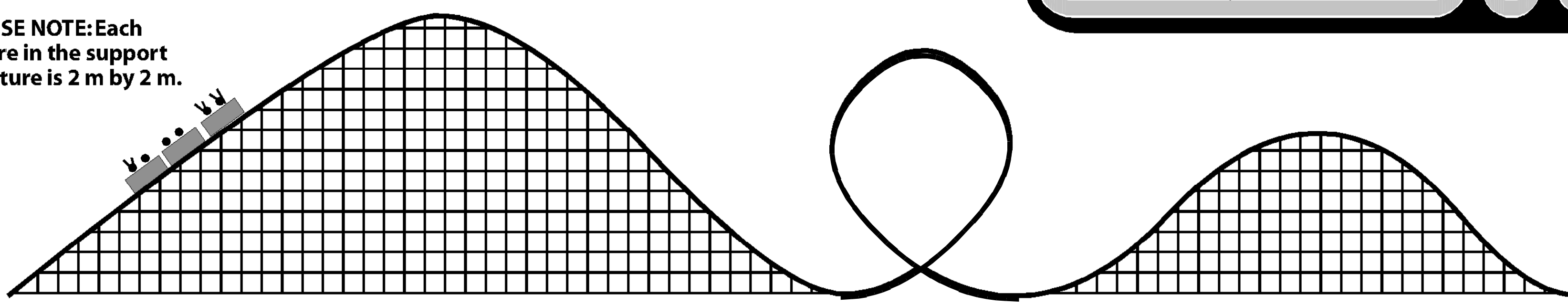
PhyzJob: Conservation of Energy at the Amusement Park

Felix

PLEASE NOTE: Each square in the support structure is 2 m by 2 m.



A 3-car roller-coaster has a fully loaded mass of 6240 kg.
a. How much work does the drive motor do to lift it to the top of the first hill?

W= PE = mgh
W = 6240 kg·9.8 m/s^2 · 28 m
W = 1,710,000 J

b. How much force did the motor have to exert to do this? *Hints: 1. Definition of work, 2. Cons. of E, 3.* d*: Pythagoras.*

W = F·d
F = W/d
F = 1,710,000 J / ((28 m)^2 + 42 m)^2)
F = 33,800 N

c. If the journey took 24 s to complete, what is the power of the drive motor? (Express in watts; convert to horsepower.)

P = W/t
P = 1,710,000 J / 24 s
P = 71,000 W

d. If the roller-coaster just barely makes it over the first hill, how fast is it going at the bottom? In mph?

v=(2KE/m)
$KE_{bot} = PE_{top}$
v = ($2PE_{top}$/m)   v = (2·1,710,000 J / 6240kg)
v = 23 m/s x 9/4 = 52mph

e. When it passes through the top of the loop, how much of the coaster's energy is potential and how much is kinetic?

$PE_{loop} = mgh_{loop}$
PE_{loop} = 6240 kg · 9.8 m/s^2 · 24 m
PE_{loop} = 1,470,000 J
$KE_{loop} = PE_{top} - PE_{loop}$ =
1,710,000 J – 1,470,000 J = 243,000 J

f. How fast is the roller-coaster going at the top of the second hill? In mph?

v=($2KE_{hill}$/m)
$KE_{hill} = PE_{top} - PE_{hill}$
$PE_{hill} = mgh_{hill}$ = 6240 kg · 9.8 m/s^2 · 16 m
PE_{hill} = 978,000 J so KE_{hill} = 732,000 J
v = (2 · 732,000 J / 6240 kg) = 15 m/s

a. 1.71 MJ b. 34 kN c. 71 kW = 95 hp d. 23 m/s = 52 mph e. PE = 1.47 MJ, KE = 0.24 MJ f. 15 m/s