9 In which situation is total linear momentum **always** conserved?

A in all collisions between two objects

B in collisions between two objects moving at equal and opposite velocity

C in collisions between two objects that form an isolated system

D in collisions between two objects with the same mass

10 An object of mass m moving with velocity $9.0\,m\,s^{-1}$ has a head-on elastic collision with a stationary object of mass $2m$.

After the collision, both objects are moving. No external forces act on the system.

What is the velocity of the object of mass $2m$ after the collision?

A $-6.0\,m\,s^{-1}$ **B** $-3.0\,m\,s^{-1}$ **C** $4.5\,m\,s^{-1}$ **D** $6.0\,m\,s^{-1}$

9 What is a statement of the principle of conservation of momentum?

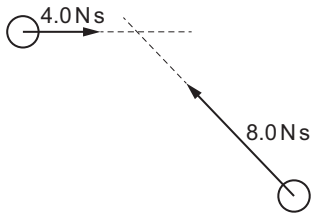
A In an elastic collision, momentum is constant.

B Momentum is the product of mass and velocity.

C The force acting on a body is proportional to its rate of change of momentum.

D The momentum of an isolated system is constant.

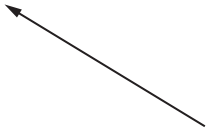
10 The diagram shows the view from above of two balls moving along a horizontal frictionless surface before they collide. The momentum of each ball is also shown.



The balls stick together during the collision.

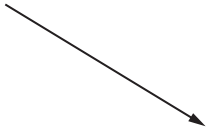
Which vector diagram represents the combined momentum of the balls after the collision?

A



B

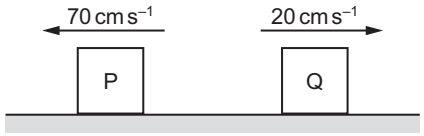
C



D

12 Two different blocks, P and Q, slide towards each other on a horizontal frictionless surface. The blocks have an elastic collision.

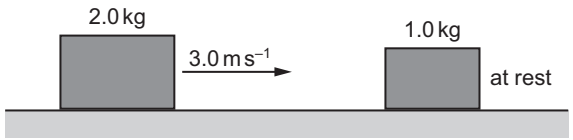
The diagram shows the velocities of the two blocks immediately after the collision.



Which row gives possible velocities of the two blocks immediately before the collision?

	velocity of P	velocity of Q
A	$10\,cm\,s^{-1}$ to the right	$60\,cm\,s^{-1}$ to the left
B	$50\,cm\,s^{-1}$ to the right	zero
C	$20\,cm\,s^{-1}$ to the left	$70\,cm\,s^{-1}$ to the right
D	$60\,cm\,s^{-1}$ to the right	$30\,cm\,s^{-1}$ to the left

10 An object of mass 2.0 kg is travelling at a speed of $3.0\,m\,s^{-1}$ on a horizontal frictionless surface. This object collides head-on with a stationary object of mass 1.0 kg. The two objects stick together on impact.



How much kinetic energy is lost on impact?

A zero **B** 2.0 J **C** 2.4 J **D** 3.0 J

11 A moving object X collides with a stationary object Y.

The objects separate after the collision.

The collision is perfectly elastic and there are no external forces acting.

Which word equation is **not** correct?

A during the collision, (force acting on object X) + (force acting on object Y) = zero

B (relative speed of approach of X and Y) + (relative speed of separation of X and Y) = zero

C (total kinetic energy before collision) = (total kinetic energy after collision)

D (total momentum before collision) = (total momentum after collision)

9 What is always conserved in elastic collisions?

	total kinetic energy	total velocity
A	yes	yes
B	yes	no
C	no	yes
D	no	no

10 Which statement does **not** describe an elastic collision between two objects?

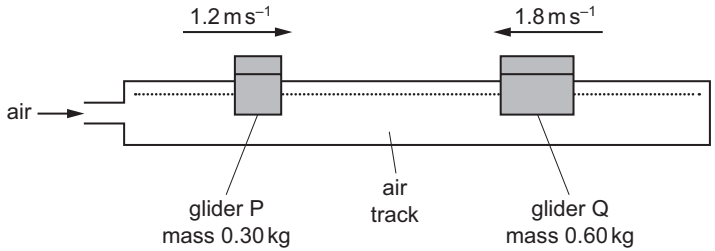
A The relative speed of approach of the two objects equals the relative speed of separation.

B The total kinetic energy of the objects is conserved.

C The total kinetic energy of the objects is reduced.

D The total linear momentum of the objects is conserved.

9 Two gliders are travelling towards each other on a horizontal air track. Glider P has mass 0.30 kg and is moving with a constant speed of 1.2 m s^{-1}. Glider Q has mass 0.60 kg and is moving with a constant speed of 1.8 m s^{-1}.



The gliders have a perfectly elastic collision.

What are the speeds of the two gliders after the collision?

	speed of P / m s^{-1}	speed of Q / m s^{-1}
A	1.2	0.6
B	2.0	1.4
C	2.8	0.2
D	3.6	0.6

4 **(a)** State the principle of conservation of momentum.

.....

.....

..... [2]

(b) An object A of mass 4.0 kg travels at a velocity of 6.0 m s^{-1} to the right on a horizontal frictionless surface. It moves towards a second object B of mass 2.0 kg that is moving at a velocity of 3.0 m s^{-1} in the same direction as A, as shown in Fig. 4.1.

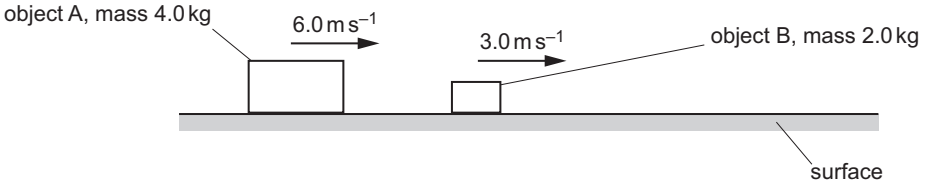


Fig. 4.1

Object A collides with object B. The two objects join and move off together with velocity *v*.

Calculate:

(i) velocity *v*

v = ... m s^{-1} [2]

(ii) the percentage of the total initial kinetic energy of the two objects that is transferred to other forms of energy during the collision.

percentage = ...% [2]

[Total: 6]

7 An isolated stationary nucleus Q decays into nucleus R and an α-particle. The α-particle has speed $1.5 \times 10^7\,\text{m s}^{-1}$.

(a) Complete the equation for this decay.

$$^{\ldots\ldots}_{88}\text{Q} \longrightarrow {}^{222}_{\ldots\ldots}\text{R} + {}^{4}_{2}\alpha$$

[1]

(b) By considering momentum, calculate the speed of nucleus R after the decay.

speed = ... m s^{-1} [3]

(c) State **three** quantities that are conserved during the decay.

1 .....

2 .....

3 .....

[3]

[Total: 7]