

> # 1. Expected number of females born at time  $n = 4$  in terms of  $c0, c1, c2, p1, p2, p3$  is  $c0 \cdot p1 \cdot p3 + c1 \cdot p2 \cdot p3 + c2 \cdot p3^2 + p1 \cdot c1 + p2 \cdot c2$

$R3 := \text{proc}(n, c0, c1, c2, p1, p2, p3)$  option remember :

if  $n = 0$  then  $c0$  :

elif  $n = 1$  then  $c1$  :

elif  $n = 2$  then  $c2$  :

else

expand( $p1 \cdot R3(n - 3, c0, c1, c2, p1, p2, p3) + p2 \cdot R3(n - 2, c0, c1, c2, p1, p2, p3) + p3 \cdot R3(n - 1, c0, c1, c2, p1, p2, p3)$ ) :

fi:

end:

seq( $R3(i, c0, c1, c2, p1, p2, p3)$ ,  $i = 1 .. 4$ )

$$c1, c2, p1 \ c0 + p2 \ c1 + p3 \ c2, c0 \ p1 \ p3 + c1 \ p2 \ p3 + c2 \ p3^2 + p1 \ c1 + p2 \ c2 \quad (1)$$

> # 2. Maple code  $F$  that would output the number of females born at time  $n$

$F := \text{proc}(c0, c1, c2, p1, p2, p3, n)$  option remember :

if  $n = 0$  then  $c0$  :

elif  $n = 1$  then  $c1$  :

elif  $n = 2$  then  $c2$  :

else

expand( $p1 \cdot F(c0, c1, c2, p1, p2, p3, n - 3) + p2 \cdot F(c0, c1, c2, p1, p2, p3, n - 2) + p3 \cdot F(c0, c1, c2, p1, p2, p3, n - 1)$ ) :

fi:

end:

seq( $F(c0, c1, c2, p1, p2, p3, i)$ ,  $i = 4$ )

$$c0 \ p1 \ p3 + c1 \ p2 \ p3 + c2 \ p3^2 + p1 \ c1 + p2 \ c2 \quad (2)$$

> seq( $F(1, 1, 1, 1, 1, 1, i)$ ,  $i = 4$ )

$$5 \quad (3)$$

> # 3i. Extinction

seq( $R3(i, 1, 1, 1, .1, .1, .1)$ ,  $i = 1 .. 1000$ )

1, 1, 0.3, 0.23, 0.153, 0.0683, 0.04513, 0.026643, 0.0140073, 0.00857803, 0.004922833, (4)

0.0027508163, 0.00162516793, 0.000929881723, 0.0005305865953, 0.0003085636248,

0.0001769031943, 0.0001016053414, 0.00005870721605, 0.00003372157518,

0.00001940341326, 0.00001118322045,  $6.430820889 \times 10^{-6}$ ,  $3.701745460 \times 10^{-6}$ ,

$2.131578680 \times 10^{-6}$ ,  $1.226414503 \times 10^{-6}$ ,  $7.059738643 \times 10^{-7}$ ,  $4.063967047 \times 10^{-7}$ ,

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$2.567142623 \times 10^{-8}$ ,  $1.477607808 \times 10^{-8}$ ,  $8.504684699 \times 10^{-9}$ ,  $4.895218901 \times 10^{-9}$ ,

