

# Work, Energy and Momentum questions

## Question 1:

Two cars crash into each other. Both cars are 1100 kg, they are travelling at 21 m/s and they are travelling in opposite directions.

- a) Find the total kinetic energy of the two cars before the collision.
  
  
  
  
  
  
  
  
  
  
- b) What do you expect to be the speed of the two cars after impact if they stick together on impact?

Hence, what is the kinetic energy of the two cars immediately after impact?

- c) What happened to all that kinetic energy?
  
  
  
  
  
  
  
  
  
  
- d) You've just shown that kinetic energy is not conserved in a collision. It turns out that there is one physical quantity that is conserved in collisions – it is called 'momentum', and is defined by  $p = mv$ , momentum is mass times velocity. Accounting for the fact that both cars are going in opposite directions (and so one must have negative velocity and hence negative momentum), find the total momentum of the system before impact.
  
  
  
  
  
  
  
  
  
  
- e) Total momentum is conserved in a collision, so what is the momentum of the two cars immediately after impact?
  
  
  
  
  
  
  
  
  
  
- f) Hence determine the speed of the wreck after the collision.

- g) Now we consider a collision between a car of mass 1234 kg and a truck of mass 14321 kg. Prior to impact, the car is stationary and the truck is travelling at a speed of 15 m/s. If the car and the truck stick on impact, find the speed of the wreck after impact.

**Question 2:**

A ball, of mass 1.2 kg, is dropped from a 30 m cliff.

- a) Find the gravitational potential energy of the ball.
- b) After it has dropped 10 m, find how much gravitational potential energy the ball has.
- c) What has happened to the rest of the energy? How much of the other kind of energy has it got? (Ignore the loss of energy due to air resistance for the purposes of this question).
- d) Find the speed of the ball after it has dropped 10 m.
- e) Show that your answer to the previous question is consistent with what is predicted by the kinematic equations of motion.
- f) Use conservation of energy to determine the speed at which the ball hits the ground.
- g) Show that your answer to the previous question is consistent with what is predicted by the kinematic equations of motion.



