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A Proposed Workbook in General Mathematics for Senior High School Students

Maribel Simon – Pudiquet

Philippine Normal University

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**A PROPOSED WORKBOOK IN GENERAL MATHEMATICS
FOR SENIOR HIGH SCHOOL STUDENTS**

A Seminar Paper
Submitted to the College of Graduate Studies
and Teacher Education Research
Philippine Normal University
Manila

In Partial Fulfilment
of the Requirements for the
degree Master of Arts in Teaching Mathematics

by
Maribel Simon - Pudiquet
September 2016

APPROVAL SHEET

This seminar paper titled “**A PROPOSED WORKBOOK IN GENERAL MATHEMATICS FOR SENIOR HIGH SCHOOL STUDENTS**” prepared and submitted by **Maribel S. Pudiquet**, in partial fulfilment of the requirements for the degree **Master of Arts in Teaching Mathematics**, has been examined and recommended for acceptance.

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M.S.P.

ABSTRACT

Researcher : Maribel Simon – Pudiquet

Title: A Proposed Workbook In General Mathematics For Senior High School Students

Key Concepts: workbook, General Mathematics, concepts, skills, senior high school, constructivist approach

Degree: Master of Arts in Teaching

Specialization: Mathematics

Adviser: Dr. Rene R. Belecina

The study aimed to develop a proposed workbook in General Mathematics for the Senior High School students. To identify the topics, the researcher reviewed the DepEd competencies of the General Mathematics Curriculum. Based on the identified topics, the workbook was then designed and developed following the constructivist approach and discovery. The developed workbook

was validated by five mathematics experts using the Experts Assessment Checklist and Five-point Likert Rating Scale utilized from the studies conducted by Hubilla (2008), Romero (2009), and De Guia (2012) with some revisions. The developed workbook was evaluated according to the variables: objectives, contents, usefulness, clarity, adequacy, and format and design. Based on the recommendations or suggestions of the experts, the workbook was revised. It was found that the workbook could be used by the senior high school students to understand better the concepts of the core subject, General Mathematics, and likewise by the teachers as an aid in teaching General Mathematics for Grade eleven students. It was recommended that the workbook be evaluated by the intended users, both the students and teacher, and that further research be made on its effect on students' mastery of the content.

TABLE OF CONTENTS

	Page
Title Page	i
Approval Sheet.	ii
Acknowledgement.	iii
Abstract.	v
Table of Contents.	vii
List of Tables.	x
List of Appendices.	xi
List of Figures	xii

CHAPTER

I THE PROBLEM AND ITS BACKGROUND

Introduction	1
Conceptual Framework	5
Statement of the Purpose	9
Significance of the Study	10
Scope and Delimitations of the Study	11
Definition of Terms	12

II	REVIEW OF RELATED LITERATURE	
	Instructional Materials and Workbooks.	14
	Advantages and Disadvantages of K to 12 Curriculum (Enhanced Basic Education Curriculum)	22
	Synthesis.	24
III	METHODOLOGY	
	Research Design	27
	Research Paradigm	28
	Participants of the Study	29
	The Development and Validation of the Workbook	30
IV	THE DEVELOPED WORKBOOK IN GENERAL MATHEMATICS FOR SENIOR HIGH SCHOOL STUDENTS	36
V	SUMMARY, CONCLUSION, AND RECOMMENDATIONS	
	Summary	48
	Findings	49
	Conclusion	49
	Recommendations	50

REFERENCES	51
APPENDICES	58
CERTIFICATION	79
AUTHENTICITY RESULTS.	80
CURRICULUM VITAE.	81

LIST OF TABLES

Table	Page
1 Mean Ranges for the Result of Expert Assessment	41
2 Results of the Validation of the Proposed Workbook in General Mathematics in Terms of Objectives.	41
3 Results of the Validation of the Proposed Workbook in General Mathematics in Terms of Contents	43
4 Results of the Validation of the Proposed Workbook in General Mathematics in Terms of Usefulness.	43
5 Results of the Validation of the Proposed Workbook in General Mathematics in Terms of Clarity	45
6 Results of the Validation of the Proposed Workbook in General Mathematics in Terms of Adequacy.	46
7 Results of the Validation of the Proposed Workbook in General Mathematics in Terms of Format and Design	46
8 Summary of the Results of the Validation of the Proposed Workbook in General Mathematics	47

LIST OF APPENDICES

Appendix	Page
A: Learning competencies of the K to 12 Basic Education Curriculum Senior School – Core Subject General Mathematics offered to Grade Eleven Students	59
B: Letter of Request	64
C: Likert’s Five Point Rating Scale with Questionnaires.	65
D: Mean Ranges for the Experts’ Assessment Checklist.	68
E: Rating Sheet for Evaluation of the Workbook in General Mathematics.	69
F: Overall Summary of the Results of Validation of the Developed Workbook in General Mathematics	
G: Profile of the Five Mathematics Experts	73
H: Workbook in General Mathematics.	78

LIST OF FIGURES

Figure		Page
1	Conceptual Paradigm of the Study	5
2	Research Paradigm	28

CHAPTER I

THE PROBLEM AND ITS BACKGROUND

Introduction

The constant thing in this world is change, and the challenge is how people deal with it. Every day, changes happen, which extends also to the Philippine education system when recently, President Aquino signed the K-to- 12 education into law in 2013, adding three years to the country's basic education curriculum. This curriculum change is known as the K- to- 12 Curriculum of the Enhanced Basic Education Program, necessitating each Filipino student to go through one year of kindergarten, six years of elementary schooling (grades 1 to 6), four years of junior high school (grades 7 to 10), and two years of senior high school (grades 11 to 12).

In addition, the new curriculum also aims for globalization in order to adapt to the international standards, thus the birth of the Philippines' K-12 program happened. In line with this program, the senior high curriculum was established as a new medium of education patterned after the standard syllabus accepted worldwide. It caters to the different talents and courses of students which tailor individual skills for each chosen profession in the future; thus, the students receive additional two years of training, specializing in their area of interests.

Magaan (2014) cited in her article the five key benefits of the K-12 BASIC Education Program. She mentioned that the implementation of the program helps students learn easily as they freely pursue their passion. Likewise, it aims to

produce globally competitive graduates, which in turn reduces unemployment, consequently improving the Philippine economy.

In addition, Cruz (2010, as mentioned by Abueva, 2015) in one of his columns in a local newspaper mentioned favorable results of the new curriculum: sufficient instructional time; more skilled and competent labor force; recognition as professionals abroad; and help Filipinos gain a competitive edge in the global market.

In response to this change, St Paul College, Pasig (SPCP), a private school for girls, made a transition in the last three years called “Releveling and Relabeling”. There was a releveling and relabeling of the pre-school, kindergarten including grade school, proportionate with the students’ ages. Thus, this action reached its effect until high school. Henceforth, the high school level was then divided into Junior High (Grades 7 to 10) and Senior High (Grades 11 to 12). Because of this, SPCP offers Senior High School in advance starting with Grade 11, a year earlier than Department of Education’s (DepEd) implementation target on S.Y. 2016-2017.

Therefore, for the school year 2015-2016, the first batch of senior high school students of SPCP composed of 375 Grade 11 students began its implementation. The students were grouped according to their interests and potentials identified in coordination with their guidance counselor and their parents. These groupings were categorized into Academic tracks, Arts and

Design, and Sports track. There were core subjects offered to the different tracks during the first semester, and one of which was the General Mathematics.

Prior to the school implementation a year earlier than DepEd's target, the Senior high teachers experienced a lot of problems especially with the learning materials used in teaching. To solve this, the teachers assigned to handle the subject General Mathematics were asked to look for a textbook or a material (containing all the topics) that could be used in teaching. Being part of the pool of senior high teachers in SPCP, the researcher visited some partner-publishing houses that sell books for Math. Also, the person in-charge for the Senior High School benchmarked with other colleges and universities to look for a single book which contained all the topics. Still others searched online, but to no avail, for not a single book was found.

Compounding this dilemma on the absence of a book for the course is the general observation that many students find Mathematics a difficult and abstract subject. Hence teachers find ways and means to make the learning process helpful, enjoyable, and productive to the students, which could be addressed by an appropriate, well-planned instructional material.

In response to this, the Paulinian teachers assigned to handle the General Mathematics subject were asked to prepare modules or handouts or any supplementary materials in the absence of a single book containing all the topics. These materials should stimulate the teaching-learning process and ensure that

the competencies are relevant to what the students are expected to learn and master when they move to college with their respective courses.

Given limited time to prepare, the researcher knew that the materials or handouts prepared are not enough to attain the target objectives because students need more enhancement activities for the mastery of the content. Likewise, since the materials supplied to the students are collated and based on different resources (normally from college books), the researcher felt the need to produce at least one book of exercises for practice during the learning session so that students could engage themselves more in dealing with the concepts when concrete reference like textbooks or supplementary material sequentially aligned with the course is offered them.

Tizon (2013) in her study cited that the use of an instructional material is an effective way to introduce any subject. Likewise, to make subjects more interesting, handling them with ease, teachers can use varied materials in the field of education to cause positive effects on the academic performance of the students.

One instructional material commonly used is the workbook that helps the teachers in various ways. For one, it is valuable to test and validate the academic standing of the students. However, if workbooks are not present, then the teachers have to spend more time in preparing varied exercises and /or activities and formative and summative tests. These activities somehow make teaching job challenging and difficult.

Moreover, Larang (2013) stressed that students should be exposed to varied exercises to master necessary skills. Teachers still give value to these instructional materials in spite of highly technological instructional materials present. They still use books, coursebooks, modular texts, worktexts, workbooks, and/or worksheets to facilitate the teaching-learning process. However, most of these instructional materials being used are commercial in nature. That is why she suggested that teachers look into the suitability of these materials to their students' abilities and capabilities. If not suited, then the teachers need to consider the possibility of modifying these materials, or better yet developing their own instructional materials.

These reasons prompted the researcher to develop a workbook in General Mathematics containing different exercises and questions pertaining to the different learning competencies included in the said subject. With the aid of the proposed material, the teachers handling General Mathematics will no longer spend much time in writing a lot of examples on the board nor prepare different exercises through power point presentations. The students can also answer the items at their own pace in school or at home given the proposed workbook.

Conceptual Framework

This study is premised on constructivist learning theory, enhanced discovery learning, and the role of a teacher in the learning process.

The constructivist approach views learning as a process of constructing meaning based on the learners' accumulated experiences or acquired existing knowledge.

As mentioned by Obrero (1999), constructivist approach relates students' prior knowledge, encourages students to challenge each other's conceptualization, and uses open—ended questions.

Teaching for conceptual change primarily involves 1) uncovering students' preconceptions about a particular topic or phenomenon; and 2) using various techniques to help students change their conceptual framework so that students can be guided to learn difficult concepts in all areas.

According to Bruner's (1973) theoretical framework, learning is an active process in which students construct new ideas or concepts based upon their past or current knowledge. In this process, the learners select and transform information, construct hypothesis, and make decisions, relying on a cognitive structure to do so. In instruction, the main objective of the teacher is to translate ideas to students according to their level of understanding and their present situation. It should address 1) predisposition toward learning; (2) the ways in which a body of knowledge can be structured so that it can be most readily grasped by the learner; (3) the most effective sequences in which to present material; and (4) the nature and pacing of rewards and punishments. Good methods for structuring knowledge should result in simplifying, generating new propositions, and increasing the manipulation of information.

Teacher should devise ways on how to make the learners understand the topics like using an instructional aid with progressive complexities of exercises. This means that exercises should start with testing the knowledge of the learners about the concepts and theories, then exposing them to the applications of the concepts to test their skills of understanding.

Some of Bruner's theoretical principles are based on the nature of learning and learning readiness, the careful organization of the instruction, and instruction designed for understanding beyond the information given. According to Manzano (2011), enhanced discovery learning is a process in which the teacher prepares the learner in a discovery task through the basic knowledge provided and by assisting the learner to complete the task. In addition, he said that in this approach, the students are allowed to formulate their own ideas validated by letting them explain their generalization.

Jean Piaget (1980) on Intellectual Development revealed that teachers are there to guide and stimulate the learners – that they are facilitators of knowledge. It is noted that learning is more meaningful if the child is allowed to explore on his/her own, make mistakes, and learn from them. In addition, students are offered by the teachers with varied situations and materials that allow them to discover learning (<http://sk.com.br/sk-piaget.html>). Furthermore, every new level of learning begins when learners make a connection with something they already know. In short, teachers need to know what their students know and what they

need to know next (Rita ,2011) so they can appropriately and efficiently plan for instruction.

Figure 1 shows the conceptual paradigm of the study which served as the basis in developing the proposed workbook for senior high school students.

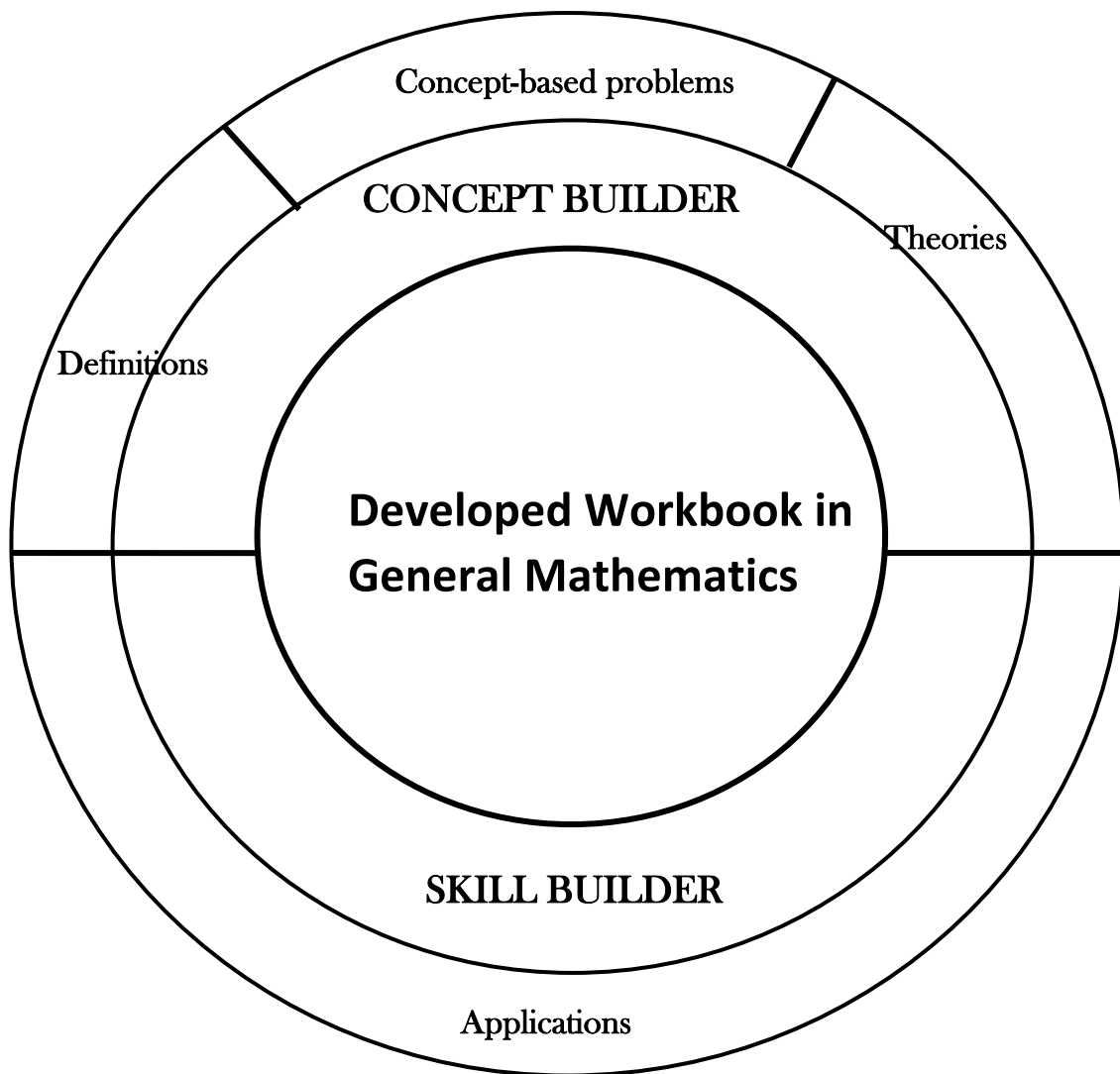


Figure 1 illustrates the focus of the study. The Developed workbook in General Mathematics is placed at the center, which serves as the focus of the study. The workbook is then divided into two parts, namely Concept Builder and Skill Builder. The elements seen in the Concept builder are the definitions of terms/concepts, the theories underlying some concepts, and the basic problems involving the direct application of the concept. The Skill Builder consists of the applications of the basic concepts to word problems or to real-life situations which involve two-step or multi-step solutions.

Statement of the Purpose

The main objective of this study was to develop and validate a workbook in General Mathematics for senior high school students.

Specifically, this study aimed to:

1. identify the lessons in General Mathematics based on the competencies in General Mathematics for Grade Eleven Students;
2. develop a Workbook in General Mathematics based on the identified lessons;
3. validate the content of the workbook through consultation with experts; and
4. revise the workbook based on the results of the validation.

Significance of the Study

The study was carried out because of the felt need for supplementary materials in Senior High School to help students in the acquisition and mastery of lessons and enhancement of computational skills in Mathematics through the proposed workbook.

Specifically, the following are the persons who will benefit from the result of the study.

Learners. The researcher made the workbook for the future reference of the students. The workbook will help them understand better the lessons and the learning competencies of the subject General Mathematics. It can serve as their reference of their lessons even if they are absent or they are at home, and thus help them attain good grades.

Teachers. The workbook will be useful for the teachers for their additional instructional reference prepared in advance; hence, there is no need spending time searching for pertinent materials for their lessons. Thus, they can use their time more in enriching the lesson and in checking papers or other requirements.

Administrators. This will serve as their motivating factor in sending teachers for seminar-workshops for professional development. It will be their guide also to review the policies they have at hand for the better implementation of the

curriculum. It will also encourage them to upgrade the financial assistance they have for their teachers who are taking master studies and who involve themselves in seminar-workshops.

Future Researchers. The result of this study may also be a basis as one of their references in conducting a study similar to the development of instructional materials or workbook.

Scope and Delimitations of the Study

This study aimed to develop and validate a proposed workbook in General Mathematics. The topics included in the developed workbook were the identified lessons in General Mathematics based on the competencies for Grade Eleven students. The lessons were divided into five chapters, namely Introduction to Functions, Rational Functions, Exploring Inverse, Exponential and Logarithmic Functions, Basic Business Mathematics, and Logic. The developed workbook consists of heading, lesson number, specific objectives, and activities/exercises categorized into Concept Builder and Lesson Builder.

The developed workbook was then subjected to validation by chosen five mathematics experts who are teachers handling higher Mathematics for at least ten (years) and have at least some units in masters studies.

In addition, only the content and features of the developed workbook was validated according to the following elements: objectives, contents, usefulness, clarity, adequacy, format and design. There was no try out done in this study.

Definition of Terms

For the common understanding of the major terms used in this study, the researcher defined the following terms operationally.

Content Validation. This refers to the process of determining the reliability and acceptability of the content of the workbook in terms of the elements: objectives, contents, usefulness, clarity, adequacy, as well as the format and design.

Enhanced Basic Education Curriculum. This refers to the newly adopted curriculum, (K to 12 Curriculum) which provides one hour contact time of the students in Mathematics. This is a program mandated by Department of Education which requires the students to have an additional two years in Basic Education. This is to ensure that the Philippine education is at par with the international standards and that more opportunities abroad may be availed by the graduates.

Graphics. It refers to the graphs used or provided in the workbook to aid understanding of the exercises and questions.

General Mathematics. It refers to the Mathematics core subject offered to the Grade eleven (11) students for the first semester. It is divided into three major units, namely Functions and their Graphs, Basic Business Mathematics, and Logic.

Instructional Material Development. It refers to the process of identification of the lessons to be included in the developed workbook based on the competencies of General Mathematics, development of the workbook based on the lessons, and revision based on the recommendations of the experts.

Instructional Materials. These are learning materials and their proper use of which help learners to learn faster and better (Agun,1988). In this study, it refers to the developed workbook for Grade eleven (11) students. The term instructional materials are used interchangeably with workbook.

Mathematics Experts. It refers to the five mathematics teachers who validated the content of the workbook. In this study, they are teachers who have been teaching mathematics for at least 10 years and who have at least units in masters.

CHAPTER II

REVIEW OF RELATED LITERATURE

The literature reviewed has provided the researcher with the necessary background relevant to the development of the proposed workbook in General Mathematics. It includes the concept on instructional materials, such as the importance, design and development of workbook, and the advantages and challenges of K-to-12 Curriculum.

Characteristics of Instructional Materials and Workbook

Trapane (2016) conducted a study on the development of supplementary instructional material based on the least learned topics as shown in the fourth quarter examination result in Geometry and Statistics for Grade seven students of Dr. Arsenio C. Nicolas High School. She used descriptive-developmental method in conducting her study. Based on her findings, the mathematics experts strongly agreed and concurred that the material can help students in their mathematics learning, performance, and achievement. As a result of her study, it was recommended that the module be used and tried out to the students in the classroom. She used constructivist approach in developing her modules.

In addition, Beronilla III (2006) mentioned that one significant skill that a teacher should have is the ability to form, prepare, or create materials appropriate to the degree of students' readiness and understanding.

Broderick (2012) cited in her article the role of the teacher in the teaching-learning process as seen in the studies involving instructional materials. He mentioned that (1) the effectiveness of the material must be expected to vary with the subject taught and with the learning outcome measured; and (2) effectiveness further depends upon the age and background of the children or group using the instructional materials, the skill and method of presentation, and the influence of the teacher.

Adequate resources, competent teachers, suitable facilities, and modern textbooks, instructional materials, and methods are needed to improve the quality of education. Thus, writing and designing educational materials does not only require knowledge of the subject matter. It requires the knowledge on how to write, how to design, possession of deep experience, and a sense of a book design to be considered an effective educational material. Likewise, the testing, evaluation, and revision of the developed material should be done consistently and continuously because development happens so fast (http://www.unesco.org/education/blm/blmintro_en.php).

Calisle (2013) emphasized the following criteria necessary in developing instructional materials. First, materials should fit the objectives of the course, unit plan and the lesson plan. Second, they should be well-organized and appropriately presented. Third, they should provide sufficient information, graphics, and illustrations. Finally, they should be designed according to the abilities and interests of the learners.

Instructional materials should be made in coherence with its purpose. Thus, in developing these, students' individual differences-- their abilities, learning styles, mental ability-- should be considered. Hence, an educator should keep in mind the objectives, nature of students, learning environment, and available resources before designing, developing, selecting, and using available instructional materials (http://www.alabamapepe.com/profdevmodule/selusing/selusing_b.htm).

The use of various instructional materials like modules, work-text, and workbook makes the teaching-learning process an effective one. It helps the learners understand the lesson better and improve their mathematical skills. Sometimes, it also helps them in catching up with their lessons if they are absent or they miss the discussion. Having a workbook in a certain subject likewise decreases the possibility of insufficient items for exercises when the situation calls for them. It also ensures the equitable transfer of knowledge since the materials are readily available for use.

Santos (2013) explained that the preparation of curriculum materials should be relevant to the fast-changing times and needs of the students. Her study focused on the development of instructional materials for remedial program of secondary students identified based on their achievement test. With descriptive-developmental research design, the study found that the developed modules are highly acceptable in terms of format and design, objectives, content,

language and style. Likewise, the developed modules are suited to the interest and motivation based on the try-out results.

Detablan (2013, adapted from Kellough,R. and Kelough N.,1999) highlighted that the most important to consider in teaching aside from detailed planning is the coherence of the lessons and discussion. The workbook, in particular, functions as an important tool for future use when teaching similar lessons, an agendum for teacher, and accessory help for substitute teachers. Moreover, it gives adequate facts on the quality of teaching –learning environment and on what the administrators and teachers could do to improve the quality of students' academic performance.

The study conducted by Adora (2014) on the development and validation of workbook in elementary Mathematics VI justified the need for it as prompted by the dismal result of the 2012 National Achievement Test among grade VI pupils. Moreover, she mentioned that it is a necessity to meet the learners' needs and equip them with skills required for their level through proper guidance, and instruction as a teaching tool like workbook. The level of acceptability of the proposed workbook was assessed by the mathematics teachers in terms of clarity, usefulness, language and style, illustrations, presentations, and suitability.

Larang (2013) mentioned in her study that workbooks are favored because students can work directly on their copy without the need to copy questions from a textbook, even as it eliminates the need for a loose leaf. With this reasons, workbooks are often used in schools for younger students, either in

elementary school or middle school. In industry, they may be customized interactive materials which are used to help provide structure to solve complex problem.

Menoy (2013) designed and developed a workbook accompanying the English 111 textbook adopted by the University of the East to provide students with exercises enhancing their communicative competence, with emphasis on their grammar skills. It was recommended in his study that the administrators support the instructional materials preparation efforts of the faculty. Likewise, the researcher used the study as benchmark in relation to the design and development of instructional material. His proposed workbook was validated by the selected faculty members and students.

In the same essence of improvement, Saturno (2013) developed an instructional material based on the analysis of the mathematics performance of the second year high school students in the National Achievement Test. The proposed material is used for remediation and validated by mathematics experts. He used a four-stage process namely: Needs Analysis and Planning, Development, Validation, and Revision.

Cortez (2013) concluded in her study that reading lesson guides with multiple intelligence integration aid teachers to become more effective and empowered to teach reading because duties to prepare their lessons were lessened. Furthermore, it was mentioned that the prepared materials are valuable instructional materials in teaching higher order thinking skills .The

activities help develop their critical and creative thinking especially if they are exposed to authentic reading materials. In her study on development and validation of reading guides for the second graders, she used descriptive method using the four stages, namely planning and assessing the needs, designing and developing the material, evaluation and validation of the material by experts, and finalizing the lesson guides with multiple intelligence activities for the second graders.

Based on the findings on the study conducted by Taroy (2013) on Development and Validation of Lesson Exemplars for first year students, he concluded that the eight (8) developed lesson exemplars permit a long-term understanding of the lesson which can develop 21st century of the first year students. Likewise, the essential understanding (EU) part showed the development of higher order thinking skills among the target students.

Lazaro (2013) developed a computer-aided instructional material on Arithmetic Series for second year high school. Her proposed material was evaluated by mathematics teachers and students. Based on the ratings given by the evaluators, the computer-aided material possesses the characteristics and qualities of an excellent material in terms of its content, instructional and evaluation characteristics.

In the study conducted by Detablan (2013) which focused on the development and validation of mathematics activities to enhance the mathematical skills of the grade three pupils with hearing impairment, it was

recommended that the mathematics activities and worksheets be used as resource material for special schools and regular schools as well. The material was tried out to the grade three pupils after being validated by a pool of experts.