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> # 3ii. Stable Population

$seq(R3(i, 1, 1, 1, .32, .32, .32), i = 1..1000)$

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1.077897978 × 10<sup>-7</sup>, 1.056192853 × 10<sup>-7</sup>, 1.034924794 × 10<sup>-7</sup>, 1.014085000 × 10<sup>-7</sup>,  
9.936648471 × 10<sup>-8</sup>, 9.736558852 × 10<sup>-8</sup>, 9.540498344 × 10<sup>-8</sup>, 9.348385814 × 10<sup>-8</sup>,  
9.160141763 × 10<sup>-8</sup>, 8.975688294 × 10<sup>-8</sup>, 8.794949078 × 10<sup>-8</sup>, 8.617849323 × 10<sup>-8</sup>,  
8.444315742 × 10<sup>-8</sup>, 8.274276525 × 10<sup>-8</sup>, 8.107661308 × 10<sup>-8</sup>, 7.944401144 × 10<sup>-8</sup>,  
7.784428473 × 10<sup>-8</sup>, 7.627677096 × 10<sup>-8</sup>, 7.474082148 × 10<sup>-8</sup>, 7.323580069 × 10<sup>-8</sup>,  
7.176108580 × 10<sup>-8</sup>, 7.031606655 × 10<sup>-8</sup>, 6.890014498 × 10<sup>-8</sup>, 6.751273515 × 10<sup>-8</sup>,  
6.615326294 × 10<sup>-8</sup>, 6.482116578 × 10<sup>-8</sup>, 6.351589244 × 10<sup>-8</sup>, 6.223690277 × 10<sup>-8</sup>,  
6.098366752 × 10<sup>-8</sup>, 5.975566808 × 10<sup>-8</sup>, 5.855239629 × 10<sup>-8</sup>, 5.737335421 × 10<sup>-8</sup>,  
5.621805395 × 10<sup>-8</sup>, 5.508601742 × 10<sup>-8</sup>, 5.397677618 × 10<sup>-8</sup>, 5.288987121 × 10<sup>-8</sup>,  
5.182485274 × 10<sup>-8</sup>, 5.078128005 × 10<sup>-8</sup>, 4.975872129 × 10<sup>-8</sup>, 4.875675331 × 10<sup>-8</sup>,  
4.777496149 × 10<sup>-8</sup>, 4.681293955 × 10<sup>-8</sup>, 4.587028940 × 10<sup>-8</sup>, 4.494662095 × 10<sup>-8</sup>,  
4.404155197 × 10<sup>-8</sup>, 4.315470794 × 10<sup>-8</sup>, 4.228572187 × 10<sup>-8</sup>, 4.143423417 × 10<sup>-8</sup>,  
4.059989247 × 10<sup>-8</sup>, 3.978235152 × 10<sup>-8</sup>, 3.898127301 × 10<sup>-8</sup>, 3.819632544 × 10<sup>-8</sup>,  
3.742718399 × 10<sup>-8</sup>, 3.667353038 × 10<sup>-8</sup>, 3.593505274 × 10<sup>-8</sup>, 3.521144548 × 10<sup>-8</sup>,  
3.450240915 × 10<sup>-8</sup>, 3.380765036 × 10<sup>-8</sup>, 3.312688160 × 10<sup>-8</sup>, 3.245982116 × 10<sup>-8</sup>,  
3.180619300 × 10<sup>-8</sup>, 3.116572664 × 10<sup>-8</sup>, 3.053815706 × 10<sup>-8</sup>, 2.992322454 × 10<sup>-8</sup>,  
2.932067463 × 10<sup>-8</sup>, 2.873025799 × 10<sup>-8</sup>, 2.815173030 × 10<sup>-8</sup>, 2.758485214 × 10<sup>-8</sup>,  
2.702938894 × 10<sup>-8</sup>, 2.648511084 × 10<sup>-8</sup>, 2.595179262 × 10<sup>-8</sup>, 2.542921357 × 10<sup>-8</sup>,  
2.491715745 × 10<sup>-8</sup>, 2.441541236 × 10<sup>-8</sup>, 2.392377068 × 10<sup>-8</sup>, 2.344202896 × 10<sup>-8</sup>,  
2.296998784 × 10<sup>-8</sup>, 2.250745199 × 10<sup>-8</sup>, 2.205423002 × 10<sup>-8</sup>, 2.161013436 × 10<sup>-8</sup>,  
2.117498124 × 10<sup>-8</sup>, 2.074859060 × 10<sup>-8</sup>, 2.033078598 × 10<sup>-8</sup>, 1.992139450 × 10<sup>-8</sup>,  
1.952024675 × 10<sup>-8</sup>, 1.912717671 × 10<sup>-8</sup>, 1.874202175 × 10<sup>-8</sup>, 1.836462247 × 10<sup>-8</sup>,  
1.799482270 × 10<sup>-8</sup>, 1.763246941 × 10<sup>-8</sup>, 1.727741266 × 10<sup>-8</sup>, 1.692950553 × 10<sup>-8</sup>,  
1.658860403 × 10<sup>-8</sup>, 1.625456711 × 10<sup>-8</sup>, 1.592725654 × 10<sup>-8</sup>, 1.560653685 × 10<sup>-8</sup>,  
1.529227536 × 10<sup>-8</sup>, 1.498434200 × 10<sup>-8</sup>, 1.468260935 × 10<sup>-8</sup>, 1.438695255 × 10<sup>-8</sup>,  
1.409724925 × 10<sup>-8</sup>, 1.381337957 × 10<sup>-8</sup>, 1.353522604 × 10<sup>-8</sup>, 1.326267356 × 10<sup>-8</sup>,  
1.299560933 × 10<sup>-8</sup>, 1.273392286 × 10<sup>-8</sup>, 1.247750584 × 10<sup>-8</sup>, 1.222625217 × 10<sup>-8</sup>,  
1.198005788 × 10<sup>-8</sup>, 1.173882108 × 10<sup>-8</sup>, 1.150244196 × 10<sup>-8</sup>, 1.127082270 × 10<sup>-8</sup>,  
1.104386744 × 10<sup>-8</sup>, 1.082148227 × 10<sup>-8</sup>, 1.060357517 × 10<sup>-8</sup>, 1.039005596 × 10<sup>-8</sup>,  
1.018083629 × 10<sup>-8</sup>, 9.975829574 × 10<sup>-9</sup>, 9.774950984 × 10<sup>-9</sup>, 9.578117392 × 10<sup>-9</sup>,  
9.385247344 × 10<sup>-9</sup>, 9.196261030 × 10<sup>-9</sup>, 9.011080245 × 10<sup>-9</sup>, 8.829628358 × 10<sup>-9</sup>,  
8.651830283 × 10<sup>-9</sup>, 8.477612444 × 10<sup>-9</sup>, 8.306902748 × 10<sup>-9</sup>, 8.139630552 × 10<sup>-9</sup>,  
7.975726638 × 10<sup>-9</sup>, 7.815123180 × 10<sup>-9</sup>, 7.657753719 × 10<sup>-9</sup>, 7.503553132 × 10<sup>-9</sup>,  
7.352457610 × 10<sup>-9</sup>, 7.204404627 × 10<sup>-9</sup>, 7.059332918 × 10<sup>-9</sup>, 6.917182450 × 10<sup>-9</sup>,  
6.777894399 × 10<sup>-9</sup>, 6.641411126 × 10<sup>-9</sup>, 6.507676152 × 10<sup>-9</sup>, 6.376634137 × 10<sup>-9</sup>,  
6.248230853 × 10<sup>-9</sup>, 6.122413166 × 10<sup>-9</sup>, 5.999129010 × 10<sup>-9</sup>, 5.878327369 × 10<sup>-9</sup>,

