PhyzSpringboard: Take a Flying Leap

Felix

CHANGING MOMENTUM

1. When a stationary baseball is hit by a bat, an impact force significantly changes the ball's momentum.

2. When an ocean-going oil-tanker coasts to a stop before arriving at port, a force significantly changes the ship's momentum.

3. Since we use *p* to represent **momentum**, how could we denote the **change** in momentum of an object?

   Δp

4. We also have a **term** for change in momentum. It is

   impulse.

5. Equations: $\Delta p = \Delta (mv) = m\Delta v$

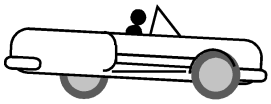
MOMENTUMOUS OCCASIONS

1. Which activity would require more impulse?

___ accelerating a soccer ball from rest to 10 m/s
√ accelerating a medicine ball from rest to 10 m/s
___ same for both
Explain.

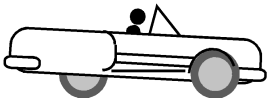
Medicine ball has more mass.

2. Which activity would require more impulse?



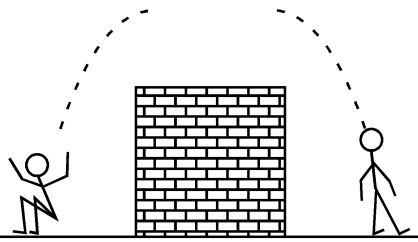
___ slowing a car from 60 mph to 40 mph
√ slowing the same car from 40 mph to 10 mph
___ same for both
Explain.

Bigger change in velocity for second car.



3. Which activity would require more impulse?
___ landing from a jump while flexing the legs (bending at the knees)
___ landing from a jump while keeping the legs straight (locking knees)
√ same for both
Explain.

Same mass;
same change in velocity



NEWTON REVISITED

1. Write Newton's second law of motion as he **originally** wrote it.

$F = \Delta p / \Delta t$

2. Rewrite that expression, solving for impulse.

$\Delta p = F \Delta t$

3. Which method of landing from a jump involves the greater impulse (the greater change in momentum)?

___ flexing the legs ___ locking the legs ✓ same for both

4. In light of this, why is it better to flex the legs when landing from a jump?

Flexing legs extends the impact time.
Extending the impact time reduces the impact force.

$F \Delta t$ $F \Delta t$

FLEX LOCK

5. Discuss the two impulses described in the "Changing Momentum" section above.

T-ball: short time (abrupt force)
Tanker: long time

FLYING LEAPS

1. Felix and Digby are into extreme adventures. They want to jump off a high bridge in New Zealand. And live to do it again sometime. They agree they should tie one end of a cord of some sort around their waist and attach the other end to the bridge. Felix says they should use a stretchy, rubber (bungee) cord. Digby says they should use a strong metal cable. Who's right and why?

Metal cable: short impact time;
big impact force.
Bungee cord: long impact time;
small impact force.

2. What is the "physics reason" for padding dashboards?

Padding increases impact time; reduces impact force.

3. When do pole vaulters and film stunt artists employ this kind of physics?

When they fall into cushioned landing bags.