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446.8606226964295`, 447.4417041944933`, 449.1485456850233`, 450.1269457803135`,
451.4033084453888`, 453.9867378066779`, 454.9746837686168`, 456.32842668924604`,
457.903893064103`, 459.513415281106`, 460.08794442217584`, 462.06536727488253`,
464.05728691054827`, 465.6715392113711`, 466.5702869308262`, 467.43904621026167`,
469.53600455911203`, 470.77365547810166`, 472.7991746619088`, 473.8352323451397`,
475.6003393693758`, 476.7690152374845`, 478.07526376667096`, 478.9421815346348`,
481.8303393762866`, 482.8347827909824`, 483.8514272124825`, 485.539148129356`,
486.52871826165125`, 488.38056709001745`, 489.66176157795616`, 491.398821593663`,
493.3144415817853`, 493.9579978053695`, 495.3588288221313`, 496.4296962157591`,
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510.26422794367284`, 511.5622897003746`, 512.6231445314074`, 513.6689855554737`,
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521.525193449492`, 522.4566961777302`, 523.9605308920159`, 525.0773856872796`,
527.9036416012724`, 528.4062138522927`, 529.8062263187069`, 530.866917883961`,
532.6881830282937`, 533.7796307537687`, 535.6643140758732`, 537.0697590831223`,
538.4285261762479`, 540.2131663762282`, 540.6313902472951`, 541.8474371212013`,
544.3238901010053`, 545.6368332489349`, 547.0109120581222`, 547.9316133644893`,
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555.7920205616825`, 556.8994764068553`, 557.5646591720586`, 559.3162370286822`,
560.2408074972957`, 562.5592076160458`, 564.1608791107861`, 564.5060559381499`,
566.698787682808`, 567.7317579011769`, 568.9239551796294`, 570.0511147824636`,
572.4199841324528`, 573.6146105267582`, 575.0938860144948`, 575.8072471409288`,
```

577.0390034720982`, 579.0988346720366`, 580.1369593623846`, 581.9465762659016`,
583.2360882191673`, 584.5617059034655`, 585.9845632049883`, 586.7427718912502`,
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599.5456403643649`, 601.6021367359326`, 602.5791678863874`, 603.6256189035792`,
604.6162184937532`, 606.383460422109`, 608.4132173111873`, 609.3895751547201`,
610.8391629377394`, 611.7742096208872`, 613.5997786756371`, 614.6462378722326`,
615.538563369407`, 618.1128313664424`, 619.1844825979537`, 620.2728936722275`,
621.7092945279486`, 622.375002739779`, 624.2699000181779`, 626.0192834276544`,
627.268396850783`, 628.3258623594604`, 630.4738874382921`, 630.8057809271976`,
632.2251411671159`, 633.5468582522518`, 635.5238003106055`, 637.3971931598373`,