$5.759958254 \times 10^{-9}$ ,  $5.643972682 \times 10^{-9}$ ,  $5.530322657 \times 10^{-9}$ ,  $5.418961149 \times 10^{-9}$ ,  
 $5.309842076 \times 10^{-9}$ ,  $5.202920282 \times 10^{-9}$ ,  $5.098151522 \times 10^{-9}$ ,  $4.995492441 \times 10^{-9}$ ,  
 $4.894900558 \times 10^{-9}$ ,  $4.796334247 \times 10^{-9}$ ,  $4.699752719 \times 10^{-9}$ ,  $4.605116008 \times 10^{-9}$ ,  
 $4.512384952 \times 10^{-9}$ ,  $4.421521178 \times 10^{-9}$ ,  $4.332487085 \times 10^{-9}$ ,  $4.245245829 \times 10^{-9}$ ,  
 $4.159761309 \times 10^{-9}$ ,  $4.075998151 \times 10^{-9}$ ,  $3.993921692 \times 10^{-9}$ ,  $3.913497968 \times 10^{-9}$ ,  
 $3.834693699 \times 10^{-9}$ ,  $3.757476275 \times 10^{-9}$ ,  $3.681813742 \times 10^{-9}$ ,  $3.607674789 \times 10^{-9}$ ,  
 $3.535028737 \times 10^{-9}$ ,  $3.463845525 \times 10^{-9}$ ,  $3.394095696 \times 10^{-9}$ ,  $3.325750387 \times 10^{-9}$ ,  
 $3.258781315 \times 10^{-9}$ ,  $3.193160768 \times 10^{-9}$ ,  $3.128861591 \times 10^{-9}$ ,  $3.065857176 \times 10^{-9}$ ,  
 $3.004121451 \times 10^{-9}$ ,  $2.943628869 \times 10^{-9}$ ,  $2.884354399 \times 10^{-9}$ ,  $2.826273510 \times 10^{-9}$ ,  
 $2.769362169 \times 10^{-9}$ ,  $2.713596825 \times 10^{-9}$ ,  $2.658954401 \times 10^{-9}$ ,  $2.605412286 \times 10^{-9}$ ,  
 $2.552948324 \times 10^{-9}$ ,  $2.501540804 \times 10^{-9}$ ,  $2.451168452 \times 10^{-9}$ ,  $2.401810426 \times 10^{-9}$ ,  
 $2.353446298 \times 10^{-9}$ ,  $2.306056056 \times 10^{-9}$ ,  $2.259620090 \times 10^{-9}$ ,  $2.214119182 \times 10^{-9}$ ,  
 $2.169534505 \times 10^{-9}$ ,  $2.125847609 \times 10^{-9}$ ,  $2.083040415 \times 10^{-9}$ ,  $2.041095209 \times 10^{-9}$ ,  
 $1.999994635 \times 10^{-9}$ ,  $1.959721683 \times 10^{-9}$ ,  $1.920259689 \times 10^{-9}$ ,  $1.881592322 \times 10^{-9}$ ,  
 $1.843703582 \times 10^{-9}$ ,  $1.806577790 \times 10^{-9}$ ,  $1.770199582 \times 10^{-9}$ ,  $1.734553905 \times 10^{-9}$ ,  
 $1.699626009 \times 10^{-9}$ ,  $1.665401439 \times 10^{-9}$ ,  $1.631866032 \times 10^{-9}$ ,  $1.599005913 \times 10^{-9}$ ,  
 $1.566807483 \times 10^{-9}$ ,  $1.535257417 \times 10^{-9}$ ,  $1.504342660 \times 10^{-9}$