Similarly, Sablay (2012) used descriptive method in developing a reading workbook in improving vocabulary skills of grade one pupils with hearing impairment. It was recommended that a similar workbook be developed for other grades and test its effects on student learning. Following the Input-Process-Output Model, the workbook was recommended to be used as resource material for the K-12 curriculum.

In the study conducted by Robiso (2010) regarding developing a workbook to respond to the weaknesses of the students in Mechanical Drawing 1 and 3, it was recommended that the revision of the developed workbook be done before its utilization, and parallel study be conducted on the developed workbooks in Mechanical Drawing 1 and 3.

Hubilla (2008) employed descriptive development research design in her study about developing and assessing a workbook in bookkeeping for private business high school. It was concluded in her study that the instructional material can be used by the students with confidence and ease with less help coming from the teachers. She used Input-Process- Output Model in the process of developing her workbook which was assessed by experts using the following variables: 1) Objectives; 2) Content; 3) Usefulness; 4) Clarity; and 5) Adequacy.

It was revealed in the study of Magboo and Salayo (2009) that the use of work text was very effective in the students' mastery and that the concept in the work text allowed for individual mastery. They stressed that effective learning requires an instructional material like worktext that encourages the students to reflect and use their ideas on the facts and information gathered. Likewise, the worktext was developed as aid in teaching because there was no textbook available in English II then.

In addition, Soriano (2008) in her study cited that the developed instructional materials are helpful and reliable activities that enhanced the problem solving ability of the students and promoted strong conceptual understanding and longer retention and transfer of ideas. She also mentioned that these were helpful tools for teachers in developing among their students the value of scientific mathematical inquiry inside the classroom. The study underwent two stages, namely 1) Planning and Preparation; and 2) Development and Writing. The instructional material was evaluated by 8 mathematics experts.

Feudo (2005) developed a workbook in Intermediate Algebra to increase the computational skills of the students in Mathematics especially in Intermediate Algebra. She likewise mentioned that good printed instructional materials help teachers engage in quality instruction and therefore bring quality education. Hence, the use of the best and most appropriate instructional material especially the workbook should be provided in schools. Her workbook was assessed using the following variables: objectives, content and scope, clarity, usefulness, and

suitability. It was recommended that teachers always update themselves with the advancement of technology in order to develop a more improved instructional material in the form of a workbook. In addition, to enhance their mathematical skills and abilities, and to arouse their interest, students should be provided with the use of instructional material like workbook in the teaching-learning process.

Advantages and Disadvantages of K to 12 Curriculum (Enhanced Basic Education Curriculum)

The birth of the K to 12 Program is likewise the introduction of the core subject General Mathematics for the Senior High School Curriculum. Luistro (2012) emphasized that as the Philippine economy weakens for the past years, there is also a concurrent decline in the Philippine education. In response to this, he mentioned that the implementation of the K to 12 Program is the answer to the problem faced by the country. With this, he emphasized the features and importance of the enhanced basic education curriculum, which includes upgrading the basic education curriculum to ensure that learners acquire the relevant knowledge and skills needed to become productive members of society, introducing relevant skills development courses and special interest subjects suited to the personality, strengths, and career direction of each learner; equipping every learner who graduates after senior high school (Grade 12) with the opportunity for improved employment and entrepreneurship; putting the learners at par with their international counterparts and makes them more

competitive in colleges and universities both here and abroad; and advancing the graduates' chances of landing 21st-century careers and acquiring self-employment skill sets (<http://newsinfo.inquirer.net/163611/>).

Abueva (2015) avers that even if the government faces a lot of problems in K-12 implementation since it became a law, it is still deemed an important innovation in education system because the quality of education relies on it, and thus it is considered vital to the country's success.

In support, Shahani (2015) discussed the positive gain and challenges of the implementation of the K-to-12 law mandated by the 2013 Enhanced Basic Education Act (R.A 10533). She said that the Department of Education is adamant about their readiness for the first batch of Senior High School in June 2016, and it firmly believes that the quality of education in the country will be enhanced. However, she also stressed the following downsides of this implementation because (1) the transition will cost money; (2) it will cost personal and institutional discomfort; (3) it will dump millions of underage high school graduates on already bloated labor market, requiring three to four effectively wasted semesters of remedial work on the part of colleges and universities; and (4) it will damage the prospects of the nation's youth both in foreign universities and foreign jobs.

Moreover, Cruz (2012) underscores in his column that higher education institutions will have financial crisis because of the decline in the enrolment of students, since there is a free college tuition for the students who will enrol in

senior high. Likewise, the resiliency of students who will transfer to college will be tested, and that senior high school teachers are required to be licensed teachers. Eventually, these will happen because of the birth of Senior High Curriculum adding several years more for Filipino learners' advantage (<https://mlephil.wordpress.com/2012/03/09/k-to-12-and-higher-education-institutions/#more-4967>).

Moreover, Fernandez (2012) specified in her article that despite the projected benefits the K to 12 program seems to offer, the recurrent problems the government faces grow exponentially. These are attributed to the shortage of teachers, school, classrooms, textbooks, stretch of curriculum, and most importantly the financial budget to manpower the education system.

Synthesis

All the research literature focused on the importance and development of instructional materials and workbooks in the teaching –learning environment in the context of the K to 12 Curriculum. They also described how the learners could be helped in the attainment of mastery and appreciation of the lesson, on how to use critical mind in solving real-life problems, and on how to solve the challenges relevant to the educational landscape of the country. The issues presented about the K to 12 Enhanced Basic Education Curriculum motivated the researcher to develop a proposed workbook in General Mathematics.

The aforementioned studies appear similar to the present study in the sense that they deal with the importance and usage of instructional materials in the teaching –learning process, and in helping the learners deepen their understanding in the different subject areas presented, and the use of descriptive method in their design.

The study of Trapane (2016), Detablan (2013), Hubilla (2008), Larang (2013), Robiso (2010), Sablay (2012), and Taroy (2013) were validated by the experts and then administered to their selected student-respondents. The instructional materials by Adora (2014), Saturno (2013), Cortez (2013), Feudo (2005), Sharma (2001), Soriano (2008), and Magboo and Salayo (2009) were assessed and validated by their chosen teacher-experts, similar to the present study as validated by five mathematics experts. In contrast, the grammar workbook and computer-aided instructional materials developed by Menoy (2013) and Lazaro (2013) respectively were scrutinized and assessed by selected teacher-experts and students.

All of the related studies were intended for use by students in different levels of education, from kindergarten to tertiary level which were different from the present study because its intended users were Senior High School students. In addition, all the related studies concluded that the instructional materials are relevant and useful to the learners except for Sharma (2001) who said that the experienced teachers see it more as an administrative task.

For content validation, the variables used by the researcher are almost the same with that of Feudo (2005) except for the last variable which is Suitability. Likewise, the present study is similar to the study of Magboo and Salayo (2009) since both studies addressed the absence of a textbook for the target course.

Based on the concepts and ideas presented, the researcher has been guided and directed to conceptualize and design a proposed workbook to make it meaningful

and useful to the students. The researcher has not found any related study that involves the development and validation of a proposed workbook in General Mathematics intended for Senior High School and in any other course or learning area.

CHAPTER III

METHODOLOGY

This chapter presents the research design applied in the development and validation of the proposed workbook in General Mathematics. It also includes the participants of the study, the research paradigm used, the development and results of the validation of the workbook.

Research Design

This study used the descriptive-development research. From the different types of research, the researcher found the descriptive method was the most appropriate method to use. Likewise, this was also developmental because it developed and assessed the workbook as an instructional material in General Mathematics.

According to Calderon and Gonzales (2010), descriptive method is a fact-finding study with adequate and accurate interpretation of the findings. It describes what is. It describes with emphasis what actually exists such as current conditions, practices, situations or phenomena.

The Input - Process - Output (I-P-O) Model in Figure 2 shows the relationship of the three components in the process of the development of the proposed workbook in General mathematics for senior high school students .

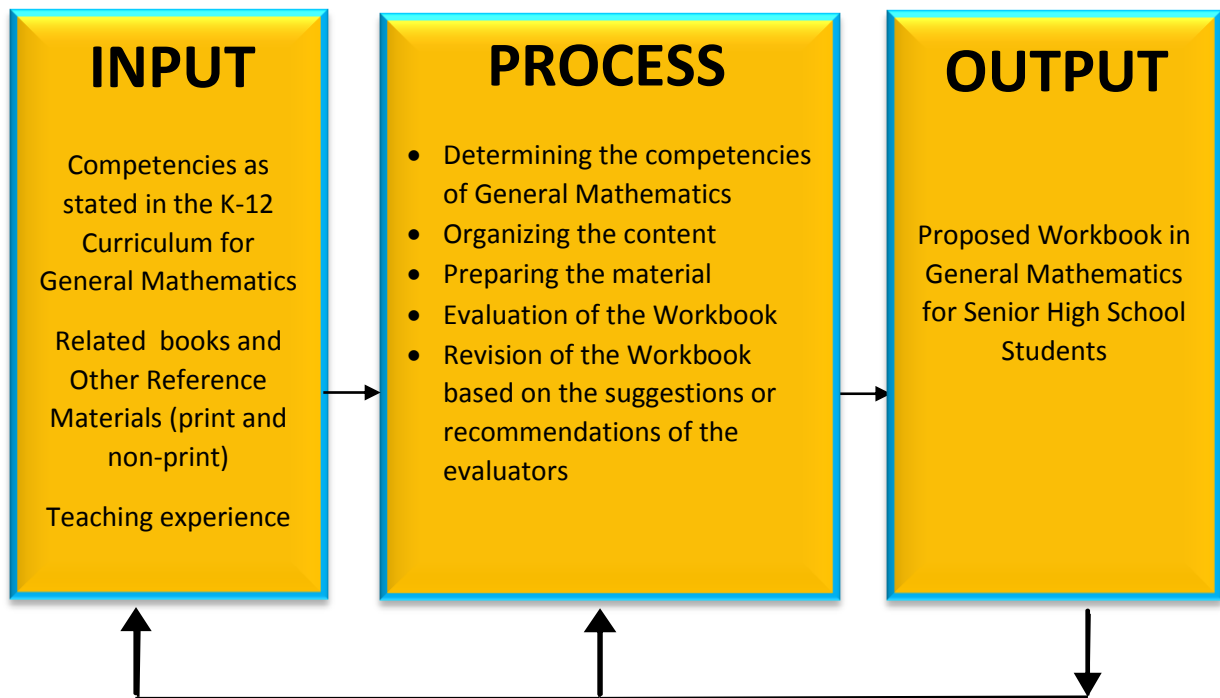


Figure 2. Research Paradigm of the Study

In this study, in the INPUT part, the researcher puts all her effort in identifying the lessons to be included by reviewing the competencies stipulated in the Curriculum Guide for General Mathematics. Since there is no concrete textbook yet of the said subject, she also reviewed books or hand-outs (printed or non-print) related to the different topics stated in the core subject in order to grasp a better idea and understanding of the said lessons. Her experience in teaching the core subject also gave her a lot of knowledge in developing the instructional material. After gathering all

the materials and concepts needed, she also consulted her team mates about their ideas.

In the PROCESS part, the researcher was guided by the different principles presented in the related literature. More so, the development of the proposed workbook underwent several stages such as determining the content, planning the activities, and assessment of the material to ensure that all things needed in making the workbook have been reviewed and studied.

In the OUTPUT part, based on the recommendations of the researcher's adviser and the mathematics experts, the proposed workbook is expected to be an effective and efficient supplementary material in the area of General Mathematics ready for use for next school year.

Participants of the Study

The present paper focused on the development and validation only of the proposed workbook by five Mathematics experts from private and public institution. The experts are teachers who have experienced teaching the subject Mathematics for at least ten years and who have earned at least units in masters. Two of the Mathematics experts have taught Grade eleven students for S. Y. 2015-2016. (See Appendix G for the profile of the evaluators of the developed workbook in General Mathematics).

The Development and Validation of the Workbook

The development of the workbook followed the following stages:

Stage I. Planning Stage

This stage includes the following procedures done by the researcher.

1. Reading and examination of the competencies in General Mathematics provided by the Department of Education for Senior High Curriculum.
2. Identification of topics based on the reviewed competencies.
3. Reading of a plethora of printed materials (textbooks, and other books), non –printed materials (internet), and going over the exercises, quizzes, and exams given to the students and the review of related literature and studies also provided useful information on the strategy employed in the study.

Stage II: Designing Stage

This stage includes the design of the elements of the developed workbook which includes the formatting, styling, content inclusion, and the actual writing of the workbook. It is where everything needed for a workbook was conceptualized and materialized.

The format of the developed workbook includes the following:

1. Heading It is a page containing the Chapter number and General topic with the general objectives stipulated

in the Curriculum Guide given by Dep Ed.

- | | |
|--------------------------|--|
| 2. Lesson No. | It contains the sequence of the topics in each chapter. |
| 3. Specific Objectives | It contains the specific goals to be attained in each lesson which are vital in the attainment of the general objectives. |
| 4. Activities/ Exercises | It is divided into two parts namely Conceptual and Procedural. |
| a) Conceptual | It is called Concept Builder. It is a part of the exercises which require concept recall, answers to simple problems, or one-step solution problems. |
| b) Procedural | It is called Skill Builder. It is a part of the exercises which require more analysis, solutions and answers to two-step or multi-step problems. |

Listed below are the identified topics included in the development of the workbook in General Mathematics based on the reviewed competencies.

Topics Covered in General Mathematics

CHAPTER 1 Introduction to Functions

Lesson 1 Basic Concepts of Functions

Lesson 2 Evaluating Functions

Lesson 3 Combinations on Functions

CHAPTER II Rational Functions

Lesson 1 Basic Concepts of Rational Functions
 ,Equations and Inequalities

Lesson 2 Properties of Rational Functions

Lesson 3 Solving Rational Equations

Lesson 4 Solving Rational Inequalities

Lesson 5 Applications of Rational Functions

CHAPTER II Exploring Inverse, Exponential, and Logarithmic Functions

Lesson 1 Understanding Inverse Functions

Lesson 2 Properties of Exponential Functions

Lesson 3	Transformations of Graphs of Exponential Functions
Lesson 4	Solving Exponential Equations
Lesson 5	Solving Exponential Inequalities
Lesson 6	Properties and Graphs of Logarithmic Functions
Lesson 7	Solving Logarithmic Equations
Lesson 8	Solving Logarithmic Inequalities
Lesson 9	Applications of Exponential and Logarithmic Functions

Extended Lesson: Piece-wise Function

CHAPTER IV Business Mathematics

Lesson 1	Understanding Simple Interest
Lesson 2	Exploring Compound Interest
Lesson 3	Obligations and Equations of Values
Lesson 4	Annuities

Lesson 5 Annuity Due

Lesson 6 Exploring Deferred Annuity

Lesson 7 Amortization

Lesson 8 Bonds

Lesson 9 Stocks

CHAPTER V Logic

Lesson 1 Exploring Propositions

Lesson 2 Operations and Truth Values of Propositions

Lesson 3 Conditional Propositions

Lesson 4 Tautologies, Contingency, and Contradiction

Lesson 5 Categorical Syllogisms, Fallacies, and

Types of Proofs

Stage III Development Stage

This stage includes the construction and development of the learning activities included in the workbook based on the planned design. Each chapter consists of the elements mentioned in Stage II: Design Stage.

After developing the proposed workbook, it was submitted to the researcher's adviser for consultation and pre-validation. Revisions were made based on the suggestions of the researcher's adviser.

Stage IV: Content Validation of the Workbook

The developed workbook was distributed to the five expert -evaluators. They used a five-point Likert rating scale questionnaire, and Expert Assessment Checklist adapted from the studies conducted by Hubilla (2008), Romero (2009), and De Guia (2012) with some revisions. The developed workbook was evaluated according to the variables: objectives, contents, usefulness, clarity, adequacy, and format and design. 9Kindly refer to see Appendix C for the indicators for each variable). In this study, the developed workbook is said to be accepted if the mean range is within the interval 3.41 -5.00.

Using the suggestions given by the evaluators regarding the style and applications, the researcher made some revisions on the developed workbook. More related books were consulted so as to provide enrichment exercises. This phase was completed after all revision and modifications have been done.

CHAPTER IV

PRESENTATION, ANALYSIS, AND INTERPRETATION

This chapter presents the developed workbook in General Mathematics for Senior High School students.

THE DEVELOPED WORKBOOK IN GENERAL MATHEMATICS

FOR SENIOR HIGH SCHOOL STUDENTS

Workbook in General Mathematics

*A companion book of questions and exercises
in
Functions, Business Mathematics, and Logic*

MARIBEL SIMON - PUDIQUET

PREFACE

The *Workbook in General Mathematics* is materialized in order to provide an additional instructional material to senior high school students especially the Grade 11 students. It is made to further enhance the mathematical skills, solving skills and logical thinking skills of the students in the area of advanced algebra (functions), business mathematics, and logic. It contains series of activities, exercises and practical problems or situations which will lead the learners to the attainment of the learning objectives stipulated in the Curriculum guide for General Mathematics.

The learning activities in the given workbook are presented sequentially and simply. It contains information that requires responses in the form of a word, symbol, numbers or equations. Likewise, the learners can answer the exercises at their own pace.

To have an easy access of the exercises, the following parts of the workbook are being provided:

- | | |
|----------------------|--|
| 1. Table of Contents | It contains all the listed chapters and topics with their corresponding pages |
| 2. Heading | It is a page containing the Chapter number and General topic with the general objectives stipulated in the Curriculum Guide given by Dep Ed. |

- | | |
|------------------------|--|
| 3. Lesson No. | It contains the sequence of the topics in each chapter. |
| 4. Specific Objectives | It contains the specific goals to be attained in each lesson which are vital in the attainment of the general objectives |
| a) Concept Builder | It is a part of the exercises which requires concept recall, answers to simple problems or one-step solution problems. |
| b) Skill Builder | It is a part of the exercises which requires more analysis ,solutions and answers to two-step or multi-step problems. |

It is hoped and desired therefore, that this workbook be found useful in the achievement of the mastery of the lessons.

M.S.P.

TABLE OF CONTENTS

CHAPTER 1	Introduction to Functions	1
	Lesson 1 Basic Concepts of Functions.....	2
	Lesson 2 Evaluating Functions.....	6
	Lesson 3 Combinations on Functions.....	8
 CHAPTER II	 Rational Functions	 11
	Lesson 1 Basic Concepts of Rational Functions , Equations and Inequalities	12
	Lesson 2 Properties of Rational Functions.....	14
	Lesson 3 Solving Rational Equations.....	17
	Lesson 4 Solving Rational Inequalities.....	19
	Lesson 5 Applications of Rational Functions	22
 CHAPTER II	 Exploring Inverse, Exponential and Logarithmic Functions	 25
	Lesson 1 Understanding Inverse Functions.....	27
	Lesson 2 Properties of Exponential Functions	30
	Lesson 3 Transformations of Graphs of Exponential Functions	34
	Lesson 4 Solving Exponential Equations.....	36
	Lesson 5 Solving Exponential Inequalities.....	38
	Lesson 6 Properties and Graphs of Logarithmic Functions	40
	Lesson 7 Solving Logarithmic Equations.....	45
	Lesson 8 Solving Logarithmic Inequalities.....	47

	Lesson 9	Applications of Exponential and Logarithmic Functions.....	49
Extended Lesson:		Piece-wise Functions.....	51
CHAPTER IV		Business Mathematics.....	54
	Lesson 1	Understanding Simple Interest.....	56
	Lesson 2	Exploring Compound Interest.....	59
	Lesson 3	Obligations and Equations of Values.....	61
	Lesson 4	Annuities.....	63
	Lesson 5	Annuity Due.....	66
	Lesson 6	Exploring Deferred Annuity.....	68
	Lesson 7	Amortization.....	70
	Lesson 8	Bonds.....	72
	Lesson 9	Stocks	74
CHAPTER V		Logic.....	76
	Lesson 1	Exploring Propositions.....	77
	Lesson 2	Operations and Truth Values of Propositions.....	79
	Lesson 3	Conditional Propositions.....	82
	Lesson 4	Tautologies, Contingency, and Contradiction.....	84
	Lesson 5	Categorical Syllogisms, Fallacies, and Types of Proofs.....	86

Results of the Workbook Validation

The following tables present the data gathered from the expert-evaluators which were tallied, analyzed, and interpreted. The result of the validation of the proposed workbook was interpreted based on the table below as guide.

Table 1
Mean Ranges for the Experts' Assessment Result

Mean Range	Point Scale	Qualitative Description
4.21 – 5.00	5	Highly Acceptable
3.41 – 4.20	4	Acceptable
2.61 – 3.40	3	Moderately Acceptable
1.81 – 2.60	2	Fairly Acceptable
1.00 – 1.80	1	Not Acceptable

The next table gives the result of the validation of the proposed workbook according to its objectives.

Table 2
Results of the Validation of the Proposed Workbook in General
Mathematics in Terms of Objectives

CRITERIA	Mean	Qualitative Description
1. Objectives are specific and clearly stated.	5.00	Highly Acceptable
2. Objectives are indicated in the content area of the workbook.	5.00	Highly Acceptable
3. Objectives are attainable.	4.60	Highly Acceptable
4. Objectives are stated in behavioral terms.	4.60	Highly Acceptable
Overall	4.55	Highly Acceptable

It can be seen in Table 2 that the five evaluators gave the objectives an over - all rating of highly acceptable, with a weighted average of 5. Moreover, all of the indicators had a mean rating of highly acceptable. This indicates that in terms of objectives, the proposed workbook was highly accepted.

Table 3
Results of the Validation of the Proposed Workbook in General
Mathematics in Terms of Contents

CRITERIA	Mean	Qualitative Description
1. Content is relevant to the objectives.	4.6	Highly Acceptable
2. Information and directions are clearly written and explained.	4.6	Highly Acceptable
3. The procedures and exercises for each lesson served as instruments to enhance learning processes and understanding of the concepts.	4.8	Highly Acceptable
4. Lessons are interesting and well-organized.	4.6	Highly Acceptable
5. Activities are suited to the comprehension level of the students and can be performed with less supervision.	4.6	Highly Acceptable
6. Enough practical exercises and application are provided and exhibit functions, business, and logic related situations.	4.4	Highly Acceptable
Overall	4.6	Highly Acceptable

The evaluators gave a weighted mean of 4.6 to the workbook regarding the content relevance to the objectives. Information and directions are clearly written and explained got an average of 4.6 as well. The weighted mean of the criterion “*The procedures and exercises for each lesson served as instruments to enhance learning processes and understanding of the concepts*” was 4.8.

“Lessons are interesting and well-organized” had a weighted mean of 4.6 which is the same with the next criterion *“Activities are suited to the comprehension level of the students and can be performed with less supervision”*. The rating of the last criterion *“Enough practical exercises and application are provided and exhibit functions, business and logic related situations”* got the lowest weighted mean. This shows that the workbook still needs an inclusion of additional practical exercises related to the topics presented. This rating was in contrast to the third criterion which got the highest rating. This indicates that the activities/ exercises in the workbook really enhance the learning process and mastery of the lessons.

Table 4
Results of the Validation of the Proposed Workbook in General
Mathematics in Terms of Usefulness

CRITERIA	Mean	Qualitative Description
1. Provides opportunity for the development and continuous application of skills.	4.6	Highly Acceptable
2. It is effective in arousing students' interest and motivates learning.	4.8	Highly Acceptable
3. It enhances solving ability and decision making of the students.	4.6	Highly Acceptable
4. Motivates students to be more creative and critical minded.	4.4	Highly Acceptable
5. The workbook can be used as make-up work when a student has been absent.	4.4	Highly Acceptable
6. The proposed material is useful even for slow learners.	4.4	Highly Acceptable
7. Students will appreciate mathematics better when the teaching-learning activities are supplemented by the workbook.	4.8	Highly Acceptable
Overall	4.57	Highly Acceptable

The result of the evaluation of the experts in the usefulness of the developed workbook is shown in Table 5. The criteria *“The workbook provides opportunity for the development and continuous application of skills”* and *“Enhances solving ability and decision making of the students”* got a weighted mean of 4.6, interpreted as highly accepted by the experts. Likewise, the evaluators highly accepted and gave a weighted mean of 4.8 to both of the criteria *“The workbook is effective in arousing students’ interest and motivates learning”* and *“Students will appreciate mathematics better when the teaching-learning activities are supplemented by the workbook”*. Further, the strong approval of the evaluators on workbook was evident in the 4.4 weighted mean on the three criteria *“The workbook motivates students to be more creative and critical minded”*, *“The workbook can be used as make-up work when a student has been absent”*, and *“The proposed material is useful even for slow learners”*. However, in the summary of individual evaluation (see Appendix page 12-13), Expert 5 moderately accepted that the workbook could be used as make-up work when a student has been absent; likewise, Expert 3 moderately accepted that the proposed material was useful even for slow learners.

The next table provides a summary of the mean as a result of expert evaluation.

Table 5

Results of the Validation of the Proposed Workbook in General Mathematics in Terms of Clarity

CRITERIA	Mean	Qualitative Description
1. Suggested activities are easy to follow.	4.6	Highly Acceptable
2. Procedures are presented in simple and precise language.	4.6	Highly Acceptable
3. Language used is clear, simple, and easy to understand within the comprehension of the students.	4.6	Highly Acceptable
4. It is adaptable to students' interest and level of comprehension.	4.2	Acceptable
Overall	4.5	Highly Acceptable

All of the experts highly accepted that the *“Activities are easy to follow, procedures are presented in simple and precise language, and language used is clear, simple, and easy to understand within the comprehension of the students”*. They just gave “accepted” rating in item 4 on *“Adaptable to students’ interest and level of comprehension”* with a weighted mean of 4.2. Still Expert 3 fairly accepted that it captures the interest of the students and meets their level of comprehension.

Table 6

Results of the Validation of the Proposed Workbook in General Mathematics in Terms of Adequacy

CRITERIA	Mean	Qualitative Description
1. Every topic is adequate for determining the mastery level of the students.	4.8	Highly Acceptable
2. It provides sufficient information and understanding of General Mathematics concepts.	4.6	Highly Acceptable
3. It covers scope of the learning area.	4.8	Highly Acceptable
4. General Mathematics concepts and theories are applied.	4.8	Highly Acceptable
Overall	4.75	Highly Acceptable

The result of the evaluation on the adequacy of the developed workbook is shown in Table 7. All of the evaluators highly accepted that *“Every topic is adequate for determining the mastery level of the students, scope of the learning area is covered, and General Mathematics concepts and theories are applied”* resulting to a weighted mean of 4.8; likewise, the *criterion “Provides sufficient information and understanding of General Mathematics concepts”* was highly accepted but only with an average of 4.6.

