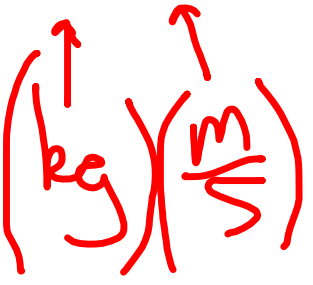
Range of Possible Collisions

Momentum

$$p = mv$$

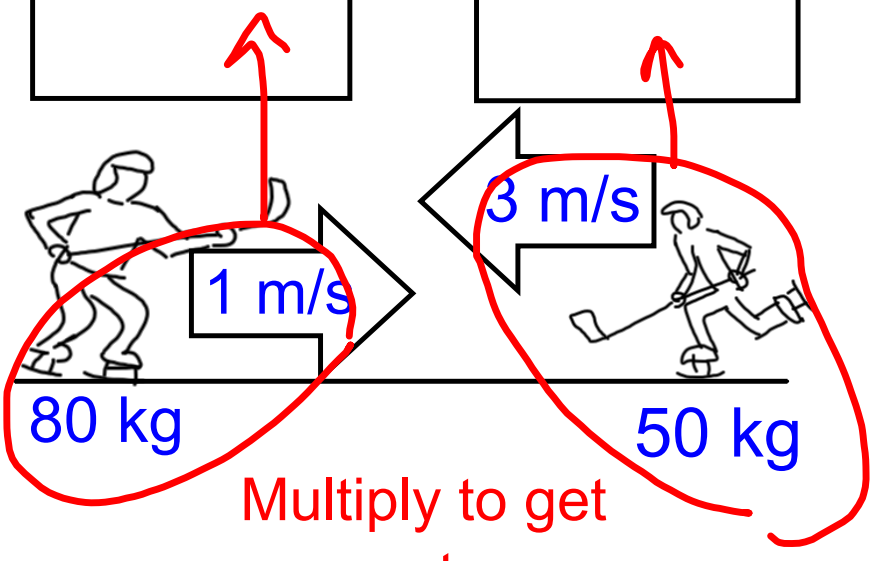


If velocity is left, it's negative!

Calculating Total Momentum Before a Collision

total momentum

LEFT = NEGATIVE



Multiply to get momentum

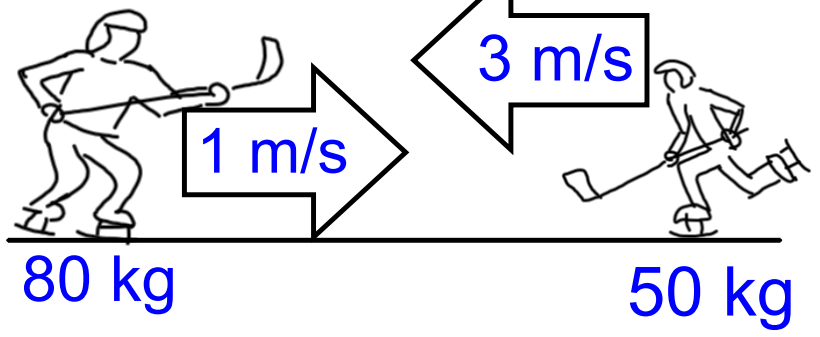
After collision:

- ☐ Goes left
- ☐ Goes right
- ☐ Stops

Calculating Total Momentum Before a Collision

LEFT = NEGATIVE

total momentum



After collision:

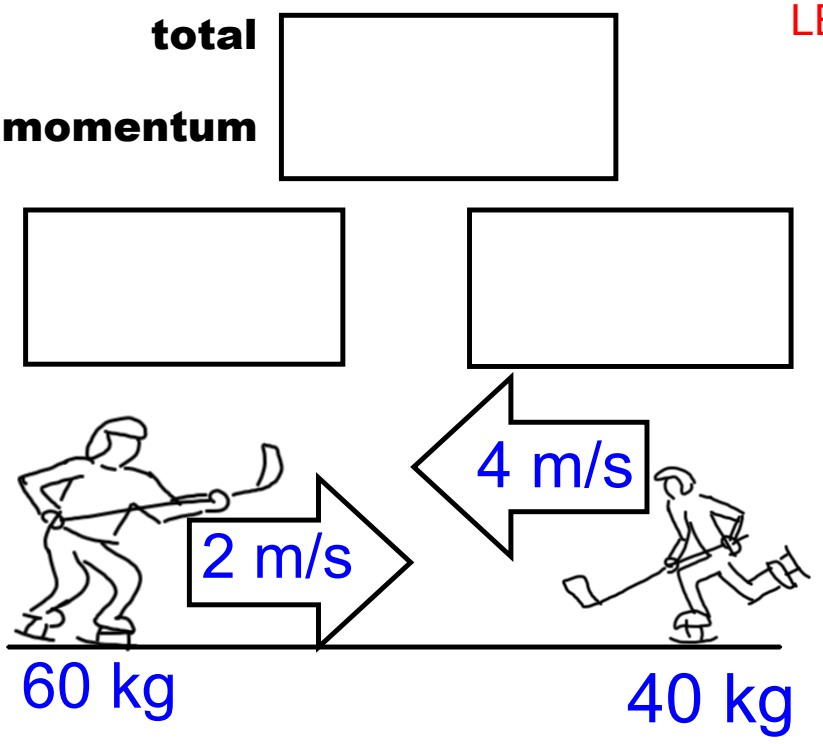
- ☐ Goes left
- ☐ Goes right
- ☐ Stops

Goes left because the total momentum is negative.