> #3iii. *Population Explosion*

$seq(R3(i, 1, 1, 1, .5, .5, .5), i = 1..1000)$

1, 1, 1.5, 1.75, 2.125, 2.6875, 3.28125, 4.046875, 5.0078125, 6.16796875, 7.611328125,  
 9.393554687, 11.58642578, 14.29565430, 17.63781738, 21.75994873, 26.84671020,  
 33.12223815, 40.86444854, 50.41669845, 62.20169257, 76.74141977, 94.67990538,  
 116.8115088, 144.1164170, 177.8039156, 219.3659207, 270.6431267, 333.9064816,  
 411.9577646, 508.2536865, 627.0589663, 773.6352087, 954.4739308, 1177.584053,  
 1452.846596, 1792.452290, 2211.441469, 2728.370177, 3366.131967, 4152.971806,  
 5123.736975, 6321.420375, 7799.064579, 9622.110966, 11871.29796, 14646.23675,  
 18069.82284, 22293.67878, 27504.86919, 33934.18541, 41866.36669, 51652.71064,  
 63726.63136, 78622.85434, 97001.09817, 119675.2919, 147649.6222, 182163.0061,  
 224743.9600, 277278.2942, 342092.6301, 422057.4421, 520714.1831, 642432.1276,  
 792601.8764, 977874.0936,  $1.206454049 \times 10^6$ ,  $1.488465010 \times 10^6$ ,  $1.836396576 \times 10^6$ ,  
 $2.265657818 \times 10^6$ ,  $2.795259702 \times 10^6$ ,  $3.448657048 \times 10^6$ ,  $4.254787284 \times 10^6$ ,  $5.249352017$   
 $\times 10^6$ ,  $6.476398174 \times 10^6$ ,  $7.990268737 \times 10^6$ ,  $9.858009463 \times 10^6$ ,  $1.216233819 \times 10^7$ ,  
 $1.500530820 \times 10^7$ ,  $1.851282793 \times 10^7$ ,  $2.284023716 \times 10^7$ ,  $2.817918664 \times 10^7$ ,  $3.476612586$   
 $\times 10^7$ ,  $4.289277483 \times 10^7$ ,  $5.291904367 \times 10^7$ ,  $6.528897219 \times 10^7$ ,  $8.055039536 \times 10^7$ ,  
 $9.937920562 \times 10^7$ ,  $1.226092866 \times 10^8$ ,  $1.512694438 \times 10^8$ ,  $1.866289680 \times 10^8$ ,  $2.302538492$   
 $\times 10^8$ ,  $2.840761305 \times 10^8$ ,  $3.504794738 \times 10^8$ ,  $4.324047267 \times 10^8$ ,  $5.334801655 \times 10^8$ ,

(6)

