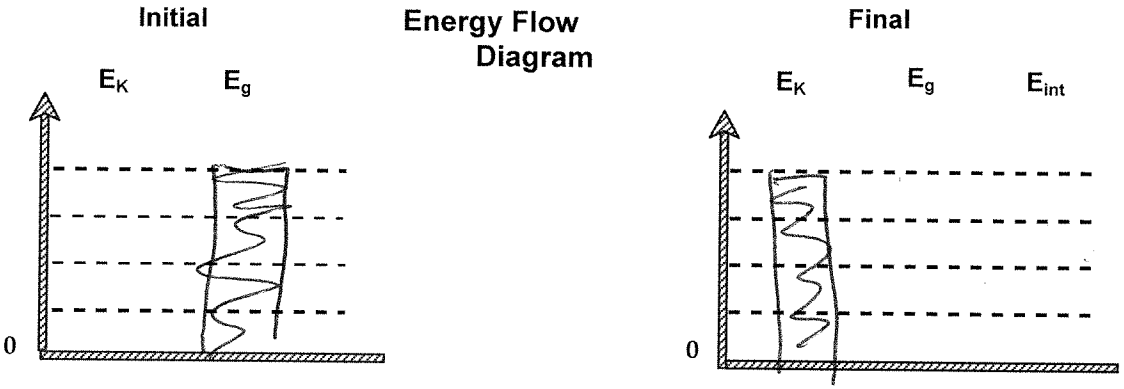
Name Key

Energy and Work Study Guide

1. A 7000 kg roller coaster reaches a maximum height of 80 m before it begins its descent.

a. What is the speed of the roller coaster at the bottom of the hill, which is at ground level?



$E_g = mgh$

$E_g = (7000)(9.8)(80)$

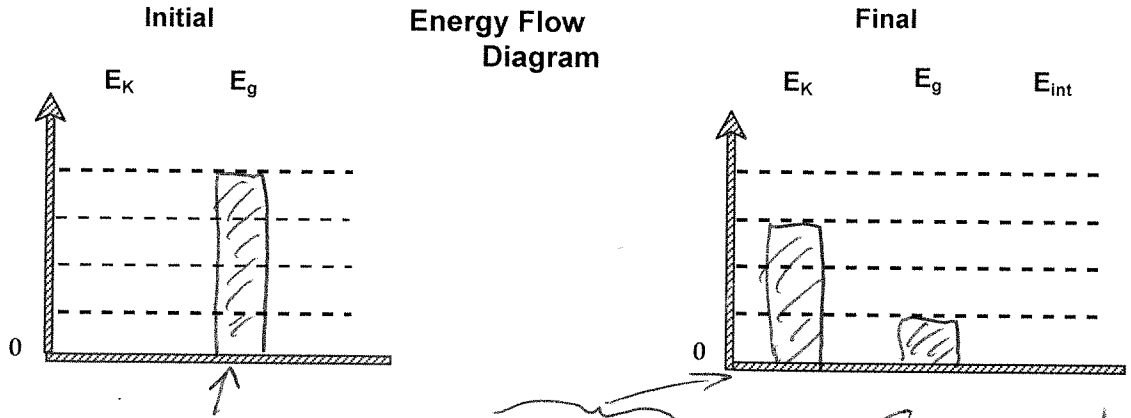
$E_g = 5488000\ J$

$E_K = \frac{1}{2}mv^2$

$5488000 = \frac{1}{2}(7000)v^2$

$v = 39.6\ m/s$

b. What is the speed of the roller coaster at the top of the next hill, which is 20 meters tall?



