(a) For the stationary states we have

$$\begin{aligned}\psi_{211} &= -\frac{r\sin\theta}{8\sqrt{\pi a_0^5}}\exp\left(-\frac{r}{2a_0}+i\phi\right)\\ \psi_{21-1} &= \frac{r\sin\theta}{8\sqrt{\pi a_0^5}}\exp\left(-\frac{r}{2a_0}-i\phi\right) = -\psi_{211}^*\end{aligned}$$

The general solution to the Schrödinger equation is

$$\sum c_n\psi_n(\mathbf{r})\exp\left(-\frac{iE_nt}{\hbar}\right) \tag{4.9}$$

Hence

$$\Psi(\mathbf{r},t) = \frac{r\sin\theta}{8\sqrt{2\pi a_0^5}}\exp\left(-\frac{r}{2a_0}-\frac{iE_2t}{\hbar}\right)\big(\exp(-i\phi)-\exp(i\phi)\big)$$

(b) For the potential energy we have

$$V(r) = -\frac{e^2}{4\pi\epsilon_0}\frac{1}{r} \tag{4.52}$$

The expectation value is

$$\begin{aligned}\langle V\rangle &= \langle\Psi|V|\Psi\rangle\\ &= \int_0^\infty\int_0^\pi\int_0^{2\pi}\Psi^*V\Psi r^2\sin\theta\,dr\,d\theta\,d\phi\\ &= -\frac{e^2}{16\pi\epsilon_0 a_0}\end{aligned} \tag{1}$$

Convert to electron volts.

$$\langle V\rangle = -6.8\,\mathrm{eV}$$

The expectation value $\langle V\rangle$ does not depend on t.