637.9255139808225`, 638.9279382668568`, 640.6947946688257`, 641.9454996657053`,
643.2788837813979`, 644.990578229748`, 646.3481915955016`, 647.7617530042888`,
648.7864008887824`, 650.1975193452564`, 650.668683891396`, 653.6495716053947`,
654.3019205863194`, 655.7094630223556`, 656.9640845994606`, 658.1756144186054`,
659.663845972964`, 660.7167325952793`, 662.2965864311004`, 664.244604652273`,
665.342763095599`, 666.5151477041729`, 667.1484948945555`, 668.9758488202351`,
670.3235852058626`, 672.4581835841698`, 673.0435782861476`, 674.3558978101232`,
676.1396743636268`, 677.230180668764`, 677.8004447462214`, 679.7421978825282`}

Expand[(f1[n] E^t - f2[n] E^(-t)) / E^t]

f1[n] - e^{-2 t} f2[n]

Cosh[0]

1

Sinh[0]

0

r1[s_, t_, j_, n_] := 2 (s + t I) Cos[(s + t I) Log[j / n]] + Sin[(s + t I) Log[j / n]]
r1a[s_, t_, j_, n_] := 2 (s + t I) Cos[(s + t I) Log[j / n]] +
  1 / (2 I) (E^(I ((s + t I) Log[j / n])) - E^(-I ((s + t I) Log[j / n])))
r1b[s_, t_, j_, n_] := 2 (s + t I) (1 / 2)
    (E^(I ((s + t I) Log[j / n])) + E^(-I ((s + t I) Log[j / n]))) +
  1 / (2 I) (E^(I ((s + t I) Log[j / n])) - E^(-I ((s + t I) Log[j / n])))
r1c[s_, t_, j_, n_] := (s + t I) (E^(I ((s) Log[j / n])) E^(I ((t I) Log[j / n])) +
     E^(-I ((s) Log[j / n])) E^(-I ((t I) Log[j / n]))) +
  1 / (2 I) (E^(I ((s) Log[j / n])) E^(I ((t I) Log[j / n])) -
     E^(-I ((s) Log[j / n])) E^(-I ((t I) Log[j / n])))
r1d[s_, t_, j_, n_] := (s + t I) (E^(I s Log[j / n]) E^(-t Log[j / n]) +
     E^(-I s Log[j / n]) E^(t Log[j / n])) +
  1 / (2 I) (E^(I s Log[j / n]) E^(-t Log[j / n]) - E^(-I s Log[j / n]) E^(t Log[j / n]))
r1e[s_, t_, j_, n_] := (s + t I) ((Cos[s Log[j / n]] + I Sin[s Log[j / n]]) E^(-t Log[j / n]) +
     (Cos[s Log[j / n]] - I Sin[s Log[j / n]]) E^(t Log[j / n])) +
  1 / (2 I) ((Cos[s Log[j / n]] + I Sin[s Log[j / n]]) E^(-t Log[j / n]) -
     (Cos[s Log[j / n]] - I Sin[s Log[j / n]]) E^(t Log[j / n]))
r1f[s_, t_, j_, n_] := (s + t I) ((Cos[s Log[j / n]] + I Sin[s Log[j / n]]) E^(-t Log[j / n]) +
     (Cos[s Log[j / n]] - I Sin[s Log[j / n]]) E^(t Log[j / n])) +
  ((Cos[s Log[j / n]] + I Sin[s Log[j / n]]) 1 / (2 I) E^(-t Log[j / n]) -
     (Cos[s Log[j / n]] - I Sin[s Log[j / n]]) 1 / (2 I) E^(t Log[j / n]))
r1g[s_, t_, j_, n_] := (s + t I) ((Cos[s Log[j / n]] + I Sin[s Log[j / n]]) E^(-t Log[j / n]) +
     (Cos[s Log[j / n]] - I Sin[s Log[j / n]]) E^(t Log[j / n])) +
  (Cos[s Log[j / n]]) 1 / (2 I) E^(-t Log[j / n]) +

