```
d2[n_, k_] := Sum[d2[j, k - 1] d2[n / j, 1], {j, Divisors[n]}];
d2[n_, 1] := 1; d2[1, 1] := 0; d2[n_, 0] := 0; d2[1, 0] := 1
dd[n_, z_] := Sum[FactorialPower[z, a] / a! d2[n, a], {a, 0, Log[2, n]}]
PrimeKappa[n_, 0] := If[n == 1, 1, 0]
PrimeKappa[n_, 1] := If[n == 1, 0, FullSimplify[MangoldtLambda[n] / Log[n]]]
PrimeKappa[n_, k_] := Sum[PrimeKappa[j, k - 1] PrimeKappa[n / j, 1], {j, Divisors[n]}]
dda[n_, z_] := Sum[ z^k / k! PrimeKappa[n, k], {k, 0, Log[2, n]}]

Table[ {n, Expand[Roots[ Expand[dda[n, x]] == 0, x]]}, {n, 2, 40}] // TableForm
```

2	x == 0
3	x == 0
4	x == 0 || x == -1
5	x == 0
6	x == 0 || x == 0
7	x == 0
8	x == 0 || x == -2 || x == -1
9	x == 0 || x == -1
10	x == 0 || x == 0
11	x == 0
12	x == 0 || x == 0 || x == -1
13	x == 0
14	x == 0 || x == 0
15	x == 0 || x == 0
16	x == 0 || x == -3 || x == -2 || x == -1
17	x == 0
18	x == 0 || x == 0 || x == -1
19	x == 0
20	x == 0 || x == 0 || x == -1
21	x == 0 || x == 0
22	x == 0 || x == 0
23	x == 0
24	x == 0 || x == 0 || x == -2 || x == -1
25	x == 0 || x == -1
26	x == 0 || x == 0
27	x == 0 || x == -2 || x == -1
28	x == 0 || x == 0 || x == -1
29	x == 0
30	x == 0 || x == 0 || x == 0
31	x == 0
32	x == 0 || x == -4 || x == -3 || x == -2 || x == -1
33	x == 0 || x == 0
34	x == 0 || x == 0
35	x == 0 || x == 0
36	x == 0 || x == 0 || x == -1 || x == -1
37	x == 0
38	x == 0 || x == 0
39	x == 0 || x == 0
40	x == 0 || x == 0 || x == -2 || x == -1

```
E2a[n_, k_, a_] :=
 E2a[n, k, a] = Sum[ E2a[n / j, k - 1, a], {j, 2, n}] - a Sum[ E2a[n / (a j), k - 1, a], {j, 1, n / a}];
E2a[n_, 0, a_] := 1
EE[n_, z_, b_] :=
 EE[n, z, b] = Sum[FactorialPower[z, a] / a! E2a[n, a, b], {a, 0, Log[If[b > 2, 2, b], n]}]
EEa[n_, z_, b_] := EEa[n, z, b] =
  Sum[Binomial[z, a] E2a[n, a, b], {a, 0, Log[If[b > 2, 2, b], n]}]
bins[ z_, a_] := Product[ (z - k), {k, 0, a - 1}] / a!
EEb[n_, z_, b_] :=
 EEb[n, z, b] = Sum[bins[z, a] E2a[n, a, b], {a, 0, Log[If[b > 2, 2, b], n]}]
EEc[n_, z_, b_] := Expand[Sum[bins[z, a] E2a[n, a, b], {a, 0, Log[If[b > 2, 2, b], n]}]]
ee[n_, z_, b_] := EEc[n, z, b] - EEc[n - 1, z, b]

Table[ {n, ee[n, z, 2]}, {n, 2, 100}] // TableForm
```

2	$-z$
3	z
4	$-\frac{3z}{2}+\frac{z^2}{2}$
5	z
6	$-z^2$
7	z
8	$-\frac{7z}{3}+\frac{3z^2}{2}-\frac{z^3}{6}$
9	$\frac{z}{2}+\frac{z^2}{2}$
10	$-z^2$
11	z
12	$-\frac{3z^2}{2}+\frac{z^3}{2}$
13	z
14	$-z^2$
15	z^2
16	$-\frac{15z}{4}+\frac{83z^2}{24}-\frac{3z^3}{4}+\frac{z^4}{24}$
17	z
18	$-\frac{z^2}{2}-\frac{z^3}{2}$
19	z
20	$-\frac{3z^2}{2}+\frac{z^3}{2}$
21	z^2
22	$-z^2$
23	z
24	$-\frac{7z^2}{3}+\frac{3z^3}{2}-\frac{z^4}{6}$
25	$\frac{z}{2}+\frac{z^2}{2}$
26	$-z^2$
27	$\frac{z}{3}+\frac{z^2}{2}+\frac{z^3}{6}$
28	$-\frac{3z^2}{2}+\frac{z^3}{2}$
29	z
30	$-z^3$
31	z
32	$-\frac{31z}{5}+\frac{29z^2}{4}-\frac{55z^3}{24}+\frac{z^4}{4}-\frac{z^5}{120}$
33	z^2
34	$-z^2$

