```
Exit[]
```

```
$Assumptions = s > 0 && S > 0 && T > t && t > 0
```

$s > 0 \&\& S > 0 \&\& T > t \&\& t > 0$

```
n[x_] := Exp[-x^2/2]/Sqrt[2 π]
```

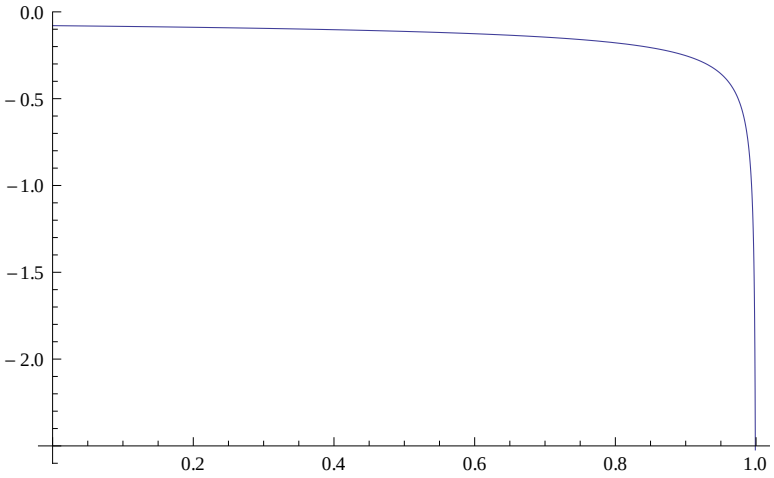
```
d[t_] := (Log[S/K] + s^2/2 (T - t))/s/Sqrt[T - t];
```

```
th[t_] := -s S n[d[t]]/Sqrt[T - t]/2
```

```
Integrate[th[t]/K^2, {K, 0, Infinity}]
```

$$-\frac{s^2}{2}$$

```
T = 1; s = 0.2; K = 1; Plot[th[x], {x, 0, 0.999}, PlotRange → All]
```




```
th[0.99999] // N
```

-3.67331×10^{-53}

```
S = K
```

K

```
th[t]
```

$$-\frac{e^{-\frac{1}{8}s^2(-t+T)}\,K\,s}{\sqrt{2\pi}\,\sqrt{-t+T}}$$

```
dn = D[n[d], t]
```

$$\frac{1}{\sqrt{2\pi}}e^{-\frac{\left(\frac{1}{2}s^2(-t+T)+\text{Log}\left[\frac{S}{K}\right]\right)^2}{2s^2(-t+T)}}\left(\frac{\frac{1}{2}s^2(-t+T)+\text{Log}\left[\frac{S}{K}\right]}{2(-t+T)}-\frac{\left(\frac{1}{2}s^2(-t+T)+\text{Log}\left[\frac{S}{K}\right]\right)^2}{2s^2(-t+T)^2}\right)$$

```
th = Simplify[-s S 2 Sqrt[T - t] dn]
```

$$-\frac{e^{\frac{\left(s^2 (t-T)-2 \text{Log}\left[\frac{S}{K}\right]\right)^2}{8 s^2 (t-T)}} S \left(s^4 (t-T)^2-4 \text{Log}\left[\frac{S}{K}\right]^2\right)}{4 \sqrt{2 \pi}\ s (-t+T)^{3/2}}$$

$$\frac{e^{\frac{\left(s^2 (t-T)-2 \text{Log}\left[\frac{S}{K}\right]\right)^2}{8 s^2 (t-T)}} S\ 4\ \text{Log}\left[\frac{S}{K}\right]^2}{4 \sqrt{2 \pi}\ s (-t+T)^{3/2}}$$

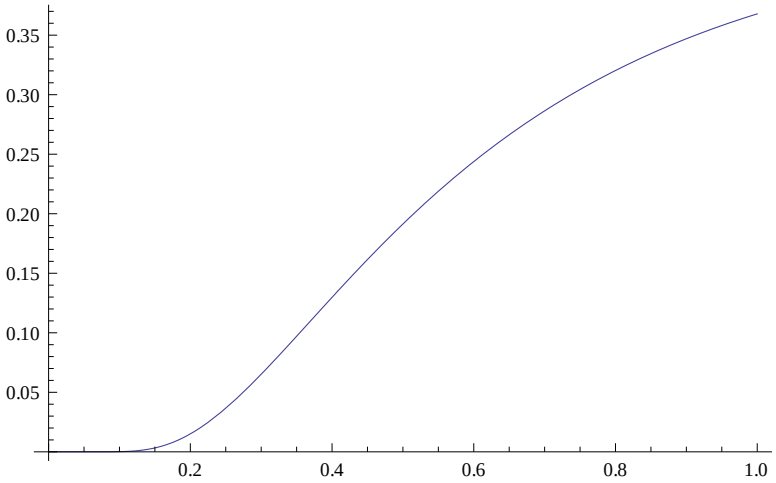
```
Simplify[D[e^((2 Log[S/K])^2/(8 s^2 (t-T))) S 4 Log[S/K]^2, t] / D[4 Sqrt[2 π] s (-t+T)^(3/2)]]
```

$$-\frac{e^{\frac{\text{Log}\left[\frac{S}{K}\right]^2}{2 s^2 (t-T)}} S\ \text{Log}\left[\frac{S}{K}\right]^4}{2 \sqrt{2 \pi}\ s^3 (-t+T)^{7/2}}$$

```
Simplify[D[Exp[-1 / x], x] / D[Sqrt[x], x]]
```

$$\frac{2 e^{-1/x}}{x^{3/2}}$$

```
Plot[Exp[-1 / x] / Sqrt[x], {x, 0, 1}]
```




```
D[Sqrt[y], y]
```

$$\frac{1}{2 \sqrt{y}}$$

Limit[th[t], t → T]

$$\text{Limit}\left[-e^{-\frac{\left(\frac{1}{2}\,s^2\,(-t+T)+\text{Log}\left[\frac{S}{K}\right]\right)^2}{2\,s^2\,(-t+T)}}\sqrt{\frac{2}{\pi}}\;s\,S\,\sqrt{-t+T}\left(\frac{\frac{1}{2}\,s^2\,(-t+T)+\text{Log}\left[\frac{S}{K}\right]}{2\,(-t+T)}-\frac{\left(\frac{1}{2}\,s^2\,(-t+T)+\text{Log}\left[\frac{S}{K}\right]\right)^2}{2\,s^2\,(-t+T)^2}\right),\;t\to T\right]$$

D[Sqrt[t], t]

$$\frac{1}{2\sqrt{t}}$$

D[d, t]

$$-\frac{s}{2\sqrt{-t+T}}+\frac{\frac{1}{2}\,s^2\,(-t+T)+\text{Log}\left[\frac{S}{K}\right]}{2\,s\,(-t+T)^{3/2}}$$