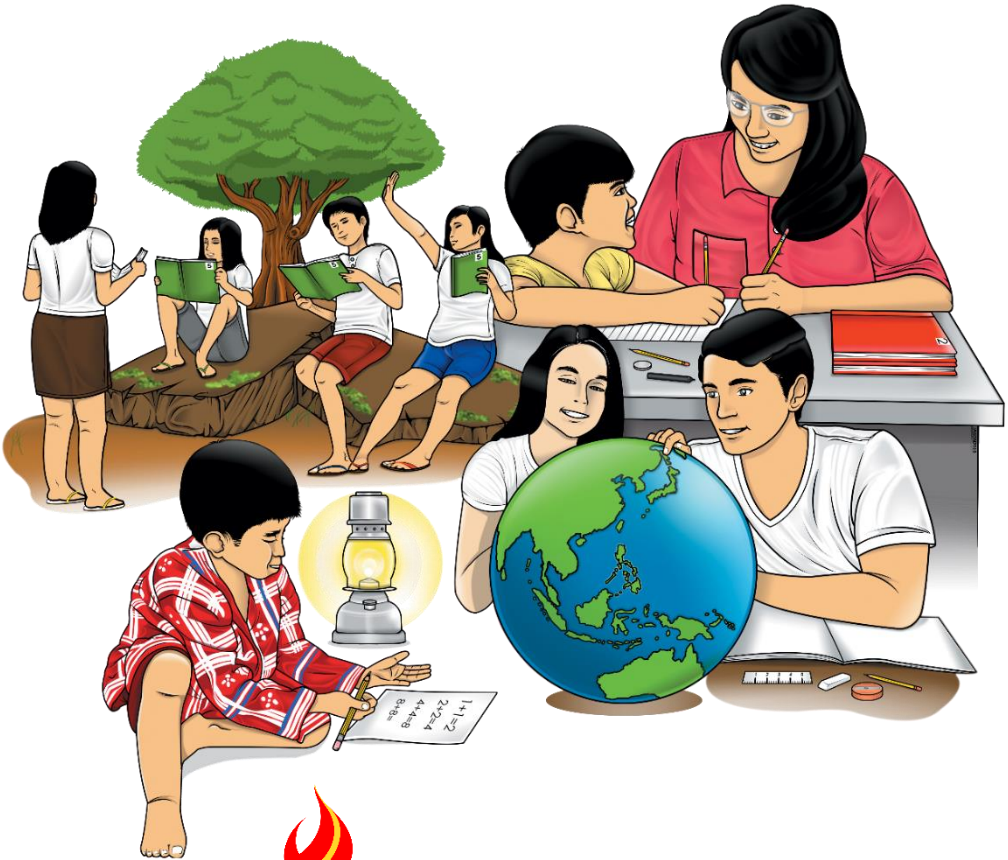
10

Mathematics

Quarter 1 – Module 8:
Dividing Polynomials Using Long and Synthetic Division



ALTERNATIVE DELIVERY MODE

ADM

Mathematics – Grade 10
Alternative Delivery Mode
Quarter 1 – Module 8: Dividing Polynomials Using Long and Synthetic Division
First Edition, 2020

COPYRIGHT PAGE

Published by the Department of Education
Secretary: Leonor Magtolis Briones
Undersecretary: Diosdado M. San Antonio

Development Team of the Module

Writer's Name: Laila B. Kiw-isen
Editor's Name: Melchor B. Ticag
Reviewer's Name: Bryan A. Hidalgo, Heather G. Banagui, Selalyn B. Maguilao, Jim Alberto
Management Team:
May B. Eclar, PhD
Marie Carolyn B. Verano
Carmel F. Meris
Ethielyn E. Taqued
Edgar H. Madlaing
Soraya T. Faculo
Francisco C. Copsiyan

Printed in the Philippines by:

Department of Education – Cordillera Administrative Region

Office Address: Wangal, La Trinidad, Benguet
Telefax: (074) 422-4074
E-mail Address: car@deped.gov.ph

10

Mathematics

Quarter 1 – Module 8:
Dividing Polynomials Using Long and Synthetic Division

Introductory Message

This Self-Learning Module (SLM) is prepared so that you, our dear learners, can continue your studies and learn while at home. Activities, questions, directions, exercises, and discussions are carefully stated for you to understand each lesson.

Each SLM is composed of different parts. Each part shall guide you step-by-step as you discover and understand the lesson prepared for you.

