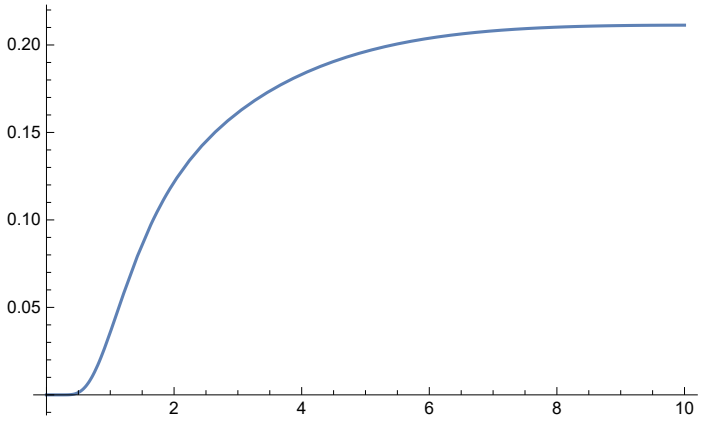
Monster group - group theory topic sequence, see http://mathworld.wolfram.com/MonsterGroup.html
Appear in some of Witten's work, so I look at some related stuff here

```
D[(1 + Exp[(-(x - p))/t])^(-1), x]
D[(1 + Exp[(-(x - p))/t])^(-1), x] // FullSimplify
```

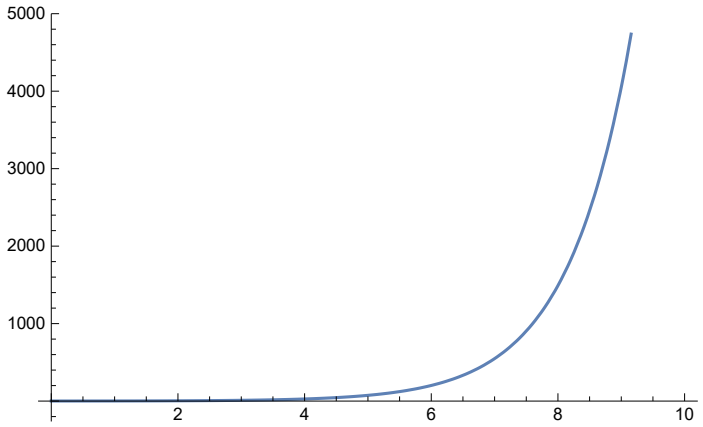
$$\frac{e^{\frac{p-x}{t}}}{\left(1+e^{\frac{p-x}{t}}\right)^2 t}$$

$$\frac{1}{2\,t+2\,t\,\text{Cosh}\left[\frac{p-x}{t}\right]}$$

```
Plot[Sum[(2 t + 2 t Cosh[(p - 93)/t])^(-1), {p, Table[Prime[i], {i, 1, 100}]}], {t, 0, 10}]
```




```
Plot[Cosh[x], {x, 0, 10}]
```




```
Sum[(2 t + 2 t Cosh[(p - 5)/t])^(-1), {p, {2, 3, 5, 7, 11, 13, 17, 19, 23}}]
```

$$\frac{1}{4\,t}+\frac{2}{2\,t+2\,t\,\text{Cosh}\left[\frac{2}{t}\right]}+\frac{1}{2\,t+2\,t\,\text{Cosh}\left[\frac{3}{t}\right]}+\frac{1}{2\,t+2\,t\,\text{Cosh}\left[\frac{6}{t}\right]}+$$

$$\frac{1}{2\,t+2\,t\,\text{Cosh}\left[\frac{8}{t}\right]}+\frac{1}{2\,t+2\,t\,\text{Cosh}\left[\frac{12}{t}\right]}+\frac{1}{2\,t+2\,t\,\text{Cosh}\left[\frac{14}{t}\right]}+\frac{1}{2\,t+2\,t\,\text{Cosh}\left[\frac{18}{t}\right]}$$

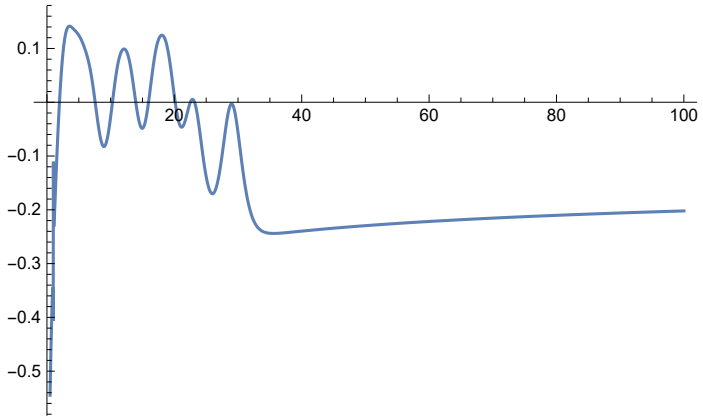
```
pmax = 10; x = 4; a = .00001; nmax = 10000;
Sum[(2 a + 2 a Cosh[(p - x)/a])^(-1), {p, Table[Prime[i], {i, 1, pmax}]}] // N
((x Log[x])^(-1)) Sum[(MoebiusMu[n]/n) x^(1/n), {n, 1, nmax}] // N
Sum[(2 a + 2 a Cosh[(p - x)/a])^(-1), {p, Table[Prime[i], {i, 1, pmax}]}] -
  ((x Log[x])^(-1)) Sum[(MoebiusMu[n]/n) x^(1/n), {n, 1, nmax}] // N
```