Table 7

Results of the Validation of the Proposed Workbook in General Mathematics in Terms of Format and Design

CRITERIA	Mean	Qualitative Description
1. The format of the workbook is easy to follow.	4.8	Highly Acceptable
2. The workbook provides a useful table of contents and general and specific objectives.	4.8	Highly Acceptable
3. The workbook can easily be carried out.	4.8	Highly Acceptable
Overall	4.8	Highly Acceptable

Table 8 shows the summary of evaluation of the developed workbook with its format and design. It is evident in the result that *“The format of the workbook is easy to follow, the workbook provides a useful table of contents and general and specific objectives, and can easily be carried out”*. Thus, the evaluators highly accepted it as shown in the rating’s weighted mean of 4.8.

The table below presents the individual evaluation of the five experts regarding the objectives, contents, usefulness, clarity, adequacy, and format and design of the developed workbook.

Table 8

Overall Summary of the Results of Validation of the Developed Workbook in General Mathematics

CRITERIA	Mean	Qualitative Description
I. Objectives	4.55	Highly Acceptable
II. Contents	4.60	Highly Acceptable
III. Usefulness	4.57	Highly Acceptable
IV. Clarity	4.50	Highly Acceptable
V. Adequacy	4.75	Highly Acceptable
VI. Format and Design	4.80	Highly Acceptable
OVERALL WEIGHTED MEAN	4.63	Highly Acceptable

The overall weighted mean of 4.63 of the workbook evaluation shows the highly acceptable rating of the evaluators. Since 4.63 is higher than 3.41, then the workbook is acceptable to the experts.

CHAPTER V

Summary of Findings, Conclusions, and Recommendations

This chapter shows the synthesis on the findings of the study, drawn conclusion, and offered recommendations.

Summary

The main objective of the development and assessment of the proposed workbook in General Mathematics is to provide the teachers ANaid in teaching General Mathematics for Grade 11 students especially in St. Paul College, Pasig which started in advance the implementation of the Senior High Curriculum. Likewise, it aims to help the students enrich their knowledge and master the competencies of the subject.

The researcher used descriptive –developmental research in her study. According to Calderon and Gonzales (2010), descriptive method is a fact-finding study with adequate and accurate interpretation of the findings. The study is also developmental because it developed and assessed a workbook in General Mathematics.

The developed workbook of the present study was evaluated by five Mathematics experts from private and public institutions. The experts are teachers who have teaching experience in Mathematics for at least ten years and who have earned at least units in masters. Likewise, two of the experts have taught Grade 11 students for S. Y. 2015-2016. The experts used a five-point

Likert rating scale and Expert Assessment Checklist adapted with some revisions from the studies conducted by Hubilla (2009), Romero (2009), and De Guia (2012). The researcher used the Mean Ranges for the interpretation of the Expert Assessment.

Findings

1. The developed workbook was highly accepted as rated by the five mathematics experts in terms of objectives, contents, usefulness, clarity, adequacy, and format and design.
2. The procedures and exercises for each lesson in the workbook served as instruments to enhance learning processes and understanding of the concepts, effective in arousing students' interest and motivates learning, and served as a supplementary tool in the teaching –learning process.
3. Based on the commendations and suggestions of the evaluators, the exercises presented were arranged from easy to difficult, attainable, and there was a variety of exercises; the workbook was full with exercises and activities that may help the learners enhance their knowledge and solve ability in Mathematics.

Conclusion

Based on the findings, the following conclusions were drawn:

1. The developed workbook helps the senior high school students to understand more the concepts of the core subject, General Mathematics.

2. The developed workbook aids the teachers in handling and facilitating the subject General Mathematics for Grade eleven students.

Recommendations

In the light of the findings and conclusions, the following recommendations are given.

1. The developed workbook can be used by the teachers in facilitating the discussion of their lessons and the intended user- Grade eleven students.
2. It can be tried out to the intended users for a more valid and reliable generalizations of the study.
3. A parallel study must be done in order to validate the findings of this research.
4. Situational analysis can still be considered so that the students can really see the significance of the values.
5. Inclusion of activities from other subjects may be done to make the material more engaging and challenging.

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APPENDICES

APPENDIX A

Learning competencies of the K to 12 Basic Education Curriculum Senior High School – Core Subject General Mathematics offered to Grade eleven students

CONTENT	LEARNING COMPETENCIES
Functions and Their Graphs	• Represent real-life ideas using functions including piece-wise functions M11GM-Ia-1 • Evaluate the functions given. M11GM-Ia-2 • Perform the addition, subtraction, multiplication, and division of functions. M11GM-Ia-3 • Determine the composition of functions. M11GM-Ia-3 • Solve problems involving functions. M11GM-Ia-4 • Represents real-life situations using rational functions. M11gm-ib-1 • Distinguishes rational function, rational equation, and rational inequality. M11gm-ib-2 • Solves rational equations and inequalities. M11gm-ib-3 • Represents a rational function through its: (a) table of values, (b) graph, and (c) equation. M11gm-ib-4 • Finds the domain and range of a rational function. M11gm-ib-5 • Determines the:(a) intercepts(b) zeroes; and(c) asymptotes of rational functionsM11GM-Ic-1

	• Graphs rational functions. M11GM-Ic-2 • Solves problems involving rational functions, equations, and inequalities. M11GM-Ic-3 • Represents real-life situations using one-to one functions. M11GM-Id-1 • Determines the inverse of a one-to-one function. M11GM-Id-2 • Represents an inverse function through its: (a) table of values, and (b) graph. M11GM-Id-3 • Finds the domain and range of an inverse function. M11GM-Id-4 • Graphs inverse functions. M11GM-Ie-1 • Solves problems involving inverse functions. M11GM-Ie-2 • Represents real-life situations using exponential functions. M11GM-Ie-3 • Distinguishes between exponential function, exponential equation, and exponential inequality. M11GM-Ie-4 • Solves exponential equations and inequalities. M11GM-Ie-f-1 • Represents an exponential function through its: (a) table of values, (b) graph, and (c) equation. M11GM-If-2 • Finds the domain and range of an exponential function. M11GM-If-3 • Determines the intercepts, zeroes, and asymptotes of an exponential function. M11GM-If-4 • Graphs exponential functions. M11GM-Ig-1
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	- Solves problems involving exponential functions, equations, and inequalities. M11GM-Ig-2 - Represents real-life situations using logarithmic functions. M11GM-Ih-1 - Distinguishes logarithmic function, logarithmic equation, and logarithmic inequality. M11GM-Ih-2 - Illustrates the laws of logarithms. M11GM-Ih-3 - Solves logarithmic equations and inequalities. M11GM-Ih-i-1 - Represents a logarithmic function through its: (a) table of values, (b) graph, and (c) equation. M11GM-Ii-2 - Finds the domain and range of a logarithmic function. M11GM-Ii-3 - Determines the intercepts, zeroes, and asymptotes of logarithmic functions. M11GM-Ii-4 - Graphs logarithmic functions. M11GM-Ij-1 - Solves problems involving logarithmic functions, equations, and inequalities. M11GM-Ij-2
Basic Business Mathematics	- Illustrates simple and compound interests. M11gm-ii-a-1 - Distinguishes between simple and compound interests. M11gm-ii-a-2 - Computes interest, maturity value, future value, and present value in simple interest and compound interest environment. m11gm-ii-a-b-1 - Solves problems involving simple and compound interests.

	M11gm-iib-2 • Illustrates simple and general annuities. M11gm-iic-1 • Distinguishes between simple and general annuities. M11gm-iic-2 • Finds the future value and present value of both simple annuities and general annuities. M11gm-iic-d-1 • Calculates the fair market value of a cash flow stream that includes an annuity. M11gm-iid-2 • Calculates the present value and period of deferral of a deferred annuity. M11gm-iid-3 • Illustrate stocks and bonds. M11gm-iie-1 • Distinguishes between stocks and bonds. M11gm-iie-2 • Describes the different markets for stocks and bonds. M11gm-iie-3 • Analyzes the different market indices for stocks and bonds. M11gm-iie-4 • Interprets the theory of efficient markets. M11gm-iie-5 M11gm-iif-1 • Illustrates business and consumer loans. M11gm-iif-1 • Distinguishes between business and consumer loans. M11gm-iif-2 • Solves problems involving business and consumer loans(amortization, mortgage). M11gm-iif-3
Logic	• Illustrates a proposition. M11gm-iig-1

	• Symbolizes propositions. M11gm-ii-g-2 • Distinguishes between simple and compound propositions. M11gm-ii-g-3 • Performs the different types of operations on propositions. M11gm-ii-g-4 • Determines the truth values of propositions. M11gm-ii-h-1 • Illustrates the different forms of conditional propositions. M11gm-ii-h-2 • Illustrates different types of tautologies and fallacies. M11gm-iii-1 • Determines the validity of categorical syllogisms. M11gm-iii-2 • Establishes the validity and falsity of real-life arguments using logical propositions, syllogisms, and fallacies. M11gm-iii-3 • Illustrates the different methods of proof (direct and indirect) and disproof (indirect and by counterexample). M11gm-ii-j-1 • Justifies mathematical and real-life statements using the different methods of proof and disproof. M11gm-ii-j-2
--	---

APPENDIX B

Letter of Request

Philippine Normal University
Taft Avenue, Manila

April 25, 2016

Dear Ma'am /Sir:

Greetings with peace and love of Christ!

I, the undersigned is a pursuing my Master of Arts in Teaching Mathematics at Philippine Normal University, Taft, Manila and is at present conducting a study with the title “ **A Proposed Workbook in General Mathematics.**”

In this regard, I would like to ask for your precious time to assess, as honestly as possible, the developed instructional material by using **the Evaluation Form-Expert's Assessment Checklist (EAC)** attached herein. With your experience and expertise in the field of Mathematics, feel free to write your commendations/recommendations for the improvement of this workbook in order to come up with the preferred results. Rest assured that your responses will be made confidential.

Thank you very much for your positive response and cooperation. I shall remain indebted to you.

Respectfully yours,

Maribel Simon Pudiquet
Researcher

Noted by:

Dr. Rene R. Belecina
Adviser

APPENDIX C

Likert's Five Point Rating Scale with Questionnaires

5 - SA	Strongly Agree
4 – A	Agree
3 –U	Undecided
2 – D	Dis Agree
1 – SD	Strongly Disagree

CRITERIA	SCALE				
I. Objectives	5	4	3	2	1
1. Objectives are specific and clearly stated.					
2. Objectives are indicated in the content area of the workbook.					
3. Objectives are attainable.					
4. Objectives are stated in behavioral terms.					
II. Contents					
7. Content is relevant to the objectives.					
8. Information and directions are clearly written and explained.					
9. The procedures and exercises for each lesson served as instruments to enhance learning processes and understanding of the concepts.					
10. Lessons are interesting and well-organized.					
11. Activities are suited to the comprehension level of the students and can be performed with less supervision.					

12. Enough practical exercises and application are provided and exhibit functions, business and logic related situations.					
III. Usefulness					
8. Provides opportunity for the development and continuous application of skills.					
9. It is effective in arousing students' interest and motivates learning.					
10. It enhances solving ability and decision making of the students.					
11. Motivates students to be more creative and critical minded.					
12. The workbook can be used as make-up work when a student has been absent.					
13. The proposed material is useful even for slow learners.					
14. Students will appreciate mathematics better when the teaching-learning activities are supplemented by the workbook.					
IV. Clarity					
5. Suggested activities are easy to follow.					
6. Procedures are presented in simple and precise language.					
7. Language used is clear, simple, and easy to understand within the comprehension of the students.					
8. It is adaptable to students' interest and level of comprehension.					
V. Adequacy					
5. Every topic is adequate for determining the mastery level of the students.					
6. Provides sufficient information and understanding of General Mathematics					

concepts.					
7. It covers scope of the learning area.					
8. General Mathematics concepts and theories are applied.					
V. Format and Design					
4. The format of the workbook is easy to follow.					
5. The workbook provides a useful table of contents and general and specific objectives.					
6. The workbook can easily be carried out					

APPENDIX D

Mean Ranges for the Experts' Assessment Checklist

Weighted Mean Range	Point Scale	Qualitative Description
4.21 – 5.0	5	Strongly Agree
3.41 – 4.20	4	Agree
2.61 – 3.40	3	Undecided
1.81 – 2.60	2	Disagree
1.0 – 1.80	1	Strongly Disagree

APPENDIX E

Rating Sheet for Evaluation of the Workbook in General Mathematics

I. PERSONAL DATA

Name: _____

School: _____

Position/title: _____

Length of Service: _____

No. of Years Teaching Mathematics: _____

Educational Attainment: _____

Outstanding Accomplishments: _____

.....

II. EVALUATION INSTRUMENT

Direction: Listed below are criteria for evaluating the various aspects of the Proposed Workbook in General Mathematics for Grade Eleven students.

Please rate each item by checking(✓) the column that corresponds for the component equivalent in the five (5)-point scale as follows:

5 - SA	Strongly Agree
4 - A	Agree
3 - U	Undecided
2 - D	DisAgree
1 - SD	Strongly Disagree

CRITERIA	SCALE				
I. Objectives	5	4	3	2	1
5. Objectives are specific and clearly stated.					
6. Objectives are indicated in the content area of the workbook.					
7. Objectives are attainable.					
8. Objectives are stated in behavioral terms.					
II. Contents					
13. Content is relevant to the objectives.					
14. Information and directions are clearly written and explained.					
15. The procedures and exercises for each lesson served as instruments to enhance learning processes and understanding of the concepts.					
16. Lessons are interesting and well-organized.					
17. Activities are suited to the comprehension level of the students and can be performed with less supervision.					
18. Enough practical exercises and application are provided and exhibit functions, business and logic related situations.					
III. Usefulness					
15. Provides opportunity for the development and continuous application of skills.					
16. It is effective in arousing students' interest and motivates learning.					
17. It enhances solving ability and decision making of the students.					
18. Motivates students to be more creative and critical minded.					

19. The workbook can be used as make-up work when a student has been absent.					
20. The proposed material is useful even for slow learners.					
21. Students will appreciate mathematics better when the teaching-learning activities are supplemented by the workbook.					
IV. Clarity					
9. Suggested activities are easy to follow.					
10. Procedures are presented in simple and precise language.					
11. Language used is clear, simple, and easy to understand within the comprehension of the students.					
12. It is adaptable to students' interest and level of comprehension.					
V. Adequacy					
9. Every topic is adequate for determining the mastery level of the students.					
10. Provides sufficient information and understanding of General Mathematics concepts.					
11. It covers scope of the learning area.					
12. General Mathematics concepts and theories are applied.					
V. Format and Design					
7. The format of the workbook is easy to follow.					
8. The workbook provides a useful table of contents and general and specific objectives.					
9. The workbook can easily be carried out					

Commendations/Recommendations:

Evaluated by:

Name of Evaluator

APPENDIX F

Overall Summary of the Results of Evolution on the Developed Workbook in General Mathematics

CRITERIA	Experts					Weighted Mean	Description
	1	2	3	4	5		
I. Objectives							
9. Objectives are specific and clearly stated.	5	5	5	5	5	5	Strongly Agree
10. Objectives are indicated in the content area of the workbook.	5	5	5	5	5	5	Strongly Agree
11. Objectives are attainable.	5	5	4	5	4	4.6	Strongly Agree
12. Objectives are stated in behavioral terms.	4	5	4	5	5	4.6	Strongly Agree
II. Contents							
1. Content is relevant to the objectives.	5	4	4	5	5	4.6	Strongly Agree
2. Information and directions are clearly written and explained.	4	5	4	5	5	4.6	Strongly Agree
3. The procedures and exercises for each lesson served as instruments to enhance learning processes and understanding of the concepts.	5	5	4	5	5	4.8	Strongly Agree
4. Lessons are interesting and well-organized.	5	5	4	5	4	4.6	Strongly Agree
5. Activities are suited to the comprehension level of the students and can be performed with less supervision.	5	5	4	4	5	4.6	Strongly Agree
6. Enough practical exercises and application are provided and exhibit functions, business and logic related situations.	5	5	3	5	4	4.4	Strongly Agree

III. Usefulness							
1. Provides opportunity for the development and continuous application of skills.	5	4	4	5	5	4.6	Strongly Agree
2. It is effective in arousing students' interest and motivates learning.	5	5	4	5	5	4.8	Strongly Agree
3. It enhances solving ability and decision making of the students.	4	5	4	5	5	4.6	Strongly Agree
4. Motivates students to be more creative and critical minded.	4	5	4	5	4	4.4	Strongly Agree
5. The workbook can be used as make-up work when a student has been absent.	5	5	4	5	3	4.4	Strongly Agree
6. The proposed material is useful even for slow learners.	5	5	3	4	5	4.4	Strongly Agree
7. Students will appreciate mathematics better when the teaching-learning activities are supplemented by the workbook.	5	5	4	5	5	4.8	Strongly Agree
IV. Clarity							
1. Suggested activities are easy to follow.	5	5	4	4	5	4.6	Strongly Agree
2. Procedures are presented in simple and precise language.	5	5	4	5	4	4.6	Strongly Agree
3. Language used is clear, simple, and easy to understand within the comprehension of the students.	5	5	4	5	4	4.6	Strongly Agree
4. It is adaptable to students' interest and level of comprehension.	5	5	3	4	4	4.2	Strongly Agree
V. Adequacy							
1. Every topic is adequate for determining the mastery level of the students.	5	5	4	5	5	4.8	Strongly Agree
2. Provides sufficient information and	5	5	4	5	4	4.6	Strongly Agree

understanding of General Mathematics concepts.							
3. It covers scope of the learning area.	5	5	4	5	5	4.8	Strongly Agree
4. General Mathematics concepts and theories are applied.	5	5	4	5	5	4.8	Strongly Agree
VI. Format and Design							
10. The format of the workbook is easy to follow.	5	5	4	5	5	4.8	Strongly Agree
11. The workbook provides a useful table of contents and general and specific objectives.	5	5	4	5	5	4.8	Strongly Agree
12. The workbook can easily be carried out	5	5	4	5	5	4.8	Strongly Agree
OVERALL WEIGHTED MEAN	4.86	4.93	4.40	4.86	4.86	4.63	Strongly Agree

Below are some unedited commendations and recommendations of the evaluators.

- The exercises presented are arranged from easy to difficult
- There was a variety of exercises.
- This workbook is designed for independent learning
- Outcome of hardwork and persistence
- The items presented are attainable
- You can still improve on the format for some pages
- Please rephrase or revise some of the instructions
- Add more items that will let the students think critically
- May consider situational analysis so that students can really see the significance of the values ;
- May I also recommend that this ,material be evaluated by the user - Grade 11
- Well done! Good job Mr. Pudiquet!
- May we can use this material for our students next year
- Adapt activities form the other subjects to make the material more engaging and challenging

- Provide a more creative and parallel application that involves real life situations as it develop students critical thinking and problem solving skills
- The proposed workbook is great!
- It is full of exercises and activities that may help the users enhance their knowledge and solving ability in Mathematics.
- I recommend that the proposed workbook must be evaluated not only by the experts in the field of mathematics but also by the user of the workbook.
- I can see that you really put a lot into this workbook.
- There are some errors in the objectives and instruction. You might want to review them.

APPENDIX G

Profile of the Five Mathematics Experts

Evaluator	Designation/School	Educational Attainment/ Accomplishments	No. of years in teaching math
Violeta P. Buli-e	Student Welfare Committee Chair; Senior High Math teacher; St. Paul College, Pasig	M.A. in Educational Management ; earned 36 units	19
April Joanne Jandusay	Grade 12 Homeroom Team Leader ; Senior High Math Teacher; St. Paul College, Pasig	B.S. in Computer Engineering; earned units in MAEd.	15
Vilma P. Cabigao	Teacher II ; Fort Bonifacio High School	M.A-Special Education (earned 42 units)	
Cheran A. Manansala	High School Math Teacher II; Nagpayong High School	M.A.in Teaching Mathematics (earned 38 units) MTAP Scholar	12
Mr. Frederick B. Chulvo	High school math teacher; St. Paul College, Pasig	M.A. in Educational Management (9 units)	10

Workbook in General Mathematics

Philippine Normal University
The National Center for Teacher Education
College of Graduate Studies and Teacher Education Research

10 May 2016

CERTIFICATION

This certifies that I have edited the seminar paper **"A PROPOSED WORKBOOK IN GENERAL MATHEMATICS FOR SENIOR HIGH SCHOOL STUDENTS"**, by Maribel S. Pudiquet, a candidate in MA in Teaching Mathematics.



MERRY RUTH M. GUTIERREZ

CGSTER Faculty



AUTHENTICITY RESULT

Date of Release: May 10, 2016
Result Code: 2016-0134
Submission ID: 672180860
Title of Output: A Proposed Workbook in General Mathematics for Senior High School Students
Author(s): Maribel Simon – Pudiquet

Authenticity Report:

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Recommendations:

- Use of quotations for exactly copied text is suggested.
- For assumed to be cited parts of the manuscript but highlighted, it is recommended that authors rephrase these portions.

Rio Anne R. Maño
(Authenticity Administrator)

Noted by:

Dr. Marie Paz E. Morales
Director, Publications Office



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Maribel Simon-Pudiquet
Liwan Norte, Enrile, Cagayan

CURRICULUM VITAE

Personal Information:

Date of Birth:	November 16, 1982
Place of Birth:	Liwan Norte, Enrile, Cagayan
Gender:	Female
Civil Status:	Married
Name of Husband:	Francisco U. Pudiquet Jr.
Citizenship:	Filipino
Religion:	Roman Catholic
Profession:	Teaching

Educational Background:

Graduate:	Master of Arts in Teaching Mathematics Philippine Normal University Taft, Manila
-----------	--

Tertiary:	St. Paul University, Philippines Tuguegarao City Cum Laude
Secondary:	Enrile Vocational High School-Annex Enrile, Cagayan Salutatorian
Elementary:	Liwan Norte, Enrile, Cagayan Enrile, Cagayan Salutatorian

Workbook in General Mathematics

*A companion book of questions and exercises
in
Functions, Business Mathematics, and Logic*

MARIBEL SIMON - PUDIQUET

PREFACE

The *Workbook in General Mathematics* is materialized in order to provide an additional instructional material to senior high school students especially the Grade 11 students. It is made to further enhance the mathematical skills, solving skills and logical thinking skills of the students in the area of advanced algebra (functions), business mathematics, and logic. It contains series of activities, exercises and practical problems or situations which will lead the learners to the attainment of the learning objectives stipulated in the Curriculum guide for General Mathematics.

The learning activities in the given workbook are presented sequentially and simply. It contains information that requires responses in the form of a word, symbol, numbers or equations. Likewise, the learners can answer the exercises at their own pace.

To have an easy access of the exercises, the following parts of the workbook are being provided:

1. Table of Contents It contains all the listed chapters and topics with their corresponding pages.
2. Heading It is a page containing the Chapter number and General topic with the general objectives stipulated in the Curriculum Guide given by Dep Ed.

3. Lesson No. It contains the sequence of the topics in each chapter.

4. Specific Objectives It contains the specific goals to be attained in each lesson which are vital in the attainment of the general objectives

a) Concept Builder It is a part of the exercises which requires concept recall, answers to simple problems or one-step solution problems.

b) Skill Builder It is a part of the exercises which requires more analysis ,solutions and answers to two-step or multi-step problems.

It is hoped and desired therefore, that this workbook be found useful in the achievement of the mastery of the lessons.

-M.S.P.

TABLE OF CONTENTS

CHAPTER I	Introduction to Functions	1
	Lesson 1 Basic Concepts of Functions.....	2
	Lesson 2 Evaluating Functions.....	6
	Lesson 3 Combinations on Functions.....	8
CHAPTER II	Rational Functions	11
	Lesson 1 Basic Concepts of Rational Functions , Equations and Inequalities	12
	Lesson 2 Properties of Rational Functions.....	14
	Lesson 3 Solving Rational Equations.....	17
	Lesson 4 Solving Rational Inequalities.....	19
	Lesson 5 Applications of Rational Functions	22
CHAPTER III	Exploring Inverse, Exponential and Logarithmic Functions	25
	Lesson 1 Understanding Inverse Functions.....	27
	Lesson 2 Properties of Exponential Functions	30
	Lesson 3 Transformations of Graphs of Exponential Functions	34
	Lesson 4 Solving Exponential Equations.....	36
	Lesson 5 Solving Exponential Inequalities.....	38
	Lesson 6 Properties and Graphs of Logarithmic Functions	40
	Lesson 7 Solving Logarithmic Equations.....	45
	Lesson 8 Solving Logarithmic Inequalities.....	47

	Lesson 9	Applications of Exponential and Logarithmic Functions.....	49
Extended Lesson:		Piece-wise Functions.....	51
CHAPTER IV		Business Mathematics.....	54
	Lesson 1	Understanding Simple Interest.....	56
	Lesson 2	Exploring Compound Interest.....	59
	Lesson 3	Obligations and Equations of Values.....	61
	Lesson 4	Annuities.....	63
	Lesson 5	Annuity Due.....	66
	Lesson 6	Exploring Deferred Annuity.....	68
	Lesson 7	Amortization.....	70
	Lesson 8	Bonds.....	72
	Lesson 9	Stocks	74
CHAPTER V		Logic.....	76
	Lesson 1	Exploring Propositions.....	77
	Lesson 2	Operations and Truth Values of Propositions.....	79
	Lesson 3	Conditional Propositions.....	82
	Lesson 4	Tautologies, Contingency, and Contradiction.....	84
	Lesson 5	Categorical Syllogisms, Fallacies, and Types of Proofs.....	86

CHAPTER I

INTRODUCTION TO FUNCTIONS

TOPICS

Lesson 1	Basic Concepts of Functions
Lesson 2	Evaluating Function
Lesson 3	Combinations on Functions

LEARNING COMPETENCIES

- Review the basic concepts of functions.
- Identify the types of relations.
- Represent real-life ideas using functions including piece-wise functions **M11GM-Ia-1**
- Evaluate the functions given. **M11GM-Ia-2**
- Perform the addition, subtraction, multiplication, and division of functions. **M11GM-Ia-3**
- Determine the composition of functions. **M11GM-Ia-3**
- Solve problems involving functions. **M11GM-Ia-4**
- Decompose the given functions.

NAME: _____ Year & Track: _____ Date: _____

LESSON 1: BASIC CONCEPTS ON FUNCTIONS

Objectives:

At the end of each lesson, the students should be able to:

- review the basic concepts of functions;
- identify the types of relations;
- determine if the relation is a function or not;
- identify the domain and range of a given function; and
- represent real-life ideas using functions.



**CONCEPT
BUILDER**

I. Multiple Choice

Read the given statements below. Then, write the letter of your choice inside the brackets.

