Solutions to Practice Problems

① $E_{init} = K_{init} + U_{init} = 0 + \frac{1}{2}kx_{init}^2 = 0.225\,J$

$E_{final} = K_{final} + U_{final} = 0 + \frac{1}{2}kx_{final}^2 = 0.048\,J$

$W = E_{final} - E_{init} = -0.177\,J$

② $E_i = K_i + U_i = \frac{1}{2}mv^2 + mgh = \frac{1}{2}(1520kg)(25m/s)^2 + (520kg)(9.8\frac{N}{kg})(200\sin 20^\circ)$
$= 1.47 \times 10^6\,J$

$E_f = K_f + U_f = \frac{1}{2}mv^2 = \frac{1}{2}(1520\,kg)(17\,m/s)^2 = 0.216 \times 10^6\,J$

$W = E_f - E_i = -1.26 \times 10^6\,J$

③ Initial: $K=0$, $U_{grav}=0$, $U_{spring}=0$

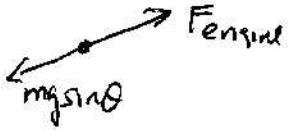
Final: $K=0$ $U_{grav}=-mgh$ $U_{spring}=\frac{1}{2}k(h-L)^2$

$E_{init} = E_{final} \Rightarrow 0 = -mgh + \frac{1}{2}k(h-L)^2$

$\frac{1}{2}kh^2 - kLh - mgh + \frac{1}{2}kL^2 = 0$

Solve using quadratic formula $\Rightarrow$ $h = 28.8\,m$

④ (a)



$P = F_{engine} \cdot v = (mg\sin\theta)(v) = 20\,kW$

total power: $20\,kW + 16\,kW = 36\,kW$

(b) The effective force of wind resistance is $F = \frac{P}{v} = \frac{16{,}000W}{15\,m/s} = 1067\,N$

$F_{wind} = mg\sin\theta$ at constant speed

$\sin\theta = \frac{F_{wind}}{mg} = 0.064 \Rightarrow \theta = 3.7^\circ$