1. Algebraic Expressions

1.1 Expressions

Essential Questions 1.1

1. What is an algebraic expression?

1.2 Polynomial Expressions

	Arithmetic	Polynomial	Algebraic
Constant	Yes	Yes	Yes
Factorial	Yes	Yes	Yes
Variable: parameter/coefficient	Yes	Yes	Yes
Variable: unknown/indeterminate	No	Yes	Yes
Power with $\mathbb{Z}^+$ exponent	No	Yes	Yes
Power with $\mathbb{Z}$ exponent	No	No	Yes
n-th root	No	No	Yes
Power with $\mathbb{Q}$ exponent	No	No	Yes

Table 1.1: Names of different types of expressions

Definition 1.2.1 – Operation of Exponentiation (OOE).

$$\underbrace{\underbrace{b}_{base}\overbrace{m}^{Exponent}}_{Power} \tag{1.1}$$

Definition 1.2.2 – Juxtaposition to Center-Dot (JTC).

$$ab = a \cdot b \tag{1.2}$$

Definition 1.2.3 – Center-Dot to Justapostion (CTJ).

$$a \cdot b = ab \tag{1.3}$$

Definition 1.2.4 – Commutative Property of Multiplication (CPM).

$$a \cdot b = b \cdot a \tag{1.4}$$

Definition 1.2.5 – Multiplicative Inverse (MI).

$$a \cdot \frac{1}{a} = 1 \tag{1.5a}$$
$$a \cdot a^{-1} = 1 \tag{1.5b}$$

Definition 1.2.6 – Associative Property of Multiplication (APM).

$$a \cdot b \cdot c = (a \cdot b) \cdot c \tag{1.6a}$$
$$a \cdot b \cdot c = a \cdot (b \cdot c) \tag{1.6b}$$

Powers

Rule 1.2.1 – Power of a Quotient of Powers (PoQPo).

$$\left(\frac{a^m}{b^n}\right)^k = \frac{a^{m \cdot k}}{b^{n \cdot k}} \tag{1.7a}$$
$$\frac{a^{m \cdot k}}{b^{n \cdot k}} = \left(\frac{a^m}{b^n}\right)^k \tag{1.7b}$$

Rule 1.2.2 – Power of a Product of Powers (PoPrPo).

$$(a^m \cdot b^n)^k = a^{m \cdot k} \cdot b^{n \cdot k} \tag{1.8a}$$
$$a^{m \cdot k} \cdot b^{n \cdot k} = (a^m \cdot b^n)^k \tag{1.8b}$$

