36.

$K = 50\ GeV = 50 \times 10^{9} \times 1.6 \times 10^{-19} = 8 \times 10^{-9}\ J$

a) $E = K + m_0c^2 = 50 \times 10^{3}\ MeV + 939\ MeV$

$= 50939\ MeV$

$E^2 = p^2c^2 + m_0^2c^4$

$p = \frac{1}{c}\sqrt{E^2 - (m_0^2c^4)} = \frac{1}{c}\sqrt{(50939)^2 - (939)^2}$

$\boxed{p = 50930\ \left(\frac{MeV}{c}\right)}$ ← note the unit!

b) $K = (\gamma - 1)\, m_0c^2$

$50 \times 10^{3} = (\gamma - 1)\ 939 \Rightarrow \gamma - 1 = 53.2$

$\gamma = 54.2 = \frac{1}{\sqrt{1 - \frac{u^2}{c^2}}}$

$\Rightarrow \frac{u^2}{c^2} = \frac{\gamma^2 - 1}{\gamma^2} \Rightarrow u = c\sqrt{\frac{\gamma^2 - 1}{\gamma^2}} = \boxed{0.9998c}$

38.

) $E = 400\ m_0c^2 = 400\ (939\ MeV) = \gamma\ m_0c^2$

$\Rightarrow \gamma = 400 = \frac{1}{\sqrt{1 - \frac{u^2}{c^2}}} \Rightarrow u = c\sqrt{\frac{\gamma^2 - 1}{\gamma^2}} = \boxed{0.999997c}$

$K = (\gamma - 1)\, m_0c^2 = 399\ (939\ MeV) = \boxed{37.5\ GeV}$