```
        (I Sin[s Log[j / n]]) 1 / (2 I) E^(-t Log[j / n]) -
        (Cos[ s Log[j / n]]) 1 / (2 I) E^(t Log[j / n]) +
        (I Sin[ s Log[j / n]]) 1 / (2 I) E^(t Log[j / n])
r1h[s_, t_, j_, n_] := (s + t I) ((Cos[s Log[j / n]] + I Sin[s Log[j / n]]) E^(-t Log[j / n]) +
        (Cos[ s Log[j / n]] - I Sin[ s Log[j / n]]) E^(t Log[j / n])) +
        (Cos[s Log[j / n]]) 1 / (2 I) (E^(-t Log[j / n]) - E^(t Log[j / n])) +
        (I Sin[s Log[j / n]]) 1 / (2 I) (E^(-t Log[j / n]) + E^(t Log[j / n]))
r1i[s_, t_, j_, n_] := (s + t I) ((Cos[s Log[j / n]] + I Sin[s Log[j / n]]) E^(-t Log[j / n]) +
        (Cos[ s Log[j / n]] - I Sin[ s Log[j / n]]) E^(t Log[j / n])) +
      - I Cos[s Log[j / n]] Sinh[-t Log[j / n]] + Sin[s Log[j / n]] Cosh[t Log[j / n]]
r1j[s_, t_, j_, n_] := (s + t I) (
        Cos[s Log[j / n]] E^(-t Log[j / n]) +
         I Sin[s Log[j / n]] E^(-t Log[j / n]) +
         Cos[ s Log[j / n]] E^(t Log[j / n]) -
          I Sin[ s Log[j / n]] E^(t Log[j / n])
       ) +
       - I Cos[s Log[j / n]] Sinh[-t Log[j / n]] + Sin[s Log[j / n]] Cosh[t Log[j / n]]
r1k[s_, t_, j_, n_] := (s + t I) (
        Cos[s Log[j / n]] ( E^(-t Log[j / n]) + E^(t Log[j / n])) +
         I Sin[s Log[j / n]] (E^(-t Log[j / n]) - E^(t Log[j / n]))
        ) +
       - I Cos[s Log[j / n]] Sinh[-t Log[j / n]] + Sin[s Log[j / n]] Cosh[t Log[j / n]]
r1l[s_, t_, j_, n_] :=
   2 (s + t I) (Cos[s Log[j / n]] Cosh[t Log[j / n]] - I Sin[s Log[j / n]] Sinh[t Log[j / n]]) +
       + I Cos[s Log[j / n]] Sinh[t Log[j / n]] + Sin[s Log[j / n]] Cosh[t Log[j / n]]
r1m[s_, t_, j_, n_] :=
   2 s Cos[s Log[j / n]] Cosh[t Log[j / n]] + 2 t I Cos[s Log[j / n]] Cosh[t Log[j / n]] +
     2 t Sin[s Log[j / n]] Sinh[t Log[j / n]] - 2 s I Sin[s Log[j / n]] Sinh[t Log[j / n]] +
     I Cos[s Log[j / n]] Sinh[t Log[j / n]] + Sin[s Log[j / n]] Cosh[t Log[j / n]]
r1n[s_, t_, j_, n_] := 2 s Cos[s Log[j / n]] Cosh[t Log[j / n]] +
     2 t Sin[s Log[j / n]] Sinh[t Log[j / n]] + Sin[s Log[j / n]] Cosh[t Log[j / n]] +
     I (2 t Cos[s Log[j / n]] Cosh[t Log[j / n]] -
        2 s Sin[s Log[j / n]] Sinh[t Log[j / n]] + Cos[s Log[j / n]] Sinh[t Log[j / n]])

