Momentum

Problem 1: Sticky blocks: blocks stick when they collide

Task: Stop the blocks

v = (a) 2 m/s
(b) 5 m/s
(c) 10 m/s

Problem 2: Sticky blocks: blocks stick when they collide

Task: Stop the blocks

v = (a) 2 m/s
(b) 1 m/s
(c) 10 m/s

Problem 3: Sticky blocks: blocks stick when they collide

Task: Stop the blocks

m = (a) 2 Kg
(b) 5 Kg
(c) 9 Kg

Momentum is the 'Amount of motion in a body'

Symbol for mass: m Units: Kg

Symbol for velocity: v Units: m/sec

Symbol for momentum: p

Formula for momentum:

$$p = m v$$

$$Units: \quad \frac{Kg\, m}{sec}$$

Sticky Blocks: Before collision

After collision

What happened to the energy of the moving blocks?

(a) Energy was nonzero before collision, zero after (Energy is not conserved if blocks stick)
(b) Energy went to heat, sound etc. created in the collision
(c) Total energy was zero to start with, and zero to end with

Sticky Blocks: Before collision

After collision

What happened to the momentum of the moving blocks?

(a) Momentum was nonzero before collision, zero after (Momentum is not conserved if blocks stick)

(b) Momentum went to heat, sound etc.

(c) Total momentum was zero at start, and zero at end

Energy is a scalar (it has magnitude only).

Energy is conserved

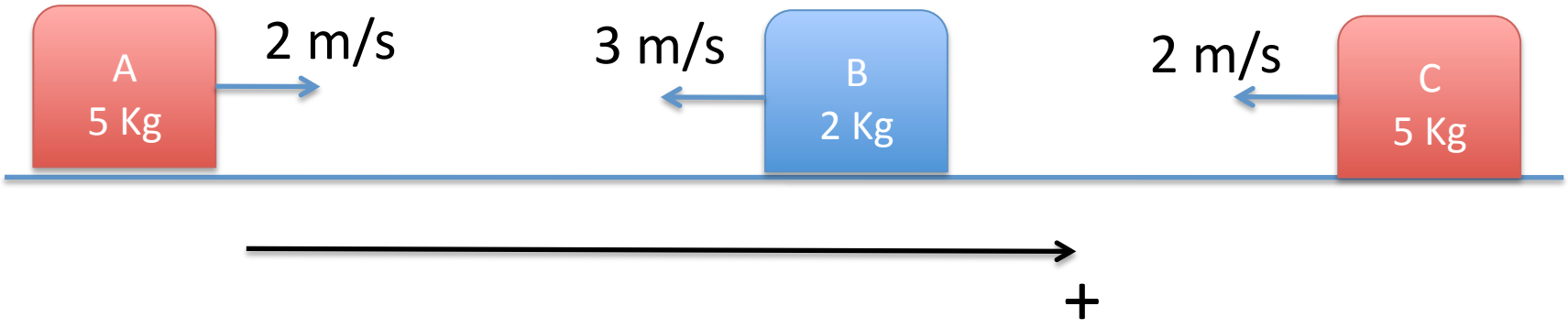
Kinetic energy before collision goes to heat energy, after collision

Momentum is a vector (it has both magnitude and direction)

Momentum is conserved

Initial momentum was zero, final momentum was zero
(so momentum of blocks did not have to go to ‘something else’)

