Please turn in Homework # 4 as you come in.

If you weren’t here on Wednesday, I still have a few copies of Wednesday’s handouts.
You lift a 1 kg ball from the ground at rest to a height of 1 m above the ground and then hold it there at rest. How much work do you do on the ball in moving it? (Take $g \approx 10 \text{ m/s}^2$.)

(A) +10 J

(B) You do no work because the ball begins and ends at rest.

(C) −10 J

(D) None of the above.
Suppose you want to ride your mountain bike up a steep hill. Two paths lead from the base to the top, one twice as long as the other. Compared to the average force you would exert if you took the short path, the average force you exert along the longer path is

(A) one-fourth as large.
(B) one-third as large.
(C) one-half as large.
(D) the same.
(E) twice as large.
(F) undetermined — it depends on the time taken
A piano mover raises a 100 kg piano at a constant rate using the pulley system shown here. With how much force is she pulling on the rope? (Ignore friction and assume $g \approx 10 \text{ m/s}^2$.)

(A) 2000 N
(B) 1500 N
(C) 1000 N
(D) 750 N
(E) 500 N
(F) 200 N
(G) 50 N
(H) impossible to determine.
Believe it or not, this relates to architecture!

My friend and I both want to hang on to a rope by our hands, perhaps because being up above the ground lets us peek over a tall fence and see into an amazing new construction site next door.

We consider two different methods of hanging onto the rope. In the first method, I hold the rope with my hands, about 5 meters off the ground, and my friend (whose mass is the same as mine) holds the rope with his hands, about 3 meters off the ground.

In the second method, I told the rope with my hands, as before, and my friend holds onto my feet (instead of the rope).

Let’s draw a picture, to make it more clear.
1st method

I hold rope

Friend holds rope

2nd method

I hold rope

Friend holds my feet
The downward force of my hands on the rope is ... 

(A) The same for both methods: equal to \( mg \) \((m = \text{my mass})\)

(B) The same for both methods: equal to \( 2mg \)

(C) Twice as much for 1st method \((2mg \text{ vs. } mg)\)

(D) Twice as much for 2nd method \((2mg \text{ vs. } mg)\)
Kansas City Hyatt Regency skywalk collapse

On 7\textsuperscript{th} July 1981, a dance was being held in the lobby of the Hyatt Regency Hotel, Kansas City. As spectators gathered on suspended walkways above the dance floor, the support gave way and the upper walkway fell on the lower walkway, and the two fell onto the crowded dance floor, killing 114 people and injuring over 200.

For more like this, read \textit{To Engineer is Human} by Henry Petroski.
As designed, each of the two skywalks hangs onto the rope with its own hands. As built, the lower skywalk’s hands are effectively hanging onto the upper skywalk’s feet! So the upper skywalk’s grip on the rope feels $2 \times$ larger force than in original design. Oops!
Look! A real use for free-body diagrams!

*Fig. 6: Free-Body Diagram (a) As Designed (b) As Built*

I don’t know why the author uses the symbol $P$ for force. When you see “$P$” here, pretend it says “$F$” or “$mg$” instead.
Upper skywalk loses its grip on the “rope”

**Fig. 7: Pulled-Out Rod at Fourth-Floor Box Beam**
A spring-loaded toy dart gun is used to shoot a dart straight up in the air, and the dart reaches a maximum height of 8 m. The same dart is shot straight up a second time from the same gun, but this time the spring is compressed only half as far before firing. How far up does the dart go this time (neglecting friction)?

(A) 1 m  
(B) 2 m  
(C) 4 m  
(D) 8 m  
(E) 16 m  
(F) 32 m
Stretching a certain spring 0.10 m from its equilibrium length requires 10 J of work. How much more work does it take to stretch this spring an additional 0.10 m from its equilibrium length?

(A) No additional work
(B) An additional 10 J
(C) An additional 20 J
(D) An additional 30 J
(E) An additional 40 J
Spring B is stiffer than spring A. Which one has more energy stored in it if you (1) compress both springs with the same force and (2) compress both springs the same displacement from their equilibrium lengths?

(A) Same energy is stored in both cases
(B) Stiffer spring stores more energy in both cases
(C) Stiffer spring stores less energy in both cases
(D) Stiffer spring stores more energy in case (1), less energy in case (2)
(E) Stiffer spring stores less energy in case (1), more energy in case (2)
67. A car accelerates from rest along a straight horizontal road. Considering the motion of the car from rest until it moves at speed \( v \), which of following work-energy diagrams correctly accounts for the energy changes in the system comprising just the car?

1. [Diagram 1]
2. [Diagram 2]
3. [Diagram 3]
4. [Diagram 4]
5. [Diagram 5]
6. [Diagram 6]
7. None of the above
At the bowling alley, the ball-feeder mechanism must exert a force to push the bowling balls up a 1.0 m long ramp. The ramp leads the balls to a chute 0.5 m above the base of the ramp. About how much force must be exerted on a 5.0 kg bowling ball?

(A) 200 N  (B) 100 N  (C) 50 N  
(D) 25 N  (E) 5.0 N  (F) impossible to determine.
A block initially at rest is allowed to slide down a frictionless ramp and attains a speed $v$ at the bottom. To achieve a speed $2v$ at the bottom, how many times as high must a new ramp be?

(A) 1  
(B) 2  
(C) 3  
(D) 4  
(E) 5  
(F) 6
Two marbles, one twice as heavy as the other, are dropped to the ground from the roof of a building. Just before hitting the ground, the heavier marble has

(A) the same kinetic energy as the lighter one.
(B) twice as much kinetic energy as the lighter one.
(C) half as much kinetic energy as the lighter one.
(D) four times as much kinetic energy as the lighter one.
(E) impossible to determine.
Suppose you drop a 1 kg rock from a height of 5 m above the ground. When it hits, how much force does the rock exert on the ground? (Take $g \approx 10 \text{ m/s}^2$.)

(A) 0.2 N
(B) 5 N
(C) 50 N
(D) 100 N
(E) impossible to determine.