1. A $q_1 = \frac{mg}{E}\left(\frac{v + v_1'}{v}\right)$

$v = \frac{0.01\,m}{40\,s} = 0.00025\,m/s$, $v_1' = \frac{0.01\,m}{37.893\,s} = 0.0002639\,m/s$

$q_1 = \frac{(1.67\times10^{-14}\,kg)(9.8\,m/s)}{3\times10^{5}\,V/m}\left(\frac{0.00025\,m/s + 0.0002639\,m/s}{0.00025\,m/s}\right)$

$\boxed{q_1 = 11.214\times10^{-19}\,C}$

B. $\#e's = \frac{q_1}{e} = \frac{11.214\times10^{-19}\,C}{1.602\times10^{-19}\,C} = \boxed{7 \text{ electrons}}$

2. A. $\frac{1}{\lambda} = R\left(\frac{1}{4^2} - \frac{1}{5^2}\right)$, or $\Delta E = (-13.6\,eV)\left(\frac{1}{n_f^2} - \frac{1}{n_i^2}\right)$

$\Delta E = (-13.6\,eV)\left(\frac{1}{25} - \frac{1}{16}\right) = \boxed{0.306\,eV}$

B. Shortest possible wavelength when the energy difference is the most!
So when $n_f = 1$, ΔE will be largest.

$\frac{1}{\lambda} = R\left(\frac{1}{1^2} - \frac{1}{5^2}\right) = (1.0947\times10^{7}\,{}^{1}/_{m})\left(\frac{1}{1} - \frac{1}{25}\right)$

$\Rightarrow \boxed{\lambda = 95.2\,nm}$

3 A. $\Delta x \Delta p \geq \frac{\hbar}{2}$

if $\Delta p = m\Delta v$

the min. uncertainty in x will be

$$\Delta x = \frac{\hbar}{2} \cdot \frac{1}{\Delta p} = \frac{\hbar}{2} \frac{1}{m(0.03v)}$$

$$= \frac{(1.055 \times 10^{-34} J \cdot s)}{2} \cdot \frac{1}{(1kg)(0.03 \times 3 m/s)}$$

$$\boxed{\Delta x = 5.86 \times 10^{-34} \; m}$$

→ very small uncertainty for a big object!

B. For the electron

$$\Delta x = \frac{\hbar}{2} \cdot \frac{1}{\Delta p}$$

$$= \frac{(1.053 \times 10^{-34} J \cdot s)}{2} \frac{1}{(9.109 \times 10^{-31} Kg)(0.03 \times 3 m/s)}$$

$$\boxed{\Delta x = 6.43 \times 10^{-4} \; m}$$

almost 1mm of uncertainty!

c. $\lambda = \frac{h}{p} = \frac{6.626 \times 10^{-34} J \cdot s}{(9.109 \times 10^{-21} kg)(3 m/s)} = \boxed{2.424 \times 10^{-4} \; m}$