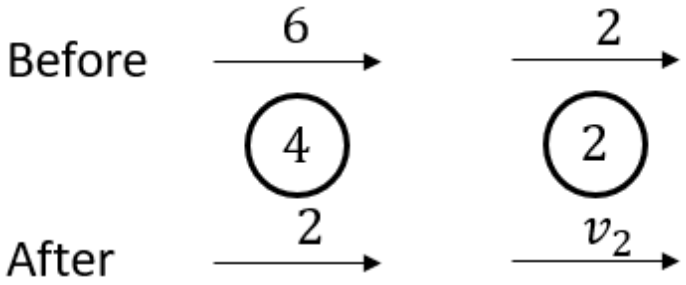
1.2) Conservation of momentum

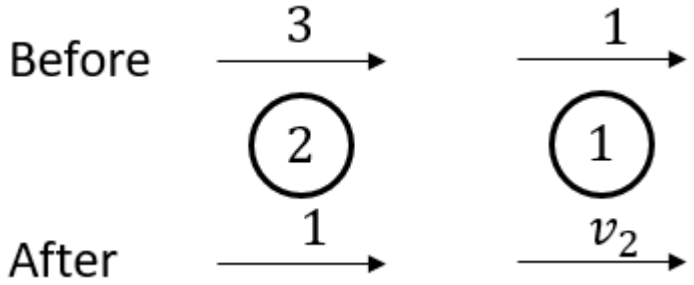
Worked example

Calculate the value of the unknown in the following isolated systems. All velocities are marked in ms^{-1} and all masses in kg.



Your turn

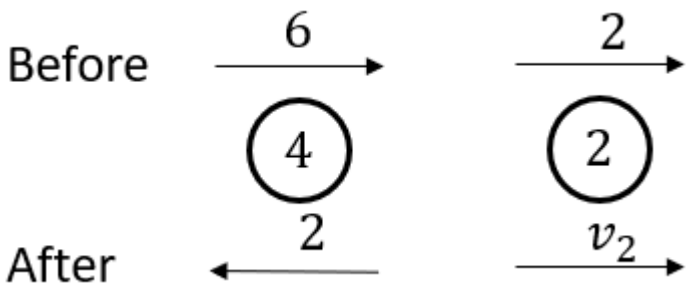
Calculate the value of the unknown in the following isolated systems. All velocities are marked in ms^{-1} and all masses in kg.



$v_2 = 5\ ms^{-1}$

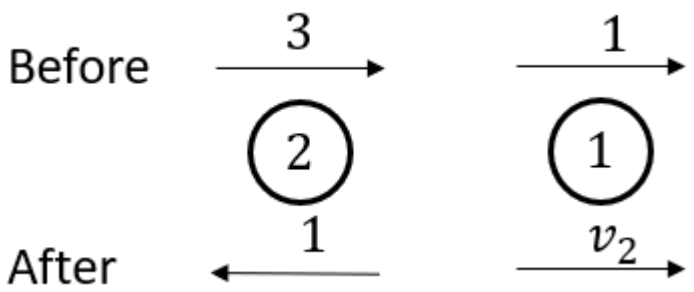
Worked example

Calculate the value of the unknown in the following isolated systems. All velocities are marked in ms^{-1} and all masses in kg.



Your turn

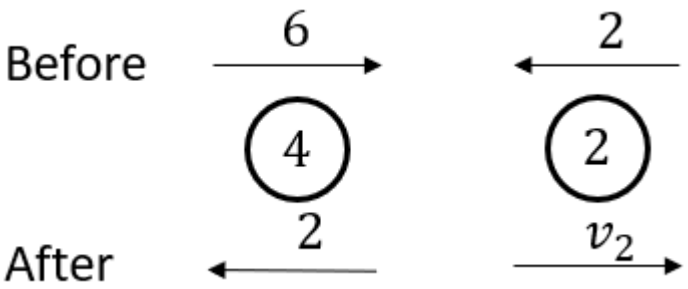
Calculate the value of the unknown in the following isolated systems. All velocities are marked in ms^{-1} and all masses in kg.



$v_2 = 9\ ms^{-1}$

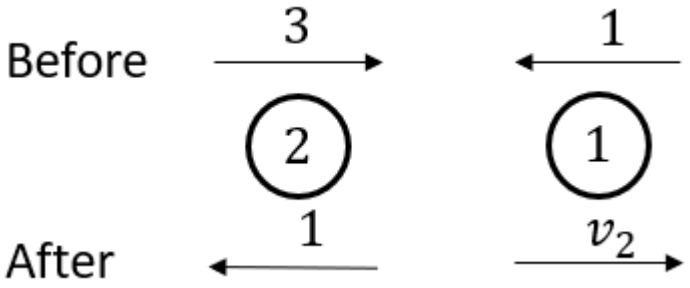
Worked example

Calculate the value of the unknown in the following isolated systems. All velocities are marked in ms^{-1} and all masses in kg.



Your turn

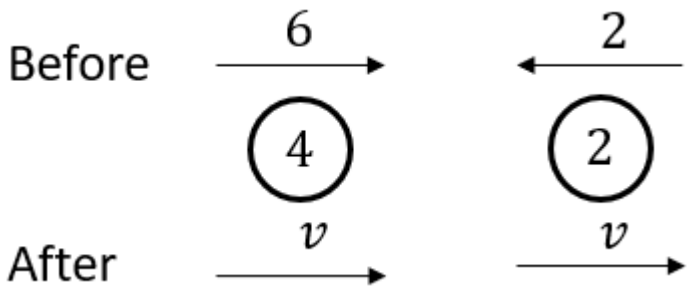
Calculate the value of the unknown in the following isolated systems. All velocities are marked in ms^{-1} and all masses in kg.



