a)

$$\langle \rho \rangle = -ih\int_{-\infty}^{\infty} \psi^* \frac{\partial \psi}{\partial x} dx \qquad 1.33$$

$$\frac{d\langle \rho \rangle}{dt} = -ih\frac{d}{dt}\int_{-\infty}^{\infty} \psi^* \frac{\partial \psi}{\partial x} dx = -ih\int_{-\infty}^{\infty} \frac{\partial}{\partial t}\left(\psi^* \frac{\partial \psi}{\partial x}\right) dx$$

$$\frac{d\langle \rho \rangle}{dt} = -ih\int_{-\infty}^{\infty} \left(\frac{\partial \psi^*}{\partial t}\frac{\partial \psi}{\partial x} + \psi^*\left[\frac{\partial}{\partial t}\frac{\partial \psi}{\partial x}\right]\right) dx$$

$$\frac{d\langle \rho \rangle}{dt} = -ih\int_{-\infty}^{\infty} \frac{\partial \psi^*}{\partial t}\frac{\partial \psi}{\partial x} dx - ih\int_{-\infty}^{\infty} \psi^*\left[\frac{\partial}{\partial t}\frac{\partial \psi}{\partial x}\right] dx$$

The Schroedinger equation (slightly adjusted) tells us:

$$\frac{\partial \psi}{\partial t} = \frac{ih}{2\mathrm{m}} \cdot \frac{\partial^2 \psi}{\partial x^2} - \frac{iV}{h} \cdot \psi$$

taking the complex conjugate,

$$\frac{\partial \psi^*}{\partial t} = -\frac{ih}{2\mathrm{m}} \cdot \frac{\partial^2 \psi^*}{\partial x^2} + \frac{iV}{h} \cdot \psi^*$$

$$-ih\int_{-\infty}^{\infty} \frac{\partial \psi^*}{\partial t}\frac{\partial \psi}{\partial x} dx = -ih\int_{-\infty}^{\infty} \left(-\frac{ih}{2\mathrm{m}} \cdot \frac{\partial^2 \psi^*}{\partial x^2} + \frac{iV}{h} \cdot \psi^*\right)\frac{\partial \psi}{\partial x} dx = -ih\int_{-\infty}^{\infty} \left(-\frac{ih}{2\mathrm{m}} \cdot \frac{\partial^2 \psi^*}{\partial x^2}\frac{\partial \psi}{\partial x} + \frac{iV}{h} \cdot \psi^* \frac{\partial \psi}{\partial x}\right) dx$$

$$-ih\int_{-\infty}^{\infty} \frac{\partial \psi^*}{\partial t}\frac{\partial \psi}{\partial x} dx = -ih\int_{-\infty}^{\infty} \left(-\frac{ih}{2\mathrm{m}} \cdot \frac{\partial^2 \psi^*}{\partial x^2}\frac{\partial \psi}{\partial x}\right) dx - ih\int_{-\infty}^{\infty} \left(\frac{iV}{h} \cdot \psi^* \frac{\partial \psi}{\partial x}\right) dx$$

$$-ih\int_{-\infty}^{\infty} \frac{\partial \psi^*}{\partial t}\frac{\partial \psi}{\partial x} dx = -\frac{h^2}{2\mathrm{m}}\int_{-\infty}^{\infty} \left(\frac{\partial^2 \psi^*}{\partial x^2}\frac{\partial \psi}{\partial x}\right) dx + V\int_{-\infty}^{\infty} \left(\psi^* \frac{\partial \psi}{\partial x}\right) dx$$

we can integrate the first part of this using integration by parts. The second part looks like $i \cdot V\frac{\langle \rho \rangle}{h}$

$$u = \frac{\partial \psi}{\partial x} \qquad dv = \frac{\partial^2 \psi^*}{\partial x^2}$$

AAAHHHHHHHHHH