- [] 1. It is any set of ordered pairs.
- A. relation B. domain C. range
- [] 2. It is a set of second elements in a relation.
- A. domain B. ordinate C. range
- [] 3. It is a set of first elements in a relation.
- A. domain B. abscissa C. range
- [] 4. It is a special type of a relation where the domain is not repeated.
- A. function B. set C. asymptote
- [] 5. It is a line test used to determine if the graph of a relation is a function or not.
- A. asymptote line test B. horizontal line test C. vertical line test
- [] 6. This is a line test used to determine if the graph of a function is a graph of many-to-one or one-to-one function
- A. diagonal line test B. horizontal line test C. vertical line test

- [] 7. What is the domain of the relation $\{(5, 4), (2, 7), (3, 6), (2, 4)\}$?
- A. $\{4, 5, 6, 7\}$ B. $\{4, 6, 7\}$ C. $\{2, 3, 5\}$
- [] 8. What is the range of the relation $\{(-1, 2), (-2, 2), (-3, 2), (-3, 2)\}$?
- A. $\{2\}$ B. $\{-1, -2, -3\}$ C. $\{-3\}$
- [] 9. What is the range of the equation $y = 4$?
- A. 4 B. 0 C. undefined
- [] 10. What is the domain of the function $f(x) = 4x^2 + 3x + 11$?
- A. set of real numbers B. set of positive numbers C. zero
- [] 11. What is the range of the function $g(x) = -|3x + 7|$?
- A. $\{y \mid y \geq 0\}$ B. $\{y \mid y \leq 0\}$ C. $\left\{y \mid y \leq -\frac{7}{3}\right\}$
- [] 12. Which of the following is the domain of $h(x) = \sqrt{2x - 3}$?
- A. $\left\{x \mid x \geq \frac{3}{2}\right\}$ B. $\left\{x \mid x \geq -\frac{3}{2}\right\}$ C. $\left\{x \mid x \geq \frac{2}{3}\right\}$
- [] 13. Which of the following is not part of the domain of the function $f(x) = \frac{2}{x - 10}$?
- A. 2 B. 10 C. -10
- [] 14. Which of the following functions has a range greater than 7 ?
- A. $\{(x, y) \mid y = x + 7\}$
 B. $\{(x, y) \mid y = -|4 - x^2| + 7\}$
 C. $\{(x, y) \mid y = 7 + \sqrt{x}\}$
- [] 15. What is the domain of $\sqrt{x^2 - 1}$?
- A. $\{x \geq -1 \text{ or } x \leq 1\}$ B. $\{x \geq -1 \text{ and } x \leq 1\}$ C. $\{x \geq 1 \text{ or } x \leq -1\}$

II. Alternate Choice

Encircle the letter A if the given is a function, and encircle the letter B if it is a relation.

1. $f(x) = -2x + x^2$ A B

2. $\{(x,y) \mid 2x - 3y^2 = 6\}$ A B

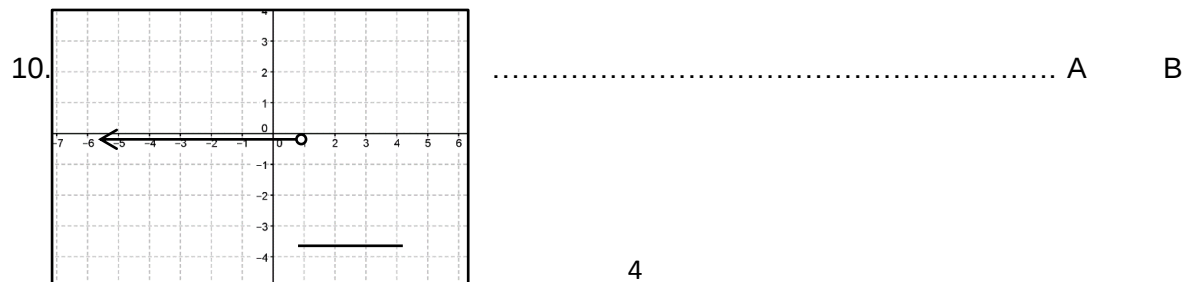
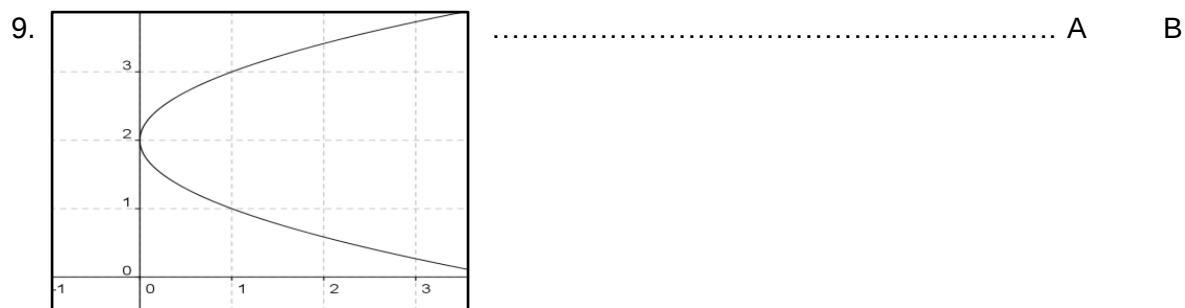
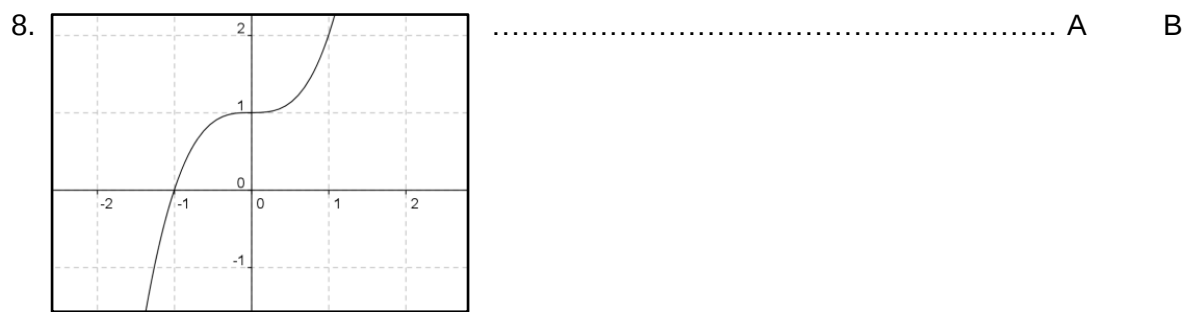
3. $y = \pm\sqrt{3x + 7}$ A B

4. $\{(x,y) \mid |x| + |y| = 5\}$ A B

5. $\{(0,0), (1,0), (2,0), (3,0)\}$ A B

6. $\{(1,1), (1,-1), (4,2), (4,-2)\}$ A B

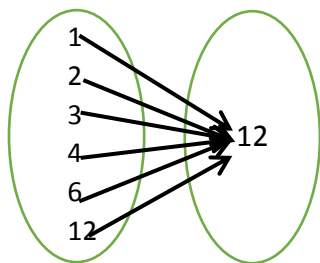
7. $\{(2,4), (4,8), (6,12), (8,16)\}$ A B



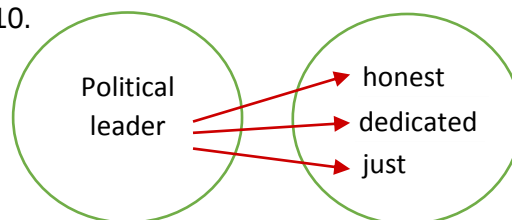
III. Which of the following situations illustrates a one-to-one relation, many-to-one relation and one-to-many relation? Write your the letter of your answer in the brackets. Write D if your answer is not on the choices.

A. one-to-one relation B. many-to-one relation C. one-to-many relation

- [] 1. to every section there corresponds an adviser
 [] 2. to every primary color there corresponds a secondary color
 [] 3. to every person there corresponds a weight
 [] 4. to every calamity victim there corresponds a humanitarian act
 [] 5. to every child born there corresponds a finger print
 [] 6. to every car there corresponds a plate number
 [] 7. to every person there corresponds a unique talent
 [] 8. $\{(-1,2),(-1,3),(-1,4),(-1,5)\}$
 [] 9.



[] 10.



**SKILL
BUILDER**

I. Find the domain and range of the given functions.

1. $\{(x,y) \mid y = 3x+1, x = -1, -2, -3\}$
2. $\{(x, y) \mid y = x^2-1, x = -2, -1, 0, 1\}$
3. $\{(x, y) \mid y = |x+1|, x = 7, 6, 5, 4\}$

II. Determine the set of ordered pairs given each condition.

1. domain is twice the range ; $y = 2, 3, 4, 5$
2. range is 1 more than half its domain ; $x = -2, -4, -6, -8$

NAME: _____ Year & Track: _____ Date: _____

LESSON 2: EVALUATING FUNCTIONS

Objectives:

At the end of each lesson, the students should be able to:

- substitute the value of the indicated variable accurately;
- answer the Cross-Number puzzle by evaluating the functions given; and
- simplify functions using the indicated values.



**CONCEPT
BUILDER**

CROSS-NUMBER PUZZLE

Evaluate each given function with the corresponding value of the indicated variable, then write your answer in the box provided, following the direction found above the given items.

ACROSS

- 1) $f(-1) = x + 123$; $x = -1$
- 3) $f(x) = |x + 36|$; $x = 15$
- 5) $f(x) = 6 + \sqrt{x}$; $x = 16$
- 7) $f(x) = -3x + 5$; $x = 6$
- 8) $f(x) = \frac{1}{2}(6x)$; $x = -6$
- 10) $f(x) = x^2 - 23$; $x = -12$
- 11) $f(x) = 20x$; $x = \frac{1}{2}$
- 13) $f(x) = x^2 - 1$; $x = -9$
- 14) $f(x) = 15x - 9$; $x = 14$

DOWN

- 1) $g(x) = x^2$; $x = 12$
- 2) $f(0) = 4b^2 - 6b + 20$; $b = 0$
- 3) $g(x) = 76 - \sqrt{9}$; $x = 9$
- 4) $g(x) = 15x + 7x^2$; $x = 8$
- 6) $g(x) = 30x + 1$; $x = 1$
- 9) $g(x) = \frac{5x}{2}$; $x = 10$
- 9) $g(x) = 7\sqrt{x} + 38$; $x = 10$
- 12) $g(x) = 4 - 2x$; $x = -4$

1		2		3	4	
	5		6			
7			8			9
	10					
11				12		
	13			14		



SKILL BUILDER

I. Evaluate the following functions.

1. $a(x) = 11x + 4$; $a(\frac{4}{5})$

2. $b(x) = -x^2 + 20$; $b(-\frac{2}{3})$

3. $c(x) = \frac{2-13x}{x+17}$; $c(\frac{1}{26})$

4. $d(x) = |-x^2 + 5x + 7|$; $d(-\frac{1}{5})$

5. $e(x) = 4\sqrt{11-7x}$; $e(-\frac{3}{7})$

II. For each function, find and simplify $f(x)$.

1. $f(x) = \sqrt{3x+7}$; $x = b-7$

2. $f(x) = 3x^2 - 3x + 1$; $x = 2c + 5$

3. $f(x) = |2 - 4x^3|$; $x = 2a - 3b$

4. $f(x) = \frac{2x-5}{x+4}$; $x = \frac{9}{12x-9}$

5. $f(x) = (4x-3)^2$; $x = \frac{2}{5x-2y}$

NAME: _____ Year & Track: _____ Date: _____

LESSON 3: COMBINATIONS ON FUNCTIONS

Objectives:

At the end of each lesson, the students should be able to:

- perform the addition, subtraction, multiplication, and division of functions;
- determine the composition of functions;
- identify the domain of the new functions formed;
- solve problems involving functions; and
- decompose the given functions.



**CONCEPT
BUILDER**

Given the functions $f(x) = x^2 + 1$, and $g(x) = x + 3$, find each of the following.

1. $f + g$

6. $(gf)(-3)$

2. $f - g$

7. $\frac{f}{g}$

3. $(fg)(0)$

8. $\left(\frac{g}{f}\right)(-2)$

4. $g \circ f$

9. $(g - f)(2)$

5. $(g \circ g)(-1)$

10. $(f \circ f)(0)$



SKILL BUILDER

I. Perform the indicated operation. Show your complete solution. Then, find the domain of the new function formed.

1. Given: $a(x) = 7x - 11$; $b(x) = 5 - 3x$ $(ab)(x)$	2) Given : $c(x) = x^2 + 3x + 2$; $d(x) = x + 2$ $(\frac{c}{d})(x)$
3. Given: $e(x) = \frac{1}{2x-1}$; $f(x) = 6x^2 + x - 2$ $(e \circ f)(x)$	4. Given: $g(x) = \sqrt{x+3} + 5$; $h(x) = 2x - 3\sqrt{2-x}$ $g(x) - h(x)$
5. Given: $i(x) = \frac{2x-3}{x+1}$; $j(x) = \frac{5}{3-2x}$ $(ij)(x)$	6. Given: $k(x) = \frac{x^2 + 5x + 6}{x^2 - 9}$; $l(x) = \frac{x^2 - 4}{3x^2 + 15x + 18}$ $\frac{l(x)}{k(x)}$

II. Solve the given problems.

1. A certain brand of product has a fixed costs of P 300.00 and the cost per item is P 35.00. What is the cost function of manufacturing the product, assuming that the function is linear?

2. What is the height reached by a circular object thrown upward if the time lapse is 3 seconds? Its height (***h***) is given by $h = -3x^2 + 9t + 5$ where x is the time in seconds.

3. How much will be the worth of a brand new car after 5 years, if its present cost is P 850,000 and it depreciates P75,000 per year?

4. Maricar has learned to travel alone. When she traveled to Cagayan Valley, she has a speed given by the function $S(x) = 2x^2 + 19x + 12$. What is the speed if $x = 9$?

5. Ben is working hard in selling electronic accessories because his boss promised him to receive a 2 % commission on his total sales over P6, 000. If his salary per week is P500, and assuming that he sells enough this week to get commission, which of $(g \circ h)(x)$ and $(h \circ g)(x)$ represents your commission? The given functions are $g(x) = 0.2x$ and $h(x) = x - 6,000$.

III. Decompose the given functions.

1. If $f(g(x)) = x^2 + 3x - 5$ and $f(x) = x - 5$, then find $g(x)$.

2. If $g(f(x)) = 2|x - 6| + 11$ and $g(x) = 2x + 11$, then find $f(x)$.

3. Given $(k \circ l)(x) = \frac{10 + 3x}{x}$ and $k(x) = \frac{2}{x}$, then find $l(x)$.

CHAPTER II

RATIONAL FUNCTIONS

TOPICS

Lesson 1	Basic Concepts of Rational Functions Equations and Inequalities
Lesson 2	Properties of Rational Functions
Lesson 3	Solving Rational Equations
Lesson 4	Solving Rational Inequalities
Lesson 5	Applications of Rational Functions

LEARNING COMPETENCIES

- Represents real-life situations using rational functions. **M11gm-ib-1**
- Distinguishes rational function, rational equation, and rational inequality. **M11gm-ib-2**
- Solves rational equations and inequalities. **M11gm-ib-3**
- Represents a rational function through its: (a) table of values, (b) graph, and (c) equation.
M11gm-ib-4
- Finds the domain and range of a rational function. **M11gm-ib-5**
- Determines the: (a) intercepts (b) zeroes; and (c) asymptotes of rational functions
M11GM-Ic-1
- Graphs rational functions. **M11GM-Ic-2**
- Solves problems involving rational functions, equations, and inequalities. **M11GM-Ic-3**

NAME: _____ Year & Track: _____ Date: _____

LESSON 1 : BASIC CONCEPTS OF RATIONAL FUNCTIONS, EQUATIONS AND INEQUALITIES

Objectives:

At the end of each lesson, the students should be able to:

- distinguish rational function, rational equation, and rational inequality; and
- represent a rational function through its: (a) table of values, (b) graph, and (c) equation.



**CONCEPT
BUILDER**

I. ODD ONE OUT

Using the definition of rational function, rational equations and rational inequalities, encircle the letter of the item that does not belong to the group

1. A) $f(x) = \frac{x-5}{3}$

B) $f(x) = \frac{2}{x-5}$

C) $f(x) = \frac{x-5}{2x}$

2. A) $g(x) = \frac{2}{3} \left(\frac{x}{2x+1} \right)$

B) $f(x) = \frac{x-3}{x^2-9}$

C) $f(x) = \frac{2(1-x)}{3(x-2)}$

3. A) $\frac{11}{12}p - 6 = 0$

B) $\frac{4-p}{p} = 12$

C) $p = \frac{y}{z}$

4. A) $-\frac{3}{5}p + \frac{2}{7} = 3p$

B) $\frac{500p}{p^2+50} = 0$

C) $\frac{p^2+3p+2}{p^2-1} = 0$

5. a) $\frac{g}{3} - 5 \geq 0$

B) $\frac{5}{g} - 3 \geq 0$

C) $-5 \geq \frac{3}{g}$

6. A) $\sqrt{g+1} < 0$

B) $|g-1| < 0$

C) $\frac{1}{g} < 0$

II. ALTERNATE CHOICE

Which of the following represents rational functions? Write the letter of your choice in the brackets.

- [] 1. A) The area of rectangle varies directly to the product of its length and width.
B) The speed is a function of time given a fixed distance.

[] 2. A) $\frac{-3x^2 + 4x + 1}{6} = \frac{2}{3}$ B) $\frac{x-8}{4} = \frac{3}{x}$

- [] 3. A)

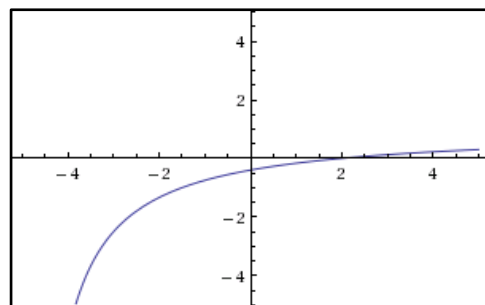
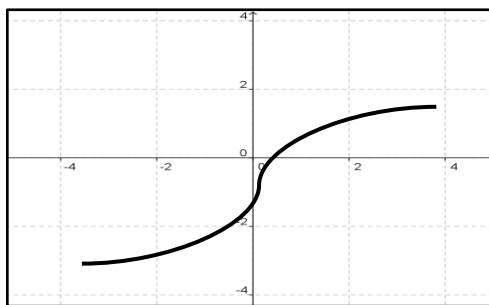
x	-3	-2	-1	1	2	3
y	$-\frac{2}{3}$	-1	-2	2	1	$\frac{2}{3}$

B)

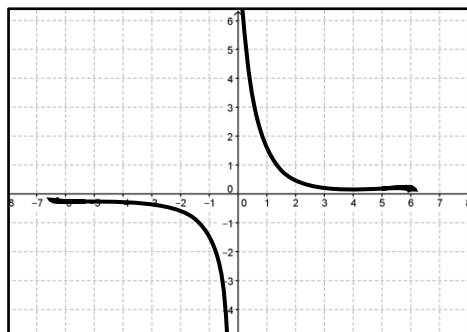
x	-3	-2	-1	0	1	2
y	$\frac{1}{8}$	$\frac{1}{4}$	$\frac{1}{2}$	1	2	4

- [] 4. A)

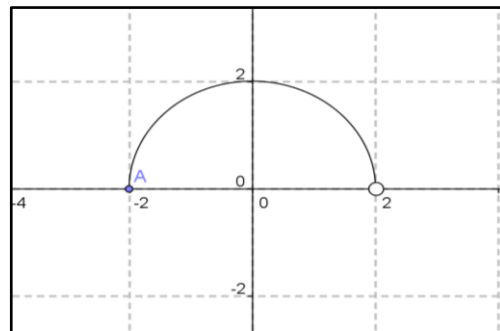
B)



- [] 5. A)



B)



NAME: _____ Year & Track: _____ Date: _____

LESSON 2: PROPERTIES OF RATIONAL FUNCTIONS

Objectives:

At the end of each lesson, the students should be able to:

- determine the: (a) intercepts (b) zeroes; and (c) asymptotes of rational function;
- find the domain and range of a rational function; and
- graph rational functions.



**CONCEPT
BUILDER**

I. Making the Right Choices!

Read and analyze each statement. Then, write the letter of your choice in the bracket provided before each number.

[] 1. Which of the following is a rational function?

A. $f(x) = \frac{x}{5} - 8$ B. $g(x) = \frac{5}{x} + 8$ C. $f(x) = \frac{|x-7|}{5}$

[] 2. Which of the following is NOT a rational function?

A. $f(x) = \frac{4}{x} - 3$ B. $f(x) = \frac{4}{\sqrt{x-3}}$ C. $f(x) = \frac{4}{x-3}$

[] 3. What is the domain of $f(x) = \frac{5}{x-14} + 10$?

A. $\{x \mid x \neq 14\}$ B. $\{x \mid x \neq 10\}$ C. $\{x \mid x \in R\}$

[] 4. What is the range of $f(x) = \frac{5}{x-14}$?

A. $\{y \mid y \neq 14\}$ B. $\{y \mid y \neq 5\}$ C. $\{y \mid y \neq 0\}$

[] 5. What is the horizontal asymptote of $g(x) = \frac{x-2}{x+1}$?

A. $y = -2$ B. $y = -1$ C. $y = 0$

[] 6. Which of the following is NOT a vertical asymptote of $g(x) = \frac{2}{(x+5)(x-4)}$?

A. $x = -5$

B. $x = 4$

C. $x = 2$

[] 7. What is the x-intercept of $h(x) = \frac{3-x}{x-4}$?

A. $x = 3$

B. $x = -3$

C. $x = -4$

For nos. 8-10, use the given function $h(x) = \frac{x+1}{5x-7}$.

[] 8. What is the zero of the function ?

A. 1

B. -1

C. $\frac{7}{5}$

[] 9. What is the y-intercept of the function?

A. $\frac{1}{5}$

B. $-\frac{1}{7}$

C. -1

[] 10. What is the domain of the function?

A. $\left\{x \mid x \neq \frac{5}{7}\right\}$

B. $\left\{x \mid x \neq \frac{1}{5}\right\}$

C. $\left\{x \mid x \neq \frac{7}{5}\right\}$

II. Given the following rational functions and graphs, determine the following.

a) Asymptote (s)

b) Domain

c) Intercept(s)

d) Range

1) $a(x) = \frac{9}{4x+2}$

2) $b(x) = \frac{11x}{3-x}$

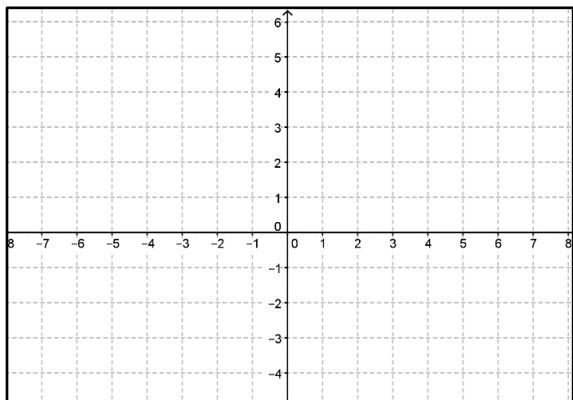
3) $c(x) = \frac{5x-1}{8x+3}$

4) $d(x) = \frac{x^2-1}{x+1}$

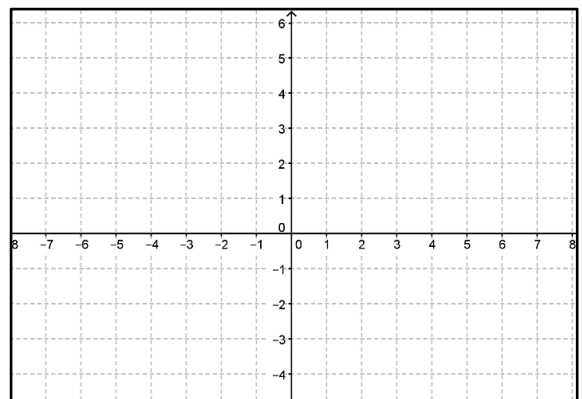
5) $e(x) = \frac{x+5}{x^2-10x+25}$

6) $g(x) = \frac{2x^2-6x-3}{x^3-8}$

7)



8)

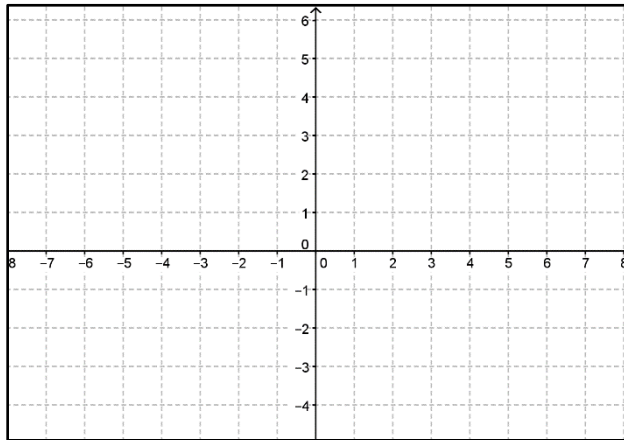




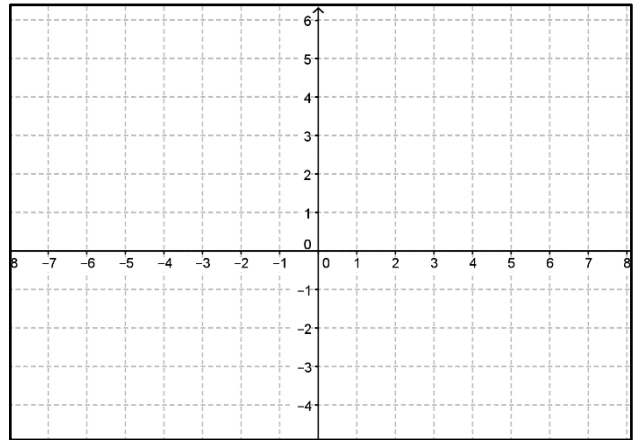
SKILL BUILDER

Graph the following rational functions.

