11.1 a

The solution to $\frac{df}{dt} = kf$ is Ce^{kt}, with C an integration constant

11.1 b

$$\frac{d f(t)}{dt} = k(t) f(t)$$

$$\frac{1}{f(t)} d f(t) = k(t) dt$$

$$\ln(f(t)) = \int k(t)\, dt$$

$$f(t) = e^{\int_0^t k(t') dt'}$$

11.1 C

earlier: $\frac{df}{dt} = kf \Rightarrow f(t) = f_0 e^{kt}$

$$\updownarrow$$

$$i\hbar \frac{\partial \psi}{\partial t} = \hat{H} \psi \Rightarrow \boxed{\psi(t) = e^{-i\hat{H}t/\hbar} \psi_0 \quad ?!}$$

is this correct?

$$\hat{H}(t) = \begin{cases} \hat{H}_1 & 0 < t < \tau \\ \hat{H}_2 & t > \tau \end{cases}$$

$$\psi(t) = e^{-i(\hat{H}_1 \tau + \hat{H}_2 (t-\tau))/\hbar} \psi_0$$

we should also be able to write: $\psi(t) = e^{-i\hat{H}_2 (t-\tau)/\hbar} e^{-i\hat{H}_1 \tau/\hbar} \psi_0$, then we require that $\hat{H}_1$ and $\hat{H}_2$ commute, as

$$e^{\hat{A}+\hat{B}} = e^{\hat{B}+\hat{A}} \text{ if } [\hat{A}, \hat{B}] = 0$$