1. In an inelastic collision, KE is always lost (think what happens in center of mass frame) so rest mass increases. $\boxed{M > 2m}$

2. $$v_x' = \frac{v_x - u}{1 - uv/c^2}$$

$$= \frac{0.75 - 0.4}{1 - 0.75 \cdot 0.4}$$

$$= \frac{0.35}{1 - 0.3} = \boxed{0.5c}$$

3. a. $E_m = E_1 + E_2$

$= \boxed{500\ MeV}$

b. $\vec{p}_m = \vec{p}_1 + \vec{p}_2$

$|p_m| = 450 - 50$

$= \boxed{400\ MeV/c}$

c. $M = \sqrt{(E/c^2)^2 - (p/c)^2}$

$= \boxed{300\ MeV/c^2}$

d. $E = \gamma mc^2 \Rightarrow \gamma = 5/3$

$1/\sqrt{1 - v^2/c^2} = 5/3 \Rightarrow v = \sqrt{1 - (3/5)^2}$

$= \boxed{0.8c}$

4. As θ becomes smaller, photons lose less energy, so electron kinetic energy gain **decreases**.

5. a. $p = mv = \sqrt{2mK}$

$= \sqrt{2 \times 10^{-30} \cdot 5 \times 10^{-17}}$

$= \sqrt{10^{-46}}$

$= \boxed{10^{-23} \text{ kg m/s}}$

b. $\lambda = h/p = \frac{10^{-33}}{10^{-23}} = 10^{-10} \text{ m}$

$= \boxed{0.1 \text{ nm}}$

c. $d \sin\theta = n\lambda$

or $\frac{d \cdot \Delta x}{L} = \lambda$

or $d \cdot 0.1 = \lambda$

$\Rightarrow d = 10 \cdot \lambda$

$= \boxed{1 \text{ nm}}$

b. a. $\Delta\lambda = \lambda_c (1 - \cos\theta)$

$= 2\lambda_c$

$= 0.00486$ nm

$\Rightarrow \boxed{\lambda' = 0.0096 \text{ nm}}$

b. $E = hc/\lambda = 1200/\lambda$

$E = 1200/0.0048$

$= \boxed{250{,}000 \text{ eV}}$

$E' = 1200/0.0096$

$= \boxed{125{,}000 \text{ eV}}$

c. $\boxed{p = 250{,}000 \text{ eV/c}}$
$\boxed{p' = 125{,}000 \text{ eV/c}}$

d. $E - E' = \boxed{125{,}000 \text{ eV}}$

- same direction as incoming photon (to conserve momentum)