$E_g = 5488000\ J = E_K + E_g$

$E_K = 5488000 - 1372000$

$E_K = 4116000\ J = \frac{1}{2}mv^2$

$v = 34.3\ m/s$

$E_g = mgh$

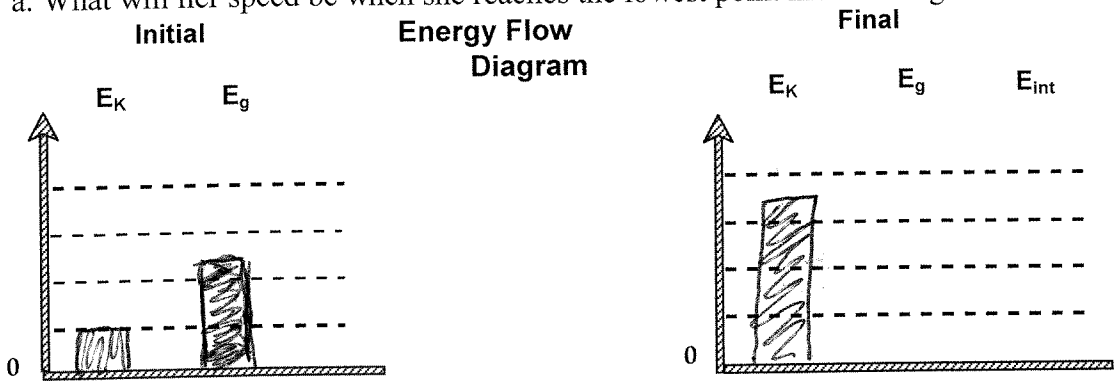
$E_g = (7000)(9.8)(20)$

$E_g = 1372000\ J$

2. A 45 kg girl on a swing is pulled back to a height of 1.1 meters above the lowest point in her swing. Her father gives her a push that makes her initial speed 3 m/s.

a. What will her speed be when she reaches the lowest point in her swing?

Energy Flow Diagram



$E_g = mgh$

$E_g = 45(9.8)(1.4)$

$E_g = 485.1\ J$

$E_K = \frac{1}{2}mv^2$

$E_K = \frac{1}{2}(45)(3)^2$

$E_K = 202.5\ J$

$E_K = \frac{1}{2}mv^2$

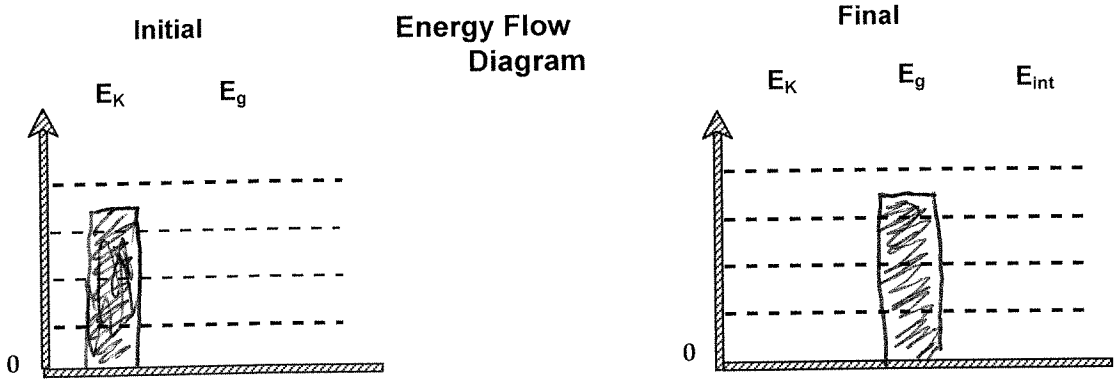
$(485.1 + 202.5) = \frac{1}{2}(45)v^2$

$687.6 = 22.5v^2$

$v = 5.53\ m/s$

b. What is the maximum height she will reach?

