ID434 Take home examination No 1

Please submit (with your name and roll no. clearly mentioned) before the commencement of the mid-semester examination)

Q 1) We are using "natural units" in which $\hbar = c = G = 1$. What is the mass of the electron in these units? (4)

Q 2) In the class we discussed why it is not quite correct to say that $\phi(x)|0\rangle$ is a state with a particle at x (or, in other words, $\phi(x)$ *creates* a particle at poistion x). The point was that if we try to localize a particle too much, the corresponding increase in momentum uncertainity (and, since one observer's momentum is another's energy, energy uncertainity) will cause particle pair creation out of the vacuum, leading to a breakdown of the single particle picture. Explain why (and under what conditions) we can at all use single particle wave functions quite successfully in spite of this? Explain also whether this makes sense for the photon. (6)