35 z^2

36 $-\frac{3 z^2}{4} - \frac{z^3}{2} + \frac{z^4}{4}$

37 z

38 $-z^2$

39 z^2

40 $-\frac{7 z^2}{3} + \frac{3 z^3}{2} - \frac{z^4}{6}$

41 z

42 $-z^3$

43 z

44 $-\frac{3 z^2}{2} + \frac{z^3}{2}$

45 $\frac{z^2}{2} + \frac{z^3}{2}$

46 $-z^2$

47 z

48 $-\frac{15 z^2}{4} + \frac{83 z^3}{24} - \frac{3 z^4}{4} + \frac{z^5}{24}$

49 $\frac{z}{2} + \frac{z^2}{2}$

50 $-\frac{z^2}{2} - \frac{z^3}{2}$

51 z^2

52 $-\frac{3 z^2}{2} + \frac{z^3}{2}$

53 z

54 $-\frac{z^2}{3} - \frac{z^3}{2} - \frac{z^4}{6}$

55 z^2

56 $-\frac{7 z^2}{3} + \frac{3 z^3}{2} - \frac{z^4}{6}$

57 z^2

58 $-z^2$

59 z

60 $-\frac{3 z^3}{2} + \frac{z^4}{2}$

61 z

62 $-z^2$

63 $\frac{z^2}{2} + \frac{z^3}{2}$

64 $-\frac{21 z}{2} + \frac{5237 z^2}{360} - \frac{95 z^3}{16} + \frac{137 z^4}{144} - \frac{z^5}{16} + \frac{z^6}{720}$

65 z^2

66 $-z^3$

67 z

68 $-\frac{3 z^2}{2} + \frac{z^3}{2}$

69 z^2

70 $-z^3$

71 z

72 $-\frac{7 z^2}{6} - \frac{5 z^3}{12} + \frac{2 z^4}{3} - \frac{z^5}{12}$

73 z

74 $-z^2$

75 $\frac{z^2}{2} + \frac{z^3}{2}$

76 $-\frac{3 z^2}{2} + \frac{z^3}{2}$

77 z^2

78 $-z^3$

79 z

80 $-\frac{15 z^2}{4}+\frac{83 z^3}{24}-\frac{3 z^4}{4}+\frac{z^5}{24}$

81 $\frac{z}{4}+\frac{11 z^2}{24}+\frac{z^3}{4}+\frac{z^4}{24}$

82 $-z^2$

83 z

84 $-\frac{3 z^3}{2}+\frac{z^4}{2}$

85 z^2

86 $-z^2$

87 z^2

88 $-\frac{7 z^2}{3}+\frac{3 z^3}{2}-\frac{z^4}{6}$

89 z

90 $-\frac{z^3}{2}-\frac{z^4}{2}$

91 z^2

92 $-\frac{3 z^2}{2}+\frac{z^3}{2}$

93 z^2

94 $-z^2$

95 z^2

96 $-\frac{31 z^2}{5}+\frac{29 z^3}{4}-\frac{55 z^4}{24}+\frac{z^5}{4}-\frac{z^6}{120}$

97 z

98 $-\frac{z^2}{2}-\frac{z^3}{2}$

99 $\frac{z^2}{2}+\frac{z^3}{2}$

100 $-\frac{3 z^2}{4}-\frac{z^3}{2}+\frac{z^4}{4}$

```
Table[{n, Expand[Roots[Expand[ee[n, x, 3 / 2]] == 0, x]]}, {n, 2, 40}] // TableForm
```

2 $x == 0$

3 $x == -\frac{1}{3} \;||\; x == 0$

4 $x == 0 \;||\; x == \frac{35}{18}-\frac{\sqrt{865}}{18} \;||\; x == \frac{35}{18}+\frac{\sqrt{865}}{18}$

5 $x == 0 \;||\; x == \frac{7}{6}-\frac{\sqrt{17}}{6} \;||\; x == \frac{7}{6}+\frac{\sqrt{17}}{6}$