$v_2 = 7\ ms^{-1}$

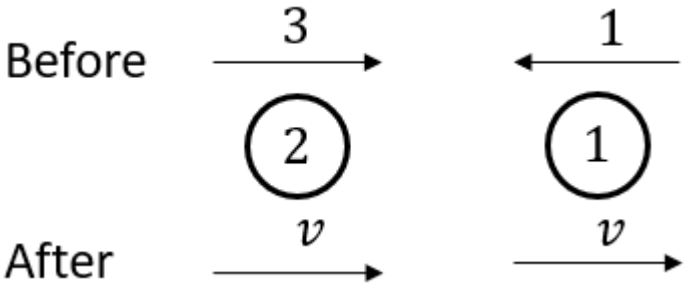
Worked example

Calculate the value of the unknown in the following isolated systems. All velocities are marked in ms^{-1} and all masses in kg.



Your turn

Calculate the value of the unknown in the following isolated systems. All velocities are marked in ms^{-1} and all masses in kg.



$v = 1.67\ ms^{-1}$ (3 sf)

Worked example

A particle P of mass $4\ kg$ is moving with speed $6\ ms^{-1}$ on a smooth horizontal plane.
Particle Q of mass $6\ kg$ is at rest on the plane.
Particle P collides with particle Q and after the collision Q moves with speed $\frac{14}{3} ms^{-1}$. Find:

a) The speed and direction of motion of P after the collision

b) The magnitude of the impulse received by P in the collision

Your turn

A particle P of mass $2\ kg$ is moving with speed $3\ ms^{-1}$ on a smooth horizontal plane.
Particle Q of mass $3\ kg$ is at rest on the plane.
Particle P collides with particle Q and after the collision Q moves with speed $\frac{7}{3} ms^{-1}$. Find:

a) The speed and direction of motion of P after the collision

b) The magnitude of the impulse received by P in the collision

a) $0.5\ ms^{-1}$; direction of motion is reversed.
b) $7\ Ns$

Worked example

Two particles A and B of masses $2\ kg$ and $4\ kg$ respectively are moving towards each other in opposite directions along the same straight line on a smooth horizontal surface.
The particles collide.
Before the collision the speeds of A and B are $3\ ms^{-1}$ and $2\ ms^{-1}$ respectively.
After the collision the direction of motion of A is reversed and its speed is $2\ ms^{-1}$. Find:
a) The speed and direction of B after the collision
b) The magnitude of the impulse given by A to B in the collision

Your turn

Two particles A and B of masses $2\ kg$ and $4\ kg$ respectively are moving towards each other in opposite directions along the same straight line on a smooth horizontal surface.
The particles collide.
Before the collision the speeds of A and B are $3\ ms^{-1}$ and $2\ ms^{-1}$ respectively.
After the collision the direction of motion of A is reversed and its speed is $2\ ms^{-1}$. Find:
a) The speed and direction of B after the collision
b) The magnitude of the impulse given by A to B in the collision

a) $0.5\ ms^{-1}$; direction of motion is reversed.
b) $10\ Ns$

Worked example

Two particles P and Q, of masses 8kg and 4kg respectively, are connected by a light inextensible string.
The particles are at rest on a smooth horizontal plane with the string slack.
Particle P is projected directly away from Q with speed $2ms^{-1}$.

a) Find the common speed of the particles after the string goes taut.
b) Find the magnitude of the impulse transmitted through the string when it goes taught.

Your turn

Two particles P and Q, of masses 8kg and 2kg respectively, are connected by a light inextensible string.
The particles are at rest on a smooth horizontal plane with the string slack.
Particle P is projected directly away from Q with speed $4ms^{-1}$.

a) Find the common speed of the particles after the string goes taut.
b) Find the magnitude of the impulse transmitted through the string when it goes taught.

a) $3.2\ ms^{-1}$
b) $6.4\ Ns$

Worked example

Two particles A and B of masses $4\ kg$ and $2\ kg$ respectively are moving towards each other in opposite directions along the same straight line on a smooth horizontal surface. The particles collide.
Before the collision the speeds of A and B are $6\ ms^{-1}$ and $4\ ms^{-1}$ respectively.
Given that the magnitude of the impulse due to the collision is $14\ Ns$, find:

a) The velocity of A after the collision
b) The velocity of B after the collision

Your turn

Two particles A and B of masses $2\ kg$ and $4\ kg$ respectively are moving towards each other in opposite directions along the same straight line on a smooth horizontal surface. The particles collide.
Before the collision the speeds of A and B are $3\ ms^{-1}$ and $2\ ms^{-1}$ respectively.
Given that the magnitude of the impulse due to the collision is $7\ Ns$, find:

a) The velocity of A after the collision
b) The velocity of B after the collision

a) $0.5\ ms^{-1}$; direction of motion is reversed
b) $0.25\ ms^{-1}$; direction of motion is unchanged.

Worked example

A truck P of mass $4M$ is moving with speed U on smooth straight horizontal rails. It collides directly with another truck Q of mass $6M$ which is moving with speed $2U$ in the opposite direction on the same rails. The trucks join so that immediately after the collision they move together. By modelling the trucks as particles, find:

a) The speed of the trucks immediately after the collision

b) The magnitude of the impulse exerted on P by Q in the collision

Your turn

A truck P of mass $2M$ is moving with speed U on smooth straight horizontal rails. It collides directly with another truck Q of mass $3M$ which is moving with speed $4U$ in the opposite direction on the same rails. The trucks join so that immediately after the collision they move together. By modelling the trucks as particles, find:

a) The speed of the trucks immediately after the collision

b) The magnitude of the impulse exerted on P by Q in the collision

a) $2U$

b) $6MU$