Calculating Total Momentum Before a Collision

total momentum

LEFT = NEGATIVE



After collision:

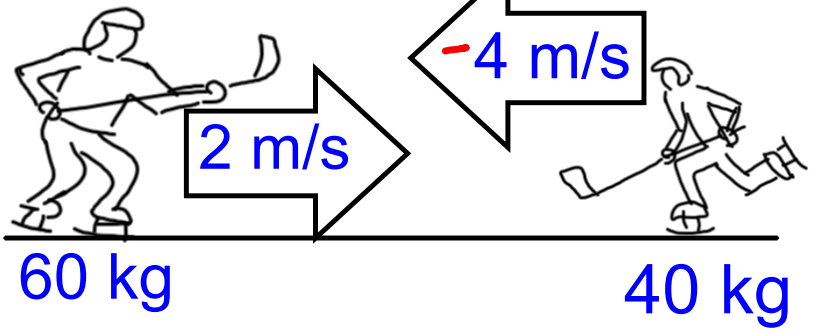
- ☐ Goes left
- ☐ Goes right

Calculating Total Momentum Before a Collision

total momentum $-40\ \frac{kg\cdot m}{s}$

LEFT = NEGATIVE

$120\ \frac{kg\cdot m}{s}$ $-160\ \frac{kg\cdot m}{s}$

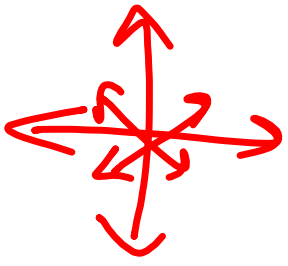


After collision:

