Activity AP4.20 Change of momentum (1)

Remember

momentum (kg m/s) = mass (kg) × velocity (m/s)

- Velocity and momentum have size *and* direction.
- Mass just has size.

In any contact between two objects

- the change in momentum of one object is equal and opposite to the change in momentum of the other

In these questions assume that

- motion to the right is the positive direction
- motion to the left is the negative direction

To calculate

1 A boat of mass 7000 kg is floating without moving, close to a pier. It is not tied up. A woman of mass 70 kg is standing on the boat. The woman jumps from the boat to the pier at 3 m/s.

a Will the boat move? If so, which way?

b What was the total momentum of the woman plus the boat before she jumped?

c What is the momentum of the woman as she jumps?

d What is the momentum of the boat just after the woman jumps?

e How fast will the boat move?

2 A man of mass 70 kg is standing on the ice of a frozen lake. The ice is so smooth and frictionless that he cannot get any grip to start moving. He realizes that he can start moving towards the shore if he throws away his rucksack, which has a mass of 2 kg. He throws the rucksack to the east at 15 m/s.

a Which way will the man move?

b What is the momentum of the rucksack as he throws it away?

c What is the momentum of the man after he throws the rucksack away?

d How fast will the man move?

Activity AP4.20 Change of momentum (1)

3 A bullet with mass 0.005 g is fired from a rifle of mass 5 kg. The bullet has a speed of 400 m/s towards the right.

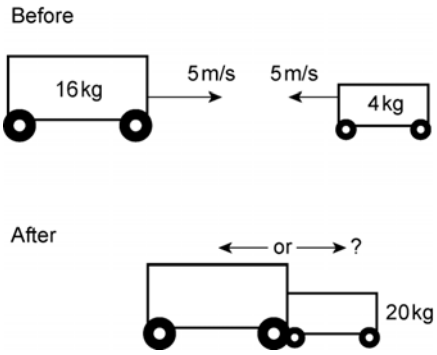
a Explain why the rifle jumps backward (recoils) as the bullet is fired.

b What is the momentum of the bullet?

c What must be the momentum of the rifle as it recoils?

d How fast is the initial backwards movement of the rifle?

4 A 16 kg trolley is travelling to the right at 5 m/s when it collides with, and sticks to, a 4 kg trolley that is moving to the left at 5 m/s. The trolleys now move together.



a What was the momentum of the 16 kg trolley before the collision?

b What was the momentum of the 4 kg trolley before the collision?

c What was the total momentum before the collision?

d What was the total momentum after the collision?

e Which way will the joined trolleys move after the collision, and how fast?