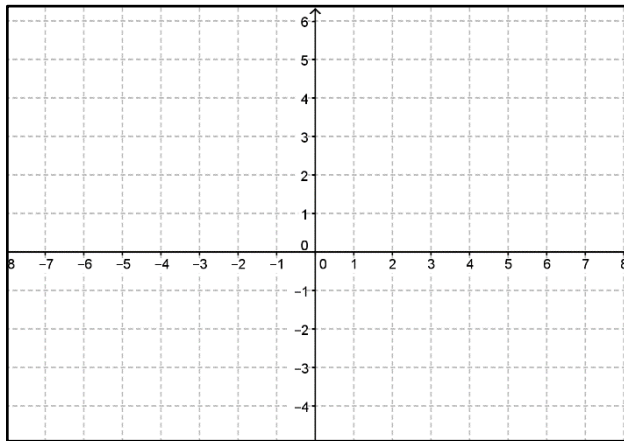
1) $H(x) = \frac{7}{x-8}$



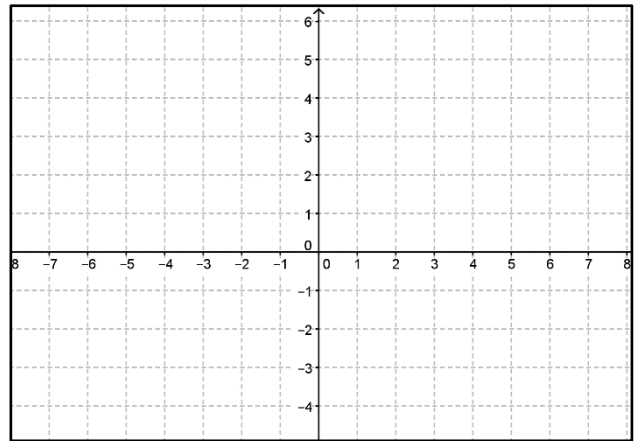
2) $I(x) = \frac{x+3}{2x-1}$



3) $K(x) = \frac{2-5x}{x^2-4}$



4) $l(x) = \frac{x^2-16}{2x^2-11x+12}$



NAME: _____ Year & Track: _____ Date: _____

LESSON 3: SOLVING RATIONAL EQUATIONS

Objectives:

At the end of each lesson, the students should be able to:

- find the solution of each rational equation by shading the equation and its solution using one color per pair; and
- solve rational equations involving two-step or multi-step solutions.



**CONCEPT
BUILDER**

“RATIONAL FUZE”

In the box, each rational equation has its corresponding value of x. Shade the equation with its solution by using the same color. *Use one color per pair.*

$\frac{12}{x} = 2$	5	$\frac{3}{2x} = \frac{3}{4}$	-2	$\frac{x}{x-2} = 3$
$-\frac{3}{4}$	$-\frac{1}{2}$	$14 = -\frac{7}{x}$	$\frac{1}{4}$	$\frac{x-1}{2x-5} = \frac{-4}{2x-5}$
$\frac{1}{x} + \frac{1}{5} = \frac{2}{5}$	$\frac{1}{0.2x} = 8$	6	$\frac{1}{x+3} = \frac{1}{2x-4}$	-3
7	2	$\frac{4}{5} = \frac{1}{x+2}$	3	$\frac{1}{3} - \frac{5}{6} = \frac{1}{x}$

**SKILL
BUILDER**

Solve the following equations.

1) $\frac{9}{x-1} - 5 = 7$	2) $\frac{1}{x} + \frac{2}{3} = 4$
3) $\frac{5}{2x^2} = \frac{x}{x^2} - \frac{3}{2x^2}$	4) $\frac{3}{x} + \frac{4}{(x+1)} = \frac{10}{x^2+x}$
5. $-\frac{x}{x^2+x} + \frac{11}{x} = \frac{2x+2}{x^2+x}$	6. $\frac{2}{x^2-x-12} = \frac{6}{(x-4)} + \frac{9}{3(x+3)}$
7) $\frac{1}{(x+1)} - \frac{2}{(x+4)} = \frac{x}{x^2+5x+4}$	8) $\frac{x+2}{x-4} + \frac{1}{x+4} = \frac{3x}{x^2-16}$
9) $\frac{-4-2x}{x^2-4} = \frac{5x}{x^3-4x^2+4x}$	10) $\frac{7}{6x^2+7x-3} + \frac{2}{(3x-1)} = \frac{6}{(2x+3)} + \frac{4}{(-1+3x)}$

NAME: _____ Year & Track: _____ Date: _____

LESSON 4: RATIONAL INEQUALITIES

Objectives:

At the end of each lesson, the students should be able to:

- determine the value of x that satisfies each given inequality; and
- solve for the solution set of each rational inequality using any method.



CONCEPT BUILDER

MAKING THE RIGHT CHOICES!

Determine the values of x that satisfy each given rational inequality. Encircle the letter of your choices.

1. $\frac{4}{x-5} \geq 0$ A. 10 B. 8 C. 6 D. 4

2. $\frac{3}{x-2} \geq 0$ A. 2 B. 3 C. 4 D. 5

3. $\frac{x+1}{4-x} < 0$ A. -3 B. -2 C. 3 D. 5

4. $\frac{2}{x-3} > -1$ A. -4 B. -2 C. 2 D. 4

5. $\frac{x+2}{x+7} < 0$ A. -1 B. -3 C. -4 D. -5

6. $\frac{5}{x-4} \geq 0$ A. 9 B. 7 C. 5 D. 3

7. $\frac{2}{x-3} \geq 0$ A. 1 B. 4 C. 5 D. 6

8. $\frac{x+3}{x+6} < 0$ A. -5 B. -1 C. -4 D. -7

9. $\frac{x+1}{4-x} < 0$ A. 3 B. -3 C. 6 D. -2

10. $\frac{2}{x-4} > -1$ A. -3 B. 3 C. -2 D. 5

11. $\frac{4}{x-5} \geq 0$ A. 11 B. 7 C. 3 D. 5

12. $\frac{2}{x-3} \geq 0$ A. 2 B. 4 C. 5 D. 7

13. $\frac{x+3}{x+6} < 0$ A. -5 B. -1 C. -4 D. -7

14. $\frac{2}{x-3} > -1$ A. -4 B. -2 C. 2 D. 4

15. $\frac{x+1}{4-x} < 0$ A. -1 B. -2 C. -3 D. -6



SKILL BUILDER

Find the solution set of the following rational inequalities using any method.

1) $\frac{2}{x-6} > 0$	2) $\frac{x}{x-5} < 0$
------------------------	------------------------

3) $\frac{x+2}{x+1} \leq 0$	4) $\frac{-2x+3}{x-4} < 2$
5) $\frac{m+3}{5-2m} \leq 4$	6) $\frac{1}{x} + \frac{6}{x} > \frac{1}{x+2}$
7) $\frac{2x}{x^2-4} < \frac{1}{x^2-4}$	8) $\frac{x^2-4x-5}{x+2} \geq 0$
9) $\frac{x+7}{x^2-1} \geq 0$	10) $\frac{x^2-16}{x^2-x-12} > -3$

NAME: _____ Year & Track: _____ Date: _____

LESSON 4: APPLICATIONS OF RATIONAL FUNCTION

Objectives:

At the end of each lesson, the students should be able to:

- apply the properties of rational functions ,equations , and inequalities in understanding each given problem; and
- solves problems involving rational functions equations, and inequalities with speed and accuracy.



SKILL BUILDER

Read and analyze each given problem. Then answer the questions that follow. Show necessary solutions.

1) The population density of a certain species in a forest is related to the distance (in kilometers) from the center of the forest to the habitat of the species. It is given by the function,

$$P_d(x) = \frac{4,000}{40 + x^2}.$$

- a) What happens to the density as the distance from the center of the forest changes from 5 to 10 km?
- b) What is the distance of the habitat of the species from the center of the forest if the population density is 400 species /km?

2) The pitch p of a musical tone and its wavelength w are related by the equation $p = \frac{v}{w}$, where v is the velocity of a sound wave through air. Suppose a sound wave has a velocity of 316 meters per second.

- a) What happens to the pitch of a tone as the wavelength decreases?
- b) Graph the equation. Draw the lines that are close to the maximum values of the pitch and the wavelength.

3) The number of kilometers per unit time travelled by Mr. Santos in going to Cagayan Valley is given by the function $D(x) = \frac{x^3 + 7x^2 - 9x - 63}{3x^2 + 18x + 54}$. What is the simplest form of the function?

4) A wavelength (***W***) of a radio wave varies inversely as its frequency (***F***). A wave with frequency of 1,200 kilohertz per second has a length of 300 meters. Predict the length of a wave with a frequency of 800 kilohertz per second.

5) The current (***I***) in an electrical conductor varies inversely as the resistance (***R***) of the conductor. The current is $\frac{1}{2}$ ampere when the resistance is 240 ohms. What is the current when the resistance is 540 ohms?

6. A positive integer is 3 less than the other. What are the two positive integers if the sum of their reciprocals is $\frac{7}{12}$?

7. The difference of a positive number and its reciprocal is $3\frac{3}{4}$. Find the number.

8. The numerator of a rational number is 3 more than the denominator. If 2 is added to both numerator and denominator, the result is $\frac{3}{2}$. Find the original fraction.

9. Find the two consecutive even numbers if the reciprocal of the larger number added to twice the reciprocal of the smaller number is equal to $\frac{13}{15}$.

10) Mercy and Maribel, who are Mass Communication Arts students, were asked to make a manuscript regarding the APEC Summit held in Manila last November, 2015. If it take Mercy to do write a manuscript for 3 hours while Maribel for 2 hours, how long will it take them if they do it together?

11) Together, each week, Francisco and Mario can deliver magazines together in 5 hours. How long would it take each of them to do the job alone if it takes Francis 4 times as long as Mario to deliver magazines each week?

12. Maja can do a job in 12 days. After she has worked for 4 days, she was joined by Kailey and took them 2 days to finish the job together. How long would it have taken Kailey to do the whole job herself?

13. A bathtub can be filled with water by Pipe X in 5 minutes, by Pipe Y in 7 minutes and then drained by Pipe C in 10 minutes. If accidentally, while the tub is being filled with water, Pipe Y is turned on. How long would it take to fill the bathtub?

14. Shaine and May joined the *Alay Lakad* organized by a certain civic organization. At the beginning of the *Alay Lakad*, Shaine and May are 25 km apart. If they leave at the same time, and walk in the same direction, Shaine overtakes May in 6 hours. If they walk towards each other, they meet in 5 hours. What is the speed of each?

15. Rodel has just enough money to rent a boat for 2.5 hours. How far out on a lake can she paddle and return on time if she paddles out at 3km per hour and back at 2 km per hour?

16. Jun is living with his grandmother whose house is near the river which is 10 kilometers upstream from his town. He can row his boat downstream to town for groceries and back in 3 hours, when the current is 2 km per hour. What is his average rowing speed in still water?

CHAPTER III

EXPLORING INVERSE, EXPONENTIAL, AND LOGARITHMIC FUNCTIONS

TOPICS

Lesson 1	Understanding Inverse Functions
Lesson 2	Properties of Exponential Functions
Lesson 3	Transformations of Graphs of Exponential Functions
Lesson 4	Solving Exponential Equations
Lesson 5	Solving Exponential Inequalities
Lesson 6	Properties and Graphs of Logarithmic Functions
Lesson 7	Solving Logarithmic Equations
Lesson 8	Solving Logarithmic Inequalities
Lesson 9	Applications of Exponential and Logarithmic Functions

LEARNING COMPETENCIES

- Represents real-life situations using one-to one functions. **M11GM-Id-1**
- Determines the inverse of a one-to-one function. **M11GM-Id-2**
- Represents an inverse function through its: (a) table of values, and (b) graph. **M11GM-Id-3**
- Finds the domain and range of an inverse function. **M11GM-Id-4**
- Graphs inverse functions. **M11GM-Ie-1**
- Solves problems involving inverse functions. **M11GM-Ie-2**
- Represents real-life situations using exponential functions.
M11GM-Ie-3
- Distinguishes between exponential function, exponential equation, and exponential inequality. **M11GM-Ie-4**
- Solves exponential equations and inequalities. **M11GM-Ie-f-1**

- Represents an exponential function through its: (a) table of values, (b) graph, and (c) equation. **M11GM-If-2**
- Finds the domain and range of an exponential function. **M11GM-If-3**
- Determines the intercepts, zeroes, and asymptotes of an exponential function. **M11GM-If-4**
- Graphs exponential functions. **M11GM-Ig-1**
- Solves problems involving exponential functions, equations, and inequalities. **M11GM-Ig-2**
- Represents real-life situations using logarithmic functions.
M11GM-Ih-1
- Distinguishes logarithmic function, logarithmic equation, and logarithmic inequality.
M11GM-Ih-2
- Illustrates the laws of logarithms. **M11GM-Ih-3**
- Solves logarithmic equations and inequalities. **M11GM-Ih-i-1**
- Represents a logarithmic function through its: (a) table of values, (b) graph, and (c) equation. **M11GM-Ii-2**
- Finds the domain and range of a logarithmic function. **M11GM-Ii-3**
- Determines the intercepts, zeroes, and asymptotes of logarithmic functions. **M11GM-Ii-4**
- Graphs logarithmic functions. **M11GM-Ij-1**
- Solves problems involving logarithmic functions, equations, and inequalities. **M11GM-Ij-2**

NAME: _____ Year & Track: _____ Date: _____

LESSON 1: INVERSE FUNCTIONS

Objectives:

At the end of each lesson, the students should be able to:

- identify if the statement is true or false using the definition of inverse functions;
- represent real-life situations using one-to one functions;
- determine the inverse of a one-to-one function;
- represent an inverse function through its: (a) table of values, and (b) graph;
- find the domain and range of an inverse function ; and
- graph functions using the graph of its inverse.



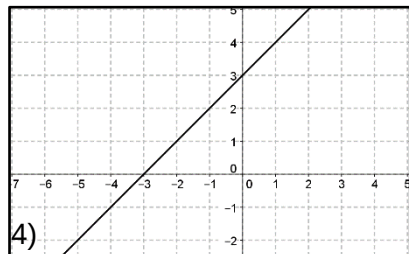
**CONCEPT
BUILDER**

I. Encircle the letter “A” if the statement is correct, otherwise, encircle the letter “B”.

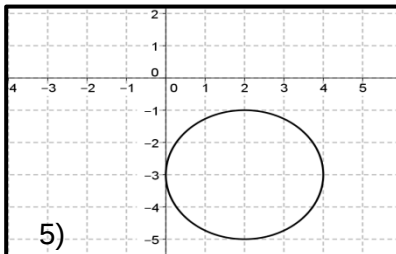
- A B 1. The domain of function *is* the range of its inverse.
- A B 2. The inverse of a function is always a function.
- A B 3. A function *m* has an inverse if and only if *m* is one-to-one.
- A B 4. Two functions *f* and *g* are inverses if $f(g(x)) = g(f(x)) = x$.
- A B 5. If $f(x) = 2x+3$, then $f^{-1}(x) = \frac{x-1}{3}$.
- A B 6. $g(x) = -\frac{x}{2}$ and $h(x) = -2x$ are inverse functions.
- A B 7. The radical function $f(x) = \sqrt{x+1}$ has an inverse which is a function.
- A B 8. The inverse of $y = x^2$ is $x = y^2$.
- A B 9. If $P = \{(-2,0), (-1,1), (0,2)\}$ and $Q = \{(0,-2), (1, -1), (2, 0)\}$, then
relation *P* is the inverse of relation *Q*.
- A B 10. If two functions are inverses of each other, then their graphs are
reflections of each other with respect to the line $y = 0$.

II. State whether each function whose graph is given has an inverse which is also a function.

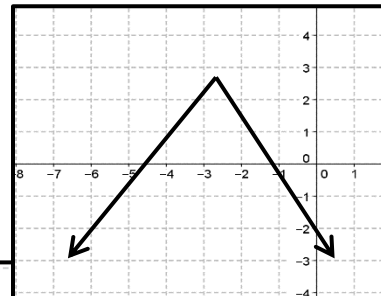
1)



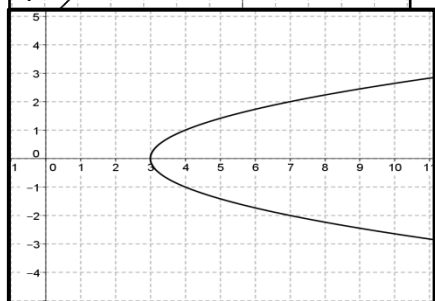
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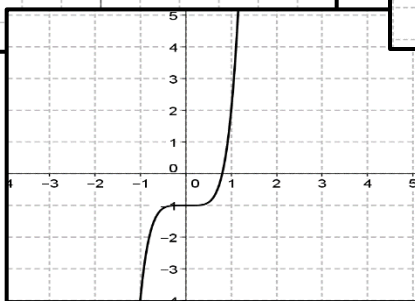
3)



4)



5)



III. Match the items in column A with its inverse function in column B. Write the letter of your answers in the brackets.

[] 1. $y = x + 5$

A. $y = x + 5$

[] 2. $y = -5 + x$

B. $y = x - 5$

[] 3. $y = 6x$

C. $y = \pm\sqrt{x}$

[] 4. $y = x^2$

D. $y = \frac{2}{x}$

[] 5. $y = \frac{2}{x}$

E. $y = \frac{1}{6}x$



**SKILL
BUILDER**

I. Find the inverse of each one-to-one function.

1. $f(x) = x + 17$

6. $g(x) = (x - 2)^3$

2. $f(x) = 11 - 5x$

7. $g(x) = \frac{x+2}{x-4}$

3. $f(x) = 4(x+3) - 5$

8. $g(x) = \frac{2x-3}{5-x}$

4. $f(x) = \frac{3}{x-1}$

9. $g(x) = 3 + (x-2)^2$; $x < 0$

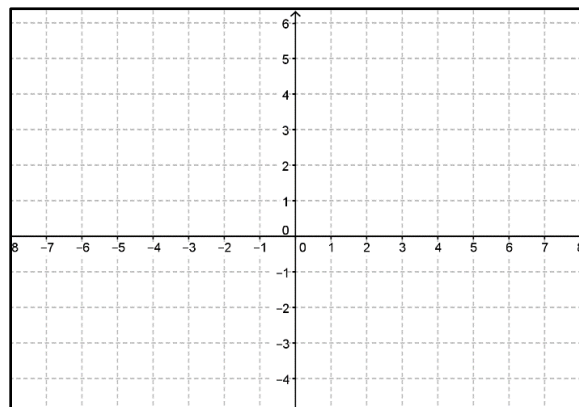
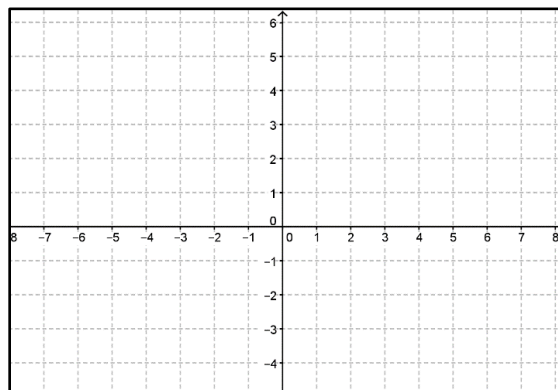
5. $f(x) = \sqrt{x-6}$

10. $g(x) = 4x^2 - 13$; $x > 0$

II. Graph each given function. Then, graph its inverse using the idea that if (x,y) is on the graph of the function, then (y,x) is located on the graph of its inverse.

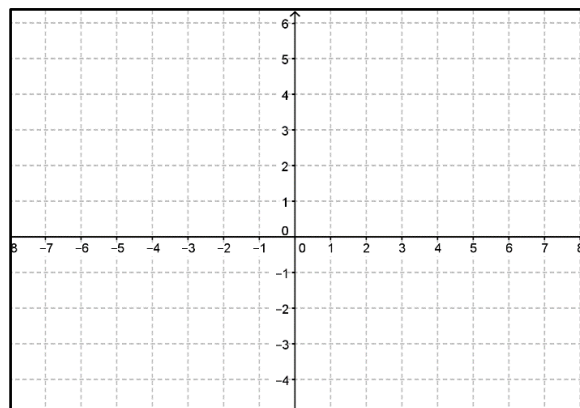
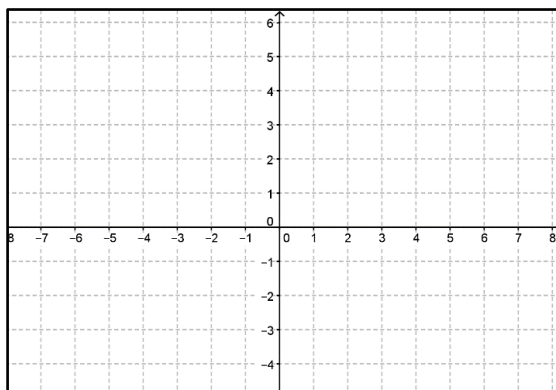
1. $f(x) = 3x + 1$

2. $g(x) = 4 - x$



3. $h(x) = x^2 + 2$

4. $i(x) = \frac{2}{x-3}$



NAME: _____ Year & Track: _____ Date: _____

LESSON 2: PROPERTIES OF EXPONENTIAL FUNCTIONS

Objectives:

At the end of each lesson, the students should be able to:

- represent an exponential function through its: (a) table of values, (b) graph, and (c) equation;
- find the domain and range of an exponential function;
- determine the intercepts, zeroes, and asymptotes of an exponential function; and
- determine if the function is increasing or decreasing.



CONCEPT BUILDER

- I. Which of the following defines an exponential function? Encircle the item number of your answer.

1. $y = 2 \bullet 8^{-x}$

4. $j(x) = 4 - 2^x$

2. $h(x) = 1^x$

5. $k(x) = 3x - 7$

3. $i(x) = 5^{x+1}$

6. $i(x) = -\left(-\frac{1}{6}\right)^x$

7.

x	-2	-1	0	1	2	3
f(x)	-4	-2	0	2	4	6

8.

x	-2	-1	0	1	2	3
f(x)	$\frac{9}{4}$	$\frac{3}{2}$	1	$\frac{2}{3}$	$\frac{4}{9}$	$\frac{8}{27}$

9.

x	-2	-1	0	1	2	3
f(x)	$\frac{1}{16}$	$\frac{1}{4}$	1	4	16	64

10.

x	-2	-1	0	1	2	3
f(x)	-25	-5	1	5	25	125

II. Write **I** if the function is increasing and **D** if it is decreasing.

[] 1. $g(x) = 9^x$

[] 4. $j(x) = (1.99)^x$

[] 2. $h(x) = 7^{-x}$

[] 5. $k(x) = \left(\frac{8}{5}\right)^x$

[] 3. $i(x) = \left(\frac{11}{12}\right)^x$

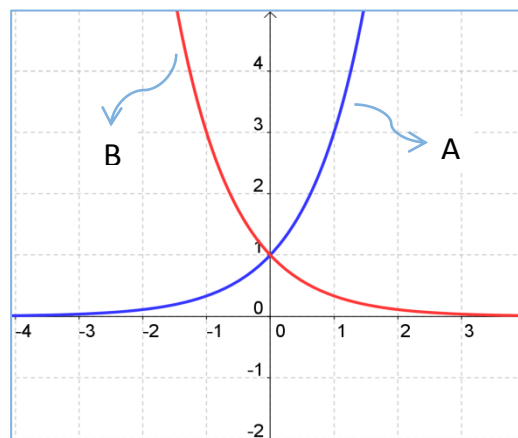
III. Indicate the word, phrase, number or equation that corresponds to each given item below. Write your answer in the box provided.

For #s 1-5 ; Given: $y = 6^x + 1$

- _____ 1. It is the domain of the function.
- _____ 2. What is the range of the given function?
- _____ 3. It is the asymptote of the function.
- _____ 4. What is the y-intercept of the function?
- _____ 5. What kind of function is the given?

For #s 6-10, use the graphs at the right.

- _____ 6. What is the point of intersection of the two graphs?
- _____ 7. What is the asymptote of the graphs?
- _____ 8. Which of the two graphs represents increasing function?
- _____ 9. Which of the two graphs represents decreasing function?



____10. What is the range of graphs A and B?

IV. Determine the asymptote in Column II of each given exponential function in Column I. Write the letter of your choice in each bracket.

	Column I	Column II
[]	1. $i(x) = -11^x$	M. $y = 11$
[]	2. $f(x) = 3 + 4^x$	N. $y = -11$
[]	3. $g(x) = 3^{x-5} - 4$	O. $y = -4$
[]	4. $h(x) = 13^{x-6} + 11$	P. $y = 3$
[]	5. $k(x) = -11 + 4^{x-6}$	Q. $y = 0$



SKILL BUILDER

Sketch the graph of the following . Then, determine the intercepts and range of each function.

1. $M(x) = 2^x + 1$

2. $N(x) = -2 + 3^x$

3. $O(x) = 4 - 4^x$

4. $P(x) = -1 - 3^x$

5. $Q(x) = -2^{x+1} - 1$

6. $R(x) = -3^{x-2} + 3$

NAME: _____ Year & Track: _____ Date: _____

LESSON 3: TRANSLATIONS OF GRAPHS OF EXPONENTIAL FUNCTIONS

Objectives:

At the end of each lesson, the students should be able to:

- graph exponential functions;
- determine the translation of the graphs of exponential functions; and
- determine the new function formed and its range based from the shifting of the graphs of exponential functions.



**CONCEPT
BUILDER**

I. Determine the translations of the graphs of the new exponential functions formed given their reference functions.

Reference Function	New Function	Translation
1. $k(x) = 5^x - 6$	$k(x) = 5^x - 8$	
2. $l(x) = 3^{x-15} + 7$	$l(x) = 3^{x+4} + 7$	
3. $m(x) = 12^{x+13} - 4$	$m(x) = 12^x$	
4. $o(x) = 5^x$	$o(x) = -5^x + 3$	
5. $p(x) = 4 - 2^{x+1}$	$p(x) = -2^{x+1}$	

II. Given the function for each item, determine the new function formed based from the given translations.

Reference Function	Translation	Resulting Function
1. $k(x) = 8^x + 11$	The graph is shifted 7 units to the right, and 6 units up	
2. $l(x) = 14^{x-9} - 6$	The graph is shifted 11 units to the left, and 11 units downward	
3. $m(x) = 4^{x+13} + 5$	The graph is shifted 13 units to the left, and 5 units downward	

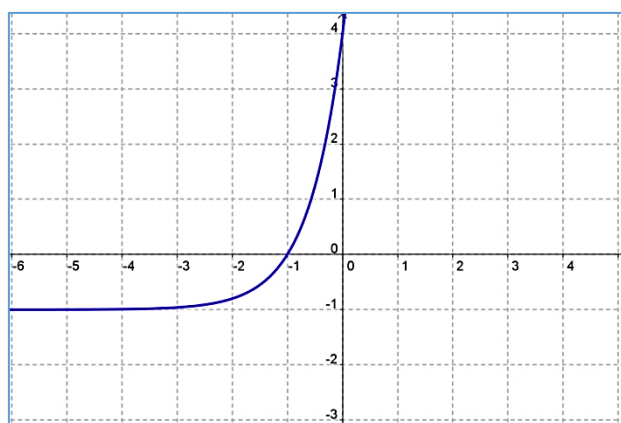
4. $n(x) = 3^{x+1}$	The graph flips across the x-axis	
5. $o(x) = 6^x - 2$	The graph flips across the y-axis and shifts 3 units down	



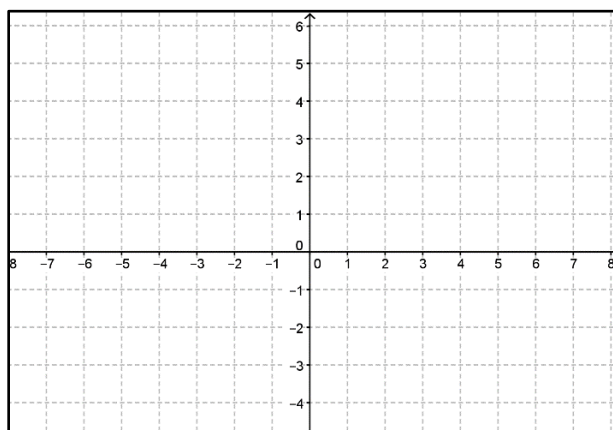
SKILL BUILDER

Read and analyze each given item. Then answer the questions /instructions given.

