1 Program of Studies Checklist:

- explain, quantitatively, that momentum is conserved in one- and two-dimensional interactions in an isolated system

Diploma Question Alert!

Which of the following quantities are scalar quantities?

A. Kinetic energy and potential energy

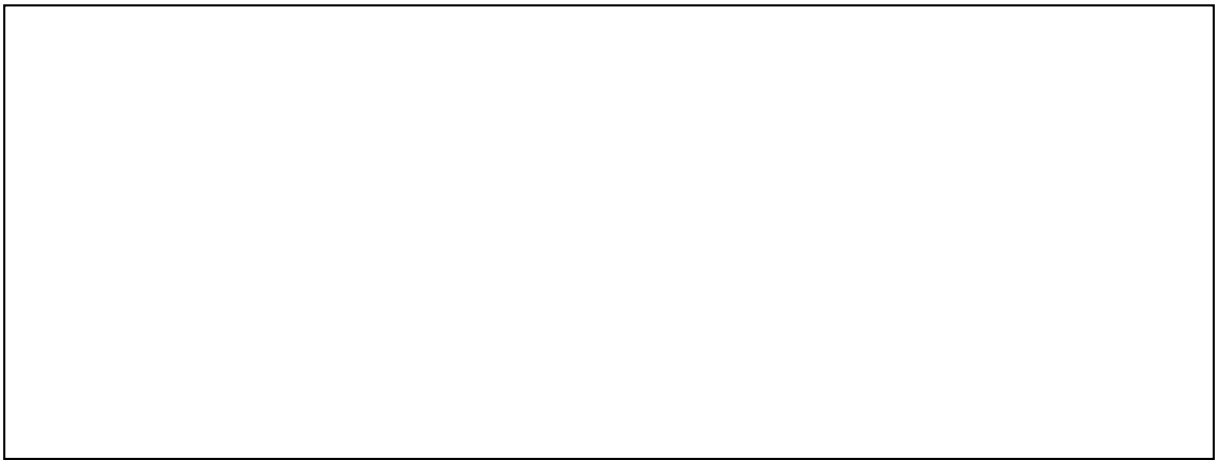
B. Kinetic energy and momentum

C. Potential energy and force

D. Momentum and force

Diploma Question Alert!

Use the following information to answer the first question.



The velocity of the 2.4kg object after collision is

A. 15 m/s to the right

B. 8.7 m/w to the left

C. 8.0 m/s to the right

D. 6.2 m/s to the left

Diploma Question Alert!

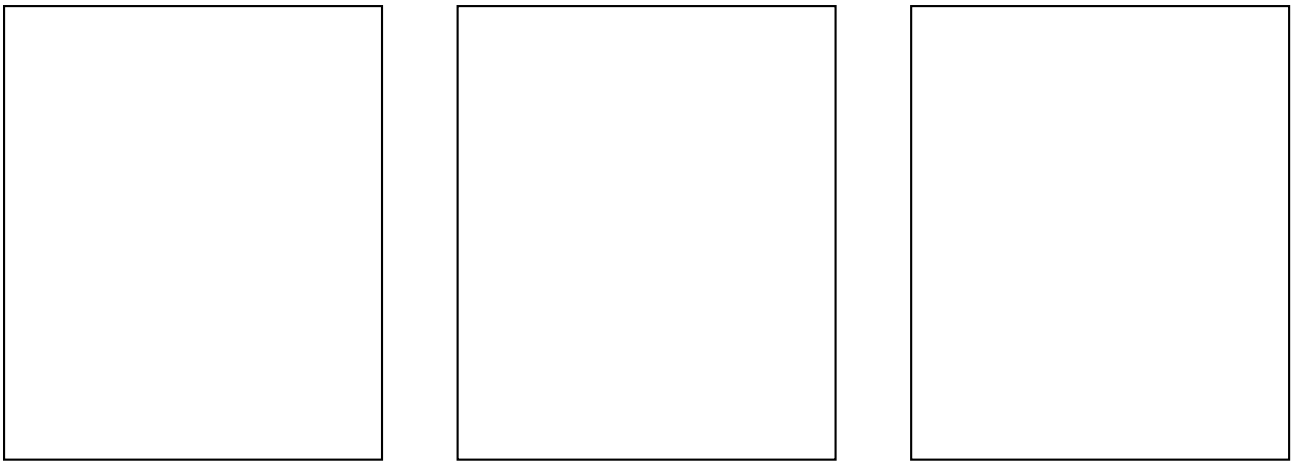
Numerical Response

A 1575 kg car, initially travelling at 10.0 m/s, collides with a stationary 2 250 kg car. The bumpers of the two cars become locked together. The speed of the combined cars immediately after impact is _____ m/s.

(Record your **three-digit answer** in the numerical-response section on the answer sheet.)

