Nemeth Code Symbols Used in High School and Strategies for Supporting Math Learning

Lesson 3: Symbols for Advanced Math, Part 3

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Objectives

Participants will be able to:

- Read and write problems containing
  1. superscripts
  2. subscripts
  3. radicals with an index
  4. functions
  5. Greek letters
- Use the five step rule for Sigma notation

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Superscript Review and Expansion

⠰ superscript indicator (dots 4-5)

⠄ baseline indicator (dot 5)

- No baseline indicator is needed if a space follows a superscript or if it is at the end of a line.
- If an exponent is raised to another exponent, the superscript indicator is used twice instead of once before the second exponent.

 $a^2 + b^2 = c^2$

 $f^{-1}(x)$ Read: f inverse of x

 e^{x^2} Read: e to the x squared power

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Subscript Review (No Indicator)

⠰ subscript indicator (dots 5-6)

A variable or function with a numeric subscript does not use a subscript indicator.

 $A = \frac{h}{2}(b_1 + b_2)$

Read: A equals open fraction h over 2 close fraction open parenthesis b sub 1 plus b sub 2 close parenthesis.

 (x_1, y_1) Read: the ordered pair x sub 1 y sub 1

 H_2O Read: H 2 O

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Examples of Subscripts and Use of the Subscript and Baseline Indicators

⠰ subscript indicator (dots 5-6)

⠁⠰⠊ a_i Read: a sub i

⠁⠰⠝⠬⠂ ⠨⠅ ⠁⠰⠝⠐⠬⠲ $a_{n+1} = a_n + 4$

Read: a sub n plus 1 equals a sub n baseline plus 4.

⠁ ⠨⠅ ⠹⠧⠰⠋⠐⠤⠧⠰⠊⠐⠌⠞⠼ $a = \frac{v_f - v_i}{t}$

Read: a equals open fraction v sub f baseline minus v sub i baseline over t close fraction.

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Examples of Logarithms with and without a Subscript Indicator

⠇⠕⠛⠰⠃ ⠁ $\log_b a$

Read: log base b of a

⠇⠕⠛⠆ ⠭ $\log_2 x$

Read: log base 2 of x

Logarithms denoted by log or ln are functions and should be followed by a space.

If the log is followed by a subscript, the space comes after that subscript.

⠇⠝ ⠭ ⠨⠅ ⠇⠕⠛⠰⠑ ⠭ $\ln x = \log_e x$

Read: natural log of x equals log base e of x

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Activity 3A

Braille the following problems.

1. $f^{-1}(x) = \frac{x+7}{2}$
2. $\log 10^{x^2} = x^2$
3. $x_r = \frac{y^2}{z}$
4. H_2SO_4

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Activity 3A: Answer Key

1. $f^{-1}(x) = \frac{x+7}{2}$

2. $\log 10^{x^2} = x^2$

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Activity 3A: Answer Key (Continued)

3. $x_r = \frac{y^2}{z}$

⠭⠂⠗ ⠨⠅ ⠽⠘⠆ ⠳ ⠵

4. H_2SO_4

⠓⠢⠎⠕⠲ ⠠⠓⠢⠎⠕⠲ ⠠⠎⠕⠲

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Radicals Review (Square Roots)

- ⠩⠜ radical symbol
- ⠜⠱ termination symbol

⠩⠜⠹⠂⠲⠱ $\sqrt{\frac{1}{4}}$

⠩⠜⠼⠃⠑⠤⠼⠉ $\sqrt{25} - 3$

⠩⠜⠭⠬⠶⠱ $\sqrt{x+7}$

⠩⠜⠼⠚⠲⠙⠊⠱ $\sqrt{0.49}$

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Radicals with an Index

⠣ index-of-radical indicator

⠣⠒⠜⠖⠲⠻ $\sqrt[3]{64}$

Read: the cube root of 64

⠣⠶⠜⠭⠻⠬⠒ $\sqrt[7]{x}+3$

Read: the 7th root of x end root plus 3

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Radicals with an Index (Continued)

⠣⠢⠜⠹⠂⠌⠒⠆⠼⠻ $\sqrt[5]{\frac{1}{32}}$

Read: the 5th root of open fraction 1 over 32 close fraction end root

⠣⠲⠜⠴⠨⠴⠴⠂⠖⠻ $\sqrt[4]{0.0016}$

Read: the 4th root of zero point zero zero one six

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Activity 3B

Interline the problems.

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Activity 3B: Answer Key

1. $f^{-1}(x) = \sqrt[3]{x} - 2$

2. $x^3 - 6x^2 + 12x - 8 = (x-2)^3$

3. $\ln e^{x^6} = x^6$

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Activity 3B: Answer Key (Continued)

4. $a_n = 2(a_{n-1} + 3)$

5. $\sqrt[8]{x^{16}} = x^2$

6. The midpoint of (x_1, y_1) and (x_2, y_2) is $\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right)$.

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Functions

- sin (sine)
- cos (cosine)
- tan (tangent)
- log (log)
- ln (natural log)

- Note that e is often used with ln.
- Do not use the English Letter Indicator in a function.