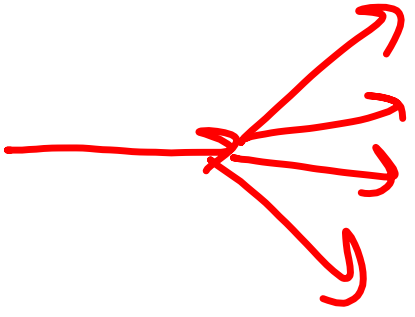
- ☑ Goes left
- ☐ Goes right

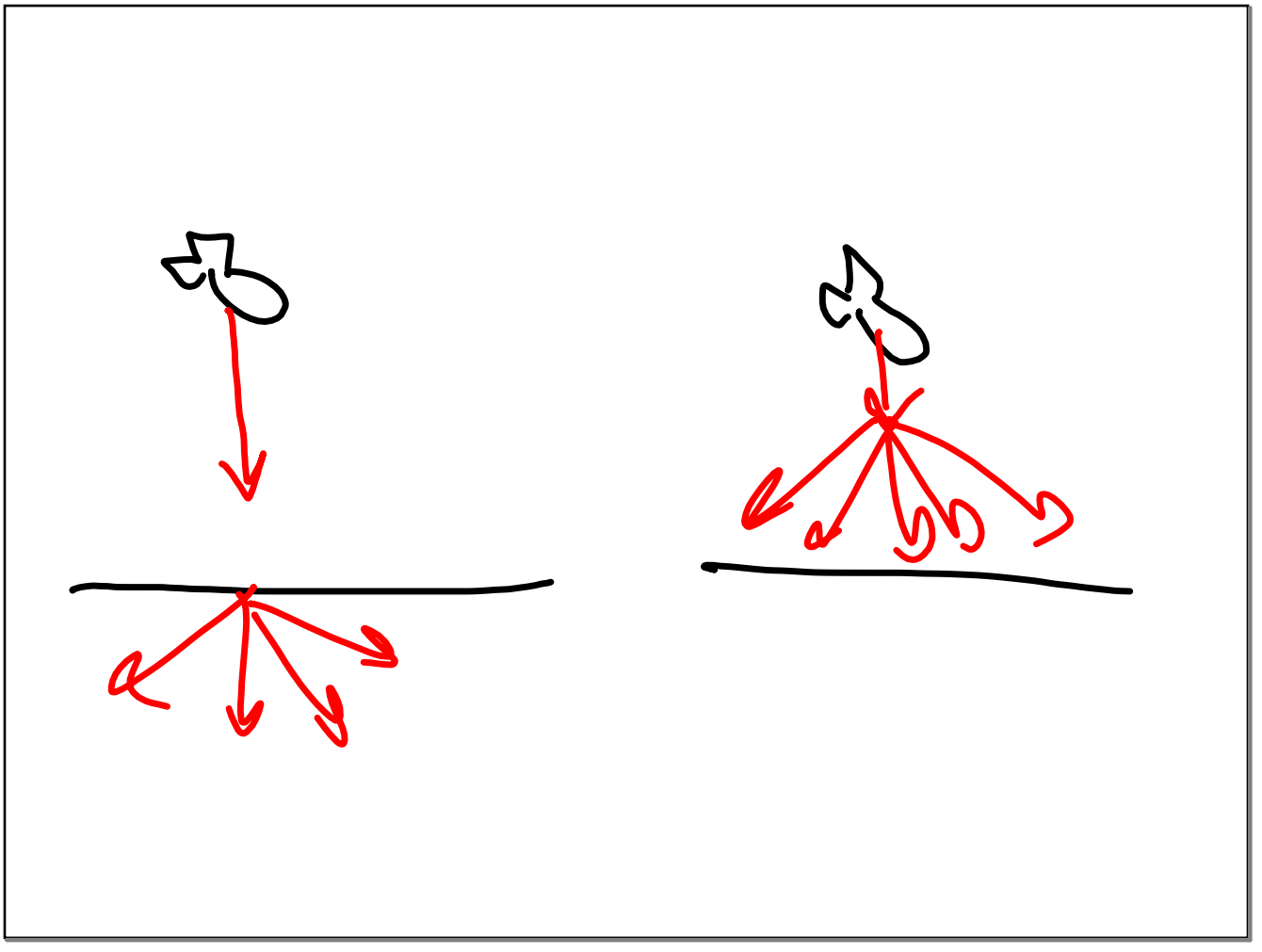
Explosions

If they start with
NO momentum

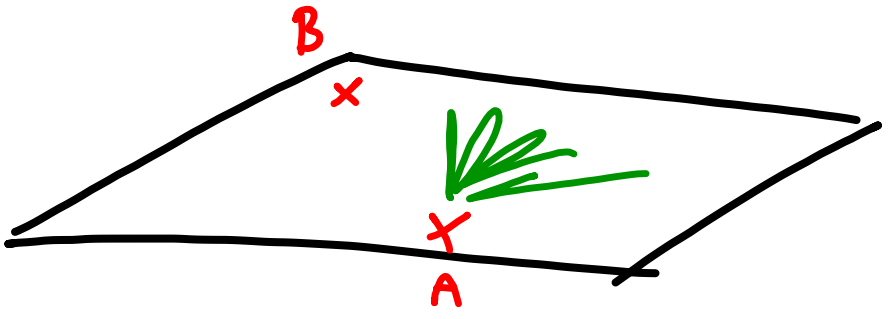


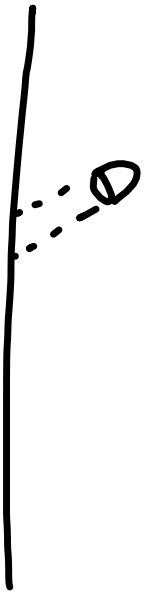
If they start with
SOME momentum





Forensics

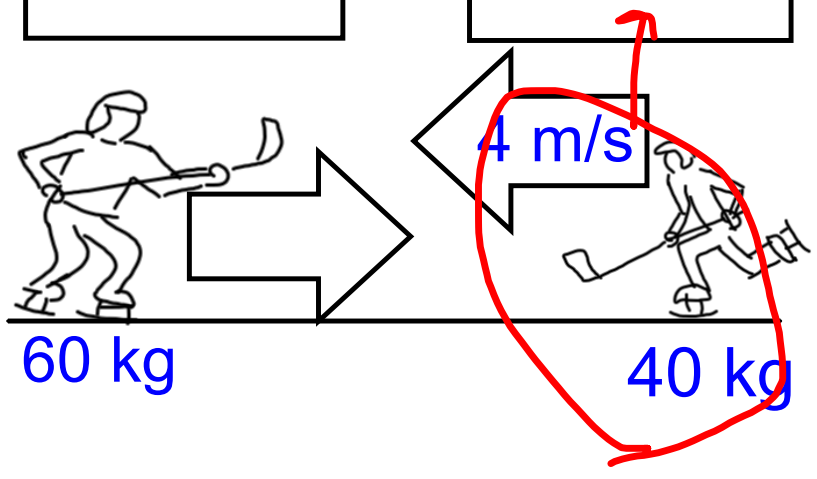




Calculating Total Momentum Before a Collision

total momentum -40 kgm/s

LEFT = NEGATIVE



After collision:

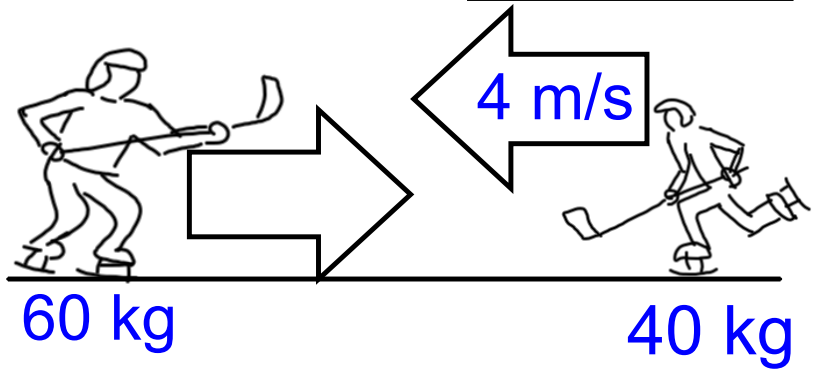
- ☐ Goes left
- ☐ Goes right

Multiply. Then that momentum plus the unknown momentum must make the total.

Calculating Total Momentum Before a Collision

total momentum -40 kgm/s

LEFT = NEGATIVE



After collision:

- ☐ Goes left
- ☐ Goes right

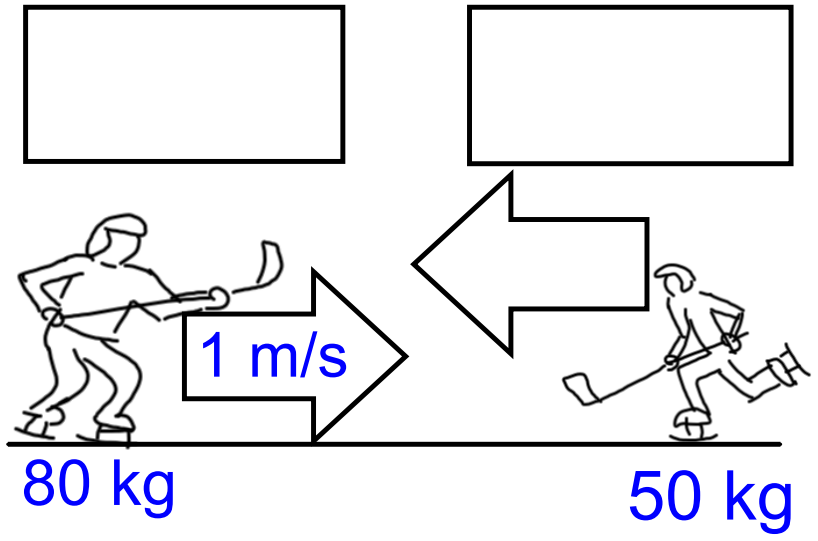
call the unknown momentum x.

Then divide to get the velocity.

Calculating Total Momentum Before a Collision

LEFT = NEGATIVE

total momentum -70 kgm/s



After collision:

- ☐ Goes left
- ☐ Goes right
- ☐ Stops

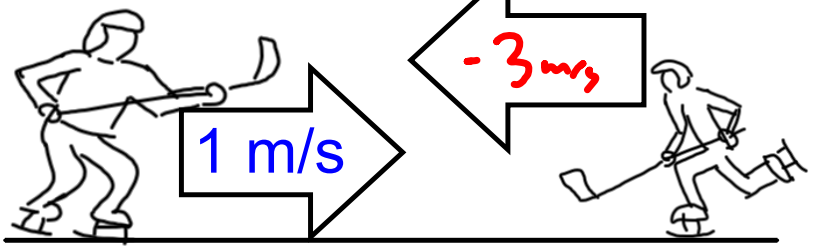
Calculating Total Momentum Before a Collision

LEFT = NEGATIVE

total momentum -70 kgm/s

80 kgm/s

X = -150 kgm/s



80 kg 50 kg

After collision:

- ☐ Goes left
- ☐ Goes right
- ☐ Stops

$X + 80 = -70$

$-80 \quad -80$

$X = -150$ kgm/s

Kinetic Energy

$\left(\frac{m}{2}\right)v^2$

Predicts

How hard it is to stop.

