PhyzSpringboard
Conservation of Energy

LEVEL I: THE FLOW OF ENERGY

1. Suppose Belly-flop Benny were to climb a ladder to a diving platform some height above the ground.

a. When he's at rest on the ground, what is his potential energy? His kinetic energy? Label these values appropriately in the diagram.

b. What kind of energy does he gain by climbing the ladder and how does he get it?

Potential energy; he gets PE from the work he does climbing the ladder.

c. When he dives, he moves from the diving platform to the pool. What happens to his potential energy on the way down?

PE transforms into KE.

2. Suppose he gains 10,000 J of potential energy by climbing to the diving platform.

a. How much work was done in the process?

10,000 J

b. What is his kinetic energy as he stands at the edge of the platform? Label it in the diagram.

3. Suppose he dives into a pool of water near the base of the ladder.

a. What is his potential energy right before he enters the water? Label it in the diagram.

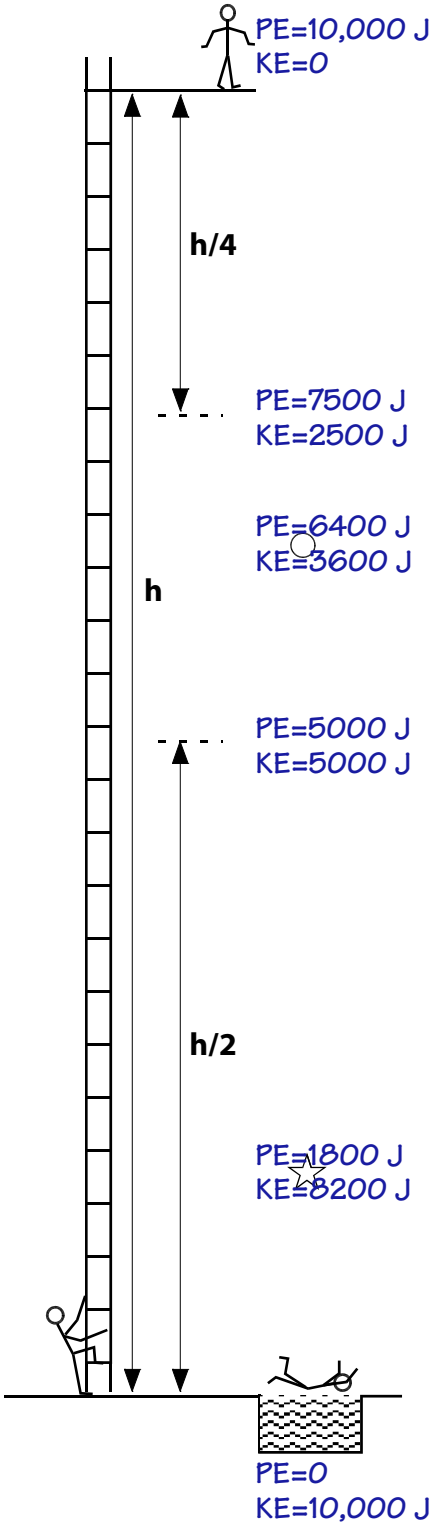
b. What is his kinetic energy right before he hits the water? Label it in the diagram.

c. Determine and label the values of Benny's potential and kinetic energy when he's half way down.

d. Determine and label the values of Benny's potential and kinetic energy when he's a quarter of the way down.

e. When Benny reaches the level shown with the star, his kinetic energy is 8200 J. Determine the value of his potential energy at that point and label both.

f. When Benny reaches the level shown with the circle, his potential energy is 6400 J. Determine the value of his kinetic energy at that point and label both.



Thanks: Paul Hewitt

LEVEL II: MASS AND HEIGHT

4. Suppose $g = 10$ m/s^2 and Belly-flop Benny has a mass of 100 kg.

a. What is the height of the diving platform? Hint: Consider the equation for potential energy and solve it for h.