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Examples of Functions

$\sin 45°$ Read: sine of 45 degrees

$\cos A$ Read: cosine of A

$\tan 2B$ Read: tangent of 2B

$\log_2 8$ Read: log base 2 of 8

$\ln e^6$ Read: natural log of e to the 6th power

Find $\sin A$, if $\cos A = \frac{1}{2}$.

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Greek Letters

- Greek letter indicator
- alpha (lowercase) α
- beta (lowercase) β
- pi (lowercase) π
- theta (lowercase) θ
- delta (uppercase) Δ

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Examples with Greek Letters

$\cos 2\alpha$ Read: cosine of two alpha

$\beta = 30°$ Read: beta equals 30 degrees

$\langle 3, \pi \rangle$ Read: open angle bracket 3 comma pi close angle bracket

$\sec\theta = 2$ Read: secant of theta equals 2

$m = \frac{\Delta y}{\Delta x}$

Read: m equals open fraction delta y over delta x close fraction.

Find $\sin(\alpha - \beta)$.

Read: Find sine of open parenthesis alpha minus beta close parenthesis.

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The Greek Letter Sigma

$\sum_{i=1}^{5} i$ Read: the sum from i=1 to 5 of i

Multipurpose indicator, sigma, directly under indicator, i = 1, directly over indicator, 5, termination indicator, i

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Steps for Sigma Notation

Uses the Five-Step Rule

Step 1 ⠐ Multipurpose indicator

Step 2 ⠨⠠⠎ sigma (uppercase) Σ - Expression being modified

Step 3 ⠩ Directly under indicator

Step 4 ⠊ ⠨⠅ ⠼⠂ $i = 1$ Modifier

Step 3 ⠣ Directly over indicator

Step 4 ⠢ 5 Modifier

Step 5 ⠻ Termination indicator

Putting it together ⠐⠨⠠⠎⠩⠊ ⠨⠅ ⠼⠂⠣⠢⠻⠊ $\sum_{i=1}^{5} i$

Read: the sum from i=1 to 5 of i

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Examples of Sigma Notation

$$\sum_{j=2}^{10} 5j - 3$$

⠐⠨⠠⠎⠩⠚ ⠨⠅ ⠼⠆⠣⠂⠴⠻⠢⠚⠤⠒

Read: the sum from j=2 to 10 of 5j minus 3

$$\sum_{i=0}^{\infty} 2\left(\frac{1}{3}\right)^{i}$$

⠐⠨⠠⠎⠩⠊ ⠨⠅ ⠼⠴⠣⠠⠿⠻⠆⠷⠹⠂⠌⠒⠼⠾⠘⠊

Read: the sum from i=0 to infinity of 2 open parenthesis open fraction 1 over 3 close fraction close parenthesis to the i power.

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Activity 3C

Braille the problems.

1. $\cot x = \dfrac{\cos x}{\sin x}$
2. $\log_3 81 = 4$
3. $\log_b m^2 = 2\log_b m$
4. $\sin\theta = \cos\left(\dfrac{\pi}{2} - \theta\right)$
5. Find the sum. $\sum_{j=0}^{\infty} (0.6)^j$
6. The formula for work is $W = |F||D|\cos A$.

Problem 1: cot stands for cotangent and would be brailled: ⠉⠕⠞

Problem 6: A multipurpose indicator (dot 5) will be needed between two vertical bars where the first is a closing vertical bar and the second is an opening vertical bar.

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Activity 3C: Answer Key

1. $\cot x = \dfrac{\cos x}{\sin x}$

⠉⠕⠞

⠐⠣⠉⠕⠎ ⠭⠐⠜ ⠐⠌ ⠐⠣⠎⠊⠝ ⠭⠐⠜⠐⠜

2. $\log_3 81 = 4$

⠐⠣⠇⠕⠛ ⠼⠉ ⠼⠓⠁ ⠀ ⠀ ⠼⠙

3. $\log_b m^2 = 2\log_b m$

⠐⠣⠇⠕⠛ ⠃ ⠍⠘⠆ ⠀ ⠀ ⠼⠃⠐⠣⠇⠕⠛ ⠃ ⠍

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Activity 3C: Answer Key (Continued)

4. $\sin\theta = \cos\left(\frac{\pi}{2} - \theta\right)$

⠠⠠⠠ ⠠⠠⠠ ⠠⠠ ⠠⠠ ⠠⠠⠠ ⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠ ⠠⠠

5. Find the sum. $\sum_{j=0}^{\infty}(0.6)^j$

⠠⠠⠠ ⠠⠠⠠⠠ ⠠ ⠠⠠⠠⠠

⠠⠠ ⠠⠠⠠⠠⠠ ⠠⠠ ⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠ ⠠⠠

6. The formula for work is $W = |F||D|\cos A$.

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⠠⠠ ⠠⠠ ⠠⠠ ⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠ ⠠⠠ ⠠⠠⠠

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