6.581821831 × 10<sup>8</sup>, 8.120335378 × 10<sup>8</sup>, 1.001847943 × 10<sup>9</sup>, 1.236031832 × 10<sup>9</sup>, 1.524956656 × 10<sup>9</sup>, 1.881418216 × 10<sup>9</sup>, 2.321203352 × 10<sup>9</sup>, 2.863789112 × 10<sup>9</sup>, 3.533205340 × 10<sup>9</sup>, 4.359098902 × 10<sup>9</sup>, 5.378046677 × 10<sup>9</sup>, 6.635175459 × 10<sup>9</sup>, 8.186160519 × 10<sup>9</sup>, 1.009969133 × 10<sup>10</sup>, 1.246051366 × 10<sup>10</sup>, 1.537318276 × 10<sup>10</sup>, 1.896669388 × 10<sup>10</sup>, 2.340019515 × 10<sup>10</sup>, 2.887003590 × 10<sup>10</sup>, 3.561846247 × 10<sup>10</sup>, 4.394434677 × 10<sup>10</sup>, 5.421642257 × 10<sup>10</sup>, 6.688961590 × 10<sup>10</sup>, 8.252519261 × 10<sup>10</sup>, 1.018156155 × 10<sup>11</sup>, 1.256152120 × 10<sup>11</sup>, 1.549780100 × 10<sup>11</sup>, 1.912044188 × 10<sup>11</sup>, 2.358988204 × 10<sup>11</sup>, 2.910406246 × 10<sup>11</sup>, 3.590719319 × 10<sup>11</sup>, 4.430056885 × 10<sup>11</sup>, 5.465591225 × 10<sup>11</sup>, 6.743183714 × 10<sup>11</sup>, 8.319415911 × 10<sup>11</sup>, 1.026409542 × 10<sup>12</sup>, 1.266334752 × 10<sup>12</sup>, 1.562342943 × 10<sup>12</sup>, 1.927543618 × 10<sup>12</sup>, 2.378110657 × 10<sup>12</sup>, 2.933998608 × 10<sup>12</sup>, 3.619826441 × 10<sup>12</sup>, 4.465967852 × 10<sup>12</sup>, 5.509896450 × 10<sup>12</sup>, 6.797845371 × 10<sup>12</sup>, 8.386854837 × 10<sup>12</sup>, 1.034729833 × 10<sup>13</sup>, 1.276599927 × 10<sup>13</sup>, 1.575007622 × 10<sup>13</sup>, 1.943168691 × 10<sup>13</sup>, 2.397388120 × 10<sup>13</sup>, 2.957782216 × 10<sup>13</sup>, 3.649169514 × 10<sup>13</sup>, 4.502169925 × 10<sup>13</sup>, 5.554560827 × 10<sup>13</sup>, 6.852950133 × 10<sup>13</sup>, 8.454840442 × 10<sup>13</sup>, 1.043117570 × 10<sup>14</sup>, 1.286948314 × 10<sup>14</sup>, 1.587774964 × 10<sup>14</sup>, 1.958920424 × 10<sup>14</sup>, 2.416821851 × 10<sup>14</sup>, 2.981758620 × 10<sup>14</sup>, 3.678750448 × 10<sup>14</sup>, 4.538665460 × 10<sup>14</sup>, 5.599587264 × 10<sup>14</sup>, 6.908501586 × 10<sup>14</sup>, 8.523377155 × 10<sup>14</sup>, 1.051573300 × 10<sup>15</sup>, 1.297380587 × 10<sup>15</sup>, 1.600645801 × 10<sup>15</sup>, 1.974799844 × 10<sup>15</sup>, 2.436413116 × 10<sup>15</sup>, 3.005929380 × 10<sup>15</sup>, 3.708571170 × 10<sup>15</sup>, 4.575456833 × 10<sup>15</sup>, 5.644978691 × 10<sup>15</sup>, 6.964503347 × 10<sup>15</sup>, 8.592469436 × 10<sup>15</sup>, 1.060097574 × 10<sup>16</sup>, 1.307897426 × 10<sup>16</sup>, 1.613620972 × 10<sup>16</sup>, 1.990807986 × 10<sup>16</sup>, 2.456163192 × 10<sup>16</sup>, 3.030296075 × 10<sup>16</sup>, 3.738633627 × 10<sup>16</sup>, 4.612546448 × 10<sup>16</sup>, 5.690738076 × 10<sup>16</sup>, 7.020959076 × 10<sup>16</sup>, 8.662121800 × 10<sup>16</sup>, 1.068690948 × 10<sup>17</sup>, 1.318499518 × 10<sup>17</sup>, 1.626701323 × 10<sup>17</sup>, 2.006945894 × 10<sup>17</sup>, 2.476073367 × 10<sup>17</sup>, 3.054860292 × 10<sup>17</sup>, 3.768939777 × 10<sup>17</sup>, 4.649936718 × 10<sup>17</sup>, 5.736868393 × 10<sup>17</sup>, 7.077872443 × 10<sup>17</sup>, 8.732338777 × 10<sup>17</sup>, 1.077353981 × 10<sup>18</sup>, 1.329187552 × 10<sup>18</sup>, 1.639887705 × 10<sup>18</sup>, 2.023214618 × 10<sup>18</sup>, 2.496144937 × 10<sup>18</sup>, 3.079623630 × 10<sup>18</sup>, 3.799491592 × 10<sup>18</sup>, 4.687630079 × 10<sup>18</sup>, 5.783372651 × 10<sup>18</sup>, 7.135247162 × 10<sup>18</sup>, 8.803124947 × 10<sup>18</sup>, 1.086087238 × 10<sup>19</sup>, 1.339962224 × 10<sup>19</sup>, 1.653180978 × 10<sup>19</sup>, 2.039615220 × 10<sup>19</sup>, 2.516379211 × 10<sup>19</sup>, 3.104587705 × 10<sup>19</sup>, 3.830291068 × 10<sup>19</sup>, 4.725628992 × 10<sup>19</sup>, 5.830253882 × 10<sup>19</sup>, 7.193086971 × 10<sup>19</sup>, 8.874484923 × 10<sup>19</sup>, 1.094891289 × 10<sup>20</sup>, 1.350824239 × 10<sup>20</sup>, 1.666582010 × 10<sup>20</sup>, 2.056148769 × 10<sup>20</sup>, 2.536777508 × 10<sup>20</sup>, 3.129754143 × 10<sup>20</sup>, 3.861340210 × 10<sup>20</sup>,



