$K_i + U_i = K_f + U_f$ $K = 1/2\ mv^2$ $U = mgh$ $P = W/t$

1. Mr. Bean falls asleep on a roller coaster. When he wakes up, he is 10 m above ground and going uphill. When he goes over the next hill, which is 45 m above ground, he is going 14.5 m/s. How fast was he going when he woke up at the 10 m mark if all forces are conservative?

$h_i = 10\ M$

$h_f = 45 M$

$V_f = 14.5\ \frac{M}{s}$

$V_i = \underline{\quad} \frac{M}{s}$

$K_i + U_i = K_f + U_f$

$\frac{1}{2} M V_i^2 + Mgh_i = \frac{1}{2} M V_f^2 + Mgh_f$

$V_i^2 + 2gh_i = V_f^2 + 2gh_f$

$V_i^2 = V_f^2 + 2gh_f - 2gh_i$

$V_i = \sqrt{V_f^2 + 2g(h_f - h_i)}$

$= \sqrt{(14.5\frac{M}{s})^2 + 2(9.8\frac{M}{s^2})(45M - 10M)}$

$\boxed{V_i = 29.9\ \frac{M}{s}}$

2. If, instead, Mr. Bean ran up stairs that were 35 m high in 125 seconds, what is his power in watts if his mass is 80 kg?

$P = \frac{W}{t}$

$= \frac{Mgh}{t}$

$= \frac{80 kg(9.8\frac{M}{s^2})(35M)}{125 s}$

$\boxed{P = 220\ W}$

EC - If instead, in question 1, Mr. Bean went over the hill at 8.0 m/s, how much energy was lost due to friction?

$K_i + U_i + E_{in} - E_{out} = K_f + U_f$

$\frac{1}{2} M V_i^2 + Mgh_i + 0 - E_{out} = \frac{1}{2} M V_f^2 + Mgh_f$

$- E_{lost} = \frac{1}{2} M (V_f^2 - V_i^2) + Mg(h_f - h_i)$

$= \frac{1}{2}(80 kg)[(8\frac{M}{s})^2 - (29.9\frac{M}{s})^2] + 80 kg(9.8\frac{M}{s^2})(45M - 10M)$

$\boxed{E_{lost} = 5760\ J}$