N@r1n[2, 3, 6, 11]
```

18.332 - 5.63168 𝕚

```
N@r1[2, 3, 6, 11]
```

18.332 - 5.63168 𝕚

```
FullSimplify[2 s Cos[s Log[j / n]] Cosh[t Log[j / n]] +
   2 t Sin[s Log[j / n]] Sinh[t Log[j / n]] + Sin[s Log[j / n]] Cosh[t Log[j / n]]]
```

$\mathrm{Cosh}\!\left[t\,\mathrm{Log}\!\left[\frac{j}{n}\right]\right]\left(2\,s\,\mathrm{Cos}\!\left[s\,\mathrm{Log}\!\left[\frac{j}{n}\right]\right]+\mathrm{Sin}\!\left[s\,\mathrm{Log}\!\left[\frac{j}{n}\right]\right]\right)+2\,t\,\mathrm{Sin}\!\left[s\,\mathrm{Log}\!\left[\frac{j}{n}\right]\right]\mathrm{Sinh}\!\left[t\,\mathrm{Log}\!\left[\frac{j}{n}\right]\right]$

```
FullSimplify[I (2 t Cos[s Log[j / n]] Cosh[t Log[j / n]] -
   2 s Sin[s Log[j / n]] Sinh[t Log[j / n]] + Cos[s Log[j / n]] Sinh[t Log[j / n]])]
```

$\mathbb{i}\left(2\,t\,\mathrm{Cos}\!\left[s\,\mathrm{Log}\!\left[\frac{j}{n}\right]\right]\mathrm{Cosh}\!\left[t\,\mathrm{Log}\!\left[\frac{j}{n}\right]\right]+\left(\mathrm{Cos}\!\left[s\,\mathrm{Log}\!\left[\frac{j}{n}\right]\right]-2\,s\,\mathrm{Sin}\!\left[s\,\mathrm{Log}\!\left[\frac{j}{n}\right]\right]\right)\mathrm{Sinh}\!\left[t\,\mathrm{Log}\!\left[\frac{j}{n}\right]\right]\right)$

```
Sum[ 1 / j ^ (1 / 2) N@r1n[N@Im@ZetaZero@1, 0, j, 10 000], {j, 1, 10 000}]
```

0.141347 + 0. i