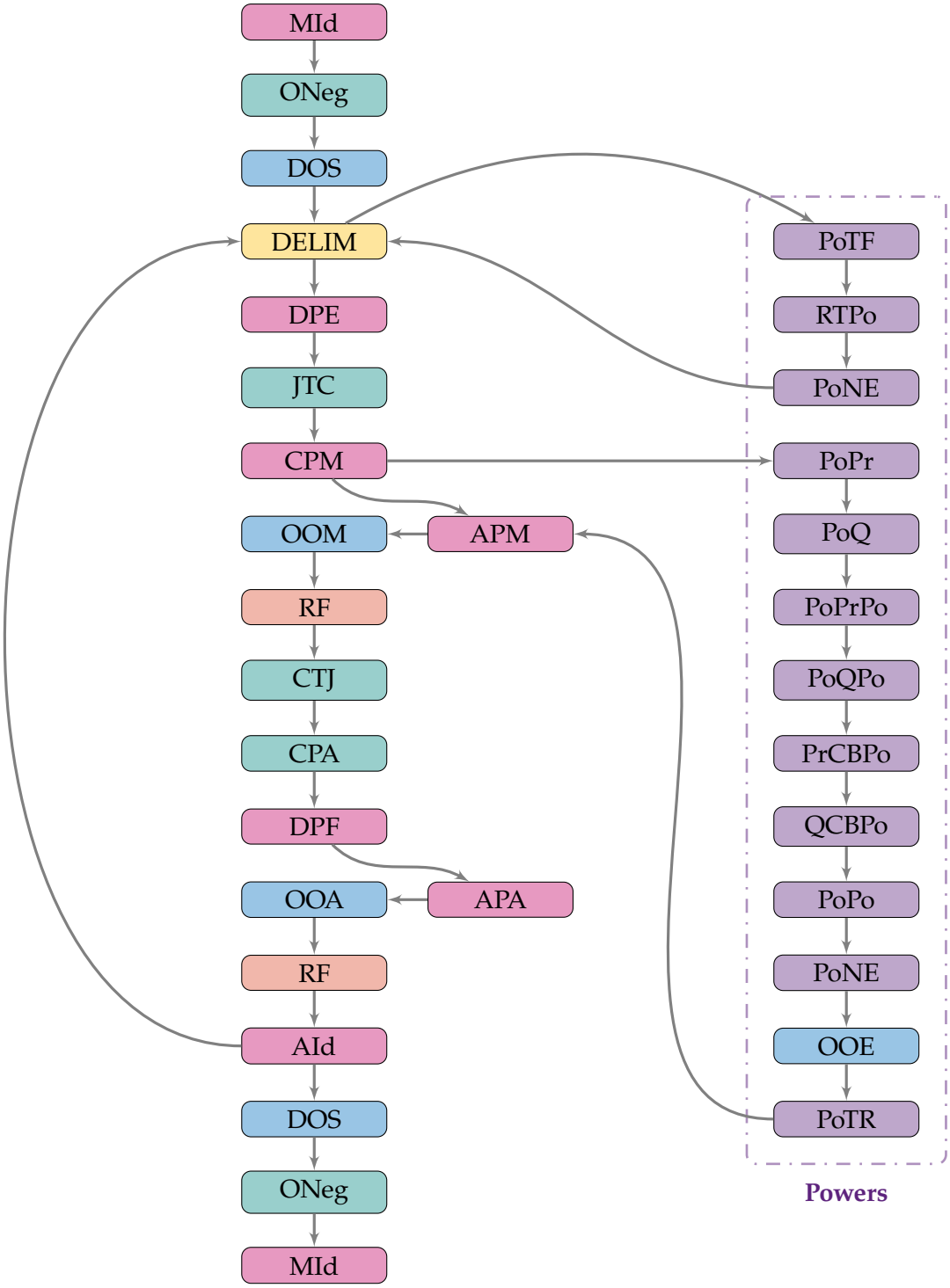

Figure 1.1: Simplifying Expressions Workflow:
■ Property, ■ Operation, ■ Notation, ■ Powers, ■ Delimiters, ■ Process, ■ Not Used

Definition 1.2.7 – Power To Factor (PoTF).

$$a^n = a_1 \cdot a_2 \cdot \ldots \cdot a_{n-1} \cdot a_n \tag{1.9}$$

Definition 1.2.8 – Factor To Power (FTPo).

$$a_1 \cdot a_2 \cdot \ldots \cdot a_{n-1} \cdot a_n = a^n \tag{1.10}$$

Definition 1.2.9 – Power Inverse (PoI).

$$(b^m)^{\frac{1}{m}} = b \tag{1.11a}$$

Definition 1.2.10 – Power Inverse (PoId).

$$1 = b^0 \tag{1.12a}$$
$$b^0 = 1 \tag{1.12b}$$

Notation 1.1 (Radical To Power (RTPo))**.**

$$\sqrt[m]{b^n} = b^{\frac{n}{m}} \tag{1.13}$$

Notation 1.2 (Power To Radical (PoTR))**.**

$$b^{\frac{n}{m}} = \sqrt[m]{b^n} \tag{1.14}$$

1.2.1 Monomials of Like Terms

Definition 1.2.11 – Additive Inverse (AI).

$$a + (-a) = 0 \tag{1.15a}$$

1.2.2 Surds

Example 1.1 – id:20141108-085327.

