Stage 1 Physics
Momentum

What is the velocity of a billiard ball of mass 100 g having a momentum of 2 s N West?

Use the law of conservation of momentum to explain the following:
(a) a cannon recoils when fired
(b) two ice skaters move apart when one pushes the other
(c) an astronaut moves backward when throwing a hammer in space
(d) a balloon will fly around the room when filled with air and released.

A cricket ball of mass 150 g is struck by a 1.5 kg cricket bat. Initially, the ball travels towards the bat at 30 m s^{-1} while the bat moves in the opposite direction at 15 m s^{-1}. The ball leaves the bat after impact. If the bat continues at 10 m s^{-1} after impact, with what speed does the ball travel?

(a) A car of mass 1000 kg slows from 54 km hr^{-1} West to rest in 6 seconds. Calculate the force on the car.
(b) What is the change in momentum for the car?
(c) Compute the reaction force to the force in (a).

Derive the formula; $\vec{F} = \dfrac{\Delta \vec{p}}{t}$

An 80 g golf ball is struck for a period of 0.03 s with a force of 500 N.
(a) What is the impulse for such a collision?
(b) The ball accelerates from the tee. What is its final speed?

Derive the law of conservation of momentum.

(a) A 100 g billiard ball travelling with speed 2 m s^{-1} collides with an identical stationary ball. If the incident ball stops on impact, with what speed does the initially stationary ball move and in what direction?
(b) How does the answer to part (a) alter if the two balls stick together after the impact?

Calculate the momenta for the following:
(a) a 20 g bullet travelling at 1000 m s^{-1} up.
(b) a 1500 kg car travelling at 20 m s^{-1} East.
(c) a 2 kg football travelling at 5 m s^{-1} down.
(d) a golf ball, 150 g, travelling at 30 m s^{-1} North East.
(e) a jumbo jet, 4 × 10^5 kg in mass, flying N27°W at 500 km hr^{-1}.

(a) Show that 1 kg m s^{-1} = 1 s N
(b) On the planet PHYS 11, time is measured in tics, length in spans and mass is measured in blobs. What will be the units for momentum on this planet?

(a) Calculate the force on a blob of plasticine of mass 25 g falling with speed 10 m s^{-1} to a cement floor and coming to rest in 0.05 s.
(b) Recalculate the force if the plasticine were replaced by a 75 g superball with the same initial speed but rebounding at 5 m s^{-1}. Assume the force acts for 0.05s.

A 900 kg car travelling at 90 km hr^{-1} collides with a brick wall which is apparently unmoved. The collision takes 0.2 s.
(a) Find the force on the car.
(b) What is the force on the wall?
(c) What happens to the car's momentum after collision?