

Mathematics

MathML for $\sqrt[3]{x}$

```
<math xmlns="http://www.w3.org/1998/Math/MathML" alttext="Cube root of x">
  <mroot>
    <mi>x</mi>
    <mn>3</mn>
  </mroot>
</math>
```

PDF objects representing the Logical Structure of $\sqrt[3]{x}$

```
1 0 obj
<< /Type /Namespace /NS (http://iso.org/pdf2/ssn) >>
endobj

2 0 obj
<< /Type /Namespace /NS (http://www.w3.org/1998/Math/MathML) >>
endobj

3 0 obj
<< /Type /StructElem /S /Formula /NS10R/Alt (Cube root of x) /K 4 0 R /Pg 9 0 R >>
endobj

4 0 obj
<< /Type /StructElem /S /math /NS 2 0 R /K 5 0 R /Pg 9 0 R /P 3 0 R >>
endobj

5 0 obj
<< /Type /StructElem /S /mroot /NS 2 0 R /K [ 6 0 R 7 0 R 2 ] /Pg 9 0 R /P 4 0 R >>
endobj

6 0 obj
<< /Type /StructElem /S /mi /NS 2 0 R /K 1 /Pg 9 0 R /P 6 0 R >>
endobj

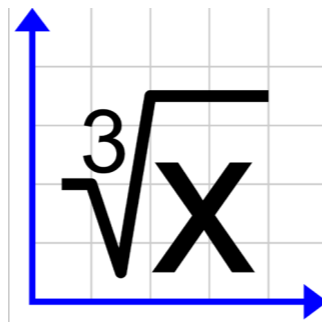
7 0 obj
<< /Type /StructElem /S /mn /NS 2 0 R /K 0 /Pg 9 0 R /P 5 0 R >>
endobj

8 0 obj  % the Structure Element that is the parent of the Formula (object 3)
<< /Type /StructElem ... >>
endobj

9 0 obj  % the page object referenced by /Pg entries in structure elements
<< /Type /Page /Contents 10 0 R ...
  /Resources << /Font << /FontA ... >> >>
>>
endobj
```

Content stream for painting of $\sqrt[3]{x}$ with Marked Content IDs

```
BT
/mn << /MCID 0 >> BDC
  8 22 Td /FontA 15 Tf (3) Tj
EMC
/mi << /MCID 1 >> BDC
  12 -17 Td /FontA 36 Tf (x) Tj
EMC
ET
/mroot << /MCID 2 >> BDC
  2 w 1 j 5 20 m 10 20 l 15 5 l 20 35 l 40 35 l s
EMC
```



Use of Associated Files via Logical Structure

```
... obj  % Document Catalog
<< /Type /Catalog /Pages ...
  /Names << /EmbeddedFiles << /Names [ (cuberoot.mathml) 11 0 R ] >> ... >> ...
>>
endobj

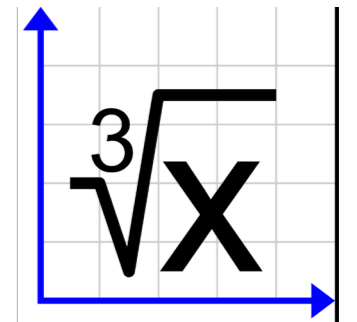
3 0 obj
<< /Type /StructElem /S /Formula /NS 1 0 R /Alt (Cube root of x) /K 4 0 R /Pg 9 0 R
  /AF [ 11 0 R ]
>>
endobj
```

Use of Associated Files via marked content

```
... obj  % Document Catalog
<< /Type /Catalog /Pages ...
  /Names << /EmbeddedFiles << /Names [ (cuberoot.mathml) 11 0 R ] >> ... >> ...
>>
endobj

9 0 obj  % the page object
<< /Type /Page /Contents 10 0 R ...
  /Resources << ...
    /Font << /FontA ... >> /Properties << /MyMathFiles << /MCAF [ 11 0 R ] >> ... >>
  >> ...
>>
endobj

10 0 obj  % page content stream
<< ... >>
stream
/AF /MyMathFiles BMC
BT
  8 22 Td /FontA 15 Tf (3) Tj
  12 -17 Td /FontA 36 Tf (x) Tj
ET
  2 w 1 j 5 20 m 10 20 l 15 5 l 20 35 l 40 35 l s
EMC
endobj
```



Embedded file stream (Associated File) containing MathML

```
11 0 obj  % Embedded file specification dictionary for MathML
<< /Type /Filespec /UF (cuberoot.mathml) /EF << /UF 12 0 R >>
  /AFRelationship /Source /Desc (MathML file for cube root of x)
>>
endobj

12 0 obj  % Embedded file stream containing the MathML (XML) data
<< /Type /EmbeddedFile /Subtype /application#2Fmathml-presentation+xml
  /Params << /ModDate (D:20242505200001Z) /Size 134 ... >>
  /Length 134 ...
>>
stream
<math xmlns="http://www.w3.org/1998/Math/MathML" alttext="Cube root of x">
  <mroot>
    <mi>x</mi>
    <mn>3</mn>
  </mroot>
</math>
endstream
endobj
```