4.763935931  $\times 10^{20}$ , 5.877515143  $\times 10^{20}$ , 7.251395643  $\times 10^{20}$ , 8.946423360  $\times 10^{20}$ ,  
1.103766707  $\times 10^{21}$ , 1.361774304  $\times 10^{21}$ , 1.680091674  $\times 10^{21}$ , 2.072816343  $\times 10^{21}$ ,  
2.557341161  $\times 10^{21}$ , 3.155124589  $\times 10^{21}$ , 3.892641046  $\times 10^{21}$ , 4.802553397  $\times 10^{21}$ ,  
5.925159515  $\times 10^{21}$ , 7.310176979  $\times 10^{21}$ , 9.018944946  $\times 10^{21}$ , 1.112714072  $\times 10^{22}$ ,  
1.372813132  $\times 10^{22}$ , 1.693710849  $\times 10^{22}$ , 2.089619026  $\times 10^{22}$ , 2.578071503  $\times 10^{22}$ ,  
3.180700690  $\times 10^{22}$ , 3.924195610  $\times 10^{22}$ , 4.841483902  $\times 10^{22}$ , 5.973190101  $\times 10^{22}$ ,  
7.369434806  $\times 10^{22}$ , 9.092054404  $\times 10^{22}$ , 1.121733966  $\times 10^{23}$ , 1.383941444  $\times 10^{23}$ ,  
1.707440425  $\times 10^{23}$ , 2.106557918  $\times 10^{23}$ , 2.598969893  $\times 10^{23}$ , 3.206484118  $\times 10^{23}$ ,  
3.956005964  $\times 10^{23}$ , 4.880729987  $\times 10^{23}$ , 6.021610035  $\times 10^{23}$ , 7.429172994  $\times 10^{23}$ ,  
9.165756509  $\times 10^{23}$ , 1.130826977  $\times 10^{24}$ , 1.395159964  $\times 10^{24}$ , 1.721281296  $\times 10^{24}$ ,  
2.123634118  $\times 10^{24}$ , 2.620037689  $\times 10^{24}$ , 3.232476551  $\times 10^{24}$ , 3.988074179  $\times 10^{24}$ ,  
4.920294210  $\times 10^{24}$ , 6.070422471  $\times 10^{24}$ , 7.489395431  $\times 10^{24}$ , 9.240056057  $\times 10^{24}$ ,  
1.139993698  $\times 10^{25}$ , 1.406469423  $\times 10^{25}$ , 1.735234364  $\times 10^{25}$ , 2.140848742  $\times 10^{25}$ ,  
2.641276265  $\times 10^{25}$ , 3.258679685  $\times 10^{25}$ , 4.020402345  $\times 10^{25}$ , 4.960179146  $\times 10^{25}$ ,  
6.119630587  $\times 10^{25}$ , 7.550106039  $\times 10^{25}$ , 9.314957887  $\times 10^{25}$ , 1.149234726  $\times 10^{26}$ ,  
1.417870559  $\times 10^{26}$ , 1.749300536  $\times 10^{26}$ , 2.158202910  $\times 10^{26}$ , 2.662687003  $\times 10^{26}$ ,  
3.285095225  $\times 10^{26}$ , 4.052992569  $\times 10^{26}$ , 5.000387398  $\times 10^{26}$ , 6.169237595  $\times 10^{26}$ ,  
7.611308781  $\times 10^{26}$ , 9.390466887  $\times 10^{26}$ , 1.158550663  $\times 10^{27}$ , 1.429364115  $\times 10^{27}$ ,  
1.763480734  $\times 10^{27}$ , 2.175697756  $\times 10^{27}$ , 2.684271302  $\times 10^{27}$ , 3.311724896  $\times 10^{27}$ ,  
4.085846977  $\times 10^{27}$ , 5.040921587  $\times 10^{27}$ , 6.219246730  $\times 10^{27}$ , 7.673007647  $\times 10^{27}$ ,  
9.466587983  $\times 10^{27}$ , 1.167942118  $\times 10^{28}$ , 1.440950841  $\times 10^{28}$ , 1.777775878  $\times 10^{28}$ ,  
2.193334419  $\times 10^{28}$ , 2.706030570  $\times 10^{28}$ , 3.338570434  $\times 10^{28}$ , 4.118967712  $\times 10^{28}$ ,  
5.081784358  $\times 10^{28}$ , 6.269661252  $\times 10^{28}$ , 7.735206661  $\times 10^{28}$ , 9.543326135  $\times 10^{28}$ ,  
1.177409702  $\times 10^{29}$ , 1.452631491  $\times 10^{29}$ , 1.792186904  $\times 10^{29}$ , 2.211114048  $\times 10^{29}$ ,  
2.727966222  $\times 10^{29}$ , 3.365633587  $\times 10^{29}$ , 4.152356929  $\times 10^{29}$ , 5.122978369  $\times 10^{29}$ ,  
6.320484442  $\times 10^{29}$ , 7.797909869  $\times 10^{29}$ , 9.620686339  $\times 10^{29}$ , 1.186954032  $\times 10^{30}$ ,  
1.464406826  $\times 10^{30}$ , 1.806714746  $\times 10^{30}$ , 2.229037802  $\times 10^{30}$ , 2.750079687  $\times 10^{30}$ ,  
3.392916118  $\times 10^{30}$ , 4.186016804  $\times 10^{30}$ , 5.164506305  $\times 10^{30}$ , 6.371719613  $\times 10^{30}$ ,  
7.861121360  $\times 10^{30}$ , 9.698673638  $\times 10^{30}$ , 1.196575730  $\times 10^{31}$ , 1.476277615  $\times 10^{31}$ ,  
1.821360354  $\times 10^{31}$ , 2.247106849  $\times 10^{31}$ , 2.772372408  $\times 10^{31}$ , 3.420419805  $\times 10^{31}$ ,  
4.219949530  $\times 10^{31}$ , 5.206370871  $\times 10^{31}$ , 6.423370103  $\times 10^{31}$ , 7.924845253  $\times 10^{31}$ ,  
9.777293114  $\times 10^{31}$ , 1.206275424  $\times 10^{32}$ , 1.488244630  $\times 10^{32}$ , 1.836124683  $\times 10^{32}$ ,