- Given below is the graph of $f(x) = 5^{x+1} - 1$, determine the new function formed and sketch its graph if its translated 5 units to the right and 2 units downward. What is the range of the new function formed?



- Graph the $f(x) = 3^x + 2$, determine the new function formed and sketch its graph if it is flipped across the x-axis and translated 3 units down. What is the range of the new function formed?



NAME: _____ Year & Track: _____ Date: _____

LESSON 4: SOLVING EXPONENTIAL EQUATIONS

Objectives:

At the end of each lesson, the students should be able to:

- determine the name associated to each kind of fear by matching the exponential equation with its solution;
- solve exponential equations; and
- find the zero of each exponential function.



CONCEPT BUILDER

MATCH YOUR CHOICE !

Beside each given exponential in **Column I** is a description of a certain fear. Solve each exponential equation and match your answer from the choices given in **Column II** in order to know the name given to each description. Write the letter of your choice in each bracket.

COLUMN I

- | | |
|---|----------------|
| [] 1. $10^x = 10^2$ | Ailurophobia |
| [] 2. $13^x = 1$ | Bathmophobia |
| [] 3. $7^x = 343$ | Cherophobia |
| [] 4. $2^x = 16$ | Dementophobia |
| [] 5. $\left(\frac{9}{10}\right)^x = \frac{9}{10}$ | Enochlophobia |
| [] 6. $2^{x-1} = 32$ | Gerascophobia |
| [] 7. $3^x = \frac{1}{9}$ | Hypnophobia |
| [] 8. $5^{x+3} = 25$ | Melissophobia |
| [] 9. $4^x = 8$ | Nosocomophobia |
| [] 10. $4^{3x+1} = 64$ | Philophobia |

COLUMN II

- | | |
|------------------|------------------------------|
| A. 0 | fear of stairs or slopes |
| B. 1 | fear of crowds |
| C. -1 | fear of bees |
| D. 2 | fear of cats |
| E. -2 | fear of sleep |
| F. 3 | fear of happiness |
| G. 4 | fear of becoming insane |
| H. 6 | fear of growing old or aging |
| I. $\frac{2}{3}$ | fear of love |
| J. $\frac{3}{2}$ | fear of hospitals |



SKILL BUILDER

I. Find the zeros of each function.

1. $A(x) = 81 - 3^{x+2}$

2. $B(x) = (0.2)^{x-6}$

3. $C(x) = 216^{2-x} - \frac{1}{6}$

4. $D(x) = 16^{\frac{3x}{4}} - 4^{x-2}$

5. $E(x) = -8 + 4^{\sqrt{3x-2}}$

II. Solve each exponential equation.

1. $36^{\frac{x}{2}} = 6^{2x-5}$

6. $8 = 8 \bullet 81^{2x-11}$

2. $(1000)^{3x+7} = 0.01$

7. $\left(\frac{9}{16}\right)^{2x} = \left(\frac{27}{64}\right)^{2-3x}$

3. $4^{3x+1} = 64$

8. $\left(\frac{2}{3}\right)^{x+5} = \left(\frac{27}{8}\right)$

4. $6 \bullet 5^{3x+1} = 750$

9. $2^{|x-8|} = 64$

5. $7^{\frac{2}{x}} = 7^{\frac{x+1}{2}}$

10. $2^{x^2-8} = 4^x$

III. Solve for x.

1. $(2^x)^2 - 3(2^x) - 4 = 0$

2. $(3^x)^2 - 32(3)^x = -64$

3. $2^{2x} - 2^{x+1} - 1 = 0$

4. $4^{x+2} + 2^{x+3} = 768$

NAME: _____ Year & Track: _____ Date: _____

LESSON 5: SOLVING EXPONENTIAL INEQUALITIES

Objectives:

At the end of each lesson, the students should be able to:

- determine if the given value of the given variable is part of the solution of each given inequality; and
- find the solution sets of the given exponential inequalities;



CONCEPT BUILDER

Determine if the given value indicated after each exponential inequality is a solution to the inequality or not. Write **S** if it is a solution, otherwise, write **NS**.

[] 1. $2^x > 2^4$; 0

[] 6. $5^m \leq 25$; 3

[] 2. $3 < 3^x$; 1

[] 7. $(0.2)^{2x} \geq (0.2)^6$; -3

[] 3. $\left(\frac{1}{5}\right)^b > \left(\frac{1}{5}\right)^2$; -1

[] 8. $(3) \geq \left(\frac{1}{3}\right)^x$; 4

[] 4. $\left(\frac{2}{3}\right)^{-3} > \left(\frac{2}{3}\right)^b$; 2

[] 9. $4^{x+1} < 4$; -4

[] 5. $\left(\frac{4}{5}\right) > \left(\frac{5}{4}\right)^m$; -2

[] 10. $\left(\frac{4}{3}\right)^n > \left(\frac{4}{3}\right)^{2n-1}$; -5



SKILL BUILDER

Write a solution set for each exponential inequality.

1. $2^a < \frac{1}{8}$

6. $64^{2m+7} \geq 4^{2m-3}$

$$2. \frac{1}{27} < 3^a$$

$$7. 16^{m-3} \leq \left(\frac{1}{216}\right)^{m+2}$$

$$3. \left(\frac{1}{7}\right)^{x+1} > \frac{1}{49}$$

$$8. \left(\frac{9}{10}\right)^{c-2} > \left(\frac{100}{81}\right)^{2c+5}$$

$$4. 9^{x+2} \geq 3^{-3+x}$$

$$9. 64^{2d} \geq 256^{d-2}$$

$$5. 8^{3x-2} < 16$$

$$10. \left(\frac{8}{25}\right)^{5b+2} < \left(\frac{4}{25}\right)^{b+1}$$

NAME: _____ Year & Track: _____ Date: _____

LESSON 6: PROPERTIES AND GRAPHS OF LOGARITHMIC FUNCTIONS

Objectives:

At the end of each lesson, the students should be able to:

- apply the properties of a logarithmic function represent a logarithmic function in determining if the statement is true or false ;
- illustrate logarithmic function through its: (a) table of values, (b) graph, and (c) equation;
- find the domain and range of a logarithmic function;
- determine the intercepts, zeroes, and asymptotes of logarithmic functions;
- illustrate the laws of logarithms; and
- evaluate each logarithmic expression.



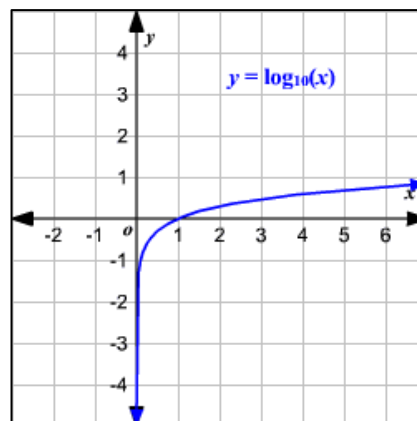
**CONCEPT
BUILDER**

I. Encircle the letter “A” if the statement is correct, otherwise, encircle “B”.

- A B 1. $y = \log_b x$ if and only if $x = b^y$.
- A B 2. The base b of $y = \log_b x$ is always greater than 0 but not equal to 1.
- A B 3. The domain of $f(x) = \log_b x$; $b > 0; b \neq 1$ is the set of real numbers.
- A B 4. The logarithmic function is the inverse of exponential function.
- A B 5. The zero of the logarithmic function $f(x) = \log_b x$ is 1.
- A B 6. Between $y = \log_5 x$ and $y = \log_6 x$, the graph of $y = \log_5 x$ increases faster .
- A B 7. The graph of $\log_{\frac{1}{4}} x = y$ decreases faster than $\log_{\frac{3}{4}} x = y$.

For nos. 8-10, use the graph of the function at the right.

- A B 8. The zero of the function is 1.
- A B 9. The function is asymptotic to the x-axis.
- A B 10. The range of the function is the set of positive real numbers.



II. Determine if the following is a logarithmic function or not. Write **A** if the function is logarithmic, otherwise, write **B** in the bracket.

Let x be any positive real number.

- | | | |
|--|---|---|
| ☐ 1. $\log_5 x = 2$ | ☐ 2. $\log_{-3} x = 4$ | ☐ 3. $\log_{\sqrt{2}} x = 8$ |
| ☐ 4. $x = \log_3 - 4$ | ☐ 5. $x = \log_1 2$ | |

III. Write **A** if the given logarithmic function is increasing and **B** if it is decreasing.

- | | | |
|---|--|--|
| ☐ 1. $\log_3 x = 9$ | ☐ 2. $\log_{\frac{1}{2}} x = 4$ | ☐ 3. $\log_2 8 = x$ |
| ☐ 4. $3 = \log_{\sqrt{3}} x$ | ☐ 5. $6 = \log_{\frac{2}{3}} x$ | |

IV. MATCH YOUR CHOICE!

Write the letter of your choice in the bracket.

A. Express the following to logarithmic form. Refer to the choices given.

- | | |
|---------------------------------------|-------------------|
| ☐ 1. $3^x = b$ | A. $y = \log_3 7$ |
| ☐ 2. $b^3 = x$ | B. $3 = \log_b x$ |
| ☐ 3. $3^b = x$ | C. $x = \log_3 b$ |
| ☐ 4. $7^3 = y$ | D. $b = \log_3 x$ |
| ☐ 5. $3^y = 7$ | E. $3 = \log_7 y$ |

B. Express the following to exponential form.

- | | |
|--|-------------------------------------|
| ☐ 1. $x = \log_2 y$ | A. $x^y = b$ |
| ☐ 2. $y = \log_2 3$ | B. $2^y = 3$ |
| ☐ 3. $\log_2 16 = 4$ | C. $2^x = y$ |
| ☐ 4. $\log_x b = y$ | D. $16 = 2^4$ |
| ☐ 5. $\log_{\frac{1}{2}} y = 2$ | E. $y = \left(\frac{1}{2}\right)^2$ |

C. Evaluate the following logarithmic expressions.

- [] 1. $\log_{36} 1$ A. 6
- [] 2. $\log_7 7$ B. 3
- [] 3. $\log_3 27$ C. -2
- [] 4. $\log_{\frac{1}{9}} 81$ D.
- [] 5. $\log_2 64$ E. 0

D. Express the following as a single logarithm.

- [] 1. $3\log_3 a + \log_3 b$ A. $\log_3 108$
- [] 2. $7\log_3 a - \frac{1}{3}\log_3 b$ B. $\log_3 \frac{a^7}{\sqrt[3]{b}}$
- [] 3. $\log_3 6 + \log_3 18$ C. $\log_3 \frac{b+3}{b-3}$
- [] 4. $\log_3 (b+3) - \log_3 (b-3)$ D. $\log_3 \frac{a}{bc}$
- [] 5. $\log_3 a - \log_3 b - \log_3 c$ E. $\log_3 a^3 b$

E. Expand each expression using the properties of logarithm

- [] 1. $\log_4 16xy$ A. $1 + 2\log_4 x + 5\log_4 y$
- [] 2. $\log_4 4x^2 y^5$ B. $\log_4 x + \log_4 y + 2$
- [] 3. $\log_4 \frac{3x}{yz}$ C. $\log_4 x + 3\log_4 y - \log_4 z$
- [] 4. $\log_4 \frac{3}{\sqrt{xy}}$ D. $\log_4 3 - \frac{1}{2}\log_4 x - \frac{1}{2}\log_4 y$
- [] 5. $\log_4 \frac{xy^3}{z}$ E. $\log_4 3 + \log_4 x - \log_4 y - \log_4 z$



SKILL BUILDER

Evaluate each expression.

1. $\log_{\frac{1}{9}} 3 + \log_{13} 1 - \log_{125} 25$

2. $\frac{\log_9 9 - \log_8 32}{\log_{64} 4 + \log_{216} 6}$

3. $\frac{\log_3 27 - \log_{\frac{2}{3}} \frac{27}{8}}{\log 100 + \log_3 81}$

B. Sketch the graph of each logarithmic function.

1. $m(x) = \log_4 x$

2. $m(x) = \log_{\frac{2}{3}} x$

3. $m(x) = \log_5 (x-1)$

4. $m(x) = \log_4 x + 2$

5. $m(x) = \log_6 x - 3$

NAME: _____ Year & Track: _____ Date: _____

LESSON 7: SOLVING LOGARITHMIC EQUATIONS

Objectives:

At the end of each lesson, the students should be able to:

- decode the name of the mathematician by matching the logarithmic equation with its solution ; and
- solve one-step to multi-step logarithmic equations.



**CONCEPT
BUILDER**

DECODING A NAME

Who is the Scottish mathematician who introduced the concept of logarithm?

To find out the name, answer each item in Column I and write the letter of your answer above the corresponding value provided below.

COLUMN I

1. $\log_2 x = 3$

2. $\log_x 16 = 4$

3. $\log_5 125 = x$

4. $\log_3 x = 4$

5. $\log_9 (x+1) = 0$

6. $\log_{49} 7 = x$

7. $\log_2 3x = \log_2 5$

8. $\log_4 (2x-1) = \log_4 (3x-2)$

9. $3^{\log_3 (x-3)} = 6$

COLUMN II

A. 0

E. 4

H. 3

I. $\frac{5}{3}$

J. 8

N. 81

O. 2

P. $\frac{1}{2}$

R. 9

8 2 3 81

81 0 $\frac{1}{2}$ $\frac{5}{3}$ 4 9



SKILL BUILDER

Solve each equation.

1. $\log_3 27 = (4x - 5)$

6. $\log_5 (3x - 2) - \log_5 x^2 = 0$

2. $\log_3 (3x + 4) = \log_3 (5x - 7)$

7. $\log_6 (-3 + 4x) - \log_6 x = \log_6 7$

3. $\log_7 x(x + 2) - \log_7 (x + 2) = 0$

8. $\log_3 5x = 1 + \log_3 (x + 4) + \log_3 (x - 2)$

4. $\log_2 4x + \log_2 9 = \log_2 72$

9. $\log_6 (7x + 6) - \log_6 x - \log_6 (x + 3) = 1 - \log_6 (x + 1)$

5. $\log_2 x(x - 7) = 3$

10. $\log_2 (1 + \log_3 (1 + \log_4 (1 + \log_5 x))) = 0$

NAME: _____ Year & Track: _____ Date: _____

LESSON 8: SOLVING LOGARITHMIC INEQUALITIES

Objectives:

At the end of each lesson, the students should be able to:

- determine the critical value of a logarithmic inequality;
- identify if the given value of x is a solution of the inequality or not ; and
- solve logarithmic inequalities.



CONCEPT BUILDER

I. Determine the critical values of the given logarithmic inequalities.

$$1. \log_2 x > 2$$

2. $\log_3 x \leq 4$

3. $\log_{11} x \leq 0$

4. $\log_4 x - 1 < 1$

5. $\log_7(x+3) > 2$

II. Encircle the letter “A” if the given value of x after each logarithmic inequality is a solution, otherwise, encircle “B”.

A	B	1. $\log_5 x < 3$	; 0
---	---	-------------------	-----

A B 2. $\log_{27} x \geq \frac{1}{3}$; 3

A B 3. $4 \geq \log_{\frac{1}{2}} x$; 1

A	B	4. $\log_3 x + 5 \geq 8$	; -1
---	---	--------------------------	------

A	B	5. $\log (2x-3) < 2$	; 2
---	---	----------------------	-----



SKILL BUILDER

Solve and graph each logarithmic inequality.

1. $\log_{11} x + 7 \leq 1$

2. $\log_2 11 + 3x \leq 14$

3. $\log_4 5x \geq \frac{3}{2}$

4. $\frac{1}{4} \geq \log_{16}(x+6)$

5. $520 < \log_8 5x + 8$

NAME: _____ Year & Track: _____ Date: _____

LESSON 9: APPLICATIONS OF EXPONENTIAL AND LOGARITHMIC FUNCTIONS

Objectives:

At the end of each lesson, the students should be able to:

- represent real-life situations using exponential and logarithmic functions.; and
- solve problems involving exponential and logarithmic functions, equations and inequalities



Solve the following problems. Show your solution.

1. Mercy is deciding on which bank she will start a savings account amounting to P30, 000. Security Life Bank offers 4 % interest compounded annually, while Cagayan Savings Bank offers 3.5 % compounded semi-annually. If she wants to earn a higher interest, which bank should she choose?
2. Mr. and Mrs. Edgar Reyes just had a new child. How much should they invest now at 8% compounded daily in order to have P 120,000 for the child's education 17 years from now?
3. In the laboratory at exactly 8 a.m. in the morning, a biologist observed that a culture of bacteria triples its number every 4 hours. If at the start, there are 180 bacteria, how many bacteria will there be at around 1:00 p.m.
4. Dexter, a resident doctor is very busy right now because an epidemic occurs in the town where he lives. At first, 35 residents are infected. After 2 days, 210 are already infected. The disease is spreading exponentially. If the infection continues to spread this rate, how many residents would be infected after 8 days?
5. The radioactive isotope technetium-99m (^{99m}Tc) is used in imaging brain. If the half-life of this isotope is 6 hours, how much will be present after 4 hours, if 16 milligrams are used?
6. The government cannot still monitor the use of a dangerous insecticide even if it is already banned because of its dangerous effects. Assuming its half-life is 12 years, how much will still be active after 6 years if Mang Nicanor, a farmer, uses 20 pounds of the active insecticide?
7. A certain town in Cagayan Valley has a population of 12,310, and has been increasing at the rate of 3.1% every year for the past 10 years. What was the population 10 years ago?
8. In order to generate a big income, together with her friends Nicole, Jasmine, Clarisse, Mische put up a networking company, called CJMN Company. They are the first set of members. They decided to recruit 5 members each to form the second set of members and each of the newly recruited member is required to recruit 5 more members. If the scheme continues for each new level, how many 8th level members will there be?

9. The sound level, measured in decibels is represented by $D = 10 \log \frac{I}{I_0}$, where I is the intensity of sound

in watts per square meter ($\frac{W}{m^2}$) and I_0 is the threshold of sound.

a) Mika played her favorite song using her own speaker. She is not contented yet, so she played again the favorite song using her brother's speaker. The intensity of the sound produced by her speaker is $\frac{1}{3}$ of the intensity of sound produced by her brother's speaker. What is the difference of the loudness of the speaker?

b) What is the sound intensity created when the whispering sound is $10^{-13} \frac{\text{watt}}{\text{cm}^2}$

10. As an incentive in passing the examination for certified public accountant, Sapphire received a cash gift from her parents amounting to P25, 000. How long will it take the money to triple its value if she deposited this with 6.5% interest compounded annually?

11. What is the magnitude of earthquake which is 6.7×10^6 joules if on the Richter scale, the magnitude M is given by $M = \log \frac{I}{I_0}$, where I is the intensity of the earthquake and I_0 is the intensity of the threshold of earthquake or the reference intensity?

12. The pH value is computed using the formula $pH = -\log H^+$, where H^+ is the concentration of Hydrogen ions in moles per liter. If the solution has pH value less than 7, then it is acidic, if it's greater than 7, it is basic and neutral if it is 7.

a) If Lanie gave me juice drink with H^+ equal to 1.3, what is the pH level of the juice? Is the juice acidic or basic?

b) Myrna wanted to make a solution with a pH value of 8. How much hydrogen ion concentration should the solution have?

13. For how many day will it take the 50% of a radioactive substance to decay, if its half –life is 50 days?

14. Currently, a certain town in Cagayan Valley has a population of 12,310, and has been increasing at the rate of 3.1% every year for the past 10 years. What was the population 10 years ago?

15. A medical laboratory has been producing syringe to be used for the medicine in curing the victims of an epidemic disease. If initially, there are 50 persons infected and it is increasing everyday by 6%. When will the laboratory produce the entire syringe needed if 600 people were infected already?

NAME: _____ Year & Track: _____ Date: _____

Extended Lesson: PIECEWISE FUNCTIONS

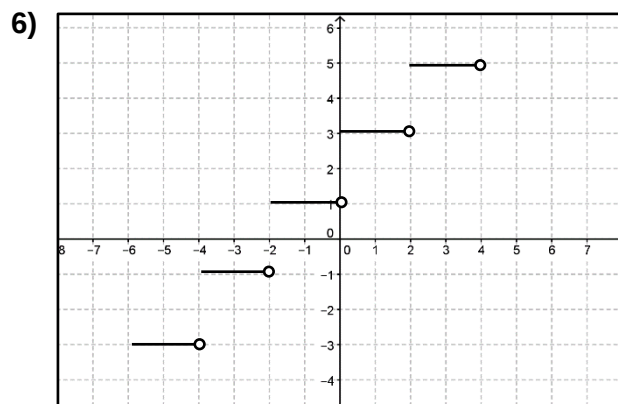
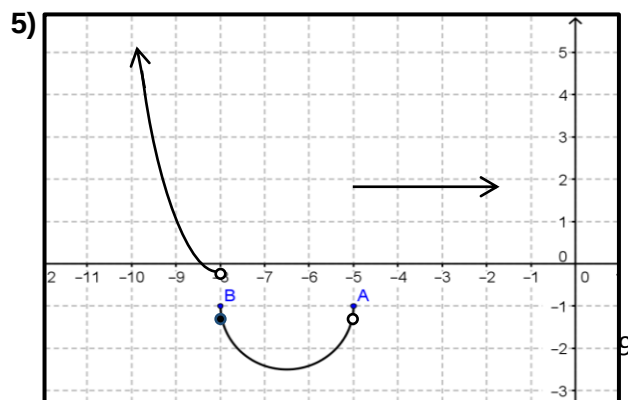
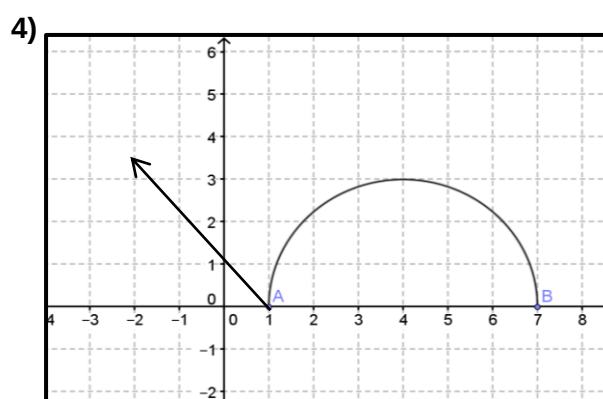
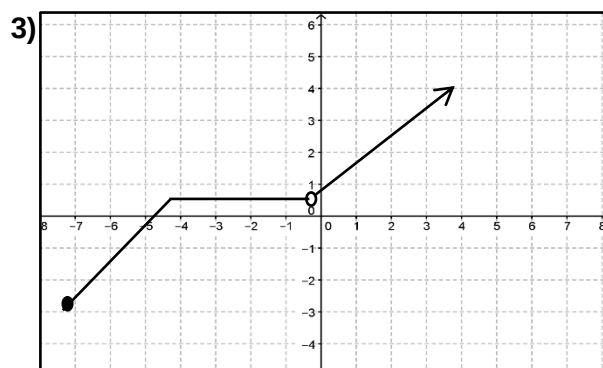
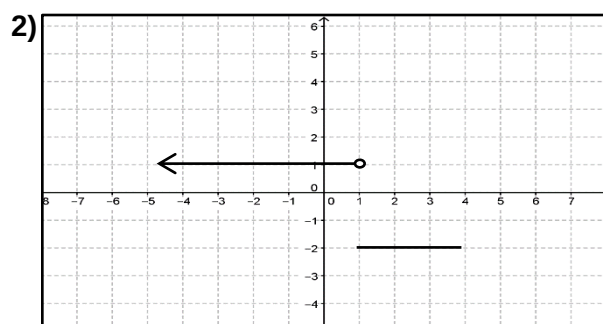
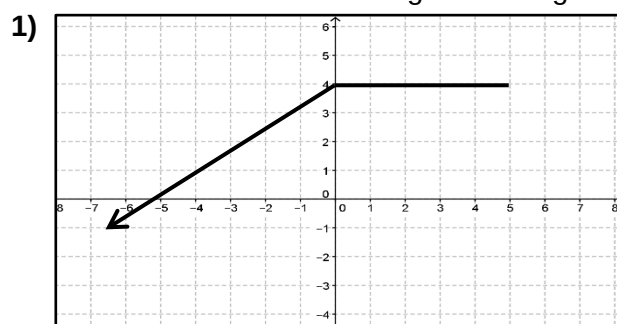
Objectives:

At the end of each lesson, the students should be able to:

- represent real-life situations using functions, including piece-wise functions;
- determine the domain and range of piecewise functions;
- graph piecewise functions; and
- solve problems involving piecewise functions.



Determine the domain and range of each given piecewise function.

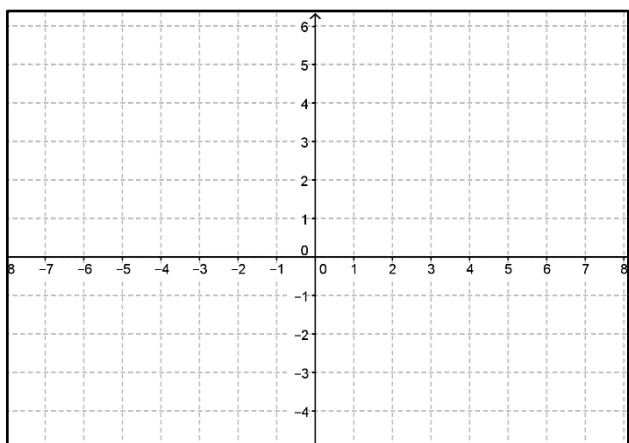




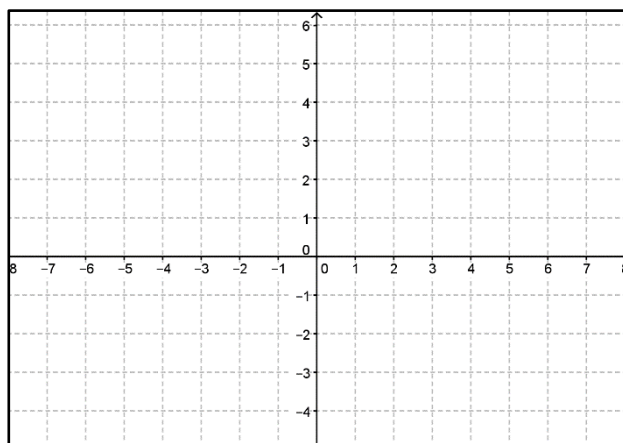
SKILL BUILDER

Graph the following functions, and determine the domain and range.

