

More Momentum Questions

Name

A cannon, mass 800kg, fires a ball of mass 12kg at 75m/s.

1. Calculate the recoil velocity of the cannon.

The cannon ball takes 15 seconds to reach its target. It slows down on the way due to air resistance, and is travelling at 60m/s when it hits its target.

2. Calculate the change in momentum of the cannon ball over the course of its flight.
3. Calculate the average force of air resistance on the cannon ball during its flight.

When it reaches its target the cannon ball hits a soldier of mass 72kg. The cannon ball and the soldier stick together.

4. Calculate the speed that the soldier & cannon ball move at after they collide.

Another 12kg cannon ball is fired at the same speed as the first, and hits its target at 60m/s. It hits a stationary armoured cart of mass 500kg and bounces off in the opposite direction at 10m/s.

5. How fast does the cart move (assuming there is no resistance to its motion)?

More Momentum Questions

A cannon, mass 800kg, fires a ball of mass 12kg at 75 m/s.

1. Calculate the recoil velocity of the cannon.

$$p_{\text{ball}} = 12 \text{ kg} \times 75 \text{ m/s} = 900 \text{ kgm/s}$$

$$p_{\text{can}} + p_{\text{ball}} = 0 \quad p_{\text{can}} = -p_{\text{ball}} = -900 \text{ kgm/s}$$

$$v = p / m \quad v_{\text{can}} = -900 \text{ kgm/s} / 800 \text{ kg} = -1.1 \text{ m/s (2sf)}$$

The cannon ball slows down on its way to the target, and is travelling at 60 m/s when it hits its target.

2. Calculate the loss of momentum of the cannon ball over the course of its flight.

$$\Delta p = 12 \times (60 - 75) = -180 \text{ kgm/s (allow 180kgm/s)}$$

3. Calculate the average force of air resistance on the cannon ball during its flight.

$$\text{Force} = \text{change in momentum} / \text{time}$$

$$\text{Force} = -180 \text{ kgm/s} / 15 \text{ s} = -12 \text{ N (allow 12N)}$$

When it reaches its target the cannon ball hits a soldier of mass 72kg. The cannon ball and the soldier stick together.

4. Calculate the speed that the soldier & cannon ball move at after they collide.

$$p_{\text{ball}} = 12 \times 60 = 720 \text{ kgm/s}$$

$$p_{\text{both}} = 720 \text{ kgm/s} \quad v = p / m \quad v = 720 / (72 + 12) = 8.6 \text{ m/s (2sf)}$$

A second cannon ball is fired at the same speed as the first. It hits a stationary armoured cart of 500kg and bounces off in the opposite direction at 10 m/s.

5. How fast does the cart move (assuming there is no resistance to its motion)?

$$\text{before: } p_{\text{ball}} = 12 \times 60 = 720 \text{ kgm/s} \quad \text{after: } p_{\text{ball}} = 12 \times -10 = -120 \text{ kgm/s}$$

$$\text{change in momentum of ball} = -120 - 720 = -840 \text{ kgm/s}$$

$$\text{change in momentum of cart} = +840 \text{ kgm/s} \quad v = p / m = 1.7 \text{ m/s (2sf)}$$