Prob. 19.20 Modulus and Poisson's ratio for PIB

Define Poisson (N) and tensile modulus (EE) operators in terms of dilatation (K) and shear (G) operators:

```
> N:=(3*K-2*G)/(6*K+2*G);EE:=(9*G*K)/(3*K+G);
```

$$N := \frac{3\,K - 2\,G}{6\,K + 2\,G}$$

$$EE := 9\,\frac{G\,K}{3\,K + G}$$

SLS expressions for G and K:

```
> G:=Gr+((Gg-Gr)*s)/(s+(1/tau_G));
```

$$G := Gr + \frac{(Gg - Gr)\,s}{s + \frac{1}{tau\_G}}$$

```
> K:=Kr+((Kg-Kr)*s)/(s+(1/tau_K));
```

$$K := Kr + \frac{(Kg - Kr)\,s}{s + \frac{1}{tau\_K}}$$

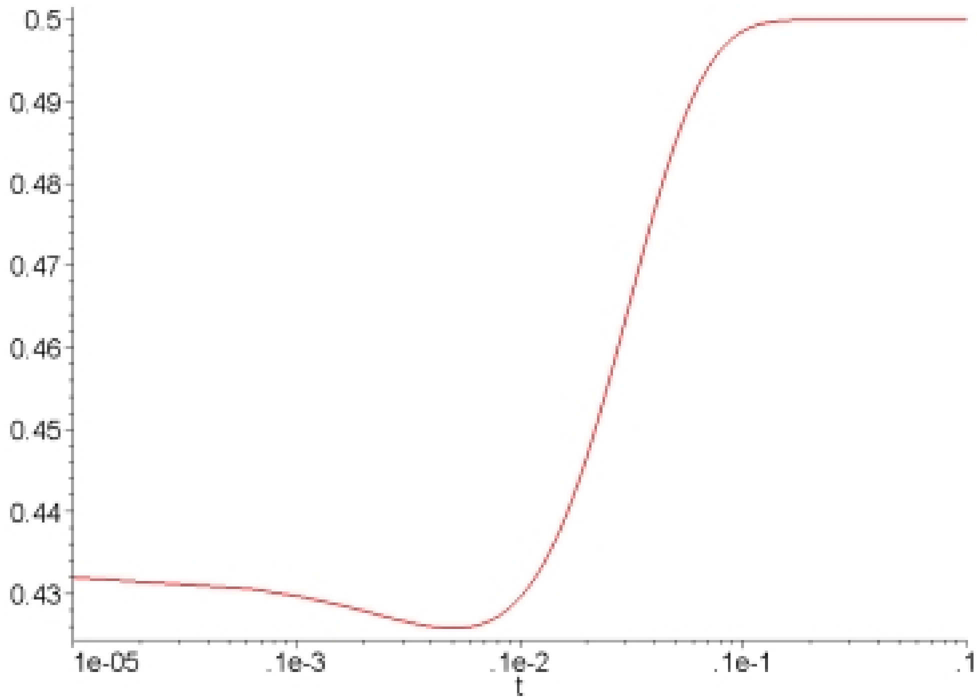
Pick model parameters from Fig. 17. Relaxation times (tau_K and tau_G) are those times at which the relaxation has dropped (1/e) of its total value.

```
> Digits:=20:Gg:=8.8*10^8:Gr:=2.4*10^5:tau_G:=.001:
> Kg:=6.2*10^9:Kr:=1.7*10^9:tau_K:=.0005:
```

Divide by *s* and invert to get relaxation function in time plane.

Poisson's ratio:

```
> with(inttrans):nu:=invlaplace(N/s,s,t):
> with(plots):semilogplot(nu,t=10^(-5) ..
  .1,numpoints=2000,thickness=2);
```



Note that Poisson's ratio approaches the rubbery value of 0.5 as the relaxation completes.
Tensile modulus:

```
> Emod:=invlaplace(EE/s,s,t):
> loglogplot(Emod,t=10^(-5) .. .1,numpoints=2000,thickness=2);
```