Damage it can do.

Speed at the bottom of a hill

Momentum

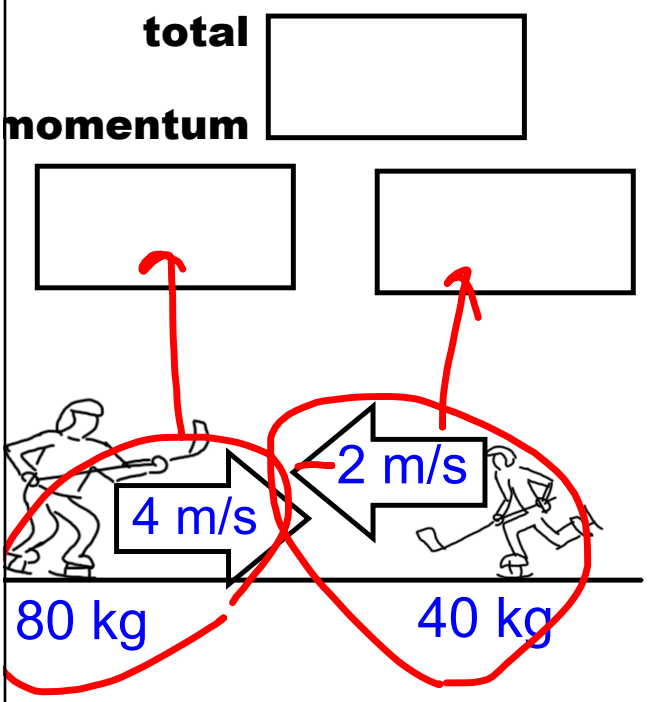
The Law of Conservation of Momentum

Total Momentum BEFORE a Collision = **Total Momentum AFTER a Collision**

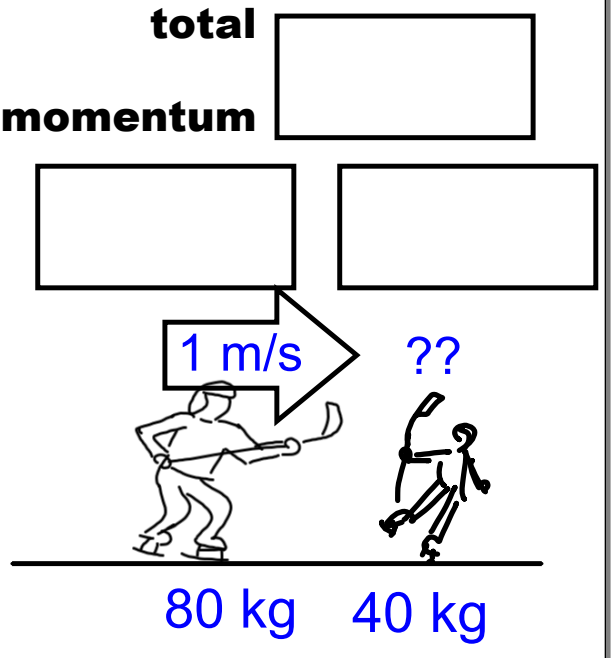
(If there are no outside forces)

Calculating Total Momentum Before a Collision

LEFT = NEGATIVE



Find the total momentum just like you've done.



The total after has to be the same.

