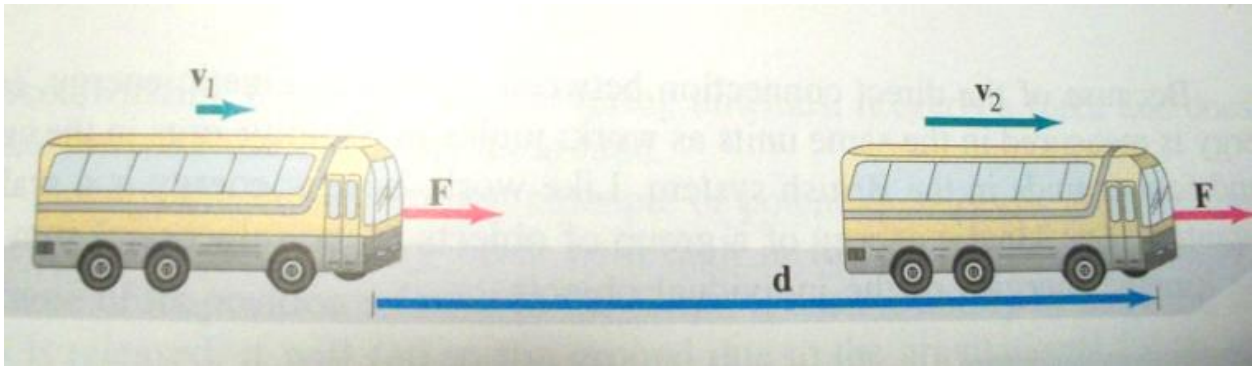
STE
Extra Work/Energy Problems



8. a) A constant force acts on a 2000 kg bus in order to accelerate it from 15 to 20 m/s in 5 seconds. (recall: $\frac{v_f - v_i}{t_f - t_i} = a$). The force is applied over a distance of 87. 5m. Find the work being done on the bus.

$$\frac{v_f - v_i}{t_f - vt_i} = a$$

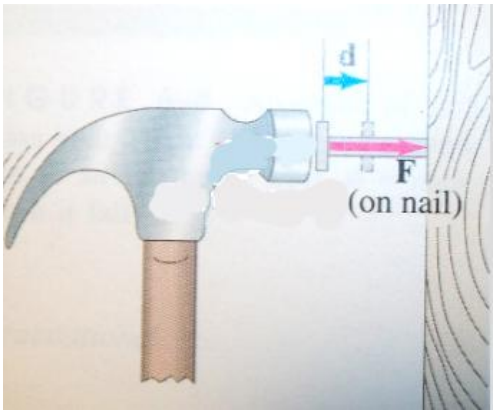
$$\frac{(20 - 15)\ m/s}{(5 - 0)s} = 1\ m/s^2$$

F = ma
= 2000(1) = 2000 N
W = F*d = 2000N (87.5)m = 175 000 J
(important: effective force is being used: same direction as displacement of bus)

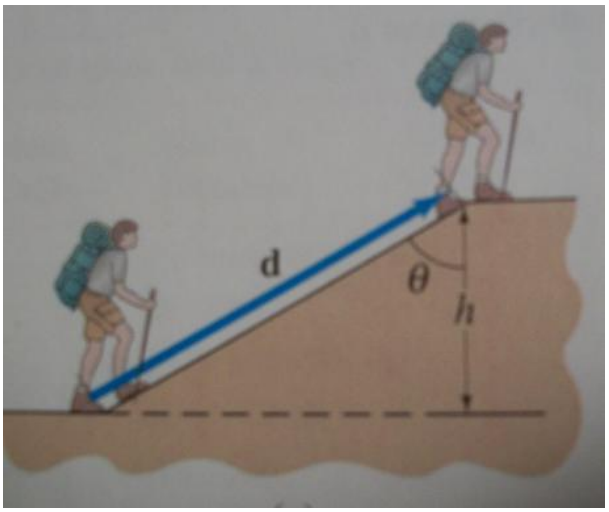
b) What is the change in the kinetic energy of the bus?

Same as work = 175 500 J
Not convinced?
$Ek_{final} - Ek_{original} = 0.5\ mv_f^2 - 0.5\ mv_i^2 = 0.5m(v_f^2 - v_i^2) = 0.5(2000)(20^2 - 15^2) = 175\ 000$ J

9. 3.6 J of work are done to drive a nail 2 cm deeper into a piece of wood. What force was applied?



W = F*d
1 J = 1 Nm
3.6 Nm = F(0.02 m)
F = 3.6/0.02 = 180 N



10. a) If a 75 kg man walks up the hill, ignoring friction, what continuous force must he apply to climb the hill if the angle shown is 70^{o}?

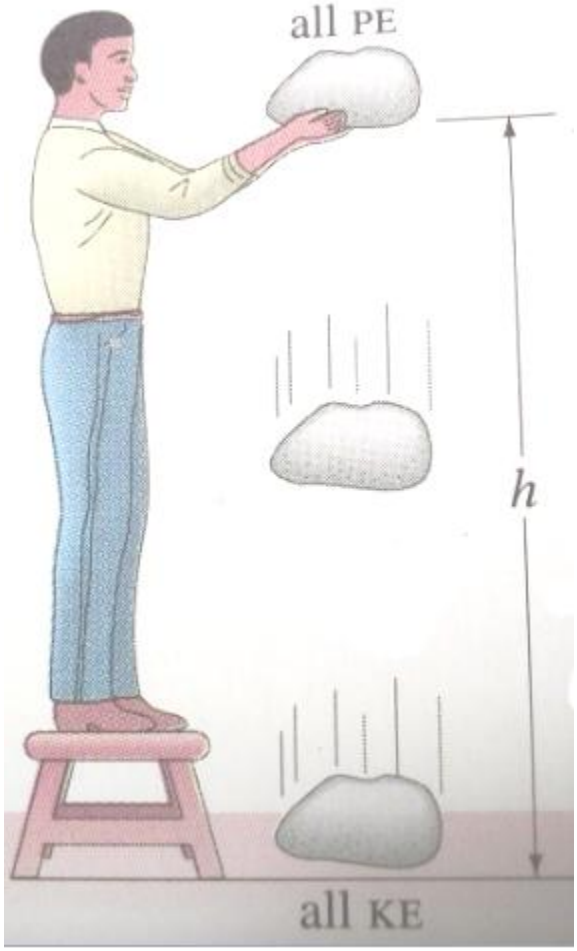
First realize that the angle of inclination is the one below his foot = $90^{o} - 70^{o} = 20^{o} = \emptyset$.

F effective = $mg\sin\emptyset = 75(9.8)\sin 20 = 251.384$ N

b) Show two ways of obtaining the work done by the man if d = 100 m.

$W = F_{effective} * d = 251.384N * 100 = 25\ 138$ J
Ep = mgh
But $h = d\cos\theta = 100\cos 70 = 34.20$ m
Ep = 75*9.8*(34.20) = 25 138 J

11. How fast is the rock travelling when it is halfway down? Total height = 4.0 m.



On top: total energy = potential + kinetic = mgh + 0(not moving) = mgh
total energy halfway = $mg(h/2) + 0.5mv^2$

but total energy does not change:
$mgh = mg(h/2) + 0.5mv^2$ (if the rest confuses you, you can start plugging in numbers right way here and solve for v)

m cancels:
$gh = g(h/2) + 0.5v^2$
$gh - g(h/2) = 0.5v^2$
$0.5gh = 0.5v^2$.
$gh = v^2$.

$$v = \sqrt{gh}$$
$$v = \sqrt{9.8(4)} = 6.26\ m/s$$