2.265322368 × 10<sup>32</sup>, 2.794845840 × 10<sup>32</sup>, 3.448146446 × 10<sup>32</sup>, 4.254157327 × 10<sup>32</sup>,  
5.248574807 × 10<sup>32</sup>, 6.475439291 × 10<sup>32</sup>, 7.989085714 × 10<sup>32</sup>, 9.856549907 × 10<sup>32</sup>,  
1.216053746 × 10<sup>33</sup>, 1.500308654 × 10<sup>33</sup>, 1.851008695 × 10<sup>33</sup>, 2.283685548 × 10<sup>33</sup>,  
2.817501448 × 10<sup>33</sup>, 3.476097846 × 10<sup>33</sup>, 4.288642421 × 10<sup>33</sup>, 5.291120857 × 10<sup>33</sup>,  
6.527930561 × 10<sup>33</sup>, 8.053846918 × 10<sup>33</sup>, 9.936449167 × 10<sup>33</sup>, 1.225911332 × 10<sup>34</sup>,  
1.512470470 × 10<sup>34</sup>, 1.866013359 × 10<sup>34</sup>, 2.302197580 × 10<sup>34</sup>, 2.840340704 × 10<sup>34</sup>,  
3.504275822 × 10<sup>34</sup>, 4.323407053 × 10<sup>34</sup>, 5.334011789 × 10<sup>34</sup>, 6.580847331 × 10<sup>34</sup>,  
8.119133086 × 10<sup>34</sup>, 1.001699610 × 10<sup>35</sup>, 1.235848826 × 10<sup>35</sup>, 1.524730872 × 10<sup>35</sup>,  
1.881139654 × 10<sup>35</sup>, 2.320859676 × 10<sup>35</sup>, 2.863365101 × 10<sup>35</sup>, 3.532682215 × 10<sup>35</sup>,  
4.358453496 × 10<sup>35</sup>, 5.377250406 × 10<sup>35</sup>, 6.634193059 × 10<sup>35</sup>, 8.184948481 × 10<sup>35</sup>,  
1.009819597 × 10<sup>36</sup>, 1.245866876 × 10<sup>36</sup>, 1.537090660 × 10<sup>36</sup>, 1.896388566 × 10<sup>36</sup>,  
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5.420839528 × 10<sup>36</sup>, 6.687971222 × 10<sup>36</sup>, 8.251297393 × 10<sup>36</sup>, 1.018005407 × 10<sup>37</sup>,  
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2.909975331 × 10<sup>37</sup>, 3.590187677 × 10<sup>37</sup>, 4.429400970 × 10<sup>37</sup>, 5.464781989 × 10<sup>37</sup>,  
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1.562111622 × 10<sup>38</sup>, 1.927258227 × 10<sup>38</sup>, 2.377758554 × 10<sup>38</sup>, 2.933564201 × 10<sup>38</sup>,  
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2.416464016 × 10<sup>40</sup>, 2.981317140 × 10<sup>40</sup>, 3.678205771 × 10<sup>40</sup>, 4.537993464 × 10<sup>40</sup>,  
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6.963472185 × 10<sup>41</sup>, 8.591197237 × 10<sup>41</sup>, 1.059940616 × 10<sup>42</sup>, 1.307703779 × 10<sup>42</sup>,  
1.613382059 × 10<sup>42</sup>, 1.990513228 × 10<sup>42</sup>, 2.455799533 × 10<sup>42</sup>, 3.029847410 × 10<sup>42</sup>,  
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4.998906796 × 10<sup>78</sup>, 6.167410900 × 10<sup>78</sup>, 7.609055092 × 10<sup>78</sup>, 9.387686394 × 10<sup>78</sup>,