Calculating Total Momentum Before a Collision

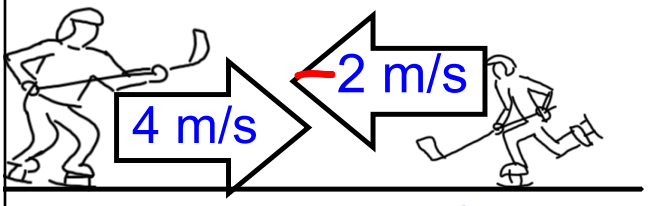
LEFT = NEGATIVE

SAME

total momentum 240 kg m/s

320 kg m/s

−80 kg m/s

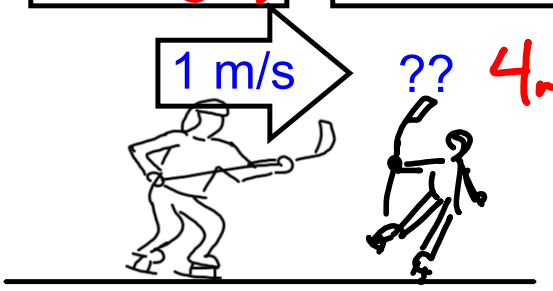


80 kg 40 kg

total momentum 240 kg m/s

80 kg m/s

160 kg m/s



80 kg 40 kg

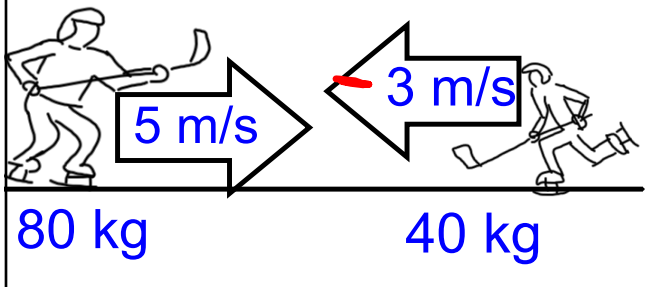
−80 −80

X = 160

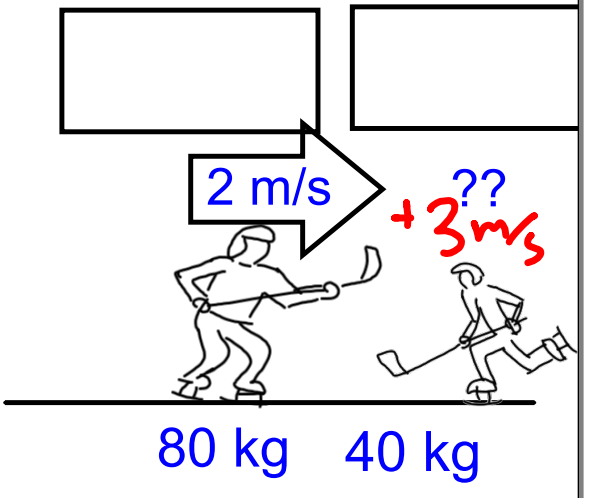
Calculating Total Momentum Before a Collision

LEFT = NEGATIVE

total momentum 280 kg m/s

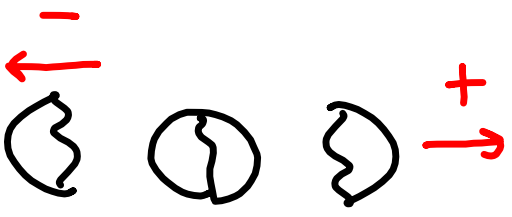


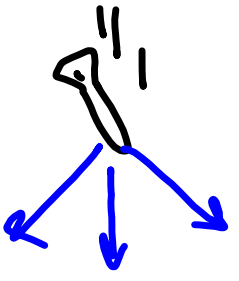
total momentum



Momentum never appears or disappears, it can only be transfered around by exerting impulses (force x time)