Simplify $2\sqrt{2} - \frac{\left(\sqrt{2}\right)^3}{3} - \left(2\left(-\sqrt{2}\right) - \frac{\left(-\sqrt{2}\right)^3}{3}\right)$

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Solution:

$$2\sqrt{2} - \frac{1\left(1\sqrt{2}\right)^3}{3} - 1\left(2\left(-1\sqrt{2}\right) - \frac{1\left(-1\sqrt{2}\right)^3}{3}\right) \quad \text{MId(??)}$$

$$2\sqrt{2} - \frac{1\left(1\sqrt{2}\right)^3}{3} - 1\left(2\left(\neg 1\sqrt{2}\right) - \frac{1\left(\neg 1\sqrt{2}\right)^3}{3}\right) \quad \text{ONeg(??)}$$

$$2\sqrt{2} + \frac{\neg 1\left(1\sqrt{2}\right)^3}{3} + \neg 1\left(2\left(\neg 1\sqrt{2}\right) + \frac{\neg 1\left(\neg 1\sqrt{2}\right)^3}{3}\right) \quad \text{DOS(??)}$$

$$2 \cdot 2^{1/2} + \frac{\neg 1\left(1 \cdot 2^{1/2}\right)^3}{3} + \neg 1\left(2\left(\neg 1 \cdot 2^{1/2}\right) + \frac{\neg 1\left(\neg 1 \cdot 2^{1/2}\right)^3}{3}\right) \quad \text{RTPo(1.13)}$$

$$2 \cdot 2^{1/2} + \frac{\neg 1\left(1 \cdot 2^{1/2}\right)^3}{3} + \neg 1\left(2 \cdot \neg 1 \cdot 2^{1/2} + \frac{\neg 1\left(\neg 1 \cdot 2^{1/2}\right)^3}{3}\right) \quad \text{JTC(1.2)}$$

$$2 \cdot 2^{1/2} + \frac{\neg 1 \cdot 1 \cdot 2^{3/2}}{3} + \neg 1\left(2 \cdot \neg 1 \cdot 2^{1/2} + \frac{\neg 1 \cdot \neg 1 \cdot 2^{3/2}}{3}\right) \quad \text{PoPrPo(1.8a)}$$

$$2 \cdot 2^{1/2} + \frac{\neg 1 \cdot 1 \cdot 2^{2/2} \cdot 2^{1/2}}{3} + \neg 1\left(2 \cdot \neg 1 \cdot 2^{1/2} + \frac{\neg 1 \cdot \neg 1 \cdot 2^{2/2} \cdot 2^{1/2}}{3}\right) \quad \text{PrCBPo(??)}$$

$$2 \cdot 2^{1/2} + \frac{\neg 1 \cdot 1 \cdot 2 \cdot 2^{1/2}}{3} + \neg 1\left(2 \cdot \neg 1 \cdot 2^{1/2} + \frac{\neg 1 \cdot \neg 1 \cdot 2 \cdot 2^{1/2}}{3}\right) \quad \text{MId(??)}$$

$$2 \cdot \sqrt{2} + \frac{\neg 1 \cdot 1 \cdot 2 \cdot \sqrt{2}}{3} + \neg 1\left(2 \cdot \neg 1 \cdot \sqrt{2} + \frac{\neg 1 \cdot \neg 1 \cdot 2 \cdot \sqrt{2}}{3}\right) \quad \text{PoTR(1.14)}$$

$$2 \cdot \sqrt{2} + \frac{\neg 1 \cdot 1 \cdot 2 \cdot \sqrt{2}}{3} + \neg 1 \cdot 2 \cdot \neg 1 \cdot \sqrt{2} + \frac{\neg 1 \cdot \neg 1 \cdot \neg 1 \cdot 2 \cdot \sqrt{2}}{3} \quad \text{DPE(??)}$$

$$2 \cdot \sqrt{2} + \frac{\neg 2 \cdot \sqrt{2}}{3} + 2 \cdot \sqrt{2} + \frac{\neg 2 \cdot \sqrt{2}}{3} \quad \text{OOM(??)}$$

$$2\sqrt{2} + \frac{\neg 2\sqrt{2}}{3} + 2\sqrt{2} + \frac{\neg 2\sqrt{2}}{3} \quad \text{CTJ(1.3)}$$

$$\left(2 + \frac{\neg 2}{3} + 2 + \frac{\neg 2}{3}\right)\sqrt{2} \quad \text{DPF(??)}$$

$$\frac{8}{3}\sqrt{2} \quad \text{OOA(??)}$$

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Dependencies:example **??**-20141108-083108

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