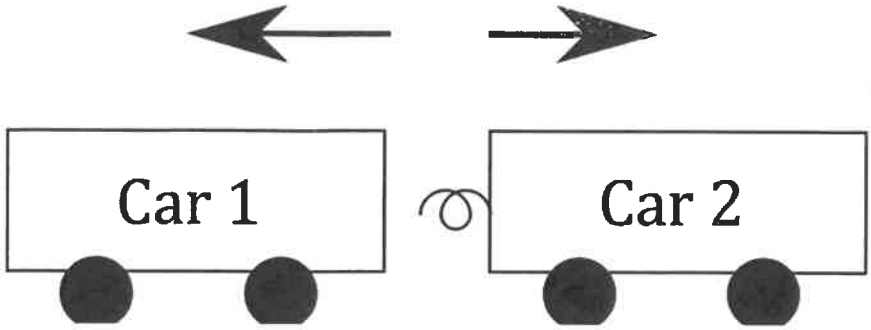
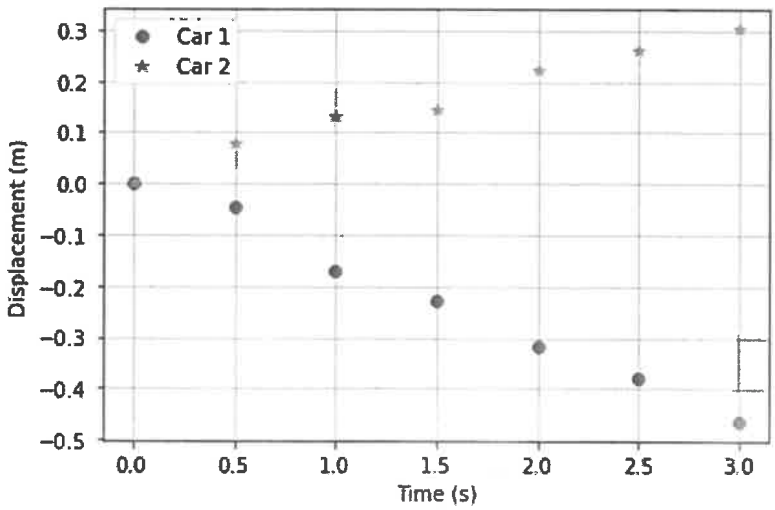
Cecil Andrews College.

Year 11 Physics Practical exam: Momentum Name: Marking Key



In a physics experiment, Kevin squeezes a spring between two weighted cars, as shown in the diagram above. He releases the cars, which then travel in opposite directions to one another. Car 1 has a mass of 200g and car 2 has a mass of 300g. Using video analysis software, Kevin determined the position of each car at set time intervals.



1. a) What is the total momentum of the two-car system *before* Kevin releases them? (1 mark)

$u_1 = u_2 = 0$.

$p = m_1 u_1 + m_2 u_2$

$p = 0$ ✓

b) Using the table, determine the *velocity* of car 1 and car 2 after they are released. (4 marks)

$d_1 = -0.45$ m ✓

$t = 3$ s

$v_1 = \frac{-0.45}{3}$

$v_1 = -0.15$ ms^{-1} ✓

$d_2 = 0.3$ ms^{-1} ✓ ← Allow freedom (choice of any 2 points)

$t = 3$ s

$v_2 = \frac{0.3}{3}$

$v_2 = 0.1$ ms^{-1} ✓ ← allow error/different

c) What is the total momentum of the two-car system after Kevin releases them? Comment on your results with respect to the law of conservation of momentum. (3 marks)

$m_1 = 0.2$ kg

$m_2 = 0.300$ kg

$v_1 = -.15$ ms^{-1}

$v_2 = 0.1$ ms^{-1}

$\Sigma p = m_1 v_1 + m_2 v_2$ ✓

$= 0.2 \times -.15 + 0.3 \times 0.1$

$= -0.03 + 0.03$

$= 0$ ✓ (or nearly)

The momentum after is the same as the momentum before. It is conserved. ✓

d) How much kinetic energy did the spring give to the two cars in total? (3 marks)

$E_{k_1} = \frac{1}{2} m_1 v_1^2$

$= \frac{1}{2} \times 0.2 \times (-0.15)^2$

$= 2.25 \times 10^{-3}$ J ✓

$E_{k_2} = \frac{1}{2} m_2 v_2^2$

$= 0.5 \times 0.3 \times (0.1)^2$

$= 1.5 \times 10^{-3}$ J ✓

$E_T = 2.25 \times 10^{-3} + 1.5 \times 10^{-3}$

$= 3.75 \times 10^{-3}$ J ✓

e) Kevin would like to determine the mass of an unlabeled disc in his collection. He adds it to the back of Car 1, increasing its mass. After releasing the spring, car 1 is found to have a velocity of -0.09ms^{-1} and car 2 is found to have a velocity of 0.12ms^{-1}, what is the mass of the disc?

(4 marks)

$v_1 = -0.09$

$v_2 = 0.12$

$m_2 = 0.3$

$v_1 m_1 + v_2 m_2 = 0$ ✓

$-0.09 m_1 + 0.3 \times 0.12 = 0$ ✓

$-0.09 m_1 = -0.036$

$m_1 = 0.4$ kg ✓

$m_{disc} + m_{car} = m_1$

$m_{disc} + 0.2 = 0.4$

$m_{disc} = 0.2$ kg ✓