Form 2 – Mathematics

Laws of indices – Lesson Worksheet

Name: _____ Class:_____ ( ) Date:_____

A. Pre-lesson

Review of Laws of indices

1. $a^m \times a^n = a^{m+n}$

2. $a^m \div a^n = \frac{a^m}{a^n} = a^{m-n}$

Warm-up Exercise - Simplify the following expressions **by using laws of indices**.

1. $a \times a^3 \times a^5$

$= a^{(\quad + \quad + \quad)}$

$=$ _____

2. $\frac{a^3 \times a^4}{a^5}$

$= a^{(\quad + \quad - \quad)}$

$=$ _____

3. $\frac{a^2 b^4}{ab}$

$= a^{(\quad)} b^{(\quad)}$

$=$ _____

Activity 1 – Concept of zero index (What does a^0 mean?)

Complete the following questions. Observe and compare (a) and (b) in each question. (Question 1 is done for you as an example)

1. (a) $\frac{p}{p} = \frac{p^1}{p^1} = p^{1-1} = p^0$ (b) $\frac{p}{p} = \frac{p^1}{p^1} = 1$

$\therefore p^0 = 1$

2. (a) $\frac{2}{2} = \frac{2^1}{2^1} = 2^{1-1} = 2^{(\quad)}$ (b) $\frac{2}{2} =$

$\therefore 2^0 =$ _____

3. (a) $\frac{m^3}{m^3} = m^{(\quad)} = m^{(\quad)}$ (b) $\frac{m^3}{m^3} = \frac{m \times m \times m}{m \times m \times m} =$

$\therefore m^0 =$ _____

4. (a) $\frac{n^5}{n^5} = n^{(\quad)} = n^{(\quad)}$ (b) $\frac{n^5}{n^5} = \frac{n \times n \times n \times n \times n}{n \times n \times n \times n \times n} =$

$\therefore n^0 =$ _____

In general,

For $a \neq 0$, $a^0 =$ _____

Activity 2 – Concept of negative index (What does a^{-n} mean?)

Complete the following questions. Observe and compare (a) and (b) in each question.
(Question 1 is done for you as an example)

1. (a) $\frac{a}{a^2} = a^{1-2} = \quad a^{-1}$ (b) $\frac{a}{a^2} = \frac{a}{a \times a} = \frac{\cancel{a}^{1}}{\cancel{a}_{1} \times a} = \frac{1}{a}$ $\therefore a^{-1} = \frac{1}{a}$
2. (a) $\frac{2}{2^2} = 2^{1-2} = \quad 2^{(\quad)}$ (b) $\frac{2}{2^2} = \frac{2}{2 \times 2} =$ $\therefore 2^{-1} =$ _____
3. (a) $\frac{a^2}{a^4} = a^{(\qquad)} = a^{(\quad)}$ (b) $\frac{a^2}{a^4} = \frac{a \times a}{a \times a \times a \times a} =$ $\therefore a^{-2} =$ _____
4. (a) $\frac{m^2}{m^5} = m^{(\qquad)} = m^{(\quad)}$ (b) $\frac{m^2}{m^5} = \frac{m \times m}{m \times m \times m \times m \times m} =$ $\therefore m^{-3} =$ _____

In general,

For $a \neq 0$, $a^{-n} =$ _____

B. Exercise

1. Simplify the following questions **by using laws of indices**.

(a) $\frac{a^3}{a^3}$ (b) $a \times a^5 \times a^0$ (c) $\frac{a^5 b^4}{a^5 b^0}$

2. Simplify the following questions **by using laws of indices** and express your answers in **positive indices**.

(a) a^{-4} (b) $a^{-6} \times a^3$

(c) $\frac{p^4 \times p^{-6}}{p}$ (d) $\frac{m^{-5} \times m^2}{m^{-3}}$

C. Mixed-type questions

Example

Simplify the following expressions and express your answers in **positive indices**. (@ 2 marks)

$$\frac{m^{-8} \times m^2}{m^{-3}}$$

$= m^{-8+2-(-3)}$ ← *1M for using law of indices*

$= m^{-3}$

$= \frac{1}{m^3}$ ← *1A for +ve index*

$$\frac{m^5 n^{-1}}{m^2 n^3}$$

$= \frac{m^5}{m^2} \times \frac{n^{-1}}{n^3}$

$= m^{5-2} n^{-1-3}$ ← *1M for using law of indices*

$= m^3 n^{-4}$

$= \frac{m^3}{n^4}$ ← *1A for +ve index*

Simplify the following expressions **by using laws of indices** and express your answers in **positive indices**.

1. $\frac{m^{-3} n^6}{m^6 n^3}$

$= m^{(\quad)} n^{(\quad)}$

2. $\frac{m^4 n^{-5}}{m^3 n^3}$

3. $\frac{m^2 n^{-2}}{m^{-7} n^3}$

4. $\frac{m^{-4} n^2}{m^6 n^8}$