Working with +/- signs for momentum

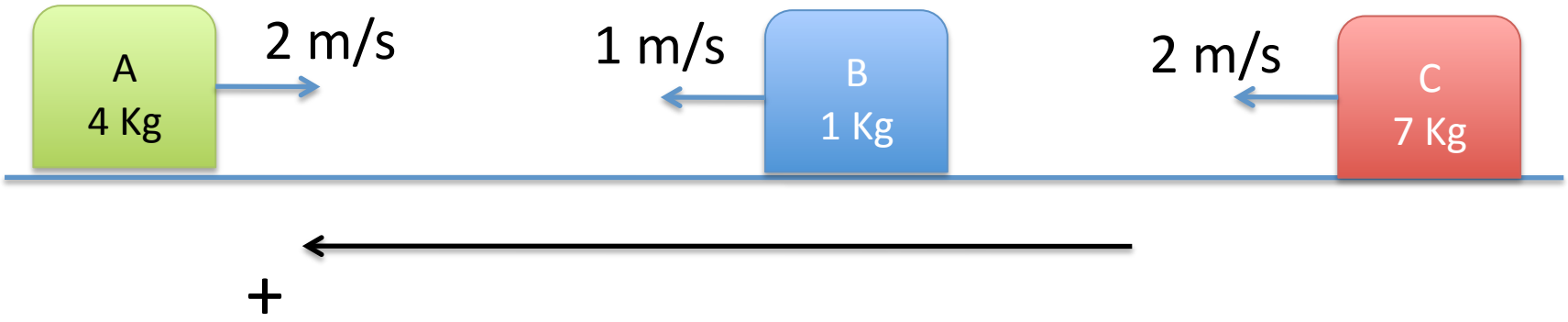


$$(a) \quad p_A = 10, \quad p_B = 6, \quad p_C = 10$$

$$(b) \quad p_A = 10, \quad p_B = -6, \quad p_C = -10$$

$$(c) \quad p_A = -10, \quad p_B = 6, \quad p_C = 10$$

Working with +/- signs for momentum

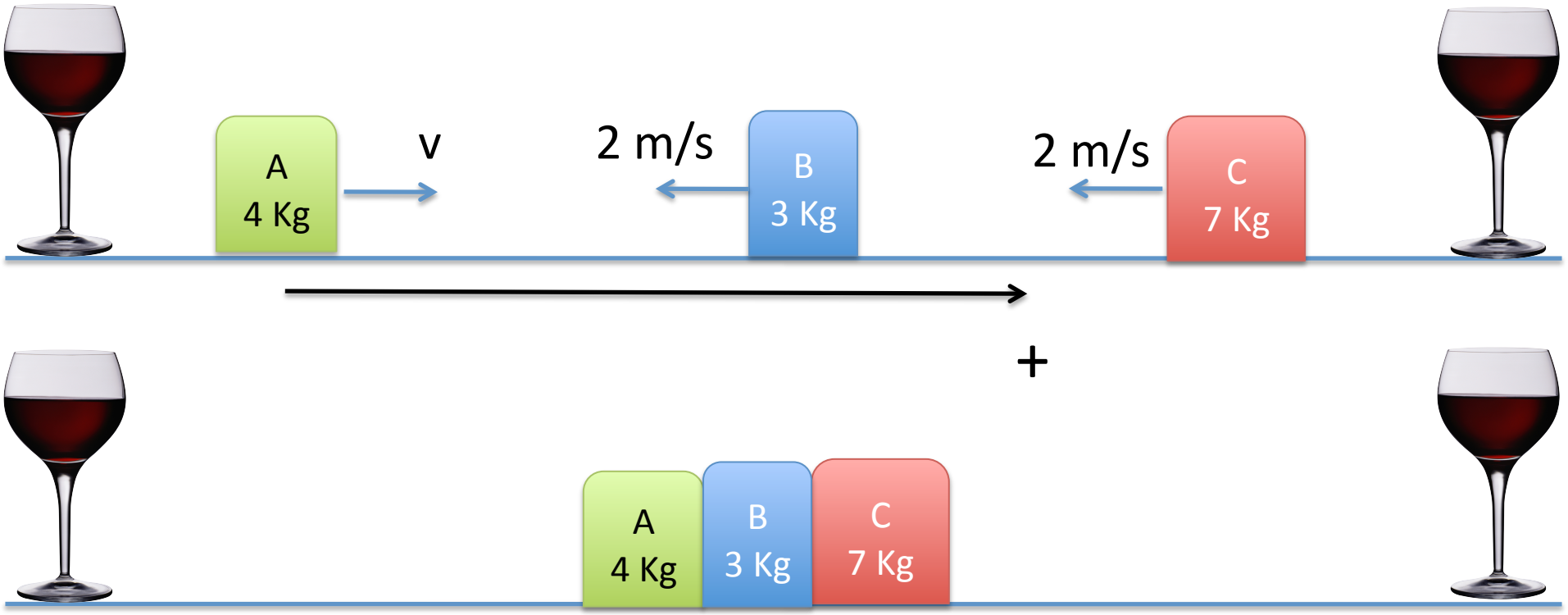


$$(a) \quad p_A = 8, \quad p_B = -1, \quad p_C = -14$$