Pre-tests are provided to measure your prior knowledge on lessons in each SLM. This will tell you if you need to proceed on completing this module or if you need to ask your facilitator or your teacher's assistance for better understanding of the lesson. At the end of each module, you need to answer the post-test to self-check your learning. Answer keys are provided for each activity and test. We trust that you will be honest in using these.

In addition to the material in the main text, Notes to the Teacher are also provided to our facilitators and parents for strategies and reminders on how they can best help you on your home-based learning.

Please use this module with care. Do not put unnecessary marks on any part of this SLM. Use a separate sheet of paper in answering the exercises and tests. And read the instructions carefully before performing each task.

If you have any questions in using this SLM or any difficulty in answering the tasks in this module, do not hesitate to consult your teacher or facilitator.

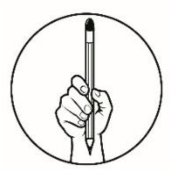
Thank you.

What I Need To Know

This module was designed and written with you in mind. It is here to indulge you in dividing polynomials using long method and synthetic division. The scope of this module permits it to be used in many different learning situations. The arrangement of the lessons follows the standard sequence of the course. But the pacing in which you read and answer this module is dependent on your ability.

After going through this module, you are expected to:

a) divide polynomials using long division and synthetic division, and
b) solve word problem that involves dividing polynomials.



What I Know

DIRECTION: Choose the letter of your answer from the given choices. Write your answer on your answer sheet.

1) If a fifth degree polynomial is divided by a third degree polynomial, what is the degree of the quotient?

   A) 1 B) 2 C) 3 D) 4

2) Divide: $x^3 - 5x^2 + 2x - 10$ by $x^2 + 2$.

   A) $x^2 - 7x + 16$ B) $x^2 - 3x + 8$ C) $x + 5$ D) $x - 5$

3) In the division algorithm $\dfrac{P(x)}{d(x)} = Q(x) + \dfrac{r(x)}{d(x)}$, what is the dividend?

   A) $P(x)$ B) $d(x)$ C) $r(x)$ D) $Q(x)$

4) Find the remainder when $x^3 - 2x^2 + 4x - 3$ is divided by $x - 2$.

   A) 27 B) 5 C) -5 D) -27

5) If $x^3 - 2x^2 - 5x + 6$ is divided by $x - 1$, the remainder is zero.

   A) True B) False C) Cannot be determined

For **#s 6 to 8**, use the illustration of long division below:

Divide $(3x^3 - 2x^2 + x - 2)$ by $(x - 4)$

$$\begin{array}{r} 3x^2 + 10x + 41 \\ x-4 \overline{) \, 3x^3 - 2x^2 + x - 2} \\ -\underline{(3x^3 - 12x^2)} \\ 10x^2 + x \\ -\underline{(10x^2 - 40x)} \\ 41x - 2 \\ -\underline{(41x - 164)} \\ 162 \end{array}$$

6) What is the remainder?

A) $41x - 164$ B) $x + 4$ C) 41 D) 162

7) Which is the divisor?

A) $x - 4$ B) $5x - 6$ C) $3x^2 + 10x + 41$ D) 162

8) Which is the quotient?

A) $x - 4$ B) $5x - 6$ C) $3x^2 + 10x + 41$ D) 162

9) Using synthetic division to divide $3y^3 - 7y^2 - 20$ by $y - 3$, which of the following is the correct first row of the algorithm?

A) $-3\rfloor \quad 3 \quad -7 \quad -20$ B) $-3\rfloor \quad 3 \quad -7 \quad 0 \quad -20$

C) $3\rfloor \quad 3 \quad -7 \quad -20$ D) $3\rfloor \quad 3 \quad -7 \quad 0 \quad -20$

For **#s 10 & 11**, use the following synthetic division:

$$\begin{array}{r|rrrr} -2 & 1 & 6 & 2 & -12 \\ & & -2 & -8 & 12 \\ \hline & 1 & 4 & -6 & 0 \end{array}$$

10) Which polynomial is the dividend?

A) $x^4 + 6x^3 + 2x^2 - 12x$ B) $x^3 + 6x^2 + 2x - 12$

C) $x^3 + 4x^2 - 6x$ D) $x^2 + 4x - 6$

11) Which polynomial is the quotient?

A) $x^4 + 6x^3 + 2x^2 - 12x$ B) $x^3 + 6x^2 + 2x - 12$

C) $x^3 + 4x^2 - 6x$ D) $x^2 + 4x - 6$

12) Find the quotient when $\left(x^3 - 2x^2 - 11x - 20\right)$ is divided by $(x - 5)$.