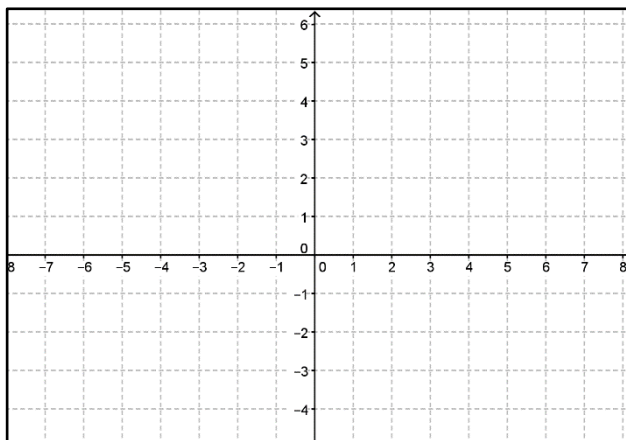
$$1) f(x) = \begin{cases} 3, & \text{if } -3 \leq x < 0 \\ 2 - x, & \text{if } x \geq 0 \end{cases}$$



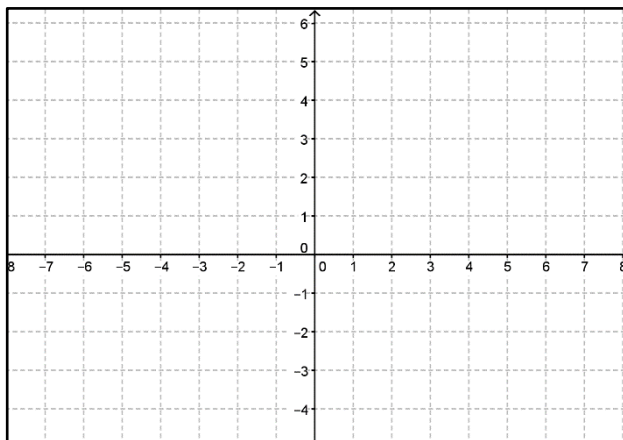
$$2) f(x) = \begin{cases} \sqrt{x+1}, & \text{if } x \geq 0 \\ \frac{2}{x}, & \text{if } x < 0 \end{cases}$$



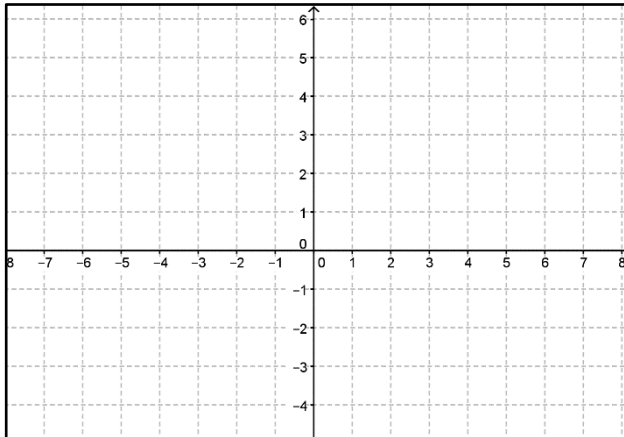
$$3) f(x) = \begin{cases} x, & \text{if } x \leq -1 \\ -1, & \text{if } x = 0 \\ x^2, & \text{if } x \geq 1 \end{cases}$$



$$4) f(x) = \begin{cases} -|x|, & \text{if } x < -2 \\ \sqrt{4-x^2} & \text{if } [-2, 2) \\ x-2, & \text{if } x \geq 2 \end{cases}$$



$$5. \ g(x) = \begin{cases} x^2 - 6x + 9, & \text{if } (3, +\infty) \\ -1, & \text{if } [1, 3] \\ -2 + x^3, & \text{if } [-\infty, 0] \end{cases}$$



Solve the given word problems.

1. To meet the needs of her family, teacher Nera is rendering a tutorial service to students of another school. The function below models her service fee where t represents the number of hours.

$$f(x) = \begin{cases} 200, & x \leq 1 \\ 350, & 1 < x < 2 \\ 90x + 200, & x \geq 2 \end{cases}$$

a) How much will a tutee pay if she ask for 2.5 hour-tutorial?

b) If the student paid P560.00, for how many hours did teacher Nera helped her?

2. Mr. Charles, a veterinarian, charges his costumers in assisting their pets (dogs and cats), especially during labor times. For normal delivery, the charge will depend on the number of hours x for labor plus 200 for every puppy/kitten delivered. If the labor is less than or equal to 2 hours, he charges his customers **300x** , if the labor time is between 2-4 hours, he charges **300x + 250** and if its longer than 4 hours, he charges **300x + 650**.

a) How much will a customer pay if her pet labored for 4 hours and had 5 puppies?

b) If the customer paid P3, 050 and has 3 puppies, how long did her pet labor?

CHAPTER IV

BUSINESS MATHEMATICS

TOPICS

Lesson 1	Understanding Simple Interest
Lesson 2	Exploring Compound Interest
Lesson 3	Obligations and Equations of Values
Lesson 4	Annuities
Lesson 5	Annuity Due
Lesson 6	Exploring Deferred Annuity
Lesson 7	Amortization
Lesson 8	Bonds
Lesson 9	Stocks

LEARNING COMPETENCIES

- Illustrates simple and compound interests. **M11gm-ia-1**
- Distinguishes between simple and compound interests.
M11gm-ia-2
- Computes interest, maturity value, future value, and present value in simple interest and compound interest environment.**m11gm-ia-b-1**
- Solves problems involving simple and compound interests. **M11gm-iib-2**
- Illustrates simple and general annuities. **M11gm-iic-1**
- Distinguishes between simple and general annuities. **M11gm-iic-2**
- Finds the future value and present value of both simple annuities and general annuities.
M11gm-iic-d-1

- Calculates the fair market value of a cash flow stream that includes an annuity.
M11gm-iid-2
- Calculates the present value and period of deferral of a deferred annuity. **M11gm-iid-3**
- Illustrate stocks and bonds. **M11gm-iie-1**
- Distinguishes between stocks and bonds. **M11gm-iie-2**
- Describes the different markets for stocks and bonds. **M11gm-iie-3**
- Analyzes the different market indices for stocks and bonds. **M11gm-iie-4**
- Interprets the theory of efficient markets. **M11gm-iie-5**
- Illustrates business and consumer loans. **M11gm-iif-1**
- Distinguishes between business and consumer loans. **M11gm-iif-2**
- Solves problems involving business and consumer loans(amortization, mortgage).
M11gm-iif-3

NAME: _____ Year & Track: _____ Date: _____

LESSON 1: SIMPLE INTEREST

Objectives:

At the end of each lesson, the students should be able to:

- illustrate simple interest;
- compute interest, maturity value, future value, and present value in simple interest; and
- solve problems involving simple interest.



**CONCEPT
BUILDER**

I. Find the value of the indicated variable.

1. $P = 10,000$ $I = ?$
 $r = 4\%$
 $t = 2 \text{ years}$

2. $I = 250$ $P = ?$
 $r = 3\%$
 $t = 3 \text{ years}$

3. $P = 7,000$ $I = ?$
 $r = 5.5\%$
 $t = 6 \text{ months}$

4. $P = 25,000$ $t = ?$
 $r = 7.8\%$
 $I = 7,400$

5. $P = 35,000$ $r = ?$
 $t = 3 \text{ months}$
 $I = 210$

II. What is the value of each indicated variable?

1. $P = 1,500$ $A = ?$
 $r = 2\%$
 $t = 5 \text{ years}$

2. $A = 12,000$ $P = ?$
 $r = 5\%$

$t = 4$ years

3. $A = 27,550$ $t = ?$
 $P = 15,000$
 $r = 8\%$
4. $A = 54,000$ $r = ?$
 $P = 18,000$
 $t = 15$ months
5. $P = 132,880$ $I = ?$
 $r = 10\%$
 $t = 30$ months



SKILL BUILDER

Solve the following problems.

1. What is the simple interest of P50,000 deposited to Life Bank which offers 7% for 6 months?
2. A lending company charges 11% annual rate for overdue accounts. How much interest will be owed on an 835 account that is 3 months overdue?
3. How much is the accumulated amount if a P85,000 bond earns 4% annual interest rate for 15 years.
4. Teresa wants to borrow P5,000 from Marie. She is willing to pay back 6,120 after 2 years. What is the annual interest rate of the she borrowed?
5. Jiggs bag the first prize in an essay writing contest. As a prize, he was given two options: either to bring home the 5,000 now or 7015 in 2 years. If the money can be invested at an interest rate of 7.25%, which option will he choose?
6. For how many years will P10,000 double itself at 3.25% annual simple interest rate?

7. Zanea needed a new set of furniture for her new room. Because of her dedication, her company lent her P25, 000 with an annual interest rate of 1.35% to be paid after 24 months. What is the total amount she paid? How much is the interest earned by the company?

8 . As an incentive in graduating high school as valedictorian, Kailey received a cash gift from her parents amounting to P35, 000. How long will it take the money to triple its value if she deposited this with 16% interest per year?

9. Faith is deciding on which bank she will start a savings account amounting to P30, 000. Wise Bank offers 7 % interest rate for 14 months, while Life Bank offers 5 % for 24 months. If she wants to earn a higher interest, which bank should she choose?

10. On May 4, 2014, Chrissy borrow P20,000 at 8% interest rate. Dawn must pay the principal and interest on September 4, 2014. What is Chrissy's simple interest using the exact time, exact interest?

11. Bart needed a new set of welding equipment in his welding shop. He then borrowed P150, 000 on April 5, 2015 from his brother who charges it at 3.5% simple interest. How much will Bart pay if he promised his brother to pay his debt on December 31, 2016? (use the Banker's Rule)

12. On November 16, 2015, Marianne owed a 90-day note amounting to P6, 000 with 12% interest. On day 40, Marianne pays P 800.00 on the note. Then, Marianne made an additional payment of P 1000, on day 80. What is the final balance due? Assume a 360-day year.

13. The face value of a simple discount note for 50 days at 9 % is P 7,000. Find the following (use ordinary interest exact time)

- a) amount of interest charge for each note.
- b) amount the borrower would receive.
- c) effective rate (to nearest tenth percent?)

NAME: _____ Year & Track: _____ Date: _____

LESSON 2: COMPOUND INTEREST

Objectives:

At the end of each lesson, the students should be able to:

- illustrate compound interest;
- compute interest, maturity value, future value, and present value in compound interest ;
- solve problems involving compound interest; and
- distinguish simple and compound interest.



**CONCEPT
BUILDER**

I. Find the unknown value using the appropriate formula. The amount is compounded yearly.

1. $P = 8,000$

$r = 3\%$

$t = 2$ years

$A = ?$

3. $P = 11,500$

$r = ?$

$t = 10$ years

$A = 19,600$

5. $P =$

$r = 12\%$

$t = 20$ years

$A = 319,774.62$

2. $P = 15,000$

$r = 4\%$

$t = 5$ years

$A = ?$

4. $P = ?$

$r = 6.5\%$

$t = 15$ years

$A = 56580.50$

II. Find the accumulated amount of P12, 000 at the end of 7 years at 8%

- compounded annually
- compounded semiannually
- compounded quarterly
- compounded monthly
- compounded continuously

III. Find the effective rate to each nominal rate.

- 3% compounded semiannually
- 11% compounded quarterly
- 12.5% compounded quarterly
- 9.6% compounded semiannually



Solve the given word problems.

1. Mary Rose deposited an amount of P19, 000 in a bank that pays 4% annual interest compounded yearly. How much money will she have in the bank after 11 years?
2. What is the equivalent nominal rate of money with an effective rate of 7.1%?
3. How much interest was earned if P125, 000 is lent with 11.5 % annual interest rate paid after 10 years compounded annually?
4. In order to buy the computer he needed in his studies, Bill borrowed money from a lending company which offers 5% annual interest rate compounded monthly. How much did he borrow if he paid P35, 358.12 at the end of 2 years?
5. What is the compound amount and interest earned if Sir Carlo deposited P3600 at 4.75% compounded continuously?
6. Dexter lend money in order to earn money. He is choosing between the two options: charging the borrower 5% interest compounded quarterly or charging the borrower at 4.5% interest compounded monthly. Which of the two will give Dexter a better deal?
7. Carl, borrowed P 35,000 from a lending company that earns 3.5 % interest compounded annually. After how many years will his money be 46,008.32?
8. How many years will it take an investment of P 12,000 to double its value when interest is compounded annually at 7%? When will the amount triples?
9. Neri is planning to put up a simple bakeshop. She needs a total amount of 120,000. She only have P85, 000 at hand. At what annual rate will she consider if she will invest her money for 2 years compounded quarterly?
10. Marissa won P 100, 000 in a singing contest tax free. She wanted to increase the amount by depositing it to a bank. Her friend Claire referred her to two banks. Bank X offers 6 % interest rate compounded semiannually while Bank Y offers 5% interest rate compounded quarterly. If she didn't withdraw any amount in 8 years, which of the two banks will she choose?
11. Sophia, a hardworking student, is a business woman in her own way. Using her total savings P24, 500, she invested it to her friend's business which pays 11% simple interest. Not fully contented, after 10 months, she withdrew her money and deposited the proceeds to a 3-year certificate of deposit paying 7.25% compounded quarterly. How much will she have after 3 years?
12. Martha and Myrtelle are best of friends. After graduating from culinary school, they decided to put up a pastry store. Martha contributed 30,000 immediately while Myrtell decided to invest first her contribution to grow it in 3 years to a bank with 6% compounded quarterly. How much should she contribute at that time to match Martha's investment?

NAME: _____ Year & Track: _____ Date: _____

LESSON 3: OBLIGATIONS AND EQUATIONS OF VALUES

Objectives:

At the end of each lesson, the students should be able to:

- determine the value of a financial obligation;
- determine the worth of equations of values; and
- apply the concepts of simple and compound interest.



CONCEPT BUILDER

Answer the following questions.

1. Last March 31, 2015, Julie Ann owed her cousin P3, 500 at 7% simple interest. The money is worth 12% compounded semi-annually, how much is her obligation if she needed to pay her cousin on March 31 2017?
2. Mary Rose borrowed money from her friend amounting to P 7,500. She needs to pay her friend on May 5, 2014. If the money is worth 7% compounded quarterly, find the value of this obligation
 - a) On May 5, 2010
 - b) On May 5, 2018
3. Which of the following obligations is more valuable if the debt is worth 12% simple interest?
 - a) P15,000 due at the end of 2 years ; or
 - b) P 17,000 due at the end of 4 years
4. What are the present values of the following obligations if the money is worth 12% compounded semi-annually?
 - a) P3,000 due at the end of 4 years
 - b) P 5,700 due at the end of 9 years?
5. Given the following conditions below, and if the money is worth 7.5% compounded monthly, which is the least valuable?
 - a) P 30,000 due at the end of 2 years without interest; or
 - b) P 20,000 due at the end of 4 years compounded annually; or
 - c) P 15, 000 due at the end of 6 years compounded monthly?



Solve the following problems.

1. Due to business failure, Mercy owed her friend Charm P6, 500 due in 2 years at 9% compound annually and her friend Kailey P9, 500 due in 7 years at 6% compounded semi-annually. Her parents pitied her and told her to settle her obligations by giving a single payment on the 5th year. If the money is worth 11% compounded semi-annually, how much is the single payment?
2. To put up mini-garments shop, Mr. & Mrs. Francisco Simon borrowed money on February 1, 2014 with two different amounts given the following conditions.
 - a) P 90,000 due at the end of 10 years at 7% compounded monthly ; and
 - b) P 110, 000 due at the end of 3 years without interest.

Mr. & Mrs. Francisco Simon promised to settle their obligations by two equal payments on 4th year and 9th year. How much will they pay if the money is worth 13% compounded annually?

3. Mr. Smith owned a lending company which is charging money at 9% worth compounded semi-annually. If Mr. Reyes borrowed from Mr. Smith's company and decided to pay P 20,000 at the end of 2 years, how much will he pay at the end of 3 years and 6th year?

The following are the obligations of Mr. Reyes.

- a) P8,000 due at the end of one year without interest
- b) P 15,000 due at the end of 5 years at 11.5% interest rate; and
- c) P 12,500 due at the end of 7 years at 10% compounded monthly?

NAME: _____ Year & Track: _____ Date: _____

LESSON 4: ANNUITIES

Objectives:

At the end of each lesson, the students should be able to:

- determine if the statement is true or false using the terms related to annuities;
- illustrate simple and general annuities;
- distinguish between simple and general annuities; and
- calculate the fair market value of a cash flow stream that includes an annuity.



**CONCEPT
BUILDER**

I. Read and analyze each given item. Encircle the letter "A" if the statement is correct, otherwise, encircle "B".

- A B 1. It is any sequence of equally spaced payments or deposits.
- A B 2. It is an annuity where regular deposits or payments are made at the end of the period.
- A B 3. It is an annuity where regular deposits or payments are made at the beginning of the period.
- A B 4. It is an annuity that does not begin until a period of time (period of deferral) has passed.
- A B 5. It is an annuity where in the interval of payments is the same as the compounding interval.
- A B 6. It is an annuity where in the interval of payments is different as the compounding interval.
- A B 7. It is a term which referring to the sum of the compound amounts of all payments or deposits compounded to the end of the term.
- A B 8. It is an annuity with definite beginning and ending dates.
- A B 9. It is an annuity with no fixed terms.
- A B 10. It is an annuity with definite beginning but never ends.

II. Determine if the given problem is a simple ordinary annuity or a general ordinary annuity. Write "A" if it is an ordinary annuity and "B" if it is a general ordinary annuity.

- [] 1. Find the value of an investment after 2 years for a P5, 000 ordinary annuity compounded semi-annually at 8%.

[] 2. Claire Simpson, a triathlete that plans to lie low for her career after 5 years to give more time to her family. To prepare for her future, she deposits at the end of each year for 5 years in an account paying 6% compounded annually. How much will she have in her account after 5 years?

[] 3. The newlywed couple got a condo unit which costs P 450,000. After paying 100,000 for the down payment, the balance will be paid off in 48 at the end of 3 months with interest rate of 3% per quarter on the unpaid amount. How much is the quarterly payment?

[] 4. Every day, before going home, Mr. Santos always drop by a lottery stall to buy a ticket. Luckily after trying for several times, he won. He then wanted to buy an annuity that that pays P10, 000 monthly for the next 5 years. How much should he pay now to get this annuity if the interest rate on the annuity is 4.5 % converted monthly?

[] 5. Clinton wants to receive an annuity in 3 years. He will make withdrawals at the end of each year. How much must Clinton invest today to receive a stream of payments for 3 years if the interest on the annuity is 7% annually?

III. Complete the table below for ordinary annuities.

Value of annuity	Amount of periodic payment	Frequency of payment	Length of time (years)	Interest rate	Present Value
	P400	Annually	3	2.5 %	
P4,000		Semi annually	4	7%	
P3,000	P200	Quarterly		5%	
		Monthly	5	6%	P5,000



SKILL BUILDER

I. Solve the following problems in Concept Builder II.

II. Solve completely each given problem.

1. Find the value of an investment after 5 years for a P 9,000 ordinary annuity at 5%.

2. An amount of P 13,000 is deposited monthly to an account earing 8.5% compounded quarterly. What is the value of the annuity at the end of 3 years? How much is the interest?

3. Mr. Frank spent his entire years in teaching leaving no time for him to have his own family. To make sure that after retiring, he could still support himself, he decided to buy an annuity. He assumes that he could still live for about 15 years after retirement and would need P15, 000 each month. How much the annuity would be if the interest rate is 7% compounded semi-annually?
4. How much would Maricar receive at the end of each year for 5 years if she buys an annuity with interest rate of 6.5 % compounded quarterly?
5. What must you invest today to receive an annuity of P 5,000 for 7 years semi-annually at a 12% annual rate, if all withdrawals will be made at the end of each year?
6. Mercy Simon would like to enrol her daughter to a 4-year dance program starting on April 1, 2016. She made a single deposit of P120, 000 on April 1, 2015 and make withdrawals at the end of each year. If the bank pays an interest rate of 7% compounded annually, how much does her equal payment yearly for 4 years so that no balance will remain after that time?
7. Mr. Soriano borrowed money that must be repaid at the end of 10 years. The company wants to make sure the loan will be repaid at the end of 10 years, so it invests P11, 300 at the end of each year at 12% compounded semi-annually. What was the original amount?
8. Ms. Lucy, a mid wife working in a public hospital, believed that she will spend P55,000 a year for 20 years once she retire in 40 years. How much must she save each year until retirement to meet her retirement goal, if the interest is 4.5% per year?
9. You believe you will spend 40,000 a year for 20 years once you retire in 40 years, if the interest rate is 6 percent per year, how much must you save each year until retirement to meet your retirement goal?
10. Rosie deposited equal amount of P7, 000 at the end of each month in a bank that pays 11% interests compounded quarterly. When will the money become P183, 382.00?

NAME: _____ Year & Track: _____ Date: _____

LESSON 5: UNDERSTANDING ANNUITY DUE

Objectives:

At the end of each lesson, the students should be able to:

- identify if the situation illustrates annuity due;
- solve the unknown values for an annuity due; and
- solve problems involving annuity due..



CONCEPT BUILDER

I. Complete the table for annuity due.

Value of annuity	Amount of periodic payment	Frequency of payment	Length of time (years)	Interest rate	Present Value
	P200	Annually	3	2.5 %	
P3,000		Semi annually	4	7%	
P5,000	P500	Quarterly		5%	
		Monthly	5	6%	P15,000



SKILL BUILDER

Solve the following problems.

1. How much would Ysa receive at the beginning of each year for 6 years if she buys an annuity with interest rate of 6.5 % compounded monthly?
2. Claire Simpson, a triathlete that plans to lie low for her career after 10 years to give more time to her family. To prepare for her future, she deposits at the beginning of each year for 5 years in an account paying 5% compounded annually. How much will she have in her account after 10 years?

3. Last January 31, 2016, Jake planned to invest an equal amount of P4, 000 to a business. He started investing last February 1, 2016 and will continue doing this every 3 months for 7 years with an interest rate 15% . How much is his total earnings?
4. Have you started saving yet? Suppose you believe you will need to accumulate P500,000 by the age of 60 years in order to achieve your desired standard of living. How much must you save at the start of each year to meet your goal, and if the rate is 8% ?
5. To support her daughter's on the job training, Mrs. Pudiquet borrowed P 30,000 and agreed to pay the loan in five equal payments at an interest rate of 11% .What will her payment be if the payment is immediately every year?
6. On his son's graduation day, Mr. Rowel bought a new car for him. He gave a down payment of P40, 000 and agreed to pay the remaining balance plus the interest by paying P17,000 at the beginning of each month for 36 months. If the interest is charge at 16% per year, and no other charges are added, what is the price of the car?
7. A lending company has to offers to choose from. Option A offers equal payment scheme every 3 months at 10% compound interest while Option B offers equal payment scheme every 6 months at 9% compound interest. If the company is willing to lend P 135,000 you payable at the start of each month for 6 years, which is a better choice?
8. Mariebelle wants to buy an annuity which pays P1, 500 monthly over a period of 12 years. How much should she deposit so that annuity can be paid and there will be no remaining money in the account. The bank pays interest at a rate of 15%.
9. Cynthia deposited equal amount of P6, 000 at the start of each month in a bank that pays 11% interests compounded quarterly. When will the money become P183, 000.00?
10. In order to ensure the education of her daughter, Mrs. Padilla decided to save money and deposit this in a bank that pays an interest of 13%. She is choosing between depositing the money either at the start of the year compounded quarterly. or at the end of the year compounded monthly. If she will deposit equal amount of P20, 000 yearly, which is a better deal?

NAME: _____ Year & Track: _____ Date: _____

LESSON 6: EXPLORING DEFERRED ANNUITY

Objectives:

At the end of each lesson, the students should be able to:

- calculate the present value and period of deferral of a deferred annuity; and
- solve problems involving deferred annuity.



I. Determine if the following is a deferred annuity or not. Write “A” if it’s a deferred annuity, otherwise, write “B”.

[] 1. In order to save P100, 000, you agreed to pay the bank at the end of each quarter. If the bank charges 7% compounded quarterly for 3 years, how much will you pay the bank each quarter?

[] 2. A newlywed couple would like to have a trust fund in order to support their future children. The company will pay the couple P100, 000 yearly for 15 years after being deferred for 5 years. If it will earn 5% interest compounded semi-annually, how much is the present value of the trust fund?

[] 3. How much would Mercy receive at the beginning of each year for 5 years if she buys an annuity with interest rate of 4.1 % compounded monthly?

[] 4. To accumulate a higher number of enrollees, a certain school offers this advertisement: For Grade 11 enrollees, you pay P15, 000 down payment plus P85, 000 lump-sum payment 2 years from now. If the money is worth 7% interest compounded monthly, how much will you pay the school after 2 years?

[] 5. A house costs P 700,000. After a down payment of P P150, 000, the balance will be paid off after 36 months. With interest rate of P7% per year on the unpaid balance. How much will you each month?



SKILL BUILDER

Solve the given problems. Show necessary solutions.

1. Marie promised to pay her debt P 75,000 monthly for 3 years .If the money is worth 7% compounded monthly and the first payment is due at the end of 4 months. What is her frist monthly payment?
2. You took the opportunity to buy a gadget from your company because of the company's offering:
“ If you buy, you pay a down payment of P3,000 only and a semi-annual payment of P 500 for 3 years. The payment will start at the end 3 months and the money earns an interest of 2.5% compounded semi-annually”.

How much is the present value of the said gadget?

3. Mr. Reyes invested to a certain business that will pay him P12, 000 yearly for 8 years. After being deferred for 1 year, the money earns an interest of 6% compounded quarterly?
 - a) How much is the expected payment to the Mr. Reyes quarterly?
 - b) How much is the present value of the trust fund?
4. Using her retirement benefits, Mr. Gordon, would like to buy a vacation house in a nearby place. After searching for advertisement regarding this, he is deciding between the two given offers.

Option1 : P50,000 down payment plus P 400,000 lump-sum payment 10 years from now

Option 2: P 50,000 down payment plus P20, 000 monthly for 10 years.

If the money earns an interest of 9% compounded quarterly, which of the two offers will Mr. Gordon choose?

5. Mrs. Soriano put up a trust fund for her daughter, Claire amounting to P1, 500,000 which earns an interest rate of 11% compounded quarterly. The company agrees to give her certain equal amount per quarter for 10 years. If the money is deferred for 2 years ,how much is each periodic payment?

