$$L\{e^{2t}\} = \frac{1}{s-2}, \quad L\{te^{2t}\} = (-1)^1 \left(\frac{1}{s-2}\right)' = -\frac{-1}{(s-2)^2} = \frac{1}{(s-2)^2}$$

$$L^{-1}\{\frac{1}{s+3}\} = e^{-3t}, \quad L^{-1}\{\ln(s+3)\} = \frac{L^{-1}\{\frac{1}{s+3}\}}{-t} = \frac{e^{-3t}}{-t}$$

$$L^{-1}\{\ln\frac{(s+3)^3}{(s-1)^2}\} = L^{-1}\{\ln(s+3)^3 - \ln(s-1)^2\} = L^{-1}\{3\ln(s+3) - 2\ln(s-1)\}$$

$$= 3L^{-1}\{\ln(s+3)\} - 2L^{-1}\{\ln(s-1)\} = 3\frac{L^{-1}\{\frac{1}{s+3}\}}{-t} - 2\frac{L^{-1}\{\frac{1}{s-1}\}}{-t}$$

$$= 3\frac{e^{3t}}{-t} - 2\frac{e^{t}}{-t} = \frac{2e^{t} - 3e^{3t}}{t}$$

$$L^{-1}\{\operatorname{Arc}\tan s\} = \frac{L^{-1}\{\frac{1}{1+s^2}\}}{-t} = \frac{\sin t}{-t}$$

$$L\{\frac{\sin t}{t}\} = \int_s^\infty \frac{1}{s^2+1} ds = \operatorname{Arc}\tan s\Big|_s^\infty = \frac{\pi}{2} - \operatorname{Arc}\tan s$$

$$\int_0^\infty e^{-st}\frac{f(t)}{t}dt = \int_s^\infty F(u)\,du \Rightarrow \int_0^\infty \frac{f(t)}{t}dt = \int_0^\infty F(s)\,ds$$

$$\int_0^\infty \frac{\sin t}{t}dt = \int_0^\infty \frac{1}{s^2+1}ds = \operatorname{Arc}\tan s\Big|_0^\infty = \frac{\pi}{2} - 0 = \frac{\pi}{2}$$

$$\int_0^\infty \frac{e^{-2t}-e^{-4t}}{t}dt = \int_0^\infty (\frac{1}{s+2} - \frac{1}{s+4})dt = \ln(s+2) - \ln(s+4)\Big|_{s=0}^\infty$$

$$= \ln(s+2) - \ln(s+4)\Big|_{s=0}^\infty = \ln\frac{(s+2)}{(s+4)}\Bigg|_{s=0}^\infty = \ln 1 - \ln\frac{1}{2} = \ln 2$$

$$L\{t^5e^{2t}\} = \frac{5!}{(s-2)^6}, \qquad L\{t^5\} = \frac{5!}{s^{5+1}}$$

$$L^{-1}\{\frac{5!}{(s-2)^6}\} = e^{2t}L^{-1}\{\frac{5!}{s^6}\} = e^{2t}5!\frac{t^5}{5!} = e^{2t}t^5$$

$$L\{t^n\} = \frac{n!}{s^{n+1}}, \qquad L^{-1}\{\frac{1}{s^{n+1}}\} = \frac{t^n}{n!}$$

$$L\{\frac{\sin 2t}{e^t}\} = \frac{2}{(s+1)^2+4} = \frac{2}{s^2+2s+5} \qquad L\{\sin 2t\} = \frac{2}{s^2+4}$$