A) $x^2 + 3x + 4$ B) $x^2 - 3x + 4$

C) $x^2 + 3x - 4$ D) $x^2 - 3x - 4$

13) What is the quotient when $\left(2x^3 - 9x^2 - 2x + 3\right)$ is divided by $(2x - 1)$?

A) $x^2 + 4x + 3$ B) $2x^2 - 8x - 6$

C) $x^2 - 4x - 3$ D) $2x^2 + 8x + 6$

14) What will be multiplied to $x^2 - 6x + 2$ to get $3x^3 - 19x^2 + 12x - 2$?

A) $3x - 1$ B) $3x + 1$ C) $x + 3$ D) $3x + 2$

15) The volume of a rectangular prism is $(2x^3 - 11x^2 + 13x - 4)cm^3$ and its height is $(x - 4)$ cm. What is the area of its base?

A) $(2x^2 - 3x + 1)\ cm^2$ B) $(2x^2 + 19x + 76)\ cm^2$

C) $(2x^2 + 3x - 1)\ cm^2$ D) $(2x^2 - 19x - 76)\ cm^2$

Lesson	Dividing Polynomials Using Long & Synthetic Division

What's In

When you were in Grade 7, you have learned that polynomial is an algebraic expression whose variables must have nonnegative-integer powers. The degree of a polynomial in one variable is the highest exponent among all the terms in the polynomial. Recall also the concepts about naming polynomials according to its number of terms (*ex. monomial, binomial, trinomial, etc.*) and its degree (*ex. linear, quadratic, cubic, etc.*). Then, answer the activity that follows.

Activity 1. Complete the table. An example was done for you.

Polynomial	**Number of Terms**	**Name of the Polynomial** *(according to the number of terms)*	**Degree**	**Name of the Polynomial** *(according to degree)*
Example: $x^2 + 2x + 1$	3	Trinomial	2	Quadratic
1) $x + 1$				
2) $2x^4 + 3x^2 + 4x + 1$				
3) $-5x^3$				
4) $x^6 - 3x^3 + 1$				
5) $3x^3 + 2x$				

What's New

Some real life applications of polynomials can be seen in the field of engineering and economy. Engineers used polynomials when designing roads, buildings and other structures and economist used it to model economic growth pattern. To understand more about polynomials, let's have the following problem:

Problem:

During a school fund raising activity, you were able to generate a total of $x^3 - 9x - 3x^2 + 27$ pesos from selling candies. If each candy costs $x + 3$ pesos, how many candies were you able to sell?

To find the number of candies, we will divide the polynomial $x^3 - 9x - 3x^2 + 27$ by $x + 3$. Hence, we need to understand the concept and learn the skill in dividing polynomials which is the focus of this module.

What Is It

In this part of the module, we will show you how to divide polynomials using long division and synthetic division. This skill is very important in factoring polynomials and finding the roots of a polynomial equation.

A. Dividing Polynomials using Long Division

To show you how to divide polynomials using long division, we will use the polynomials specified in the problem from the previous page. That is to divide $x^3 - 9x - 3x^2 + 27$ by $x + 3$. Be guided with the following steps:

Example 1. Divide $(x^3 - 9x - 3x^2 + 27)$ by $(x + 3)$.

Solution:

1) Arrange the polynomials in descending powers of x and write in the form $divisor\overline{)dividend}$. If there are missing terms, replace it with 0.

$$\frac{x^3 - 9x - 3x^2 + 27}{x + 3} \Longrightarrow x+3\overline{)x^3 - 3x^2 - 9x + 27}$$

2) Divide the first term of the dividend by the first term of the divisor to get the first term of the quotient:

$$\begin{array}{r} x^2 \qquad\qquad\quad \\ x+3\overline{)x^3 - 3x^2 - 9x + 27} \end{array} \longrightarrow \quad x^3 \div x = x^2$$

3) Multiply the divisor by the first term of the quotient.

$$\begin{array}{l} \qquad\;\; x^2 \\ x+3\overline{)x^3 - 3x^2 - 9x + 27} \\ \qquad\;\; \underline{x^3 + 3x^2} \end{array} \longrightarrow \quad (x + 3)(x^2) = x^3 + 3x^2$$

4) Subtract the product from the dividend then bring down the next term.