```
N@Sinh[-10]
```

-11 013.2


```
N@Cos[3 + 4 I]
```

-27.0349 - 3.85115 i

```
N[Cos[3] Cos[4 I] - Sin[3] Sin[4 I]]
```

-27.0349 - 3.85115 i

```
N[Cos[3] Cosh[4] - I Sin[3] Sinh[4]]
```

-27.0349 - 3.85115 i

```
ra1[n_, s_, t_] := (2 (s + t I) Sin[ (s + t I) Log[n]] + Cos[ (s + t I) Log[n]])
    Sum[ j ^ (-1 / 2) Sin[ (s + t I) Log[j]], {j, 1, n}] +
   (2 (s + t I) Cos[ (s + t I) Log[n]] - Sin[ (s + t I) Log[n]])
    Sum[ j ^ (-1 / 2) Cos[ (s + t I) Log[j]], {j, 1, n}]
s1o[n_, s_, t_] := Sin[ (s + t I) Log[n]]
s2o[n_, s_, t_] := Cos[ (s + t I) Log[n]]
s1[n_, s_, t_] := Sin[ s Log[n]] Cosh[t Log[n]] + I Cos[s Log[n]] Sinh[t Log[n]]
s2[n_, s_, t_] := Cos[ s Log[n]] Cosh[t Log[n]] - I Sin[s Log[n]] Sinh[t Log[n]]
ra2[n_, s_, t_] :=
 (2 s s1[n, s, t] + 2 t I s1[n, s, t] + s2[n, s, t]) Sum[ j ^ (-1 / 2) s1[j, s, t], {j, 1, n}] +
  (2 s s2[n, s, t] + 2 t I s2[n, s, t] - s1[n, s, t]) Sum[ j ^ (-1 / 2) s2[j, s, t], {j, 1, n}]
ra3[n_, s_, t_] := (2 s (Sin[ s Log[n]] Cosh[t Log[n]] + I Cos[s Log[n]] Sinh[t Log[n]]) +
     2 t I (Sin[ s Log[n]] Cosh[t Log[n]] + I Cos[s Log[n]] Sinh[t Log[n]]) +
     (Cos[ s Log[n]] Cosh[t Log[n]] - I Sin[s Log[n]] Sinh[t Log[n]]))
    Sum[ j ^ (-1 / 2) (Sin[ s Log[j]] Cosh[t Log[j]] + I Cos[s Log[j]] Sinh[t Log[j]]), {j, 1, n}] +
   (2 s (Cos[ s Log[n]] Cosh[t Log[n]] - I Sin[s Log[n]] Sinh[t Log[n]]) +
     2 t I (Cos[ s Log[n]] Cosh[t Log[n]] - I Sin[s Log[n]] Sinh[t Log[n]]) -
     (Sin[ s Log[n]] Cosh[t Log[n]] + I Cos[s Log[n]] Sinh[t Log[n]]))
    Sum[ j ^ (-1 / 2) (Cos[ s Log[j]] Cosh[t Log[j]] - I Sin[s Log[j]] Sinh[t Log[j]]), {j, 1, n}]
ra4[n_, s_, t_] := (Cos[s Log[n]] Cosh[t Log[n]] +
     2 s Cosh[t Log[n]] Sin[s Log[n]] - 2 t Cos[s Log[n]] Sinh[t Log[n]] +
     2 i t Cosh[t Log[n]] Sin[s Log[n]] + 2 i s Cos[s Log[n]] Sinh[t Log[n]] -
     i Sin[s Log[n]] Sinh[t Log[n]]
    ) Sum[ j ^ (-1 / 2) (Sin[ s Log[j]] Cosh[t Log[j]] + I Cos[s Log[j]] Sinh[t Log[j]]),
     {j, 1, n}] +
   (2 s Cos[s Log[n]] Cosh[t Log[n]] - Cosh[t Log[n]] Sin[s Log[n]] +
     2 t Sin[s Log[n]] Sinh[t Log[n]] +
     2 i t Cos[s Log[n]] Cosh[t Log[n]] - i Cos[s Log[n]] Sinh[t Log[n]] -
     2 i s Sin[s Log[n]] Sinh[t Log[n]])
    Sum[ j ^ (-1 / 2) (Cos[ s Log[j]] Cosh[t Log[j]] - I Sin[s Log[j]] Sinh[t Log[j]]), {j, 1, n}]
ra5[n_, s_, t_] := (Cos[s Log[n]] Cosh[t Log[n]] +
     2 s Cosh[t Log[n]] Sin[s Log[n]] - 2 t Cos[s Log[n]] Sinh[t Log[n]] +
     I (2 t Cosh[t Log[n]] Sin[s Log[n]] + 2 s Cos[s Log[n]] Sinh[t Log[n]] -
        Sin[s Log[n]] Sinh[t Log[n]])
    ) (Sum[ j ^ (-1 / 2) Sin[ s Log[j]] Cosh[t Log[j]], {j, 1, n}] +
     I Sum[ j ^ (-1 / 2) Cos[s Log[j]] Sinh[t Log[j]], {j, 1, n}]) +
```