NAME: _____ Year & Track: _____ Date: _____

LESSON 7: AMORTIZATION

Objectives:

At the end of each lesson, the students should be able to:

- identify the amortization schedule of a loan; and
- solve problems involving business and consumer loans(amortization, mortgage).



SKILL BUILDER

Read and analyze each given problem. Then solve showing necessary solutions.

1. Find the yearly payments that are need to amortize a loan of P15, 000 in 4 years with 3% interest per year.
2. You bought a television set P 32,000 and agree to pay it in 18 equal monthly payments at 4.5% interest per month on the unpaid balance. How much is your monthly payment to amortize your debt?
3. Show an amortization schedule for a p 15,000 debt that is to be amortized in 8 equal months at 3% interest compounded monthly on the unpaid balance?
4. Since Derek is your best friend and you have means compared to him, you lend him money by paying his computer amounting to P54, 000. If you charge him 1% per month, how should you receive each month to amortize his debt for 24 months? How much interest will you receive?
5. Danilo decided to use his savings in buying a house for P750, 000. He gave a down payment of P 250,000 and take out a 20-year mortgage for P 500,000 at an annual interest rate of 8%.
 - a) How much will he pay monthly to amortize the loan?
 - b) What is the total interest paid when the loan is amortized for 20 years?

- c) What portion of his first payment is the interest and the amount used in paying his debt?
6. If you borrow a P50, 000 fifteen-year mortgage at an interest rate of 3% per month, then how much will be your monthly payment? How much of the first payment is interest, and how much is the amortization?
7. An educational institution buys sets of computer units costing P 800,000. The institution paid 25% down and amortizes the rest with equal monthly payments for 2 years at 7% compounded monthly. How much interest will the institution pay?
8. Teresa borrowed P5, 000 from her friend Mae for 1 year with 3.5% interest rate compounded monthly. How much will she pay Mae each month? How much must she pay, if she decided to pay off the remaining balance all at once after making 4 payments?
9. Mr. and Mrs. Donato Navarro bought a new and bigger house for their family, thus making their old house to a vacation house. To pay this, they borrowed P 900,000 million from a lending company and will pay this for 30 years with an interest of p 5.5% per month. In 10 years, the couple decided to sell their old house and lot to pay off the mortgage. What is the principal balance of the loan?
10. Emily decided to buy a new condominium upon seeing the interest rates given. Currently she has P15, 000 for a down payment. Interest rates are as follows
- a) 15% for loans up to 80% of the value of the condominium
 - b) 16% for loans between 80% and 90 % of the value of the condominium
- If she can only afford mortgage payments of at most P 1,500 per month, find the value of the largest condominium Alice can afford to acquire if the mortgage is for 20 years only?

NAME: _____ Year & Track: _____ Date: _____

LESSON 8: BONDS

Objectives:

At the end of each lesson, the students should be able to:

- illustrate bonds;
- use the concepts related to bonds in determining if the statement is correct or not;
- describe the different markets for bonds;
- analyze the different market indices for bonds; and
- solve problems involving bonds.



**CONCEPT
BUILDER**

I. Determine if the statement is correct or not. Write "A" if it's true, otherwise, write "B" in the bracket.

- [] 1. Stocks and bonds are both long term financial instruments
- [] 2. Bond prices fluctuate as interest rates change.
- [] 3. A bond that is priced above its face value is said to sell at par.
- [] 4. The Bureau of Treasury is the largest issuer of Philippine bonds
- [] 5. The interest rate risk is directly proportions to market interest rates
- [] 6. A bond is an agreement to pay a fixed sum of money at a certain date in the future.
- [] 7. If the bond is purchased for the same price, then the bond is purchased at premium.
- [] 8. If the purchase price of a bond is less than the face value, then it is purchased at a discount.
- [] 9. Unsecured bonds are backed up by corporate collaterals that have significant value such as property.
- [] 10. The yield to maturity is the discount rate that makes the present value of the bond's payments equal to its price.



Solve the following problems.

1. What is the current market price of a bond with a par value of P85,000 with a coupon rate of 13% and a current yield of 12.51% ?
2. Fifteen MSP Corporation bonds has a coupon rate of 7 % and a current market price of P75, 000? The par value of each bond is P70, 000 and the commission charge is P800 .The bond is purchase on June 1, and the bond pays an interest of every May 1 and August 1.The commission is P1,000.
 - a) What is the value of the coupon?
 - b) Find the total bond purchase price?
3. Suppose the DSG Corporation makes annual coupon payments. Merigold who bought the bond at the beginning of 2011 for P 33,000 will receive 4 annual coupon payments of P 2,300 and a principal payment of P40,000 in four years. What is the present value of the DSG bond if the return of investment is 7%
4. The total commission charge for 5 Finance Corporation bonds with a coupon rate of P 5.5% is P2, 500. The par value is P 120,000 and its current market price is P130, 000. The transaction is 50 days since the last interest payment. Find the total proceeds of the sale of the 5 Finance Corporation bonds?
5. XYZ Corporation's bond with a coupon rate 11% currently selling at a premium of 120. The par value of the bond is P 30,000.
 - a) What is the annual interest?
 - b) What is the current market price?
 - c) What is the current yield?
6. A 4-year maturity bond with a 14 percent coupon rate can be bought for P 1,200. What is the yield to maturity if the coupon is paid annually? (You may use online calculator to compute for the yield-to-maturity)

NAME: _____ Year & Track: _____ Date: _____

LESSON 9: STOCKS

Objectives:

At the end of each lesson, the students should be able to:

- illustrate stocks ;
- use the concepts related to stocks in determining if the statement is correct or not;
- distinguish between stocks and bonds ;
- describe the different markets for stocks ;
- analyze the different market indices for stocks; and
- solve problems involving stocks.



**CONCEPT
BUILDER**

I. Determine if the statement is correct or not. Write “A” if it’s true, otherwise, write “B” in the bracket.

- [] 1. Stockholders can invest in more than one company.
- [] 2. Stocks are ownership shares in a publicly held corporation.
- [] 3. Common stockholders have voting rights in the company.
- [] 4. Bond market is a place where stocks are sold and bought.
- [] 5. Buyers and sellers value the stock on the basis of supply and demand.
- [] 6. The two common types of stock are common and preferred stocks.
- [] 7. A dividend is a periodic cash distribution from the firm to its shareholders.
- [] 8. Stockbrokers do not sometimes charge commissions for the buying and selling of stock.
- [] 9. Preferred stockholders must be given their dividends first before common stockholders.
- [] 10. A stockholder can earn in stocks through a decrease in stock price or capital appreciation.

II. Fill in the blanks based on the following.

MSP Corporation Stock Listing

High	Low	Stock	Div.	Yld %	P-E ratio	Number of Sales Outstanding	High	Low	Close
P 60	P45	MSP	7	12.7	18	100,000	62.5	54.75	55

- | | |
|--------------------------------------|--|
| _____ 1. Name of corporation | _____ 6. Sales in 100 shares |
| _____ 2. Price-earnings per ratio | _____ 7. Yield % |
| _____ 3. Dividend per share per year | _____ 8. Lowest price traded for the year |
| _____ 4. Lowest price for the day | _____ 9. Highest price traded for the year |
| _____ 5. Highest price for the day | |



SKILL BUILDER

Solve the following stock problems.

1. Rose 150 shares of ABC Corporation at P55.75 per share. What is the total cost to Rose if 3% is the assumed commission?
2. DMA Corporation is increasing next year's dividend to P7.00 per share. The announced stock price next year is P120. Likewise, stocks of other companies offer expected rates of return of 11%. What should DMA Corporation common stock sell for?
3. You bought 200 shares at P90. At the end of 1 year, you sold your total shares at P101 per share. What is the rate of return of your investment if the current dividend per share is P5 and the commission rate in buying and selling the stock is 2%?
4. KMS Corporation pays its cumulative preferred stockholders P 4.5 per share. The corporation has 40,000 shares of preferred and 80,000 shares of common. Due to economic crises in 2011, 2012, and 2013, KMS paid no dividends. In 2014, the board of directors decided to pay out P800, 000 in dividends. How much of the total amount of dividends does each type of stock receive as dividends?
5. The stock records of Dexter Corporation show the following:
 - Preferred stock issued: 20,000 shares
 - Preferred stock cumulative: P3 per share
 - Common stock issued: 50,000 shares
 - In 2015, the corporation did not pay dividends
 - In 2016, the corporation paid P450, 000 in dividends

How much is the dividend per share of common stockholder?

CHAPTER V

UNDERSTANDING LOGIC

TOPICS

Lesson 1	Exploring Propositions
Lesson 2	Operations and Truth Values of Propositions
Lesson 3	Conditional Propositions
Lesson 4	Tautologies, Contingency, and Contradiction
Lesson 5	Categorical Syllogisms, Fallacies, and Types of Proofs

LEARNING COMPETENCIES

- Illustrates a proposition. **M11gm-iig-1**
- Symbolizes propositions. **M11gm-iig-2**
- Distinguishes between simple and compound propositions. **M11gm-iig-3**
- Performs the different types of operations on propositions. **M11gm-iig-4**
- Determines the truth values of propositions. **M11gm-iih-1**
- Illustrates the different forms of conditional propositions. **M11gm-iih-2**
- Illustrates different types of tautologies and fallacies. **M11gm-iii-1**
- Determines the validity of categorical syllogisms. **M11gm-iii-2**
- Establishes the validity and falsity of real-life arguments using logical propositions, syllogisms, and fallacies. **M11gm-iii-3**
- Illustrates the different methods of proof (direct and indirect) and disproof (indirect and by counterexample). **M11gm-ijj-1**
- Justifies mathematical and real-life statements using the different methods of proof and disproof. **M11gm-ijj-2**

NAME: _____ Year & Track: _____ Date: _____

LESSON 1: EXPLORING PROPOSITIONS

Objectives:

At the end of each lesson, the students should be able to:

- illustrates a proposition;
- distinguishes between simple and compound propositions; and
- create simple and compound propositions based from a given topic.



**CONCEPT
BUILDER**

I. Determine whether each of the following is a proposition or not. Write **P** if it is a **proposition**, otherwise, write **S**.

- [] 1. $3x - 7 = 5$
- [] 2. Logic matters.
- [] 3. Clean the house, Neri.
- [] 4. Are you coming with us?
- [] 5. February is a month of love.
- [] 6. Cagayan Valley is in Region II.
- [] 7. She enjoys cooking for her family.
- [] 8. Always walk along the pedestrian lane.
- [] 9. A proposition is denoted using a variable.
- [] 10. The Enhanced Basic Education Act of 2013.

II. Write **S** if the statement is a simple proposition and **C** if it's a compound proposition.

- [] 1. Ten is divisible by 5.
- [] 2. $8 \times 5 = 40$ and $7 \times (-5) = -35$.
- [] 3. An even number is composite.
- [] 4. Granny loves the warmth of summer.
- [] 5. Neither Carl nor Jake will enroll in STEM.
- [] 6. If Emy will work hard, then she will succeed.
- [] 7. Margaux will choose HUMSS strand or ABM strand.
- [] 8. Either Claire will run for a position or Jam will not vote.
- [] 9. An equilateral triangle is likewise an equiangular triangle.
- [] 10. The Philippine education system is constantly changing to better.



SKILL BUILDER

I. For each of the following compound propositions, identify the connector then break them down into 2 simple propositions.

1. Human beings are herbivores and carnivores.
2. Either Leonila will dance or Regine will sing.
3. Marites speaks French and Daisy speaks English.
4. Fifteen is an odd number or a composite number.
5. Seventeen plus eighteen is thirty- five and four times six is twenty –four.

II. Given the 4 simple propositions below, formulate at least 2 compound propositions.

1. The youth is the hope of tomorrow.
2. The youth is a partner of the community
3. Clare is 17 years old.
4. Ben is the leader an organization called “Youth Circle”

Propositions: _____

III. Create a simple and compound propositions about the topic given below.

1. TWENTY-FIRST CENTURY LEARNERS

Simple: _____

Compound: _____

2. K-TO-12 ENHANCED BASIC CURRICULUM

Simple: _____

Compound: _____

3. DIVERSITY

Simple: _____

Compound: _____

NAME: _____ Year & Track: _____ Date: _____

LESSON 2: OPERATIONS AND TRUTH VALUES OF PROPOSITIONS

Objectives:

At the end of each lesson, the students should be able to:

- symbolize propositions;
- translate propositions to symbolic forms and vice versa;
- perform the different types of operations on propositions; and
- determine the truth values of propositions.



CONCEPT BUILDER

I. Determine if each statement illustrates conjunction (C), disjunction (D), Equivalence (E), Implication (I) or Negation (N). Write **C, D, E, I** or **N**, respectively in the first bracket. Then, write “A” if the statement is true, otherwise, write “B” in the second bracket.

- | | | |
|-----|-----|--|
| [] | [] | 1. $27 \div 3 \neq 8$. |
| [] | [] | 2. Twelve is divisible by 3 and 4. |
| [] | [] | 3. Seven is not a multiple of 20. |
| [] | [] | 4. Philippines has cold or hot weather. |
| [] | [] | 5. Mammals are not cold-blooded animals. |
| [] | [] | 6. Franchesca plays the violin or the piano. |
| [] | [] | 7. If I don't eat my meal, then I will be hungry. |
| [] | [] | 8. A triangle is equiangular if and only it is equilateral. |
| [] | [] | 9. If Sid excels in class, then he will graduate with honors. |
| [] | [] | 10. The Reyes family prays together and attends the mass Every Sunday. |

II. Given the two propositions marked as **m** and **s**, translate the following statements into symbolic forms. Write your answer on each blank provided.

m: Reading is interesting.

n : Reading makes you visit different places.

- _____ 1. Reading is boring.
- _____ 2. Reading is interesting and it makes you visit different places.
- _____ 3. Reading is interesting unless it makes you visit different places.
- _____ 4. If reading is interesting, then it will make you visit different places.
- _____ 5. Either reading is interesting or makes you visit different places.
- _____ 6. Reading is interesting iff it makes you visit different places.

- _____ 7. Reading makes you visit different places only if it is not interesting.
- _____ 8. Reading doesn't let you visit different places or it is interesting.
- _____ 9. Reading makes you visit different places or it is not interesting.
- _____ 10. Reading is not interesting but if it makes you visit different places, then it is interesting.

III. Given the two propositions marked as **a**, and **b**

- Translate each of the following symbolic form into statement and write your answer after each item.
- Determine if the resulting statement is either true or false and encircle "A" if it's true, otherwise, encircle "B".

a : An scalene triangle has no congruent sides.

b : A hexagon has 6 sides.

A	B	1. $a \vee b$	_____
A	B	2. $a \wedge b$	_____
A	B	3. $\sim a$	_____
A	B	4. $\sim b$	_____
A	B	5. $a \rightarrow b$	_____
A	B	6. $b \rightarrow a$	_____
A	B	7. $a \leftrightarrow b$	_____
A	B	8. $\sim a \vee b$	_____
A	B	9. $\sim a \wedge \sim b$	_____
A	B	10. $\sim a \rightarrow \sim b$	_____



SKILL BUILDER

I. Given the three propositions marked as **p**, **q** and **r**, find the truth values of the given symbolic forms below. Encircle the letter "A" if it's true, and encircle "B" if it is false.

p : Some mammals have two legs.

q : All even numbers are divisible by 2.

r : All Tax payers are degree holders.

A	B	1. $\sim p$
A	B	2. $p \vee q$
A	B	3. $q \wedge p$

- | | | |
|---|---|-------------------------------|
| A | B | 4. $p \vee r$ |
| A | B | 5. $\sim q$ |
| A | B | 6. $\sim q \wedge r$ |
| A | B | 7. $\sim(\sim p)$ |
| A | B | 8. $q \vee \sim r$ |
| A | B | 9. $\sim r \wedge (p \vee q)$ |
| A | B | 10. $\sim p \vee \sim r$ |

II. If **m** and **n** are known to be true, **p** and **r** are known to be false, but the truth values of **x** and **y** are not known, determine the truth values of the following.

1. $p \vee n$
2. $r \wedge x$
3. $m \rightarrow p$
4. $(n \rightarrow p) \rightarrow r$
5. $p \vee (m \vee \sim n)$
6. $(x \rightarrow y) \vee m$
7. $\sim m \wedge \sim r$
8. $(x \wedge \sim n) \wedge \sim p$
9. $m \wedge \sim (\sim x \wedge \sim y)$
10. $(m \rightarrow y) \rightarrow (r \vee x)$

III. Give two propositions that are relevant in your day to day activities. Then, write them into symbolic forms.

NAME: _____ Year & Track: _____ Date: _____

LESSON 3: CONDITIONAL PROPOSITIONS

Objectives:

At the end of each lesson, the students should be able to:

- illustrate the different forms of conditional propositions;
- write the statements as conditionals;
- determine the hypothesis and conclusion of a conditional
- rewrite the conditional as converse, inverse, and contrapositive ;
- determine the truth values of conditional propositions;
- write the conditionals as biconditional; and
- formulate conditionals given a verse.



**CONCEPT
BUILDER**

I. Rewrite the given statements as conditionals. Then, underline the hypothesis once and conclusion twice.

1. Politicians are responsible citizens.

2. Smart people are good decision – makers.

3. Dedicated teachers are noble.

4. Equilateral triangle is a triangle with 3 congruent sides.

5. According to Jose Rizal, “The youth is the hope of our fatherland.”

II. Determine the truth values of the following conditionals. Encircle the letter “A” if it is true, otherwise, encircle “B”.

- | | | |
|---|---|--|
| A | B | 1. If two angles have the same measures, then they are congruent. |
| A | B | 2. If you are 18 years old, then you can vote. |
| A | B | 3. If the peso value in the Philippine stock market went down, then the economy is high. |

- A B 4. If there are no illegal loggers, then there is no flood.
 A B 5. If a quadrilateral is a square, then it is a parallelogram



SKILL BUILDER

I. Rewrite the given conditionals in *Content Builder II* as converse, inverse, and contrapositive. Then, determine its truth value. Form its biconditional if it is possible.

II. Construct a conditional given the following situations below.

Science:	Trees helps prevent flood.
English:	How to encourage teenagers to read printed books
T.L.E :	B.M.I. of an individual
Economics:	Law of supply and demand
Filipino:	Ang halaga ng “Araw ng Kagitingan” sa mga Pilipino

III. Read the given verse below entitled “**The Gift of Love**” (*Corinthians 13:1-7; 13*) and give or form at least three conditionals. Using the conditionals, form its converse, inverse, and contrapositive.

THE GIFT OF LOVE

If I speak in the tongues of mortals and of angels, but do not have love, I am a noisy gong or a clanging cymbal. And if I have prophetic powers and understand all mysteries and all knowledge, and if I have all faith, so as to remove mountains, but do not have love. I am nothing.

If I give away all my possessions, and if I hand over my body so that I may boast, but do not have love, I gain nothing. Love is patient, love is kind, love is not envious or boastful or arrogant or rude.

It does not insist on its own way; it is not irritable or resentful; it does not rejoice in wrongdoing but rejoices in the truth. It bears all things, believes all things, hope all things and endures all things. And now faith, hope and love abide, these three; and the greatest of these is love.

NAME: _____ Year & Track: _____ Date: _____

LESSON 4: TAUTOLOGIES, CONTRADICTION, AND CONTINGENCY

Objectives:

At the end of each lesson, the students should be able to:

- determine if the statements is true or false using the concept of tautologies, contradiction and contingency;
- illustrates different forms of tautologies using the exercises given;
- identify the truth city or falsity of propositions using the different logical equivalence; and
- show that the given proposition is a tautology or contradiction using truth tables.



I. Determine if the statement is either true or false. Encircle the letter “A” if it is true, otherwise, encircle “B”.

- | | | |
|---|---|---|
| A | B | 1. A compound proposition can be either true or false or both. |
| A | B | 2. A compound proposition (in any form) that is always false is contingency. |
| A | B | 3. Tautology is a compound proposition (in any form) that is always true. |
| A | B | 4. Two propositions x and y are logically equivalent if $x \leftrightarrow y$ is a tautology. |
| A | B | 5. Material equivalence and logical equivalence are forms of tautologies |

II. Using the different laws of logical equivalences, determine if each equivalence is true or not. Encircle the letter “A” if it is true, otherwise, encircle “B”. Letters x , y , and z are propositions while f and t are propositions which are true.

- | | | |
|---|---|--|
| A | B | 1. $y \vee t \leftrightarrow t$ |
| A | B | 2. $z \wedge f \leftrightarrow z$ |
| A | B | 3. $x \vee x \leftrightarrow \sim x$ |
| A | B | 4. $x \vee y \leftrightarrow y \vee x$ |
| A | B | 5. $x \leftrightarrow \sim(\sim x)$ |
| A | B | 6. $\sim(x \wedge y) \leftrightarrow \sim x \wedge \sim y$ |
| A | B | 7. $z \wedge (x \wedge y) \leftrightarrow (x \wedge z) \wedge y$ |
| A | B | 8. $\sim y \vee \sim z \leftrightarrow \sim(y \wedge z)$ |
| A | B | 9. $x \vee (y \vee z) \leftrightarrow (x \vee y) \vee z$ |
| A | B | 10. $x \wedge (y \vee r) \leftrightarrow (x \wedge y) \vee (x \wedge r)$ |



SKILL BUILDER

I. Determine whether each proposition is a tautology, contradiction or contingency. Write your answer on the space provided before each item.

- _____ 1. $\sim(x \wedge x)$
- _____ 2. $x \leftrightarrow y$
- _____ 3. $x \vee \sim y$
- _____ 4. $\sim x \wedge \sim y$
- _____ 5. $x \rightarrow (x \vee y)$
- _____ 6. $(x \wedge y) \rightarrow (x \rightarrow y)$
- _____ 7. $(x \wedge y) \wedge (x \rightarrow \sim y)$
- _____ 8. $\sim(y \rightarrow z) \leftrightarrow (y \wedge \sim z)$
- _____ 9. $[(x \rightarrow y) \wedge (y \rightarrow r) \rightarrow (x \rightarrow z)]$
- _____ 10. $[x \rightarrow (y \rightarrow z)] \rightarrow [(x \rightarrow y) \rightarrow (x \rightarrow z)]$

II. Show that the following biconditionals are tautologies by using truth tables.

1. $y \leftrightarrow [\sim x \wedge (x \vee y)]$
2. $\{[x \vee y \wedge \sim] \wedge y\} \leftrightarrow (y \wedge \sim y)$

III. Using truth tables, show that the following are contradictions.

1. $(x \leftrightarrow y) \wedge (\sim x \wedge p)$
2. $[\sim y \wedge (\sim p \vee q)] \wedge p$

NAME: _____ Year & Track: _____ Date: _____

LESSON 5: CATEGORICAL SYLLOGISMS, FALLACIES, AND TYPES OF PROOFS

Objectives:

At the end of each lesson, the students should be able to:

- identify the different types of fallacies;
- determine the validity of categorical syllogisms;
- establish the validity and falsity of real-life arguments; using logical propositions, syllogisms, and fallacies;
- illustrate the different methods of proof (direct and indirect) and disproof (indirect and by counterexample); and
- justify mathematical and real-life statements using the different methods of proof and disproof.



**CONCEPT
BUILDER**

I. Identify the fallacies committed in each of the following.

1. Surveys shows that Filipino is the least favorite subject. So I Filipino is my least favorite subject too.
2. Suzette likes wearing dress clothing. She also like pink color. Therefore, I am certain that likes wearing pink dresses.
3. She felt awed with the dessert in front of her.
4. Marie is not a Christian. So she is clearly an atheist.
5. The teacher said, "You should not believe her statements because she is a good liar."
6. "Loud music is deafening to the ears."
"There is a deafening silence."
Therefore, loud music is silence.
7. If it will shine brightly today, then I will wear my sunglasses. I am wearing my sunglasses. Therefore, it is shining brightly today.
8. A student under the STEM track class says that Chemistry is an easy subject.
Therefore, all the 40 students on the said class finds Chemistry easy.
9. The boss said, "You are fired!" because of your inefficiency.

The secretary said, "Sir please don't remove me because I am the bread winner of my family. If I don't have work, then they don't have anything to eat."

10. Every member of the basketball team is a three-point shooter.

Therefore, the basketball team is a three-point shooter team.

II. Identify the major term, minor term, and middle term of each syllogism.

1. All taxpayers are good citizens.
Teachers are good citizens.
Therefore, all taxpayers are teachers.
2. A mathematician is intelligent.
Francis Bulton is a mathematician.
Therefore, Francis Bulton is intelligent.
3. All sunflowers are yellow.
No gumamela is a sunflower.
Therefore, no gumamela is yellow.
4. All Itawes live in Region II.
Some Ilocanos live in Region II.
So, some Ilocanos are Itawes.
5. Some whole numbers are not odd integers.
Some composite numbers are not whole numbers.
Therefore, some composite numbers are not odd integers.

III. Determine the first assumption to be made to start an indirect proof of the following statements.

1. An even number is divisible by 2.
2. If a proposition is invalid, then it must a false conclusion.
3. If $5x < 15$, then $x < 3$.
4. If a square is a rectangle, then it is a parallelogram.
5. If **a** and **b** are odd integers, then $a + b$ is an even integer.



SKILL BUILDER

I. Evaluate the validity of the following arguments.

1. All men have two legs.
Carl is a man.
Therefore, Carl has two legs.
2. Some singers are good dancers.
Some good dancers love fame.
Therefore, some singers love fame.
3. All teachers are hardworking.
Some artists are hardworking.
Therefore, some teachers are artists.
4. No students are hard-headed.
Some teenagers are not hard-headed.
Therefore, some teenagers are not students.
5. All shrubs are non-flowering plants.
Bamboos are shrubs.
Therefore, bamboos are non-flowering plants.

II. Formulate a possible conclusion using the premises given. Then determine if the conclusion formed is valid or not. If it is invalid, identify the fallacy involved in the syllogism.

1. Some plants are trees.
Some trees are bearing fruits.
2. All Filipinos are worth dying for.
Mark is a Filipino.
3. Some scholars are good in writing.
Some scholars are artists.
4. All comedians don't have no problems.
Children have no problems.
5. Some polygons are quadrilaterals.
All rectangles are quadrilaterals

III. Prove the following using direct proof or indirect proof or other methods of proof.

1. Show that “The square of an odd number is also an odd number”.
2. Prove that “The sum of the squares of two odd integers is an even number.”
3. Show that “The quotient of a square of an odd number divided by 4 has a remainder of $\frac{1}{4}$.”
4. If Marites study hard in Mathematics, then she will get high score in her Mathematics exam. Marites got D in her Math exam. Show that she did not study hard.
5. Maricar said “If Erwin will not attend the Graduation Ball, then she will definitely stay at home.” Maricar attended the Graduation Ball. Show that Erwin attended the Graduation Ball.