$$
\begin{array}{r l}
 & x^2 \\
x+3 & \overline{)\,x^3-3x^2-9x+27} \\
 & -\underline{(x^3+3x^2)} \downarrow \\
 & \qquad -6x^2-9x
\end{array}
$$

5) Repeat steps 2 to 4. This time, the difference and the next term will be the new dividend.

$$
\begin{array}{r l}
 & x^2-6x \\
x+3 & \overline{)\,x^3-3x^2-9x+27} \\
 & -\underline{(x^3+3x^2)} \\
 & \qquad -6x^2-9x \\
 & \quad \underline{-(-6x^2-18x)} \\
 & \qquad\qquad 9x+27
\end{array}
$$

$\longrightarrow$ $-6x^2 \div x = -6x$

$\longrightarrow$ $(x+3)(-6x) = -6x^2 - 18x$

6) Continue the process until a remainder is obtained. The **remainder can be zero or a polynomial whose degree is lower than the divisor**.

$$
\begin{array}{r l}
 & x^2-6x+9 \\
x+3 & \overline{)\,x^3-3x^2-9x+27} \\
 & -\underline{(x^3+3x^2)} \\
 & \qquad -6x^2-9x \\
 & \quad \underline{-(-6x^2-18x)} \\
 & \qquad\qquad 9x+27 \\
 & \qquad\quad \underline{-(9x+27)} \\
 & \qquad\qquad\quad 0
\end{array}
$$

$\longrightarrow$ $9x \div x = 9$

$\longrightarrow$ $(x+3)(9x) = 9x + 27$

Therefore, **the quotient is $\boldsymbol{x^2-6x+9}$**.

In general, when a polynomial is divided by another polynomial, we express the result in the following form:

$$\frac{P(x)}{d(x)} = Q(x) + \frac{r(x)}{d(x)}$$

where $P(x)$ is the dividend, $d(x) \neq 0$ is the divisor, $Q(x)$ is the quotient, and $r(x)$ is the remainder. Multiplying this equation by the divisor $d(x)$ leads us to the division algorithm.

> **The Division Algorithm**
>
> If a polynomial $P(x)$ is divided by a polynomial $d(x)$, where $d(x) \neq 0$ and the degree of $P(x)$ is greater than or equal to the degree of $d(x)$, then a unique polynomials $Q(x)$ and $r(x)$ exist such that
>
> $$P(x) = d(x) \cdot Q(x) + r(x).$$

Example 2. Divide $(x^4 + 2x^3 - 4x^2 - 10x + 5)$ by $(x^2 - 5)$.

Solution: Follow the procedures shown from example 1.

$$
\begin{array}{rll}
 & x^2 + 2x + 1 & \longrightarrow \text{Quotient} \\
x^2 - 5 \big) & \overline{x^4 + 2x^3 - 4x^2 - 10x + 5} & \\
 & \underline{-(x^4 \qquad - 5x^2)} & \longrightarrow \text{Multiply: } x^2(x^2 - 5) \\
 & 2x^3 + x^2 \;\; -10x & \longrightarrow \text{Subtract. Bring down } -10x \\
 & \underline{-(2x^3 \qquad -10x)} & \longrightarrow \text{Multiply: } 2x(x^2 - 5) \\
 & x^2 \qquad\qquad +5 & \longrightarrow \text{Subtract. Bring down 5} \\
 & \underline{-(x^2 \qquad\qquad -5)} & \longrightarrow \text{Multiply: } 1(x^2 - 5) \\
 & 10 & \longrightarrow \text{Remainder}
\end{array}
$$

Therefore, you can write the result as

$$\therefore \frac{x^4 + 2x^3 - 4x^2 - 10x + 5}{x^2 - 5} = x^2 + 2x + 1 + \frac{10}{x^2 - 5}$$

B. DIVIDING POLYNOMIALS USING SYNTHETIC DIVISION

There is a more efficient way of dividing polynomials if the divisor is a linear binomial in the form $x - a$. This method is called synthetic division. A detailed discussion on how this synthetic division will be done is given below. Just like long division, arrange the polynomials first in descending powers of x and write 0 as coefficient of any missing term.

Example 3: Divide $(x^3 - 9x - 3x^2 + 27)$ by $(x + 3)$ using synthetic division.