$7.125899130722441 \times 10^{-43425}$

0.406262

$Aborted

```
Plot[Sum[(2 a + 2 a Cosh[(p - x)/a])^(-1), {p, Table[Prime[i], {i, 1, pmax}]}] -
  ((x Log[x])^(-1)) Sum[(MoebiusMu[n]/n) x^(1/n), {n, 1, nmax}], {x, 0, 100}]
```




```
Limit[1/(2 t + 2 t Cosh[(p-y)/t]), t → 0]
Limit[1/(2 t + 2 t Cosh[(p-y)/t]), t → 0]

Limit[e^((p-y)/t)/((1 + e^((p-y)/t))^2 t), t → 0]
Limit[e^((p-y)/t)/((1 + e^((p-y)/t))^2 t), t → 0]
```

Monster Stuff

```
a[n_] := If[n < 1, Boole[n == -1],
  SeriesCoefficient[1728 KleinInvariantJ[Log[x] / (2 Pi I)] + x O[x]^n, {x, 0, n}]]
```

```
a[1]
```

196 884

```
Nmax = 20;
A = Join[{1, 744}, Table[a[i], {i, 1, Nmax}]]
```

{1, 744, 196 884, 21 493 760, 864 299 970, 20 245 856 256, 333 202 640 600, 4 252 023 300 096,
 44 656 994 071 935, 401 490 886 656 000, 3 176 440 229 784 420, 22 567 393 309 593 600,
 146 211 911 499 519 294, 874 313 719 685 775 360, 4 872 010 111 798 142 520, 25 497 827 389 410 525 184,
 126 142 916 465 781 843 075, 593 121 772 421 445 058 560, 2 662 842 413 150 775 245 160,
 11 459 912 788 444 786 513 920, 47 438 786 801 234 168 813 250, 189 449 976 248 893 390 028 800}

```
A[[2]]
```

744

```
Table[FactorInteger[A[[i]]] // MatrixForm, {i, 1, (Nmax + 2)}]
```

$$\left\{\begin{pmatrix} 1 & 1 \end{pmatrix}, \begin{pmatrix} 2 & 3 \\ 3 & 1 \\ 31 & 1 \end{pmatrix}, \begin{pmatrix} 2 & 2 \\ 3 & 3 \\ 1823 & 1 \end{pmatrix}, \begin{pmatrix} 2 & 11 \\ 5 & 1 \\ 2099 & 1 \end{pmatrix}, \begin{pmatrix} 2 & 1 \\ 3 & 5 \\ 5 & 1 \\ 355\,679 & 1 \end{pmatrix}, \begin{pmatrix} 2 & 14 \\ 3 & 3 \\ 45\,767 & 1 \end{pmatrix},$$

$$\begin{pmatrix} 2 & 3 \\ 5 & 2 \\ 2143 & 1 \\ 777\,421 & 1 \end{pmatrix}, \begin{pmatrix} 2 & 13 \\ 3 & 6 \\ 11 & 1 \\ 13 & 2 \\ 383 & 1 \end{pmatrix}, \begin{pmatrix} 3 & 3 \\ 5 & 1 \\ 7 & 1 \\ 271 & 1 \\ 174\,376\,673 & 1 \end{pmatrix}, \begin{pmatrix} 2 & 17 \\ 3 & 1 \\ 5 & 3 \\ 199 & 1 \\ 41\,047 & 1 \end{pmatrix}, \begin{pmatrix} 2 & 2 \\ 3 & 7 \\ 5 & 1 \\ 4723 & 1 \\ 15\,376\,021 & 1 \end{pmatrix},$$

$$\begin{pmatrix} 2 & 12 \\ 3 & 5 \\ 5 & 2 \\ 13 & 2 \\ 5\,366\,467 & 1 \end{pmatrix}, \begin{pmatrix} 2 & 1 \\ 3 & 1 \\ 11 & 1 \\ 13 & 3 \\ 1\,008\,344\,102\,147 & 1 \end{pmatrix}, \begin{pmatrix} 2 & 16 \\ 3 & 5 \\ 5 & 1 \\ 10\,980\,221\,089 & 1 \end{pmatrix}, \begin{pmatrix} 2 & 3 \\ 3 & 3 \\ 5 & 1 \\ 23 & 1 \\ 112\,291 & 1 \\ 1\,746\,673\,133 & 1 \end{pmatrix},$$

$$\begin{pmatrix} 2 & 14 \\ 7 & 1 \\ 281 & 1 \\ 96\,457 & 1 \\ 8\,202\,479 & 1 \end{pmatrix}, \begin{pmatrix} 3 & 6 \\ 5 & 2 \\ 7 & 1 \\ 1483 & 1 \\ 666\,739\,430\,527 & 1 \end{pmatrix}, \begin{pmatrix} 2 & 20 \\ 3 & 3 \\ 5 & 1 \\ 4\,189\,962\,969\,331 & 1 \end{pmatrix}, \begin{pmatrix} 2 & 3 \\ 3 & 2 \\ 5 & 1 \\ 7699 & 1 \\ 960\,746\,133\,390\,619 & 1 \end{pmatrix},$$

$$\begin{pmatrix} 2 & 11 \\ 3 & 8 \\ 5 & 1 \\ 2333 & 1 \\ 4337 & 1 \\ 16\,858\,043 & 1 \end{pmatrix}, \begin{pmatrix} 2 & 1 \\ 3 & 3 \\ 5 & 3 \\ 7\,027\,968\,414\,997\,654\,639 & 1 \end{pmatrix}, \begin{pmatrix} 2 & 15 \\ 5 & 2 \\ 23 & 1 \\ 619 & 1 \\ 16\,243\,743\,628\,447 & 1 \end{pmatrix}\right\}$$

```
2 * 2 * 2 * 3 * 31
```

744