McCrum Prob. 4.17

```
> restart:with(inttrans):Digits:=4:
```

Compute shift factor for 50C relative to 20C

```
> a_50:=exp((Delta[H]/R)*(1/(273+50) - 1/(273+20)));
```

$$a\_50 := \mathbf{e}^{\left(-\frac{30}{94639}\frac{\Delta_H}{R}\right)}$$

```
> Delta[H]:=145e3;R:=8.314;'a_50'=a_50;
```

$$\Delta_H := 145000.$$

$$R := 8.314$$

$$a\_50 = .003974$$

Define step function and relaxation modulus

```
> u:= t -> Heaviside(t):
> E_rel:= t-> 2*t^(-0.09)*10^9;
```

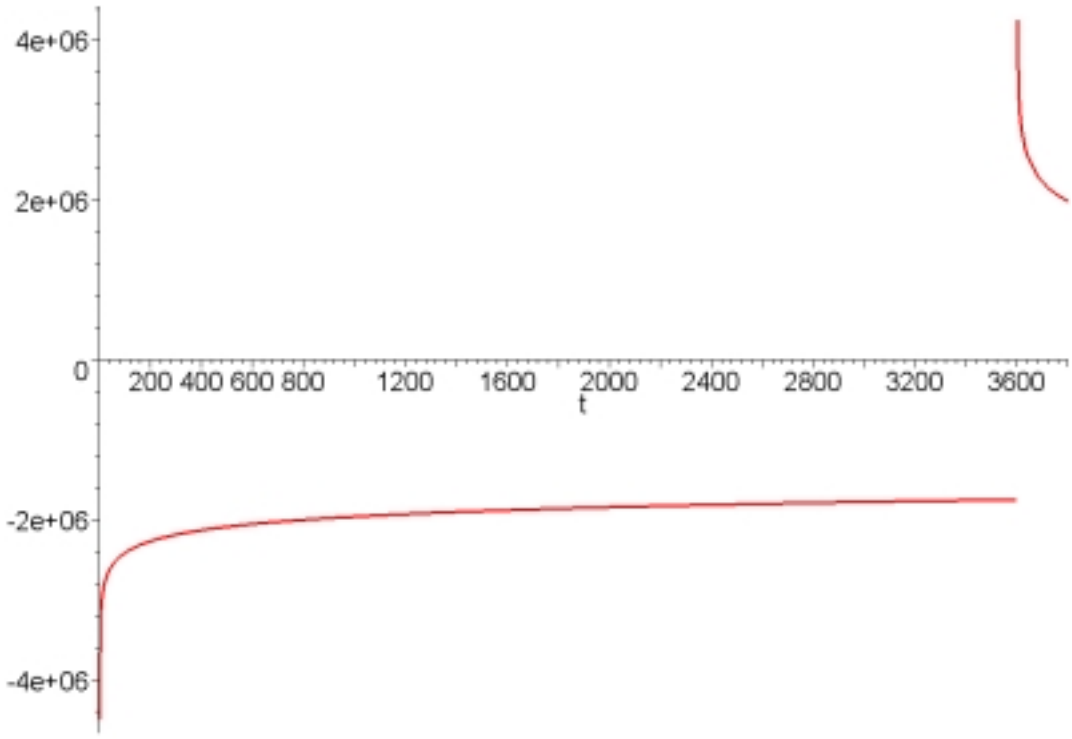
$$E\_rel := t \rightarrow 2000000000\,\frac{1}{t^{.09}}$$

Compute stress and plot

```
> alpha:=.0001:sigma:= alpha*E_rel(t/a_50)*(20-50) +
  alpha*E_rel(t-3600)*u(t-3600)*(50-20);
```

$$\sigma := -.3648\ 10^{7}\,\frac{1}{t^{.09}} + .6000\ 10^{7}\,\frac{\text{Heaviside}(t-3600)}{(t-3600)^{.09}}$$

```
> plot(sigma(t),t=.1..3800,thickness=3);
```



Compute stress after 3600+100s

```
> t:=3700;'sigma_3700s (MPa)'=sigma/1e6;
```

$$t := 3700$$

$$\text{sigma\_3700s}(MPa) = 2.222$$