(*These polynomials are the same as example 1. Let's find out if synthetic and long division will give the same quotient).*

Arrange the dividend in descending order: $x^3 - 3x^2 - 9x + 27$

$$\begin{array}{r|rrrr} -3 & 1 & -3 & -9 & 27 \\ \hline & & & & \end{array}$$

Write the coefficient of the polynomials.
The divisor is $x+3$, so use $a=-3$

get the inverse of the constant term of the divisor.

$$\begin{array}{r|rrrr} -3 & 1 & -3 & -9 & 27 \\ \hline & 1 & & & \end{array}$$

Bring down the first coefficient

$$\begin{array}{r|rrrr} -3 & 1 & -3 & -9 & 27 \\ & & -3 & & \\ \hline & 1 & & & \end{array}$$

Multiply -3 by 1 and write the result below -3

$$\begin{array}{r|rrrr} -3 & 1 & -3 & -9 & 27 \\ & & -3 & & \\ \hline & 1 & -6 & & \end{array}$$

Add -3 and -3

$$\begin{array}{r|rrrr} -3 & 1 & -3 & -9 & 27 \\ & & -3 & 18 & \\ \hline & 1 & -6 & 9 & \end{array}$$

Multiply -3 by -6 and write the result below -9
Add -9 and 18.

$$\begin{array}{r|rrrr} -3 & 1 & -3 & -9 & 27 \\ & & -3 & 18 & -27 \\ \hline & 1 & -6 & 9 & 0 \end{array}$$

Repeat the process until all columns are filled.
Multiply -3 by 9 and write the result below -27.
Add 27 and -27.

$$\begin{array}{r|rrrr} -3 & 1 & -3 & -9 & 27 \\ & & -3 & 18 & -27 \\ \hline & 1 & -6 & 9 & 0 \end{array}$$

Identify the quotient and the remainder

Coefficient of the quotient

remainder

Quotient, $Q(x) = x^2 - 6x + 9$
Remainder, $r(x) = 0$

The **degree of the quotient is one less than the degree of the dividend**.

Thus the quotient is $\boldsymbol{x^2 - 6x + 9}$.

From the previous examples, we were able to see that both long division and synthetic division yield the same answer.

Example 4: Divide $(2x^4 - 3x^2 + x - 4)$ by $(x - 2)$.

$$\begin{array}{r|rrrrr} 2 & 2 & 0 & -3 & 1 & -4 \\ & & & & & \\ \hline & & & & & \end{array}$$

Write the coefficient of the polynomials. Since x^3 is a missing term, write 0 as its coefficient. The divisor is $x - 2$, so use $a = 2$

$$\begin{array}{r|rrrrr} 2 & 2 & 0 & -3 & 1 & -4 \\ & & 4 & 8 & 10 & 22 \\ \hline & 2 & 4 & 5 & 11 & 18 \end{array}$$

Perform the synthetic division.

$$\begin{array}{r|rrrrr} 2 & 2 & 0 & -3 & 1 & -4 \\ & & 4 & 8 & 10 & 22 \\ \hline & \underbrace{2 \quad 4 \quad 5 \quad 11}_{\text{Coefficient of the quotient}} & & & & \underset{\text{remainder}}{18} \end{array}$$

Identify the quotient and the remainder.

Quotient, $Q(x) = 2x^3 + 4x^2 + 5x + 11$
Remainder, $r(x) = 18$

Hence, the result can be written as:

$$\therefore \frac{2x^4 - 3x^2 + x - 4}{x - 2} = 2x^3 + 4x^2 + 5x + 11 + \frac{18}{x - 2}$$

Example 5: Divide $(3x^3 - 16x^2 + 3x + 12)$ by $(3x + 2)$

In this example, the leading coefficient of the divisor is not 1. Hence, divide both terms of the divisor, $(3x + 2)$, by 3 so that it will be in the form $x - a$. So the new divisor will now be $x + \frac{2}{3}$.

$$\begin{array}{r|rrrr} -\frac{2}{3} & 3 & -16 & 3 & 12 \\ & & & & \\ \hline & & & & \end{array}$$

Write the coefficient of the polynomials.

The divisor is $x + \frac{2}{3}$, so use $a = -\frac{2}{3}$.

$$\begin{array}{r|rrrr} -\frac{2}{3} & 3 & -16 & 3 & 12 \\ & & -2 & 12 & -10 \\ \hline & 3 & -18 & 15 & 2 \end{array}$$

Perform the synthetic division.

$$\begin{array}{r|rrrr} -\frac{2}{3} & 3 & -16 & 3 & 12 \\ & & -2 & 12 & -10 \\ \hline & 3 & -18 & 15 & 2 \end{array}$$

Identify the quotient and the remainder.