Energy Flow Diagram



$E_K = 687.6\ J$

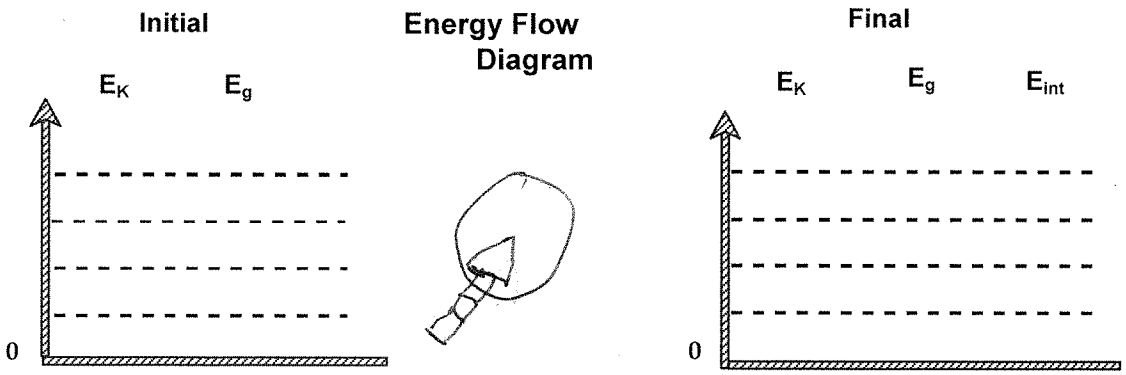
(at the bottom of her swing)

$E_g = mgh$

$687.6 = (45)(9.8)(h)$

$h = 1.56\ m$

3. A force of 20 N is used to accelerate a 4.25 kg block over a distance of 3 meters.
A) How much work is done on the block by the 20 N force?

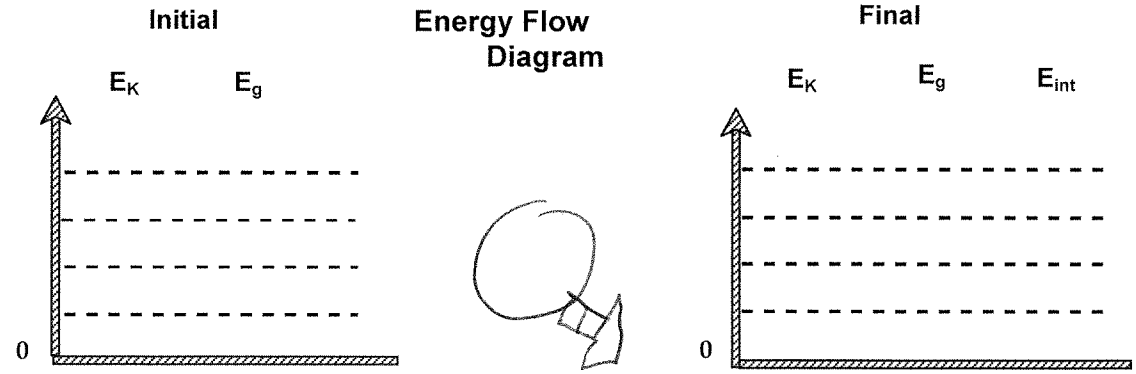


$W = Fd$

$W = 20(3)$

$W = 60\,J$

B) There is a frictional force of 7.5 N acting on the block during the 3 meters. How much work does friction do on the block?

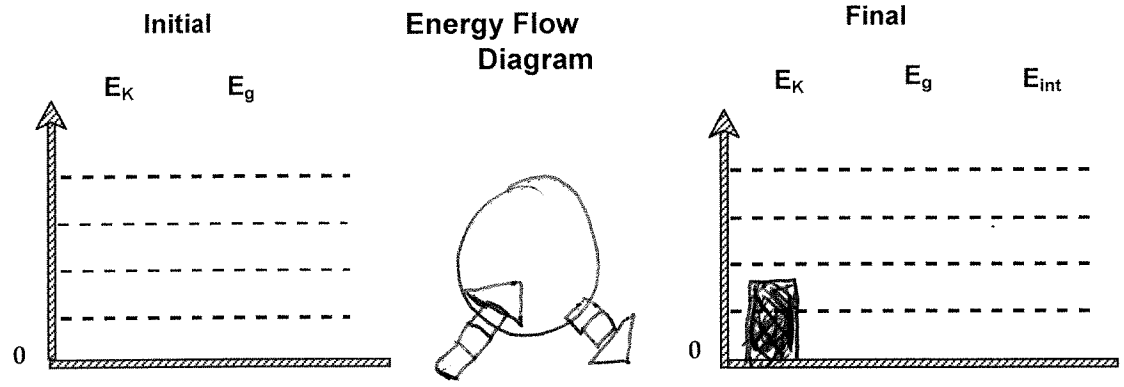


$W = Fd$

$W = (7.5)(3)$

$W = 22.5\,J$

C) Find the E_K of the block after the 3 meters.



