

State Examinations Commission – Physics Higher Level, 2005

Question 1

In an experiment to verify the principle of conservation of momentum, a body A was set in motion with a constant velocity. It was then allowed to collide with a second body B, which was initially at rest and the bodies moved off together at constant velocity.

The following data was recorded.

Mass of body A = 520.1 g

Mass of body B = 490.0 g

Distance travelled by A for 0.2 s before the collision = 10.1 cm

Distance travelled by A and B together for 0.2 s after the collision = 5.1 cm

Draw a diagram of the apparatus used in the experiment. (9)

Describe how the time interval of 0.2 s was measured. (6)

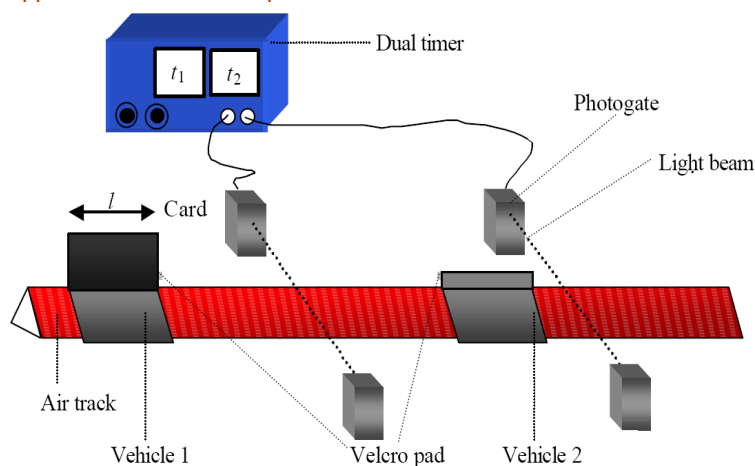
Using the data,

calculate the velocity of the body A (i) before, (ii) after, the collision;

show how the experiment verifies the principle of conservation of momentum. (18)

How were the effects of friction and gravity minimised in the experiment? (7)

Draw a diagram of the apparatus used in the experiment. (9)



Describe how the time interval of 0.2 s was measured. (6)

The time interval was measured by the millisecond dual timer. When the card broke the light beam the timer started and when it emerged from the light beam the timer stopped. The time was read from the LCD display on the timer.

Calculate the velocity of the body A (i) before, (ii) after, the collision. (6)

velocity before collision: $v = s/t = 0.101/0.2 = 0.505 \text{ m s}^{-1} \approx 0.51 \text{ m s}^{-1}$

velocity after collision: $v = s/t = 0.051/0.2 = 0.255 \text{ m s}^{-1} \approx 0.26 \text{ m s}^{-1}$

Show how the experiment verifies the principle of conservation of momentum. (12)

momentum before $p = mv = (0.5201)(0.505) = 0.263 \approx 0.26 \text{ kg m s}^{-1}$

momentum after $p = (0.5201 + 0.4900)(0.255) = 0.258 \approx 0.26 \text{ kg m s}^{-1}$

According to principle of conservation of momentum, in the absence of external forces, momentum before collision = momentum after collision. We see this is the case, hence the principle is verified.

How were the effects of friction and gravity minimised in the experiment? (7)

Friction was minimised by the air pump providing an air cushion for the trolley to glide along and the effects of gravity were eliminated by ensuring the track was horizontal before taking any measurements.