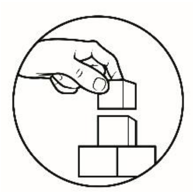
Coefficient of the quotient

remainder

Quotient: $3x^2 - 18x + 15$
Remainder: 2

Since the divisor $3x + 2$ was divided by 3 to get $a = -\frac{2}{3}$, then divide also every terms in the quotient , $(3x^2 - 18x + 15)$, by 3. Hence, the quotient will be $x^2 - 6x + 5$ and the result can be written as

$$\therefore \frac{3x^3 - 16x^2 + 3x + 12}{3x + 2} = x^2 - 6x + 5 + \frac{2}{3x + 2}$$



What's More

Now, your turn!

Activity 2: Divide the following polynomials using long division. Show your complete solution in your answer sheet.

a) $(2x^3 + 9x^2 + 3x - 4) \div (x + 4)$

b) $(8x^3 + 27) \div (2x + 3)$

c) $\dfrac{11x - 20x^2 + 12x^3 - 14}{x - 2}$

d) $\dfrac{x^4 + 3x^3 + 6x - 4}{x^2 + 2}$

Activity 3:

Divide the following polynomials using synthetic division. Identify the quotient, $Q(x)$, and the remainder, $r(x)$. Then, match the remainder to the decoder that follows. Show your complete solution on your answer sheet.

C) $(4x^2 + x - 3) \div (x - 3)$

E) $(x^4 + x^3 - 3x^2 - 4x - 4) \div (x + 3)$

H) $(3x^2 + 4x - x^4 - 2x^3 - 4) \div (x + 2)$

O) $(\ 2x^5 - 2x^3 + 4x^2 - 3) \div\ (x + 1)$

P) $(-x^4 + 2x^5 - 2x - 3x^2 + 1) \div (x - 2)$

T) $(-25 - 4x^4 - 3x^2 + 4x) \div (x - 4)$

R) $(2x^3 + 5x^2 - 4x - 5) \div (2x + 1)$

What is the other term for the number sign #?

1	36	−1081	1	−1081	0	1	−2	33	35

What I Have Learned

Let us sum up what we have learned in this module.

Activity 4. Perform what is asked.

A) Fill in the blank with the correct term.

When dividing polynomials, we express the result in the following form:

$$\frac{P(x)}{d(x)} = Q(x) + \frac{r(x)}{d(x)}$$

Where $P(x)$ is the ________1________, $d(x) \neq 0$ is the __________2__________, $Q(x)$ is the __________3__________, and $r(x)$ is the __________4__________.

B) Use the synthetic division below to find the following:

$$\begin{array}{r|rrrrr} 2 & 2 & 0 & 0 & -1 & -36 \\ & & 4 & 8 & 16 & 30 \\ \hline & 2 & 4 & 8 & 15 & -6 \end{array}$$

a. Dividend: ______________

b. Divisor: ______________

c. Remainder: ______________

d. Quotient: ______________

What I Can Do

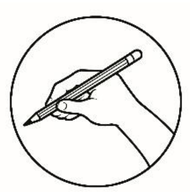
In this activity, you will apply dividing polynomials in solving word problems.

Activity 5. Solve the following problems:

1) Pedro bought $\left(18x^3 - 39x^2 + 8x + 16\right)$ pesos worth of tokens for your classroom Christmas party. If each token is worth $(3x - 4)$ pesos, how many tokens did Peter buy?

2) Lita works $(x + 5)$ hours today as a service crew in a fast-food chain and earns $\left(2x^3 + 23x^2 - 26x + 3\right)$ pesos. How much does Lita earn per hour?

3) The area of a rectangle is $4x^4 + 4x^3 + 4x^2 + 2x + 1$ square centimeter. If the length of the rectangle is $2x^2 + 1$ centimeter, what is the width of the rectangle?



Assessment

DIRECTION: Choose the letter of your answer from the given choices. Write your answer on a separate sheet of paper.

1) If a sixth degree polynomial is divided by a second degree polynomial, what is the degree of the quotient?

   A) 1 B) 2 C) 3 D) 4

2) Divide: $x^3 + 2x^2 - 5x - 10$ by $x^2 - 5$.

   A) $x^2 - 3x + 10$ B) $x^2 + 7x + 30$ C) $x + 2$ D) $x - 2$

3) In the division algorithm $\frac{P(x)}{d(x)} = Q(x) + \frac{r(x)}{d(x)}$, what is the divisor?

