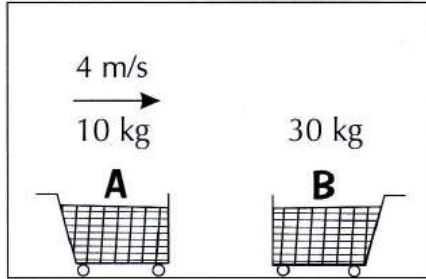


Circle the correct words or phrases to make the following statements true.

- a) If the velocity of a moving object doubles, its **kinetic energy** / **momentum** will double.
- b) If you drop a suitcase out of a moving car, the car's momentum will **decrease** / **increase**.
- c) When two objects collide the total momentum **changes** / **stays the same**.
- d) When a force acts on an object its momentum **changes** / **stays the same**.

Shopping trolley A has a mass of 10 kg and is moving east at 4 m/s. It collides with trolley B which has a mass of 30 kg and is moving west at 1 m/s. The two trolleys join together.

- a) Complete the diagram showing the masses and velocities of the trolleys **before** they collide.



For this one you'll need to know the total momentum of the two trolleys before the collision.

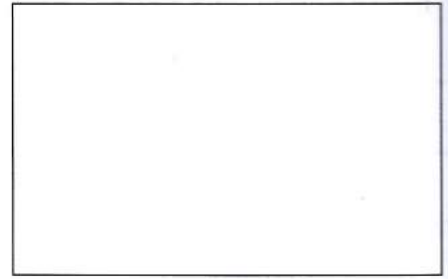
- b) Find the **velocity** of the trolleys **after** the collision (when they are joined) and draw a diagram showing their speed and direction.

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A skateboarder with a mass of 60 kg is moving at 5 m/s. He skates past his bag, picks it up from the floor and slows down to 4.8 m/s. Find the mass of the skater's bag.

You might find it helpful to draw a diagram showing the masses and velocities involved.



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A 0.15 kg cricket ball is dropped vertically onto a floor. It hits the floor at a speed of 10 m/s and bounces vertically back up at the same speed. If the ball is in contact with the floor for 0.02 s, what is the average force exerted on it?

How does the ball's velocity change?

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Choose just one answer: A, B, C or D.

- 1 Which one of the following is NOT a vector quantity? (1 mark)
- A force B speed
C momentum D acceleration

- 2 The purpose of an airbag or crumple zone in a car is to increase the time taken for the driver to stop. What is the advantage of this? (1 mark)
- A it reduces the driver's momentum
B it reduces the driver's energy
C it reduces the force on the driver
D it reduces the energy of the impact

- 3 Calculate the momentum of a 60 kg person running at 5 m/s. (1 mark)
- A 12 kgm/s B 300 kgm/s
C 120 kgm/s D 300 kgm/s²

- 4 What will a resultant force always cause? (1 mark)
- A a change in direction
B a change in energy
C a change in speed
D a change in velocity

- 5 A tennis player returns a serve. How does the force on the ball relate to its momentum? (1 mark)
- A the force is the rate of change of momentum of the ball
B the force is the overall change of momentum multiplied by the time taken to cause the change
C the force is the momentum of the ball as it is hit
D the force is the momentum of the ball leaving the racket divided by the time taken to cause the change

- 1 A boy falls from a climbing frame to the ground in 0.7 s.

- a) Taking the value of acceleration due to gravity to be 10 m/s^2 , calculate his velocity on impact. (2 marks)

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- b) Calculate the momentum of the boy on impact if his mass is 40 kg. (1 mark)

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- c) If the boy takes 0.2 s to come to rest, calculate the average force exerted on his body. (2 marks)

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- d) Explain the advantage to the boy if the climbing frame had been installed over a safety surface that increases the time taken to break his fall to 0.5 s. (2 marks)

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- 2 Wearing seatbelts in cars became compulsory for drivers and front seat passengers in 1992.

- a) A car of mass 1000 kg and driver of mass 70 kg travelling at 30 m/s collides with a stationary lorry and rapidly comes to rest. The car's crumple zone offers some protection by reducing the rate of deceleration. The vehicle takes 0.1 s to stop. Calculate the average force exerted on the car driver. (3 marks)

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