Conservation of Energy – Bungee jumping!! (Show clear formulas and work on separate page.)

A 101-kg man goes bungee jumping. He leaps off a very tall bridge, and falls 38.0 meters before the bungee cord loses its slack. The bungee cord stretches an additional 27.0 meters before he comes to a temporary stop.

a) How fast is he going by the time the bungee cord loses its slack?

b) How much gravitational potential energy has he lost by the time he reaches the bottom of his path?

c) Assuming negligible air resistance, how much energy must be stored in the bungee cord?

d) What type of energy is the energy in the bungee cord?

e) Assuming the bungee cord follows Hooke's Law, what is the spring constant of the bungee cord?

f) At the bottom of the path, how much force is the cord exerting on the man?

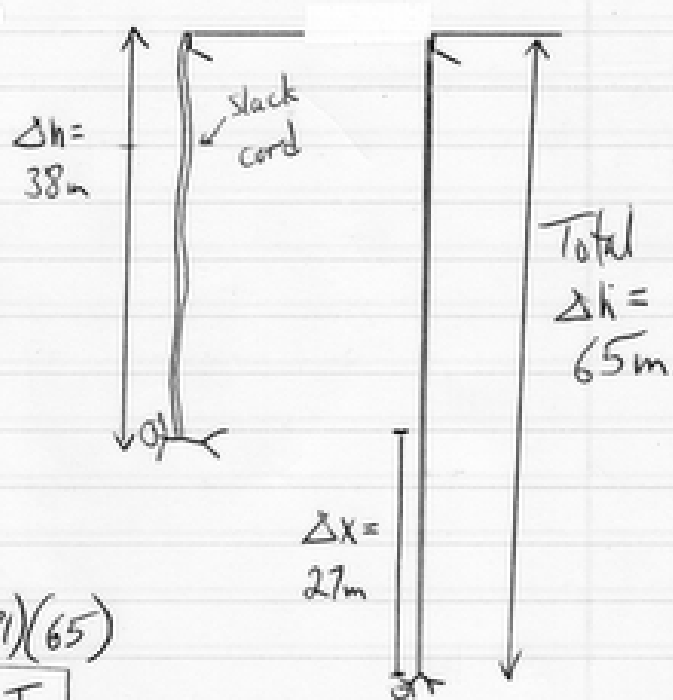
h) How much force does gravity exert on the man?

i) Make a free body diagram of the man at the bottom of the stretched bungee cord, at the instant he is at rest.

j) What is the acceleration (magnitude and direction) of the man at the instant he is at the bottom of the path?

Conservation of Energy

Bungee Jumping Problem



a) GPE converted to KE

$mg\Delta h = \frac{1}{2} m v^2$

$v = \sqrt{2 \cdot g \cdot \Delta h}$

$= \sqrt{2(9.81)(38)}$

$= 27.3 \frac{m}{s}$

b) $\Delta GPE = mg\Delta h = (101)(9.81)(65)$

$\boxed{\Delta GPE = {}^{-}64{,}400\ J.}$

c) No KE (since he is instantaneously at rest), so all energy must have gone into cord.

d) Elastic PE

e) Elastic PE = lost GPE

$\frac{1}{2} k x^2 = mg\Delta h$

$\frac{1}{2} \cdot k \cdot 27^2 = (101)(9.81)(65)$

$\boxed{k = 177\ N/m}$

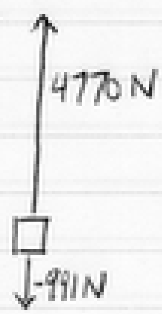
f) $F = kx$ (Hooke's Law)

$= (176.68 \frac{N}{m})(27m) = 4770.6$

$\boxed{F_{cord} = 4770\ N}$

h) Weight $= m \cdot g = (101\ kg)(9.81\ \frac{m}{s^2}) = \boxed{991\ N}$

i)



Net F = 3780N, upwards

j) $a = \frac{\text{net } F}{m} = \frac{3780\,N}{101\ kg} = \boxed{37.4 \frac{m}{s^2}}$