A) $P(x)$ B) $d(x)$ C) $r(x)$ D) $Q(x)$

4) Find the remainder when $x^3 - 2x^2 + 4x - 3$ is divided by $x + 2$.

A) 27 B) 5 C) −5 D) −27

5) If $x^3 - 2x^2 - 5x + 6$ is divided by $x + 1$, the remainder is zero.

A) True B) False C) Cannot be determined

For **#s 6 to 8**, use the illustration of long division below:

Divide $(2x^3 + 3x^2 - 10x + 12)$ by $(x - 3)$

$$
\begin{array}{r l}
 & 2x^2 + 9x + 17 \\
x-3 & \overline{)\,2x^3 + 3x^2 - 10x + 12} \\
 & -\underline{(2x^3 - 6x^2)} \\
 & \qquad 9x^2 - 10x \\
 & \quad \underline{-(9x^2 - 27x)} \\
 & \qquad\qquad 17x + 12 \\
 & \qquad\quad \underline{-(17x - 51)} \\
 & \qquad\qquad\qquad 63
\end{array}
$$

6) What is the remainder?

A) 17 B) 63 C) $x - 3$ D) $17x - 51$

7) Which is the divisor?

A) $2x^2 + 9x + 17$ C) $2x^3 + 3x^2 - 10x + 12$
B) $x - 3$ D) 63

8) Which is the quotient?

A) $2x^2 + 9x + 17$ C) $2x^3 + 3x^2 - 10x + 12$
B) $x - 3$ D) 63

9) Using synthetic division to divide $7y^3 - 3y^2 - 20$ by $y + 3$, which of the following is the correct first row of the algorithm?

A) $3\rfloor \quad 7 \quad -3 \quad 0 \quad -20$ C) $-3\rfloor \quad 7 \quad -3 \quad -20$
B) $-3\rfloor \quad 7 \quad -3 \quad 0 \quad -20$ D) $3\rfloor \quad 7 \quad -3 \quad -20$

For **#s 10 and 11**, use the following synthetic division:

$$\begin{array}{r|rrrr} 3 & 1 & -6 & 2 & 21 \\ & & 3 & -9 & -21 \\ \hline & 1 & -3 & -7 & 0 \end{array}$$

10) Which polynomial is the dividend?

A) $x^3 - 6x^2 + 2x + 21$
B) $x^4 - 6x^3 + 2x^2 + 21x$
C) $x^3 - 3x^2 - 7x$
D) $x^2 - 3x - 7$

11) Which polynomial is the quotient?

A) $x^3 - 6x^2 + 2x + 21$
B) $x^4 - 6x^3 + 2x^2 + 21x$
C) $x^3 - 3x^2 - 7x$
D) $x^2 - 3x - 7$

12) Find the quotient when $\left(x^3 + 2x^2 - 19x - 20\right)$ is divided by $(x + 5)$.

A) $x^2 + 3x + 4$
B) $x^2 - 3x + 4$
C) $x^2 + 3x - 4$
D) $x^2 - 3x - 4$

13) What is the quotient when $\left(2x^3 + 9x^2 - 2x - 3\right)$ is divided by $(2x + 1)$?

A) $x^2 + 4x - 3$
B) $x^2 - 4x + 1$
C) $2x^2 + 8x - 6$
D) $2x^2 - 8x - 6$

14) What will be multiplied to $x^2 - 6x + 2$ to get $3x^3 - 17x^2 + 2$?

A) $x + 3$
B) $3x + 2$
C) $3x + 1$
D) $3x - 1$

15) The volume of a rectangular prism is $(2x^3 + 11x^2 + 11x - 4)cm^3$ and its height is $(x + 4)$ *cm*. What is the area of its base?

A) $(2x^2 - 3x + 1)\ cm^2$
B) $(2x^2 + 19x + 76)\ cm^2$
C) $(2x^2 + 3x - 1)\ cm^2$
D) $(2x^2 - 19x - 76)\ cm^2$

Additional Activities

This time, let's have more challenging problems to solve!

Activity 6. Answer the following problems:

A) Complete the synthetic division below and fill out the questions that follow:

$$
\begin{array}{c|ccccc}
\boxed{} & 2 & -3 & \boxed{} & -2 & 4 \\
 & & 4 & \boxed{} & 4 & 4 \\
\hline
 & 2 & \boxed{} & 2 & 2 & \boxed{}
\end{array}
$$

Identify:

1) $P(x)$ = ________________________________

2) $Q(x)$ = ________________________________

3) $d(x)$ = ________________________________

4) $r(x)$ = ________________________________

B) The long division below is incorrect. What mistake was made?