Total Momentum is still there even after collisions and explosions

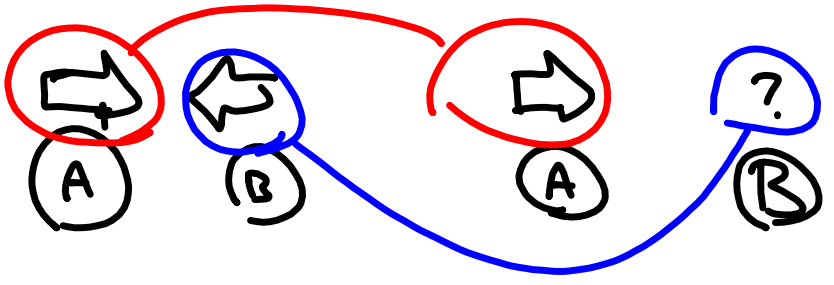


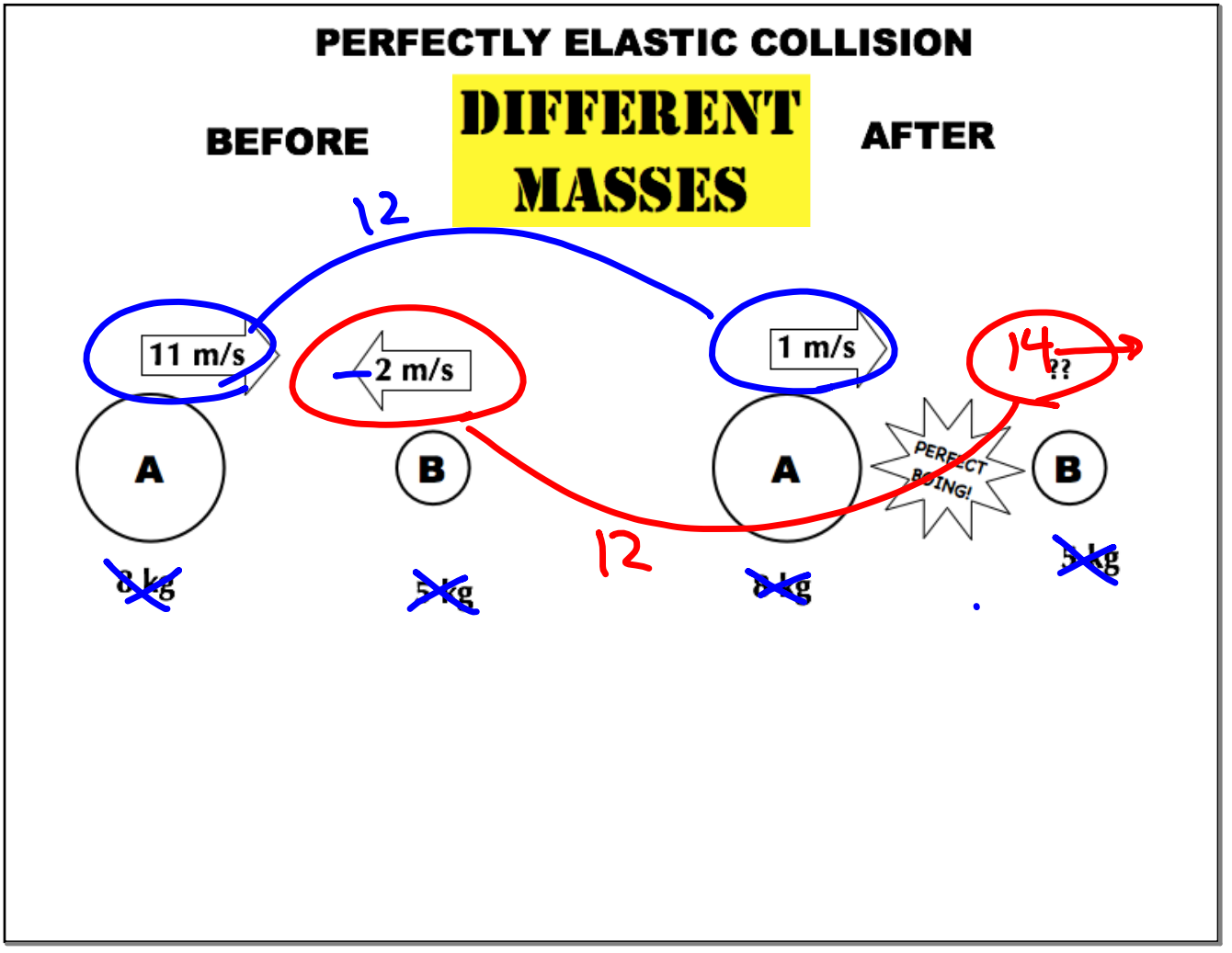


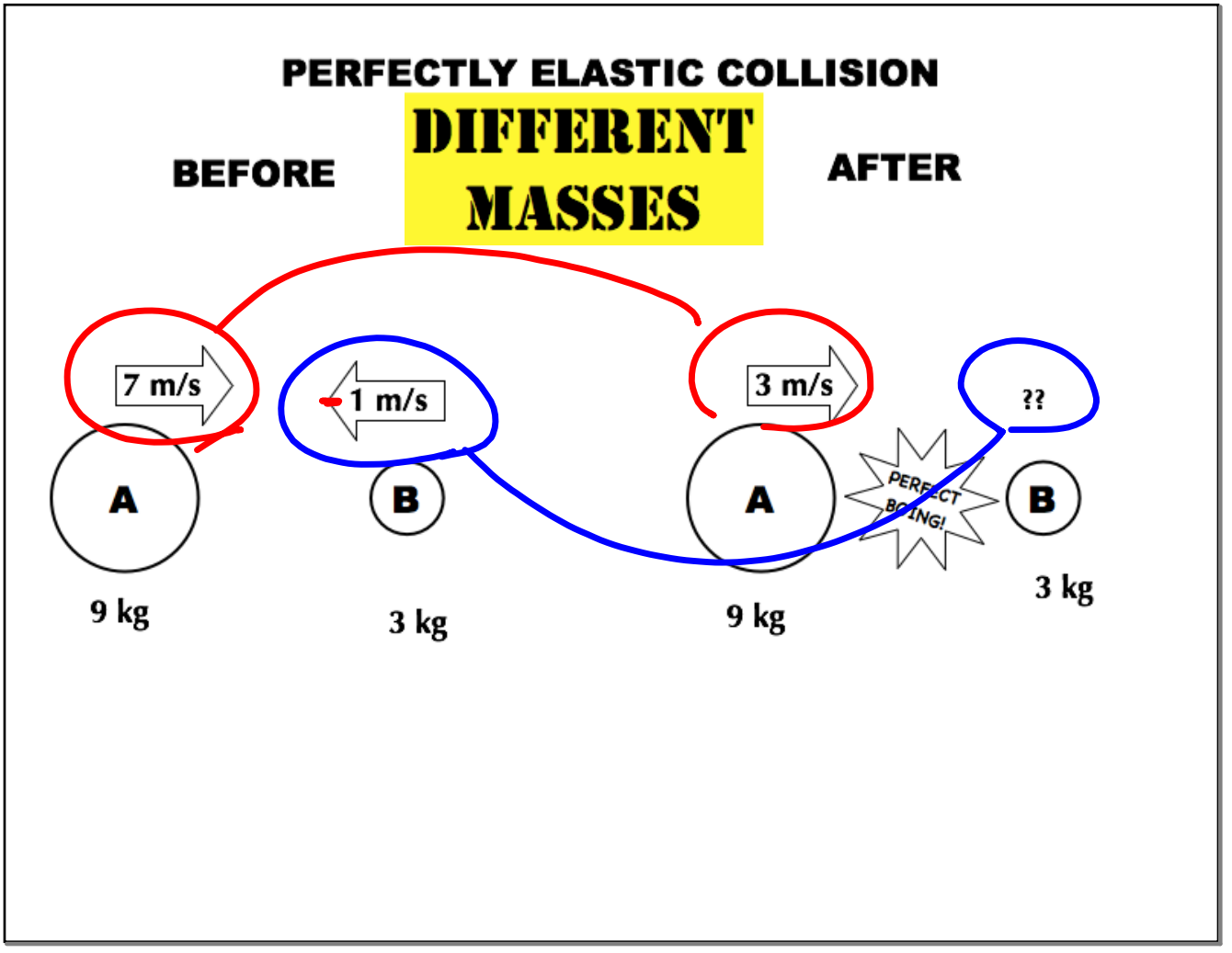
PERFECTLY ELASTIC COLLISIONS

Same mass >> VELOCITIES SWITCH!

Different masses >> ANOTHER TRICK!




PERFECTLY ELASTIC COLLISION
DIFFERENT MASSES
BEFORE
AFTER
12
11 m/s
2 m/s
1 m/s
14
??
A
B
A
B
PERFECT BOING!
12
8 kg
5 kg
8 kg
5 kg