$E_K = 60 - 22.5 = W_{Total}$

$E_K = 37.5\ J$

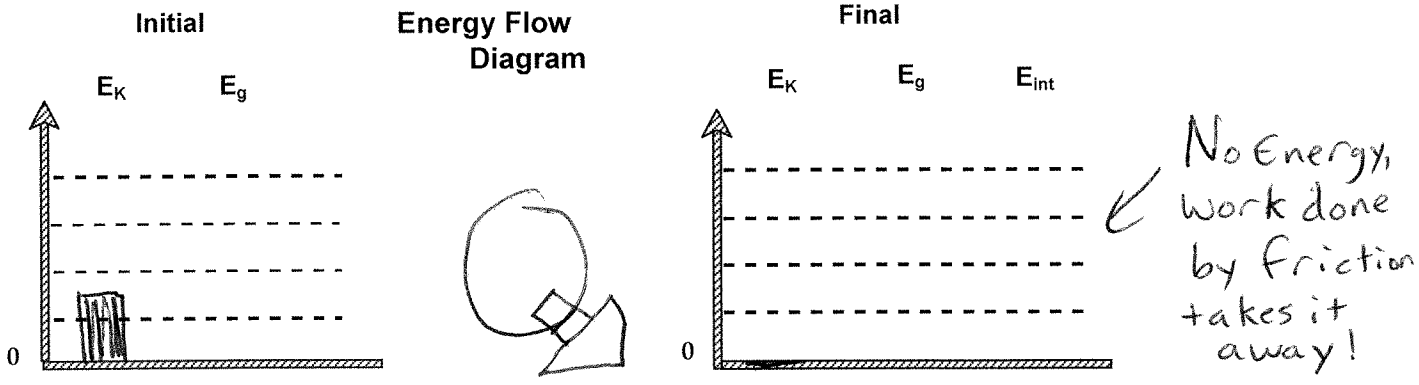
D) Find the speed of the box after the 3 meters.

$E_K = \frac{1}{2}mv^2$

$37.5 = \frac{1}{2}(4.25)v^2$

$v = 4.2\ m/s$

E) Once the person pushes the ~~box 3 meters, he stops~~ applying the 20 N force. How far will the block slide before it comes to rest?



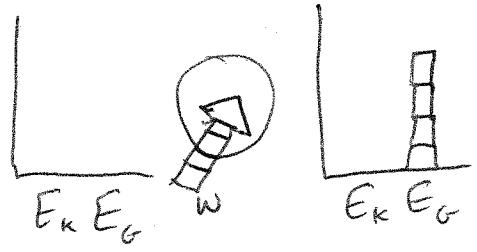
$W = Fd$ ← Friction stops it!

$37.5 = (7.5)(d)$

$d = 5\ m$

4. An elevator lifts a 1500 kg car a distance of 21 meters in 15 seconds.

a. What is the work done by the motor in lifting the elevator?



$W \rightarrow E_G$

$W = mgh$

$W = (1500)(9.8)(21)$

$W = 308,700\,J$

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

$P = \frac{308\,700}{15}$

$P = 20580\,W$

b. What is the power of the motor?

5. A 1200 kg car reaches a speed of 18 m/s in 5.2 seconds.

a. What is the kinetic energy of the car?

$E_K = \frac{1}{2} mv^2$

$E_K = \frac{1}{2}(1200)(18)^2$

$E_K = 194,400\,J$

b. What is the power of the motor?

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

$P = \frac{194,400}{5.2}$

$P = 37,385\,W$