Dirac Integral

This integral is needed for Page 205 # 18.

Maple uses parts in each integral.

```
> int(exp(-s*t)*(t^2-8*t+17),t=4..T);
```

$$-\frac{e^{-sT}T^2s^2-8e^{-sT}Ts^2+2e^{-sT}Ts+17e^{-sT}s^2-e^{-4s}s^2-8e^{-sT}s+2e^{-sT}-2e^{-4s}}{s^3}$$

```
> limit(%,T=infinity);
```

$$\lim_{T\to\infty}\left(-\frac{e^{-sT}T^2s^2-8e^{-sT}Ts^2+2e^{-sT}Ts+17e^{-sT}s^2-e^{-4s}s^2-8e^{-sT}s+2e^{-sT}-2e^{-4s}}{s^3}\right)$$

```
> Int(exp(-s*t)*(t^2-8*t+17),t=4..infinity)=exp(-4*s)/s+2*exp(-4*s)
  /s^3;
```

$$\int_4^\infty e^{-st}\left(t^2-8t+17\right)\,dt=\frac{e^{-4s}}{s}+\frac{2e^{-4s}}{s^3}$$

```
> int(exp(-s*t)*(2*t-8),t=4..T);
```

$$-\frac{2\left(e^{-sT}Ts-4e^{-sT}s+e^{-sT}-e^{-4s}\right)}{s^2}$$

```
> limit(%,T=infinity);
```

$$\lim_{T\to\infty}\left(-\frac{2\left(e^{-sT}Ts-4e^{-sT}s+e^{-sT}-e^{-4s}\right)}{s^2}\right)$$

```
> Int(exp(-s*t)*(2*t-8),t=4..T)=2*exp(-4*s)/s^2;
```

$$\int_4^T e^{-st}\left(2t-8\right)\,dt=\frac{2e^{-4s}}{s^2}$$

We now compute the Laplace transform.

```
> s*(exp(-4*s)/s+2*exp(-4*s)/s^3)-2*exp(-4*s)/s^2;
```

$$s\left(\frac{e^{-4s}}{s}+\frac{2e^{-4s}}{s^3}\right)-\frac{2e^{-4s}}{s^2}$$

```
> simplify(%);
```

$$e^{-4s}$$

Of course, we could do the whole thing all at once.

```
> int(exp(-s*t)*(t^2-8*t+17)*Dirac(t-4),t=0..infinity);
```

$$e^{-4s}$$

Or:

```
> with(inttrans);
```

[*addtable*, *fourier*, *fouriercos*, *fouriersin*, *hankel*, *hilbert*, *invfourier*, *invhilbert*, *invlaplace*, *invmellin*,

laplace, *mellin*, *savetable*]

```
> laplace((t^2-8*t+17)*Dirac(t-4),t,s);
```

$$e^{-4\,s}$$