6 $x == 0 \;||\; x == \frac{86}{27}+\frac{1}{81}\left(8\,454\,672-243\sqrt{133\,594\,341}\right)^{1/3}+\frac{1}{27}\left(313\,136+9\sqrt{133\,594\,341}\right)^{1/3} \;||\; x == \frac{86}{27}$

7 $x == 0 \;||\; x == \frac{5}{3}+\frac{1}{27}\left(43\,011-1458\sqrt{321}\right)^{1/3}+\frac{1}{3}\left(59+2\sqrt{321}\right)^{1/3} \;||\; x == \frac{5}{3}-\frac{1}{54}\left(43\,011-1458\sqrt{321}\right.$

8 $x == 0 \;||\; x == \frac{5}{2}+\frac{1}{54}\sqrt{2495+\frac{14\,551\,957}{\left(48\,038\,673\,185+162\,i\sqrt{29\,484\,847\,057\,714\,747}\right)^{1/3}}+\left(48\,038\,673\,185+162\,i\sqrt{29\,484\,8}\right.$

9 $x == 0 \;||\; x == \frac{8}{9}+\frac{67}{9\left(224+3\,i\sqrt{27\,843}\right)^{1/3}}+\frac{1}{9}\left(224+3\,i\sqrt{27\,843}\right)^{1/3} \;||\; x == \frac{8}{9}-\frac{67}{18\left(224+3\,i\sqrt{27\,843}\right)^{1/3}}-\frac{}{6\sqrt{3}\,(2}$

10 $x == 0 \;||\; x == 0$

11 $x == 0 \;||\; x == \frac{13}{6}-\frac{1}{6}\sqrt{55-\frac{185\times 3^{2/3}}{\left(-5861+2\sqrt{13\,336\,549}\right)^{1/3}}+\left(3\left(-5861+2\sqrt{13\,336\,549}\right)\right)^{1/3}}-\frac{1}{2}\sqrt{\frac{110}{9}-\frac{\left(-5861+2\right.}{}}$

12 $x == 0 \;||\; x == \text{Root}\left[-9720+16\,434\,\#1-13\,745\,\#1^2+5605\,\#1^3-1215\,\#1^4+81\,\#1^5\,\&,\,1\right] \;||\; x == \text{Root}\left[-9\right.$

13 $x == 0$

14 $x == 0 \;||\; x == 0 \;||\; x == 2 + \frac{19}{3\left(48+i\sqrt{4555}\right)^{1/3}} + \frac{1}{3}\left(48 + i\sqrt{4555}\right)^{1/3} \;||\; x == 2 - \frac{19}{6\left(48+i\sqrt{4555}\right)^{1/3}} - \frac{19\,i}{2\sqrt{3}\ (48+i\sqrt{}$

15 $x == \frac{2}{3} \;||\; x == 0 \;||\; x == 0$

16 $x == 0 \;||\; x == \text{Root}\left[-960 + 13\,252\,\#1 - 26\,340\,\#1^2 + 13\,205\,\#1^3 - 3240\,\#1^4 + 243\,\#1^5\ \&,\ 1\right] \;||\; x == \text{Root}\left[-\right.$

17 $x == 0 \;||\; x == 1 - \frac{5}{3\left(-12+\sqrt{269}\right)^{1/3}} + \frac{1}{3}\left(-12 + \sqrt{269}\right)^{1/3} \;||\; x == 1 + \frac{5}{6\left(-12+\sqrt{269}\right)^{1/3}} + \frac{5\,i}{2\sqrt{3}\ \left(-12+\sqrt{269}\right)^{1/3}} - \frac{1}{6}\left(-\right.$

18 $x == 0 \;||\; x == \text{Root}\left[174\,960 - 437\,612\,\#1 + 425\,992\,\#1^2 - 151\,725\,\#1^3 + 29\,085\,\#1^4 - 5103\,\#1^5 + 243\,\#1^6\ \&,\right.$

19 $x == 0$

20 $x == 2 \;||\; x == 0 \;||\; x == 0$

21 $x == 0 \;||\; x == 0 \;||\; x == \frac{31}{12} - \frac{1}{12}\sqrt{329 - \frac{984}{\left(5626-\sqrt{29\,791\,009}\right)^{1/3}} - 8\left(5626 - \sqrt{29\,791\,009}\right)^{1/3}} - \frac{1}{2}\sqrt{\frac{329}{18} + \frac{}{3\left(562\right.}}$

22 $x == 0 \;||\; x == 0$

23 $x == 0 \;||\; x == \text{Root}\left[5120 - 17\,496\,\#1 + 24\,954\,\#1^2 - 23\,805\,\#1^3 + 10\,125\,\#1^4 - 1539\,\#1^5 + 81\,\#1^6\ \&,\ 1\right] \;||\; x$