PE = mgh so
h = PE/mg = 10,000 J / 100kg · 10 m/s^2 = 10 m

b. What's the height of the circle?

h = PE/mg = 6400 J / 100kg · 10 m/s^2 = 6.4 m

c. When Benny has a kinetic energy of 7700 J, what is his height above the ground?

KE = E – PE = 10,000 J – 7700 J = 3300 J
h = PE/mg = 3300 J / 100kg · 10 m/s^2 = 3.3 m

LEVEL III: SPEED

5. a. What is Belly-flop Benny's impact speed when he hits that water? Hint: Consider the equation for kinetic energy and solve for speed.

KE = 1/2mv^2 so
v = 2KE/m = 2·10,000 J / 100kg = 14 m/s

b. What is Benny's speed when he's half way down?

v = 2KE/m = 2·5000 J / 100kg = 10 m/s

c. When Benny has a potential energy of 8100 J, what is his speed?

KE = E – PE = 10,00 J – 8100 J = 1900 J
v = 2KE/m = 2·1900 J / 100kg = 6.2 m/s

LEVEL IV: SPEED TO HEIGHT

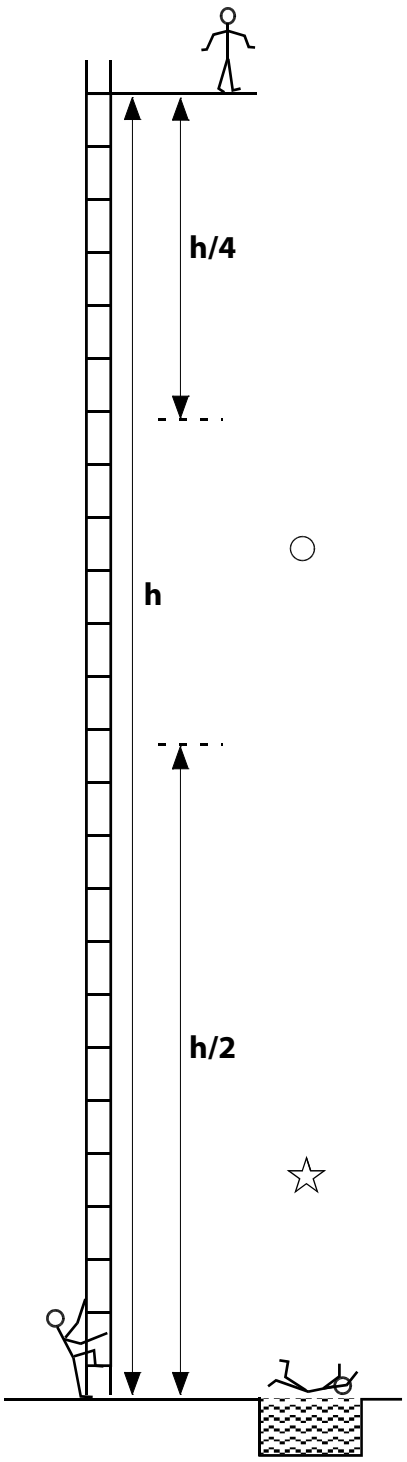
6. When Benny is moving at 5 m/s, what is his height above the ground? Hint: Determine his kinetic energy, then potential energy, then height.

KE = 1/2mv^2 = 0.5 · 100 kg · (5 m/s)^2 = 1250 J
PE = E – KE = 10,000 J – 1250 J = 8750 J
h = PE/mg = 8750 J / 100 kg · 10 m/s2 = 8.8 m

LEVEL V: HEIGHT TO SPEED

7. When Benny is 2.4 m above the ground, what is his speed?

PE = mgh = 100 kg · 10 m/s^2 · 2.4 m = 2400 J
KE = E – PE = 10,000 J – 2400 J = 7600 J
v = 2KE/m = (2 · 7600 J / 100 kg) = 12 m/s



EPILOG: BACK TO LEVEL I

8. After splashdown, Benny's potential energy and kinetic energy are gone. Gone where?

To the water: splash and warming; to the air: sound.