```
       (2 s Cos[s Log[n]] Cosh[t Log[n]] - Cosh[t Log[n]] Sin[s Log[n]] +
          2 t Sin[s Log[n]] Sinh[t Log[n]] +
          I (2 t Cos[s Log[n]] Cosh[t Log[n]] - Cos[s Log[n]] Sinh[t Log[n]] -
             2 s Sin[s Log[n]] Sinh[t Log[n]])
        ) (Sum[ j ^ (-1 / 2) Cos[ s Log[j]] Cosh[t Log[j]], {j, 1, n}] -
          I Sum[ j ^ (-1 / 2) Sin[s Log[j]] Sinh[t Log[j]], {j, 1, n}])
   ra6[n_, s_, t_] := (Cos[s Log[n]] Cosh[t Log[n]] + 2 s Cosh[t Log[n]] Sin[s Log[n]] -
          2 t Cos[s Log[n]] Sinh[t Log[n]] +
          I (2 t Cosh[t Log[n]] Sin[s Log[n]] + 2 s Cos[s Log[n]] Sinh[t Log[n]] -
             Sin[s Log[n]] Sinh[t Log[n]])
        ) (Sum[ j ^ (-1 / 2) Sin[ s Log[j]] Cosh[t Log[j]], {j, 1, n}]) +
      (Cos[s Log[n]] Cosh[t Log[n]] +
          2 s Cosh[t Log[n]] Sin[s Log[n]] - 2 t Cos[s Log[n]] Sinh[t Log[n]] +
          I (2 t Cosh[t Log[n]] Sin[s Log[n]] + 2 s Cos[s Log[n]] Sinh[t Log[n]] -
             Sin[s Log[n]] Sinh[t Log[n]])
        ) I Sum[ j ^ (-1 / 2) Cos[s Log[j]] Sinh[t Log[j]], {j, 1, n}] +
      (2 s Cos[s Log[n]] Cosh[t Log[n]] -
          Cosh[t Log[n]] Sin[s Log[n]] + 2 t Sin[s Log[n]] Sinh[t Log[n]] +
          I (2 t Cos[s Log[n]] Cosh[t Log[n]] - Cos[s Log[n]] Sinh[t Log[n]] -
             2 s Sin[s Log[n]] Sinh[t Log[n]])
        ) (Sum[ j ^ (-1 / 2) Cos[ s Log[j]] Cosh[t Log[j]], {j, 1, n}]) +
      (2 s Cos[s Log[n]] Cosh[t Log[n]] -
          Cosh[t Log[n]] Sin[s Log[n]] + 2 t Sin[s Log[n]] Sinh[t Log[n]] +
          I (2 t Cos[s Log[n]] Cosh[t Log[n]] - Cos[s Log[n]] Sinh[t Log[n]] -
             2 s Sin[s Log[n]] Sinh[t Log[n]])
        ) (-I Sum[ j ^ (-1 / 2) Sin[s Log[j]] Sinh[t Log[j]], {j, 1, n}])
   ra7[n_, s_, t_] :=
     (Cos[s Log[n]] Cosh[t Log[n]] + 2 s Cosh[t Log[n]] Sin[s Log[n]] - 2 t Cos[s Log[n]]
           Sinh[t Log[n]]) Sum[ j ^ (-1 / 2) Sin[ s Log[j]] Cosh[t Log[j]], {j, 1, n}] +
      (I (2 t Cosh[t Log[n]] Sin[s Log[n]] + 2 s Cos[s Log[n]] Sinh[t Log[n]] -
             Sin[s Log[n]] Sinh[t Log[n]])
        ) Sum[ j ^ (-1 / 2) Sin[ s Log[j]] Cosh[t Log[j]], {j, 1, n}] +
      (Cos[s Log[n]] Cosh[t Log[n]] +
          2 s Cosh[t Log[n]] Sin[s Log[n]] - 2 t Cos[s Log[n]] Sinh[t Log[n]])
       I Sum[ j ^ (-1 / 2) Cos[s Log[j]] Sinh[t Log[j]], {j, 1, n}] +
      (I (2 t Cosh[t Log[n]] Sin[s Log[n]] + 2 s Cos[s Log[n]] Sinh[t Log[n]] -
             Sin[s Log[n]] Sinh[t Log[n]])
        ) I Sum[ j ^ (-1 / 2) Cos[s Log[j]] Sinh[t Log[j]], {j, 1, n}] +
      (2 s Cos[s Log[n]] Cosh[t Log[n]] -
          Cosh[t Log[n]] Sin[s Log[n]] + 2 t Sin[s Log[n]] Sinh[t Log[n]])
       Sum[ j ^ (-1 / 2) Cos[ s Log[j]] Cosh[t Log[j]], {j, 1, n}] +
      (I (2 t Cos[s Log[n]] Cosh[t Log[n]] - Cos[s Log[n]] Sinh[t Log[n]] -
             2 s Sin[s Log[n]] Sinh[t Log[n]])
        ) Sum[ j ^ (-1 / 2) Cos[ s Log[j]] Cosh[t Log[j]], {j, 1, n}] +
      (2 s Cos[s Log[n]] Cosh[t Log[n]] -
          Cosh[t Log[n]] Sin[s Log[n]] + 2 t Sin[s Log[n]] Sinh[t Log[n]])
       (-I Sum[ j ^ (-1 / 2) Sin[s Log[j]] Sinh[t Log[j]], {j, 1, n}]) +
      (I (2 t Cos[s Log[n]] Cosh[t Log[n]] - Cos[s Log[n]] Sinh[t Log[n]] -
             2 s Sin[s Log[n]] Sinh[t Log[n]])
        ) (-I Sum[ j ^ (-1 / 2) Sin[s Log[j]] Sinh[t Log[j]], {j, 1, n}])
   ra8[n_, s_, t_] :=
     (Cos[s Log[n]] Cosh[t Log[n]] + 2 s Cosh[t Log[n]] Sin[s Log[n]] - 2 t Cos[s Log[n]]
```