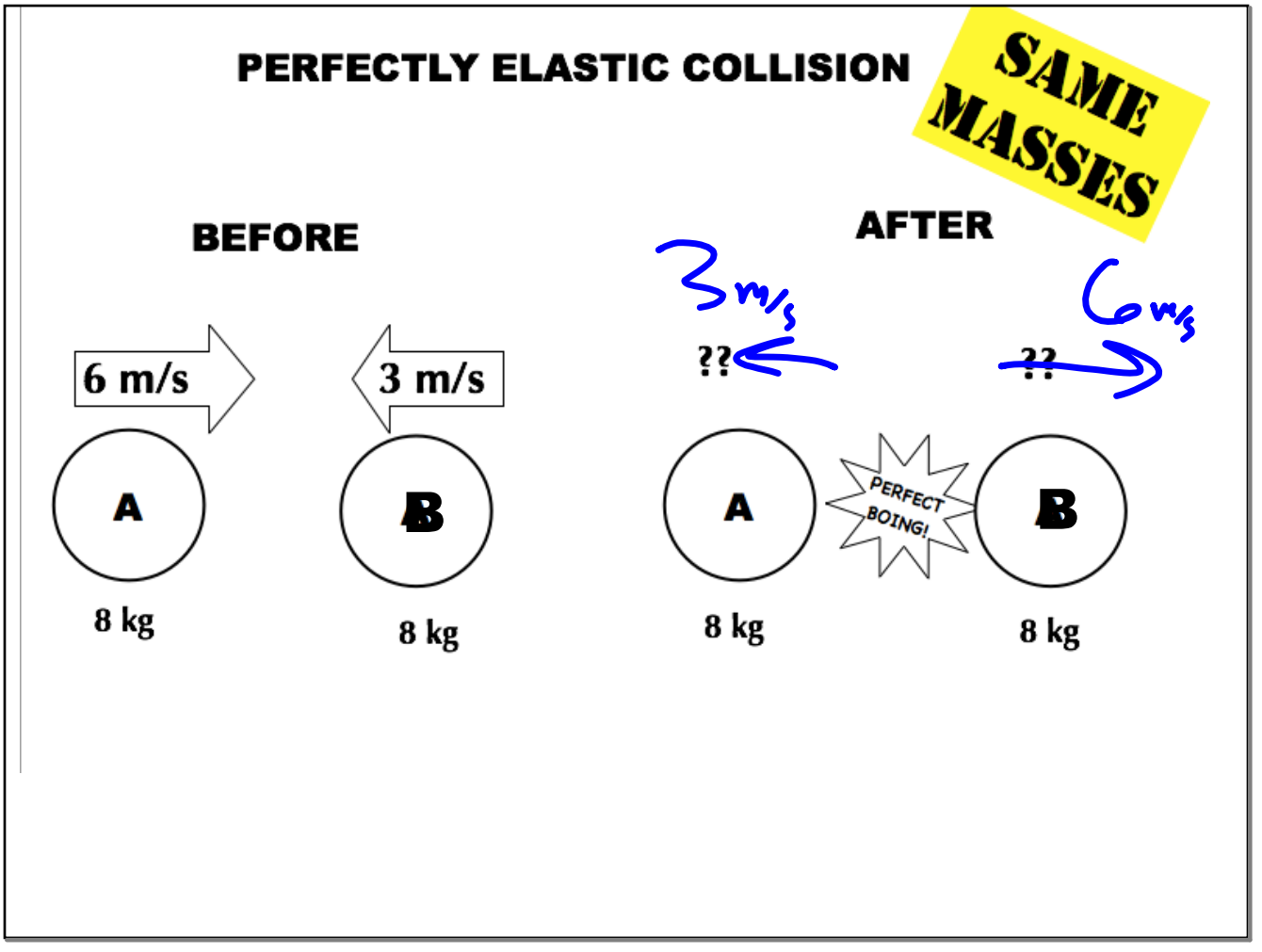

PERFECTLY ELASTIC COLLISION
DIFFERENT MASSES
BEFORE
AFTER
7 m/s
1 m/s
3 m/s
??
A
B
A
B
PERFECT BOING!
9 kg
3 kg
9 kg
3 kg

The Law of Conservation of Momentum

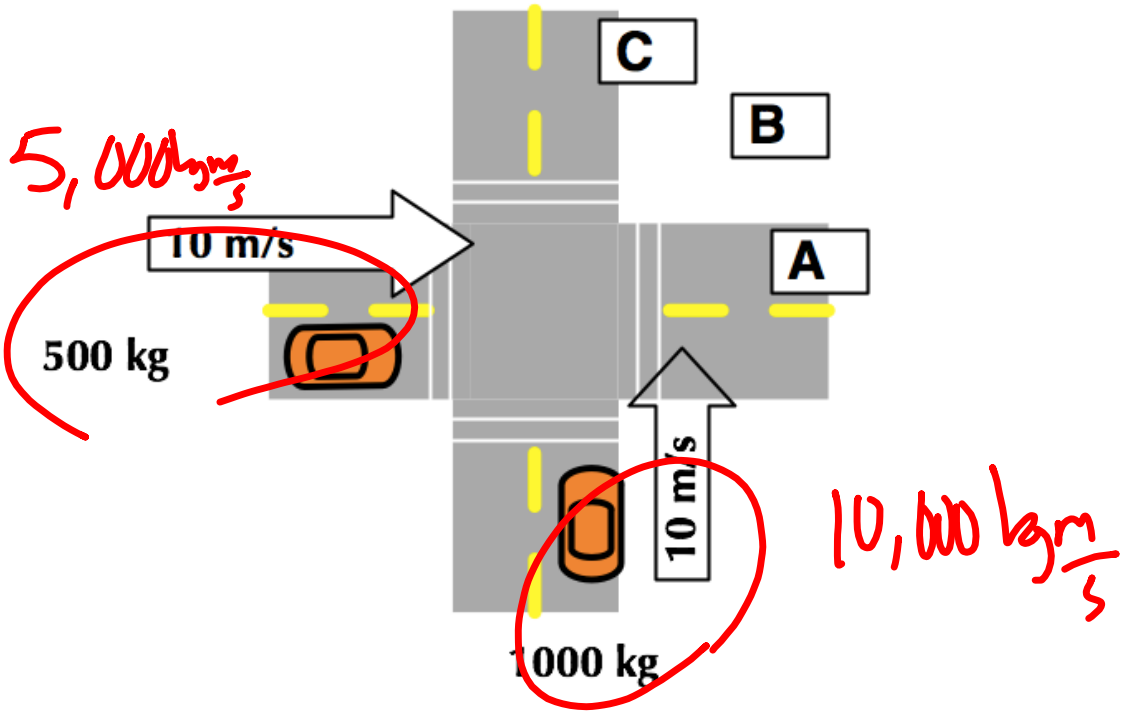
Total Momentum BEFORE a Collision = **Total Momentum AFTER a Collision**

(If there are no outside forces)

