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bin[z_, a_] := Product[z - j, {j, 0, a - 1}] / a!
d1[n_, z_] := Product[(-1)^p[[2]] bin[-z, p[[2]]], {p, FI[n]}}];
FI[n_] := FactorInteger[n]; FI[1] := {}

d1[2^7, 4] d1[3^4, 4]

4200

d1[2^7 × 3^4, 4]

4200

d1[12, z]


$$-\frac{1}{2} (-1 - z) z^2$$


d1[4, z] d1[3, z]


$$-\frac{1}{2} (-1 - z) z^2$$


pp[n_, z_, p_] := If[Prime[p] > n, 1,
  Sum[d1[Prime[p]^a, z] pp[n/Prime[p]^a, z, p+1], {a, 0, Log[Prime[p], n]}]]
p2[n_, z_, p_] := If[Prime[p] > n, 1,
  Sum[(-1)^a bin[-z, a] p2[n/Prime[p]^a, z, p+1], {a, 0, Log[Prime[p], n]}]]
p4[n_, z_, p_] := If[Prime[p] > n, 1,
  Sum[Product[1 +  $\frac{(z-1)}{k}$ , {k, 1, a}] p4[n/Prime[p]^a, z, p+1], {a, 0, Log[Prime[p], n]}]]]
F[n_, z_, p_, k_] := If[Prime[p] > n || n <= 1, 1,
   $\left(1 + \frac{(z-1)}{k}\right) F[n/Prime[p], z, p, k+1] + F[n, z, p+1, 1]$ ]

Expand[p2[100, z, 1]]


$$1 + \frac{428 z}{15} + \frac{16289 z^2}{360} + \frac{331 z^3}{16} + \frac{611 z^4}{144} + \frac{67 z^5}{240} + \frac{7 z^6}{720}$$


Expand[F[100, z, 1, 1]]


$$1 + \frac{428 z}{15} + \frac{16289 z^2}{360} + \frac{331 z^3}{16} + \frac{611 z^4}{144} + \frac{67 z^5}{240} + \frac{7 z^6}{720}$$


Log[3, 2^s]


$$\frac{\text{Log}[2^s]}{\text{Log}[3]}$$


N[Log[2^7]]

4.85203

N[7 Log[2]]

4.85203

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Limit[Binomial[-z, 3] / z, z → 0]
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$$-\frac{1}{3}$$

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Limit[ (1 + z / n) ^n, n → Infinity]
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$$e^z$$