```
        Sinh[t Log[n]]) Sum[ j^ (-1 / 2) Sin[ s Log[j]] Cosh[t Log[j]], {j, 1, n}] +
    (2 s Cos[s Log[n]] Cosh[t Log[n]] - Cosh[t Log[n]] Sin[s Log[n]] + 2 t Sin[s Log[n]]
        Sinh[t Log[n]]) Sum[ j^ (-1 / 2) Cos[ s Log[j]] Cosh[t Log[j]], {j, 1, n}] +
    ((2 t Cos[s Log[n]] Cosh[t Log[n]] - Cos[s Log[n]] Sinh[t Log[n]] -
        2  s Sin[s Log[n]] Sinh[t Log[n]]))
     (Sum[ j^ (-1 / 2) Sin[s Log[j]] Sinh[t Log[j]], {j, 1, n}]) +
    - ((2 t Cosh[t Log[n]] Sin[s Log[n]] + 2 s Cos[s Log[n]] Sinh[t Log[n]] -
         Sin[s Log[n]] Sinh[t Log[n]]))
     Sum[ j^ (-1 / 2) Cos[s Log[j]] Sinh[t Log[j]], {j, 1, n}] +
    I (Cos[s Log[n]] Cosh[t Log[n]] + 2 s Cosh[t Log[n]] Sin[s Log[n]] - 2 t Cos[s Log[n]]
        Sinh[t Log[n]]) Sum[ j^ (-1 / 2)  Cos[s Log[j]] Sinh[t Log[j]], {j, 1, n}] +
    - I (2 s Cos[s Log[n]] Cosh[t Log[n]] - Cosh[t Log[n]] Sin[s Log[n]] +
        2 t Sin[s Log[n]] Sinh[t Log[n]])
     ( Sum[ j^ (-1 / 2) Sin[s Log[j]] Sinh[t Log[j]], {j, 1, n}]) +
    I ((2 t Cosh[t Log[n]] Sin[s Log[n]] + 2 s Cos[s Log[n]] Sinh[t Log[n]] -
        Sin[s Log[n]] Sinh[t Log[n]]))
     Sum[ j^ (-1 / 2) Sin[ s Log[j]] Cosh[t Log[j]], {j, 1, n}] +
    I ((2 t Cos[s Log[n]] Cosh[t Log[n]] - Cos[s Log[n]] Sinh[t Log[n]] -
        2  s Sin[s Log[n]] Sinh[t Log[n]]))
     Sum[ j^ (-1 / 2) Cos[ s Log[j]] Cosh[t Log[j]], {j, 1, n}]
ra9[n_, s_, t_] := (Cos[s Log[n]] Cosh[t Log[n]] +
        2 s Cosh[t Log[n]] Sin[s Log[n]] - 2 t Cos[s Log[n]] Sinh[t Log[n]])
    Sum[ j^ (-1 / 2) Sin[ s Log[j]] Cosh[t Log[j]], {j, 1, n}] +
    (2 s Cos[s Log[n]] Cosh[t Log[n]] - Cosh[t Log[n]] Sin[s Log[n]] + 2 t Sin[s Log[n]]
        Sinh[t Log[n]]) Sum[ j^ (-1 / 2) Cos[ s Log[j]] Cosh[t Log[j]], {j, 1, n}] +
    ((2 t Cos[s Log[n]] Cosh[t Log[n]] - Cos[s Log[n]] Sinh[t Log[n]] -
        2  s Sin[s Log[n]] Sinh[t Log[n]]))
     (Sum[ j^ (-1 / 2) Sin[s Log[j]] Sinh[t Log[j]], {j, 1, n}]) +
    - ((2 t Cosh[t Log[n]] Sin[s Log[n]] + 2  s Cos[s Log[n]] Sinh[t Log[n]] -
         Sin[s Log[n]] Sinh[t Log[n]]))
     Sum[ j^ (-1 / 2)  Cos[s Log[j]] Sinh[t Log[j]], {j, 1, n}] +
    I ((Cos[s Log[n]] Cosh[t Log[n]] + 2 s Cosh[t Log[n]] Sin[s Log[n]] - 2 t Cos[s Log[n]]
            Sinh[t Log[n]]) Sum[ j^ (-1 / 2)  Cos[s Log[j]] Sinh[t Log[j]], {j, 1, n}] +
        - (2 s Cos[s Log[n]] Cosh[t Log[n]] - Cosh[t Log[n]] Sin[s Log[n]] + 2 t Sin[s Log[n]]
            Sinh[t Log[n]]) ( Sum[ j^ (-1 / 2) Sin[s Log[j]] Sinh[t Log[j]], {j, 1, n}]) +
        ((2 t Cosh[t Log[n]] Sin[s Log[n]] + 2  s Cos[s Log[n]] Sinh[t Log[n]] - Sin[s Log[n]]
            Sinh[t Log[n]]]) Sum[ j^ (-1 / 2) Sin[ s Log[j]] Cosh[t Log[j]], {j, 1, n}] +
        ((2 t Cos[s Log[n]] Cosh[t Log[n]] - Cos[s Log[n]] Sinh[t Log[n]] - 2  s Sin[s Log[n]]
            Sinh[t Log[n]]]) Sum[ j^ (-1 / 2) Cos[ s Log[j]] Cosh[t Log[j]], {j, 1, n}])
ra9[1000, .5, .3]
```

-4.22662 - 5.82755 i

```
ra1[1000, .5, .3]
```

-4.226624969204295` - 5.8275475674013535` i

```
Expand[2 s (Cos[ s Log[n]] Cosh[t Log[n]] - I Sin[s Log[n]] Sinh[t Log[n]]) +
  2 t I (Cos[ s Log[n]] Cosh[t Log[n]] - I Sin[s Log[n]] Sinh[t Log[n]]) -
  (Sin[ s Log[n]] Cosh[t Log[n]] + I Cos[s Log[n]] Sinh[t Log[n]])]
```

2 s Cos[s Log[n]] Cosh[t Log[n]] + 2 𝕚 t Cos[s Log[n]] Cosh[t Log[n]] -
 Cosh[t Log[n]] Sin[s Log[n]] - 𝕚 Cos[s Log[n]] Sinh[t Log[n]] -
 2 𝕚 s Sin[s Log[n]] Sinh[t Log[n]] + 2 t Sin[s Log[n]] Sinh[t Log[n]]

-I I

1

Sinh[0]

0

N@E^(3 I)

- 0.989992 + 0.14112 𝕚

N@E^(-3 I)

- 0.989992 - 0.14112 𝕚