① (a) $(2000\ \text{cal/d})(4.2\times10^3\ \text{J/cal}) \times \frac{1\ \text{day}}{86{,}400\ \text{s}} = 97\ \text{W}$

(b) I took 2.5 s to go up stairs of height 1.7 m.

$$\text{Power} = \frac{\text{energy}}{\text{time}} = \frac{mgh}{t} = \frac{(80\ \text{kg})(9.8\ \text{N/kg})(1.7\ \text{m})}{2.5\ \text{s}} = 533\ \text{W}$$

or about 0.7 hp.

(c) For Mt. Everest $\Delta U = mgh = (80\ \text{kg})(9.8\ \text{N/kg})(8848\ \text{m}) = 6.9\times10^6\ \text{J}$

at $2000\ \text{cal/d} = 8.4\times10^6\ \text{J/day}$, it takes

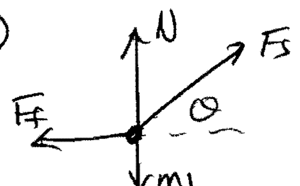
$$\frac{6.9\times10^6\ \text{J}}{8.4\times10^6\ \text{J/d}} = 0.8\ \text{d}$$

② Energy per unit time $= \frac{45\ \text{kwh}}{3\ \text{h}} = 15\ \text{kW} = 1.5\times10^4\ \text{J/s}$

The original $\Delta T$ was 20°C. At 25°C the heat loss should be

$$\left(\frac{25}{20}\right)(1.5\times10^4\ \text{J/s}) = \left(\frac{25}{20}\right)(45\ \text{kwh}) = 56\ \text{kwh}$$

③




$$F_{net,x} = F_s\cos\theta - F_f = m\frac{\Delta v}{\Delta t}$$

$$F_{net,y} = N + F_s\sin\theta - mg = 0$$

$$N = mg - F_s\sin\theta$$

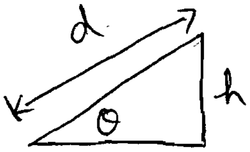
$$F_f = \mu N = \mu(mg - F_s\sin\theta)$$

$$\Delta v = \frac{t}{m}\left[F_s\cos\theta - F_f\right] = \frac{t}{m}\left[F_s\cos\theta - \mu(mg - F_s\sin\theta)\right]$$

$$v = v_0 + \frac{t}{m}\left[k_s s\cos\theta - \mu(mg - k_s s\sin\theta)\right]$$

④ (a) At the bottom of the incline:

$$E_i = U_i + K_i = 0 + \frac{1}{2}mv_i^2 = 91.9\,J$$



At the highest point

$$E_f = U_f + K_f = mgh + 0 = mg\,d\sin\theta$$

$$E_i = E_f \Rightarrow d = \frac{E_i}{mg\sin\theta} = 1.25\,m$$

(b) At the new highest point.

$$E_f = U_f + K_f = mgh' + 0 = mgd'\sin\theta = 69.8\,J$$

$$W_{net} = E_f - E_i = 69.8\,J - 91.9\,J = -22.1\,J$$

(c) Let $E_i$ be the energy at the highest point $= 69.8\,J$

$$E_f \text{ at bottom} = U_f + K_f = 0 + \frac{1}{2}mv_f^2$$

$$W_{net} = E_f - E_i \Rightarrow E_f = W + E_i = 69.8\,J - 22.1\,J$$
$$= 47.7\,J$$

$$v_f = \sqrt{\frac{2(47.7\,J)}{15\,kg}} = 2.5\,m/s$$