1.158207619  $\times 10^{79}$ , 1.428940884  $\times 10^{79}$ , 1.762958571  $\times 10^{79}$ , 2.175053538  $\times 10^{79}$ ,  
2.683476497  $\times 10^{79}$ , 3.310744302  $\times 10^{79}$ , 4.084637168  $\times 10^{79}$ , 5.039428983  $\times 10^{79}$ ,  
6.217405227  $\times 10^{79}$ , 7.670735690  $\times 10^{79}$ , 9.463784951  $\times 10^{79}$ , 1.167596294  $\times 10^{80}$ ,  
1.440524179  $\times 10^{80}$ , 1.777249484  $\times 10^{80}$ , 2.192684978  $\times 10^{80}$ , 2.705229321  $\times 10^{80}$ ,  
3.337581891  $\times 10^{80}$ , 4.117748095  $\times 10^{80}$ , 5.080279654  $\times 10^{80}$ , 6.267804821  $\times 10^{80}$ ,  
7.732916285  $\times 10^{80}$ , 9.540500379  $\times 10^{80}$ , 1.177061074  $\times 10^{81}$ , 1.452201370  $\times 10^{81}$ ,  
1.791656241  $\times 10^{81}$ , 2.210459342  $\times 10^{81}$ , 2.727158477  $\times 10^{81}$ , 3.364637030  $\times 10^{81}$ ,  
4.151127424  $\times 10^{81}$ , 5.121461465  $\times 10^{81}$ , 6.318612959  $\times 10^{81}$ , 7.795600924  $\times 10^{81}$ ,  
9.617837674  $\times 10^{81}$ , 1.186602578  $\times 10^{82}$ , 1.463973219  $\times 10^{82}$ , 1.806179782  $\times 10^{82}$ ,  
2.228377789  $\times 10^{82}$ , 2.749265394  $\times 10^{82}$ , 3.391911482  $\times 10^{82}$ , 4.184777332  $\times 10^{82}$ ,  
5.162977104  $\times 10^{82}$ , 6.369832959  $\times 10^{82}$ , 7.858793698  $\times 10^{82}$ , 9.695801881  $\times 10^{82}$ ,  
1.196221427  $\times 10^{83}$ , 1.475840492  $\times 10^{83}$ , 1.820821054  $\times 10^{83}$ , 2.246441487  $\times 10^{83}$ ,  
2.771551517  $\times 10^{83}$ , 3.419407029  $\times 10^{83}$ , 4.218700016  $\times 10^{83}$ , 5.204829280  $\times 10^{83}$ ,  
6.421468162  $\times 10^{83}$ , 7.922498729  $\times 10^{83}$ , 9.774398085  $\times 10^{83}$ , 1.205918249  $\times 10^{84}$ ,  
1.487803965  $\times 10^{84}$ , 1.835581012  $\times 10^{84}$ , 2.264651613  $\times 10^{84}$ , 2.794018294  $\times 10^{84}$ ,  
3.447125459  $\times 10^{84}$ , 4.252897683  $\times 10^{84}$ , 5.247020719  $\times 10^{84}$ , 6.473521932  $\times 10^{84}$ ,  
7.986720168  $\times 10^{84}$ , 9.853631410  $\times 10^{84}$ , 1.215693676  $\times 10^{85}$ , 1.499864417  $\times 10^{85}$ ,  
1.850460616  $\times 10^{85}$ , 2.283009354  $\times 10^{85}$ , 2.816667193  $\times 10^{85}$ , 3.475068581  $\times 10^{85}$ ,  
4.287372563  $\times 10^{85}$ , 5.289554168  $\times 10^{85}$ , 6.525997656  $\times 10^{85}$ , 8.051462194  $\times 10^{85}$ ,  
9.933507009  $\times 10^{85}$ , 1.225548343  $\times 10^{86}$ , 1.512022632  $\times 10^{86}$ , 1.865460838  $\times 10^{86}$ ,  
2.301515907  $\times 10^{86}$ , 2.839499689  $\times 10^{86}$ , 3.503238217  $\times 10^{86}$ , 4.322126906  $\times 10^{86}$ ,  
5.332432405  $\times 10^{86}$ , 6.578898763  $\times 10^{86}$ , 8.116729037  $\times 10^{86}$ , 1.001403010  $\times 10^{87}$ ,  
1.235482895  $\times 10^{87}$ , 1.524279404  $\times 10^{87}$ , 1.880582654  $\times 10^{87}$ , 2.320172477  $\times 10^{87}$ ,  
2.862517267  $\times 10^{87}$ , 3.531636199  $\times 10^{87}$ , 4.357162972  $\times 10^{87}$ , 5.375658220  $\times 10^{87}$ ,  
6.632228696  $\times 10^{87}$ , 8.182524944  $\times 10^{87}$ , 1.009520593  $\times 10^{88}$ , 1.245497978  $\times 10^{88}$ ,  
1.536635533  $\times 10^{88}$ , 1.895827052  $\times 10^{88}$ , 2.338980282  $\times 10^{88}$ , 2.885721433  $\times 10^{88}$ ,  
3.560264383  $\times 10^{88}$ , 4.392483049  $\times 10^{88}$ , 5.419234432  $\times 10^{88}$ , 6.685990932  $\times 10^{88}$ ,  
8.248854206  $\times 10^{88}$ , 1.017703978  $\times 10^{89}$ , 1.255594246  $\times 10^{89}$ , 1.549091822  $\times 10^{89}$ ,  
1.911195023  $\times 10^{89}$ , 2.357940546  $\times 10^{89}$ , 2.909113695  $\times 10^{89}$ , 3.589124632  $\times 10^{89}$ ,  
4.428089437  $\times 10^{89}$ , 5.463163882  $\times 10^{89}$ , 6.740188975  $\times 10^{89}$ , 8.315721147  $\times 10^{89}$ ,  
1.025953700  $\times 10^{90}$ , 1.265772356  $\times 10^{90}$ , 1.561649085  $\times 10^{90}$ , 1.926687570  $\times 10^{90}$ ,  
2.377054505  $\times 10^{90}$ , 2.932695580  $\times 10^{90}$ , 3.618218827  $\times 10^{90}$ , 4.463984456  $\times 10^{90}$ ,

$5.507449432 \times 10^{90}$ ,  $6.794826358 \times 10^{90}$ ,  $8.383130123 \times 10^{90}$ ,  $1.034270296 \times 10^{91}$ ,  
 $1.276032972 \times 10^{91}$