$$(b) \quad p_A = -8, \quad p_B = 1, \quad p_C = -14$$

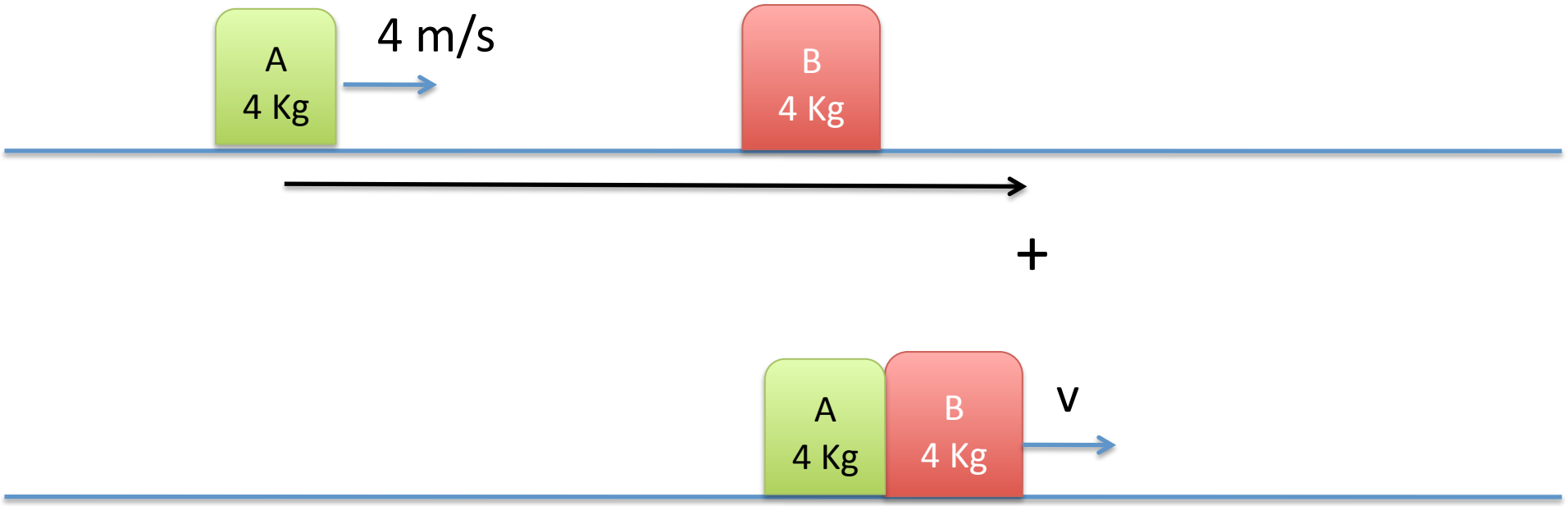
$$(c) \quad p_A = -8, \quad p_B = 1, \quad p_C = 14$$

Colliding multiple sticky blocks



v = (a) 3 m/s
(b) -5 m/s
(c) 5 m/s

Sticky blocks: Finding final velocity



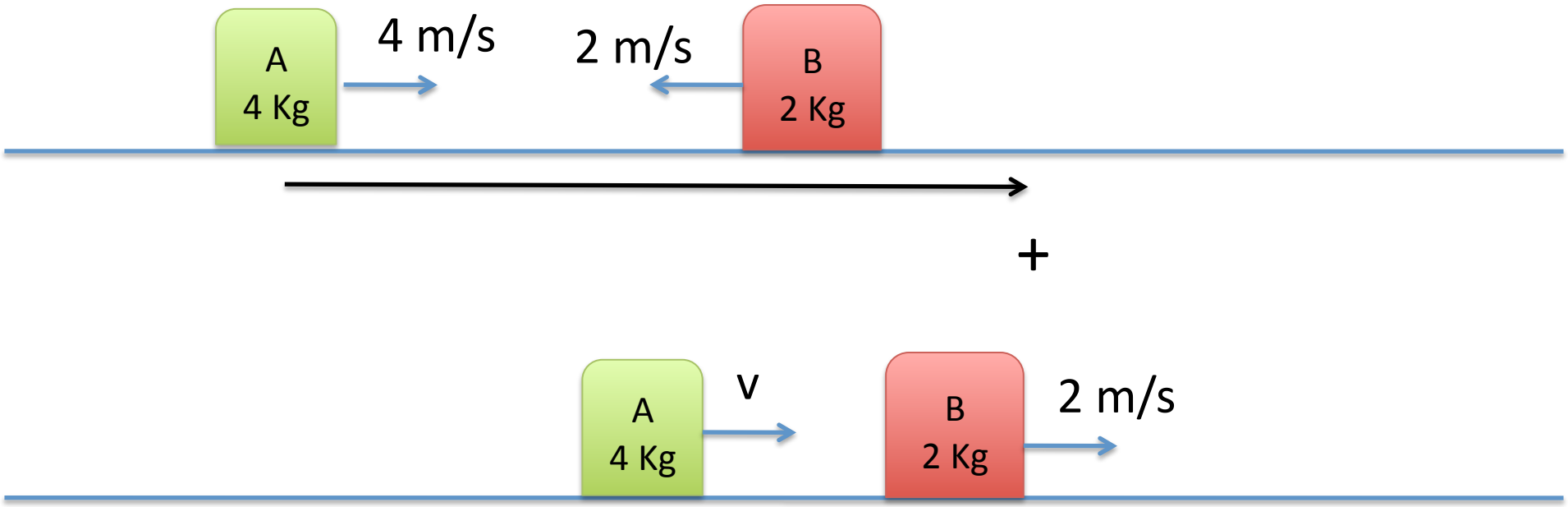
Total momentum before collision (a) 32 (b) 16 (c) -16

