Problem 1:

Total power required for each case is the sum of the rates of changes in potential and kinetic energies. That is;

$\dot{W}_{total} = \dot{W}_a + \dot{W}_g$ → potential
↳ kinetic

a) $\dot{W}_{total} = 0$ (Because there is no acceleration and change in elevation is zero)

b) $\dot{W}_2 = 0$ $\quad \dot{W}_{total} = \dot{W}_g = mg \dfrac{\overbrace{(z_2 - z_1)}^{\Delta z}}{\Delta t} = mg \cdot V_{vertical}$

$= m \cdot g \cdot V \cdot \sin 30°$

$= (1200\ kg)(9.81\ m/s^2) \cdot \left(\dfrac{50.000\ m}{3600\ s}\right) \cdot \left(\dfrac{1\ kJ}{1000\ kg\ m^2/s^2}\right) \cdot 0{,}5$

$= 81.7\ kW$

c) $\dot{W}_g = 0$ $\quad \dot{W}_{total} = \dot{W}_a = \dfrac{1}{2} m \dfrac{(V_2^2 - V_1^2)}{\Delta t}$

$= \dfrac{1}{2} (1200\ kg) \cdot \dfrac{\left(\left(\dfrac{90.000\ m}{3600\ s}\right)^2 - 0\right)}{12\ s} \cdot \left(\dfrac{1\ kJ}{1000\ kg \cdot m^2/s^2}\right)$

$= 31.3\ kW$

Quiz Problem 1:

a) $\dot{W}_a = 0$ since the velocity is constant. Also, the vertical rise is $h = (100\ m) \cdot (\sin 30°) = 50m$. Thus,

$\dot{W}_g = mg \dfrac{(z_2 - z_1)}{\Delta t} = (1150\ kg)(9.81\ m/s^2) \dfrac{(50\ m)}{12\ s} = 47.0\ kW$

$\dot{W}_{total} = \dot{W}_a + \dot{W}_g = 0 + 47.0 = 47.0\ kW$

b) The power needed for accelerate is

$\dot{W}_a = \dfrac{1}{2} m \dfrac{(V_2^2 - V_1^2)}{\Delta t} = \dfrac{1}{2} (1150\ kg) \dfrac{[(30\ m/s)^2 - 0]}{12} \cdot \left(\dfrac{kJ}{1000\ kg\ m^2/s^2}\right)$

$= 43.1\ kW$

$\dot{W}_{total} = \dot{W}_a + \dot{W}_g = 47.0 + 43{,}1 = 90{,}1 \cdot kW$

c) The power needed to decelerate is;

$$\dot{W}_a = \frac{1}{2} m \frac{(v_2^2 - v_1^2)}{\Delta t} = \frac{1}{2} m (1150\ kg) \left[\frac{(5\ m/s)^2 - (35\ m/s)^2}{12\ s} \right] \left(\frac{kJ}{1000\ kg\ \frac{m^2}{s^2}} \right)$$

$$= -57.5\ kW$$

and $\dot{W}_{total} = \dot{W}_a + \dot{W}_p = -57.5 + 47.0 = -10.5\ kW$