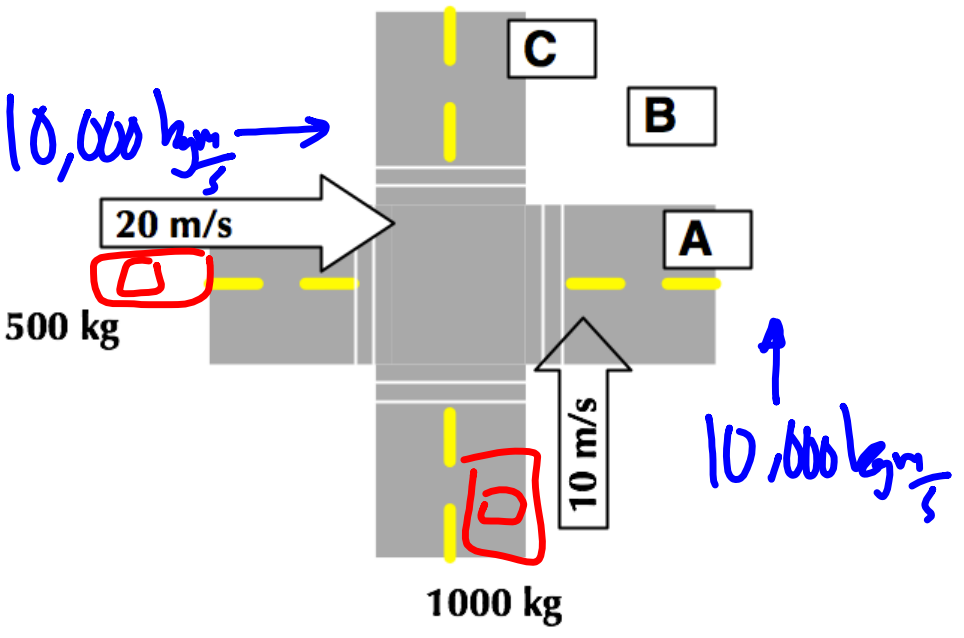
What's wrong with this picture?

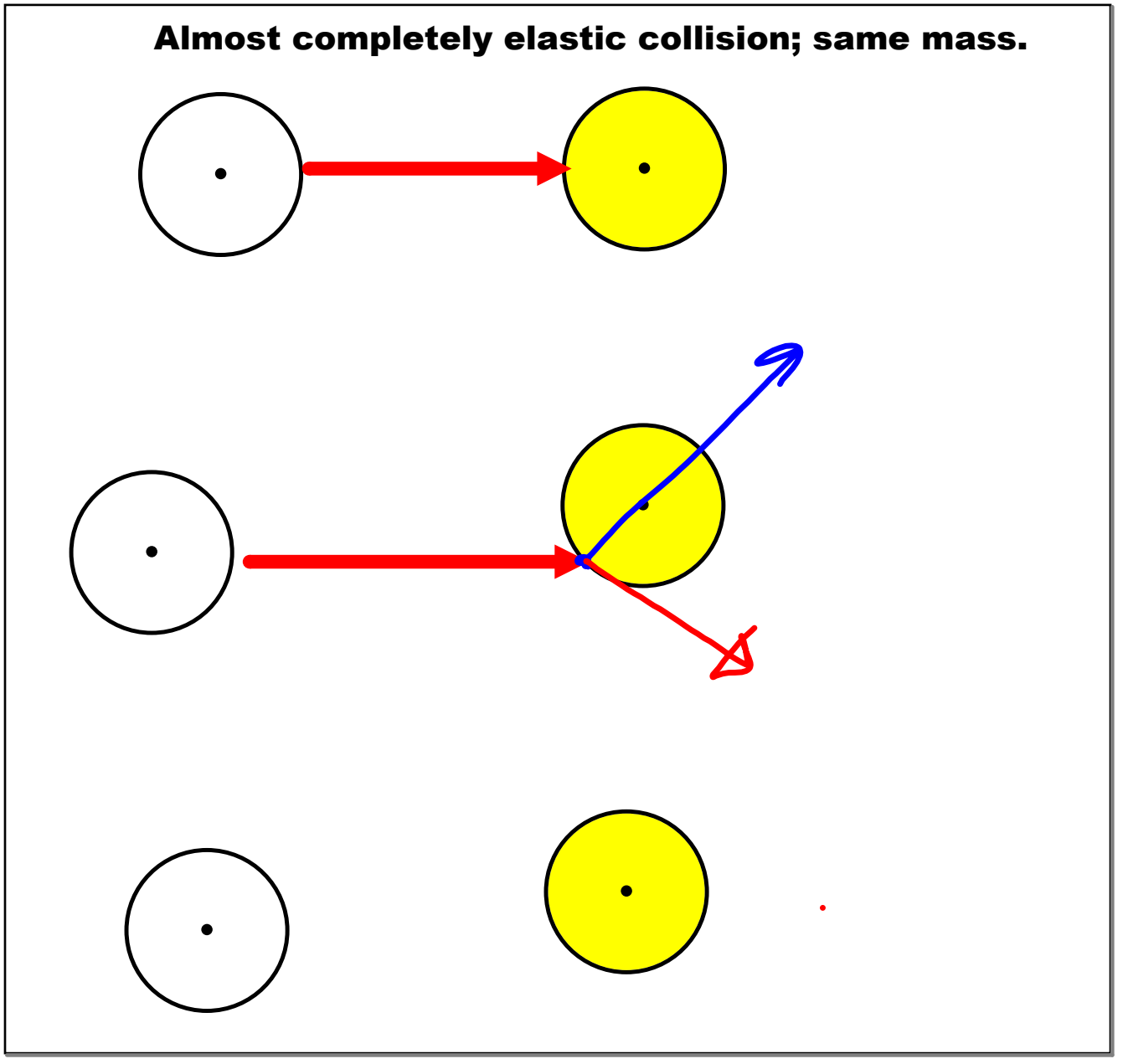

PERFECTLY ELASTIC COLLISION
SAME MASSES
BEFORE
AFTER
6 m/s
3 m/s
A
B
8 kg
8 kg
3 m/s
6 m/s
??
??
A
PERFECT BOING!
B
8 kg
8 kg

Which way did the wreckage go after the collision?



Totally Inelastic Collisions at an Angle




Almost completely elastic collision; same mass.