Total momentum after collision (a) 32 (b) 16 (c) -16

Total mass after collision (a) 4 (b) 8 (c) 0

Velocity of combined blocks after collision (a) 4 (b) 2 (c) -2

Bouncing blocks: Finding final velocity



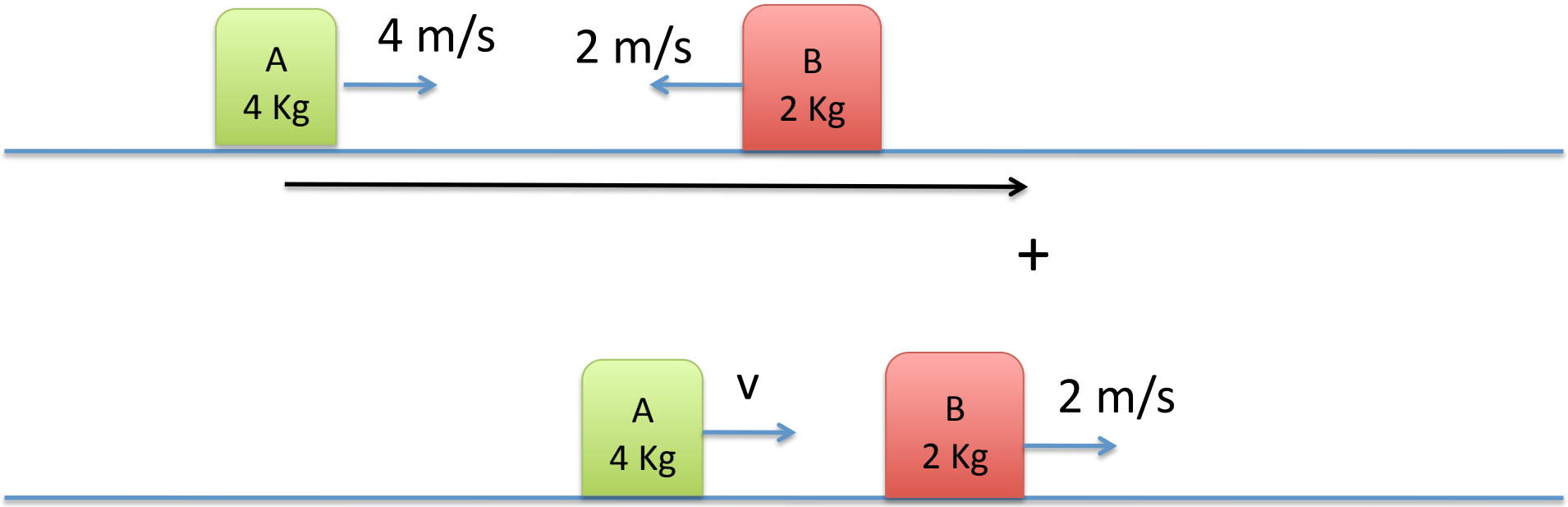
Total momentum before collision (a) 32 (b) 12 (c) -12

Momentum of B after collision (a) 4 (b) 2 (c) -4

Momentum of A after collision (a) 6 (b) -4 (c) 8

Velocity of A after collision (a) -2 (b) 2 (c) 4

Impulse: Momentum transferred to a body



What is the impulse given to body B by body A ?

Initial momentum of B: (a) 4 (b) -4 (c) 2

Final momentum of B: (a) 4 (b) -4 (c) 2

Impulse given to B: (a) -8 (b) 8 (c) 0

Problem C3B.4:

A 1.0 Kg cart travelling at 1.0 m/s rightwards hits a 4.0 Kg cart at rest.

After the collision,
the lighter cart is observed to move to the left at 0.5 m/s.

What impulse did the interaction deliver to the massive cart (magnitude and direction)?

What is that cart's velocity after the collision (magnitude and direction)?