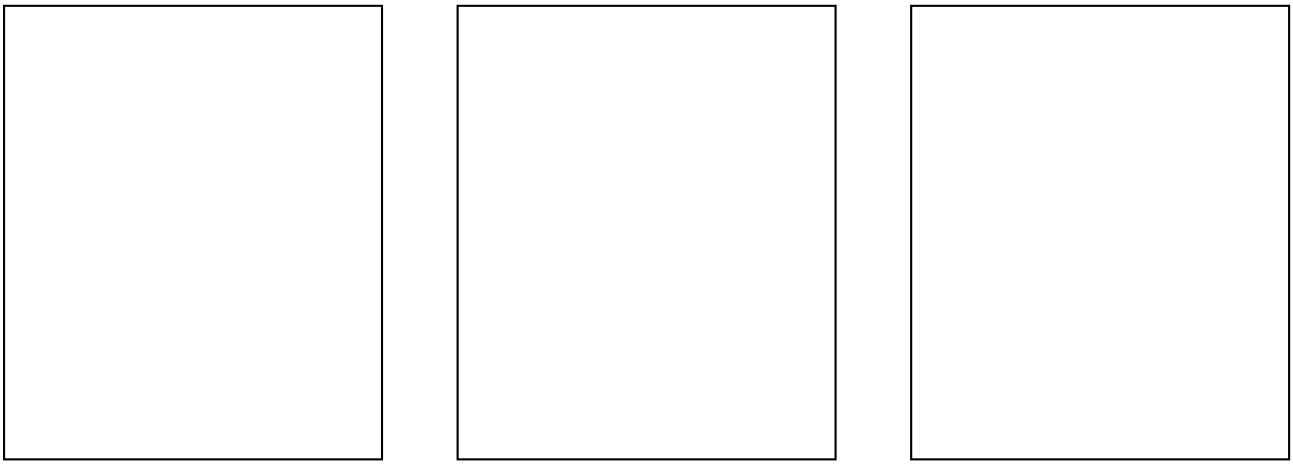
2 Non-linear Conservation of Momentum

Just as momentum is conserved in one dimension,



(the sum of the momentums in all diagrams is the same)

is is also conserved in other, non-linear directions.



(the sum of the momentums in all diagrams is the same)

In situations where objects are moving in two dimensions, (i.e. the _____ and _____ directions), we need to break the momentum vectors into _____.

The components in the _____ direction will be _____, and the components in the _____ direction will be _____!

2.1 Example

A 4.0 kg cat is travelling South at 2.8 m/s when it collides with a 6.0 kg bat travelling East at 3.0 m/s. The objects stick together upon collision. What is the velocity of the cat-bat system?

Step 1: Draw a diagram.

Step 2: Write *separate* conservation statements for the x and y directions.

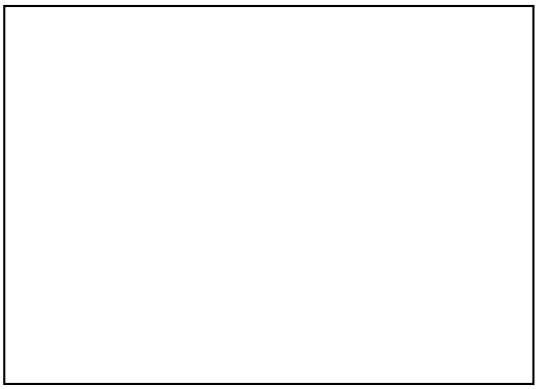
Step 3: Find final momentum in both the x and y directions individually.

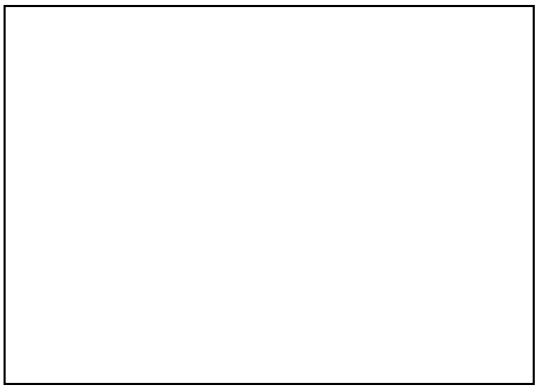
Step 4: Find the resultant momentum using vector addition, and solve for velocity.

3 Glancing Collisions

3.1 Example

A 4.0 kg bicycle is moving East at an unknown velocity when it hits a stationary 6.1 kg tricycle. After collision, the bicycle moves at 2.8 m/s 32° N of E, and the tricycle moves at 1.5 m/s 41° S of E. What was the initial velocity of the bicycle?





Step 1: Draw a diagram.

Step 2: Break vectors into components.

Step 3: Write conservation statements for the x and y directions.

Step 4: Solve for the unknown variable.

Diploma Question Alert!

A 115 g arrow travelling east at 20 m/s imbeds itself in a 57 g tennis ball moving north at 42 m/s. The direction of the ball-arrow combination after impact is

A. 46° N of E

B. 46° E of N

C. 25° E of N

D. 25° N of E

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A lump of clay with a mass of 50.0 g is moving south at a speed of 20.0 cm/s. It collides head-on with a second lump of clay with a mass of 70.0 g that is moving north at a speed of 40.0 cm/s.

The two lumps stick together, and no external horizontal forces act on the system. The **velocity** of the combined lump after the collision is

A. 60.0 cm/s, south

B. 31.7 cm/s, south

C. 20.0 cm/s, north

D. 15.0 cm/s, north