Divide: $(x^3 - 6x^2 + 2x - 3) \div (x - 2)$

$$
\begin{array}{rl}
 & x^2 - 4x + 10 \\
x - 2 \,\big) & \overline{x^3 - 6x^2 + 2x - 3} \\
 & \underline{(x^3 - 2x^2)} \\
 & \quad -4x^2 + 2x \\
 & \underline{\quad -(4x^2 + 8x)} \\
 & \qquad\qquad 10x - 3 \\
 & \underline{\qquad\qquad -(10x - 20)} \\
 & \qquad\qquad\qquad 17
\end{array}
$$

C) Find the constant C such that the denominator will divide evenly into the numerator.(*To divide evenly means the remainder must be zero).*

1) $\dfrac{2x^3 + 9x^2 - x + C}{x + 4}$

2) $\dfrac{x^4 - x^3 - 3x^2 - Cx - 3}{x - 3}$

Answer Key

What I Know

1. B	6. D	11. D
2. D	7. A	12. A
3. A	8. C	13. C
4. B	9. D	14. A
5. A	10. B	15. A

What's In.
Activity 1

1) $x+1$	2	Binomial	1	Linear
2) $2x^4+3x^2+4x+1$	4	Multinomial	4	Quartic
3) $-5x^3$	1	Monomial	3	Cubic
4) x^6-3x^3+1	3	Trinomial	6	6th Degree
5) $3x^3+2x$	2	binomial	3	Cubic

What's More
Activity 2

a) $2x^2+x-1$
b) $4x^2-6x+9$
c) $12x^2+4x+19+\frac{24}{x-2}$
d) x^2+3x-2

Activity 3

C) $Q(x)=4x+13, r(x)=36$
E) $Q(x)=x^3-2x^2+3x-3, r(x)=35$
H) $Q(x)=-x^3+3x-2, r(x)=0$
O) $Q(x)=2x^4-2x^3+4x-4,\ r(x)=1$
P) $Q(x)=2x^4+3x^3+6x^2+9x+16,\ r(x)=33$
T) $Q(x)=-4x^3-16x^2-67x-264, r(x)=-1081$
R) $Q(x)=x^2+2x-3, r(x)=-2$

OCTOTHORPE

What I Have Learned
Activity 4

A) 1) dividend
2) divisor
3) quotient
4) remainder

B) 1) $2x^4-x-36$
2) $x-2$
3) -6
4) $2x^3+4x^2+8x-15$

What I Can Do
Activity 5

1. $(6x^2-5x-4)$ tokens
2. $\left(2x^2+13x-91+\frac{458}{x+5}\right)$ pesos
3. $(2x^2+2x+1)$ centimeter

Assessment

1. D	6. B	11. D
2. C	7. B	12. D
3. B	8. A	13. A
4. D	9. B	14. C
5. B	10. A	15. C

Additional Activities
Activity 6

A)

$$
\begin{array}{r|rrrrr}
\mathbf{2} & 2 & -3 & \mathbf{0} & -2 & 4 \\
 & & 4 & \mathbf{2} & 4 & 4 \\
\hline
 & 2 & \mathbf{1} & 2 & 2 & \mathbf{8}
\end{array}
$$

1) $P(x)=2x^4-3x^3-2x+4$
2) $Q(x)=2x^3+x^2+2x+2$
3) $d(x)=x-2$
4) $r(x)=8$

B) $2x-8x$ is not $10x$ (6th row)

C) 1) $C=-20$
2) $C=8$

References

Algebraic Division taken from http://mathematics.laerd.com

Larson, R. (2006). *Precalculus with limits.* Boston, MA: Houghton Mifflin Co.

Leithold, L. (1989). *College Algebra and Trigonometry.* Reading Mass.: Addison Wesley.

Young, C. (2010). *Precalculus*. Hoboken, N.J.: Wiley.

For inquiries or feedback, please write or call:

Department of Education – Bureau of Learning Resources (DepEd-BLR)

Ground Floor, Bonifacio Bldg., DepEd Complex
Meralco Avenue, Pasig City, Philippines 1600

Telefax: (632) 8634-1072; 8634-1054; 8631-4985

Email Address: blr.lrqad@deped.gov.ph * blr.lrpd@deped.gov.ph