Electromagnetism I – Problem sheet 10

A metal bar with length L, mass m, and resistance R is placed on frictionless metal rails that are inclined at an angle α above the horizontal. The top end of the rails are connected with a conducting wire. The resistance of the rails and wire are negligible. The rails are embedded in a uniform magnetic field B perpendicular to the plane in which the rails sit. The bar is released from rest and slides down the rails.

1. Determine the magnitude of the induced emf on the loop when the bar has reached a velocity v. [Express the result as a function of B, L and v]. **[2]**
2. Evaluate the terminal velocity v_t of the bar. [Express the result as a function of B, L, R, m, g (gravitational acceleration) and α]. **[4]**
3. Show that when the terminal velocity is reached, the rate at which electrical energy is being dissipated is equal to the rate at which the gravitational force is doing work. **[4]**