24 $x == 0 \;||\; x == 0 \;||\; x == -\frac{37}{9} - \frac{2017}{9\left(93\,421-18\sqrt{1\,610\,322}\right)^{1/3}} - \frac{1}{9}\left(93\,421 - 18\sqrt{1\,610\,322}\right)^{1/3} \;||\; x == -\frac{37}{9} + \frac{}{18\left(93\,4\right.}$

25 $x == 0 \;||\; x == \frac{5}{18} - \frac{i\sqrt{119}}{18} \;||\; x == \frac{5}{18} + \frac{i\sqrt{119}}{18}$

26 $x == 0 \;||\; x == \text{Root}\left[-3\,674\,160 + 7\,501\,612\,\#1 - 6\,912\,108\,\#1^2 + 3\,483\,081\,\#1^3 - 1\,186\,920\,\#1^4 + 234\,738\,\#1^{}\right.$

27 $x == 0 \;||\; x == \frac{7}{4} - \frac{1}{2}\sqrt{\frac{67}{12} + \frac{1}{3}\,2^{2/3}\left(\frac{1}{3}\left(521 + i\sqrt{361\,295}\right)\right)^{1/3} + \frac{52}{3^{2/3}\left(\frac{1}{2}\left(521+i\sqrt{361\,295}\right)\right)^{1/3}}} - \frac{1}{2}\sqrt{\frac{67}{6} - \frac{1}{3}\,2^{2/}}$

28 $x == 0 \;||\; x == 0 \;||\; x == -1$

29 $x == \frac{2}{3} \;||\; x == 0$

30 $x == 0 \;||\; x == 0 \;||\; x == \frac{11}{12} - \frac{i\sqrt{95}}{12} \;||\; x == \frac{11}{12} + \frac{i\sqrt{95}}{12}$

31 $x == 0 \;||\; x == \text{Root}\left[-2560 + 3384\,\#1 + 414\,\#1^2 - 8595\,\#1^3 + 5985\,\#1^4 - 1269\,\#1^5 + 81\,\#1^6\ \&,\ 1\right] \;||\; x == \text{Ro}$

32 $x == 0 \;||\; x == -\frac{145}{4} + \frac{1}{4}\sqrt{\frac{1}{3}\left(65\,315 + \frac{113\,876\times 2^{2/3}}{\left(-2\,864\,615+9\,i\sqrt{468\,411\,316\,953}\right)^{1/3}} + 4\left(2\left(-2\,864\,615 + 9\,i\sqrt{468\,411\,316\right.\right.\right.}$

33 $x == \frac{2}{3} \;||\; x == 0 \;||\; x == 0$

34 $x == 0 \;||\; x == 0 \;||\; x == \frac{5}{3} + \frac{1}{27}\left(43\,011 - 1458\sqrt{321}\right)^{1/3} + \frac{1}{3}\left(59 + 2\sqrt{321}\right)^{1/3} \;||\; x == \frac{5}{3} - \frac{1}{54}\left(43\,011 - 14\right.$

35 $x == 0 \;||\; x == 0 \;||\; x == \text{Root}\left[346\,880 - 739\,368\,\#1 + 649\,782\,\#1^2 - 274\,995\,\#1^3 + 59\,535\,\#1^4 - 6237\,\#1^5 + 2^{}\right.$

36 $x == 0 \;||\; x == 0 \;||\; x == -\frac{25}{24} + \frac{1}{24}\sqrt{3761 - \frac{51\,512}{\left(4\,296\,178-57\sqrt{5\,598\,701\,085}\right)^{1/3}} - 8\left(4\,296\,178 - 57\sqrt{5\,598\,701\,085}\right)^{}}$

37 $x == 0$

38 $x == 0 \;||\; x == 0 \;||\; x == \frac{5}{2} + \frac{1}{6}\sqrt{\frac{1}{3}\left(-115 + \frac{35\,293}{\left(3\,312\,395+6\,i\sqrt{916\,357\,046\,187}\right)^{1/3}} + \left(3\,312\,395 + 6\,i\sqrt{916\,357\,046\,18}\right.\right.$

39 $x == 0 \;||\; x == \text{Root}\left[9\,797\,760 - 26\,342\,192\,\#1 + 29\,564\,292\,\#1^2 - 16\,350\,012\,\#1^3 + 5\,455\,107\,\#1^4 - 1\,102\,24^{}\right.$

40 $x == 0 \;||\; x == 0 \;||\; x == -2 \;||\; x == -1$