NAME: KEY

Work and Power Practice

1. On his way off to college, Huan drags his suitcase 15.0 m from the door of his house to the car at a constant speed with a horizontal force of 95 N.
   a. How much work does Huan do to overcome friction?

$W = Fd$ $W = (95)(15)$ $W = 1425\ J$

   b. Against what force does Huan do work?

Friction

2. Saanvi, a 30 kg child, climbs a tree to rescue her cat that is afraid to jump 8.0 m to the ground. (Saanvi is evidently fearless.)
   a. Against what force does Saanvi do work?

Gravity. (She went up)

   b. How much work does Saanvi do?

The work she did gave her Potential Energy - so calculate that!

$PE = mgh$ $PE = (30)(10)(8) = 2400\ J$

3. Marina does 3.2 J of work to lower the window shade in her bedroom a distance of 0.80 m. How much force must Marina exert?

$W = Fd$ $3.2 = F(.8)$

$F = 4\ N$

4. At Six Flags, a ride called the Wicked Cyclone is a giant steel/wooden roller coaster. The height of the first hill is 33 meters. The train of cars has a mass of 4500 kg. (I am actually guessing on the mass, but the height is correct.)
   a. How much work is required to get the train of cars from the ground to the top of the first hill?

The work turns into Potential Energy - so calculate PE gained!

$PE = mgh$ $PE = (4500)(10)(33)$

$PE = 1,485,000\ J$

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b. What power is generated to bring the train of cars up in 30 s?

$P = \frac{W}{t}$ $P = \frac{1,485,000}{30}$ $P = 49,500\ W$

c. How fast are the car moving at the bottom of the first hill?

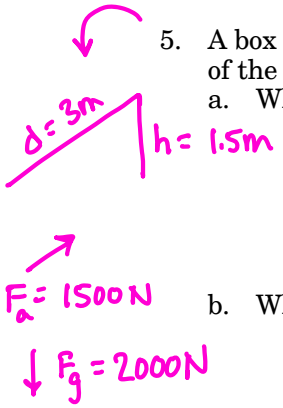
Then the PE turns into KE so

$KE = \frac{1}{2}mv^2$ $1,485,000 = \frac{1}{2}(4500)v^2$

$v^2 = 660$ $v = 25.7\ m/s$

5. A box weighing 2000 N is dragged up a 3 m long incline with an applied force of 1500 N. The top of the incline is 1.5 m above the ground.

a. When dragging the box along the incline, how much work is done by the applied force?



$W = Fd$ $W = (1500)(3)$ $W = 4500\ J$

b. What is this work done against? (*Hint: you are fighting two other forces.*)

Both friction and gravity. (So it turns out that the work done by the applied force turns in Potential Energy and Thermal Energy.)

c. If you lifted the box straight up to a height of 1.5m, how much work would you do?

Then you would be giving only PE (no friction to fight.)

So $PE = mgh$ $PE = (2000)(1.5)^*$ $PE = 3000\ J$

* weight of 2000 N means $mg = 2000$

d. What force do you do work against when lifting the box?

only gravity.

e. Why use a ramp if it requires more work?

It still ends up being easier because it requires less force.

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6. Jack (30 kg) and Jill (20 kg) went up the hill to see who could generate the most power when doing work against gravity. They ran up a hill with a vertical height of 12 m. Jack reached the top in 6.8 seconds and Jill reached the top in 5.0 seconds.
   a. Who did more work?

They gave themselves PE, so find that!

Jack: $PE = mgh$
$= (30)(10)(12)$
$= 3600\,J$

Jill: $PE = mgh$
$= (20)(10)(12)$
$= 2400\,J$

So Jack

   b. Who was more powerful?

Jack: $P = \frac{W}{t}$
$P = \frac{3600}{6.8}$
$P = 529\,W$

Jill: $P = \frac{W}{t}$
$P = \frac{2400}{5}$
$P = 480\,W$

Jack

7. Gary holds a 4 N book stationary 2 m above the ground. How much work does Gary do on the book?

$W = Fd$ $F = 4N$ but $d = 0$ m! If didn't move!

So $W = (4)(0)$

$W = 0\,J$

(Yes, the "2m above the ground" was useless information.)

Answers:

1. a) 1425 J b) friction 2.a) gravity b) 2400 J 3) 4 N
4. a) 1,485,00 J b) 49,500 W c) 25.7 m/s
5. a) 4500 J b) friction & gravity c) 3000 J d) only gravity e) still requires less force
6. a) Jack = 3600 J & Jill = 2400 J b) Jack = 530 W & Jill = 480 W
7) none. (its not moving, so no displacement, so no work is done.)