times 5 \text{ years} \\ &= \text{K}9360/\text{year} \times 5 \text{ years} \\ &= \text{K}46\,800\end{aligned}$$

$$\begin{aligned}\text{(l) 5 Years BSP Bank Account} &= \text{Savings Per Annum} \times 5 \text{ Years} \\ &= \text{K}8892/\text{year} \times 5 \text{ years} \\ &= \text{K}44\,460\end{aligned}$$

$$\begin{aligned}\text{(m) Total Savings} &= \text{Sum of Savings} \\ &= \text{K}46\,800 + \text{K}44\,460 \\ &= \text{K}91\,260\end{aligned}$$

$$\begin{aligned}\text{Equity Required} &= 10\% \times \text{K}90\,000 \\ &= \text{K}9\,000\end{aligned}$$

Yes Jacob can meet the term of 10% equity.

2. Ruthie Sawmill

Expenditure Per Month

No	Item	Unit Cost	Total
1	Wages		4000
2	Food		300
3	Freight	1000	2000
4	Operational Cost		2000

Revenue

No	Item	Unit Price	Total
1	Hardwood	13 000	13 000
2	Softwood	9 000	9 000

Profit/Loss

Revenue	(less) Expenditure	Profit/Loss
22 000	8 300	13 700

Note: all values in the table are in kina.

$$(a) \text{ Loan Required} = \text{Running Cost Per Month} \times 2 \text{ months}$$

$$= 8\,300 \times 2$$

$$= \text{K}16\,300$$

$$(b) \text{ Interest} = Prt, \text{ where } t = \frac{2}{12}$$

$$= 16300 \times \frac{1}{6} \times 6\%$$

$$= 16300 \times 1\%$$

$$= \text{K}163$$

$$(c) \text{ Total Repaid} = P + I = 16\,300 + 163$$

$$= \text{K}16\,463$$

(d) Yes. K13 700 Profit exceeds K8 300 Running cost per month.

Bibliography

Ley, John and Michael Fuller, Insight General Mathematics 8, ____, ____, 84 and 326

O'Sullivan, Rose and Christine McRae, Outcome Edition Mathematics 9, ____, __

Priddle, A.G and T.H. Davies, Mathematics 8, BrooksWaterloo-QLD.Aust,1989, ____

Rayner, David, Complete Mathematics for GCSE and Standard Grade, ____, ____, 13

SS Mathematics 10A, Dept. of Education-PNG, 1987, __

SS Mathematics 10B, Dept. of Education-PNG, 1987, __

SS Mathematics 10A, Harper Collins-Australia, 1992, __

SS Mathematics 10B, Harper Collins-Australia, 1992, __

apps_59858_13510798883347805_320293d

FreeGreatPicture.com-17419-hardware-t

230124_7986_S