

## State Examination Commission – Physics Higher Level, 2011

### Question 1

A student carried out an experiment to verify the principle of conservation of momentum. The student adjusted the apparatus till a body **A** was moving at a constant velocity  $u$ . It was then allowed to collide with a second body **B**, which was initially at rest, and the two bodies moved off together with a common velocity,  $v$ .

The following data were recorded:

mass of body <b>A</b> .....	= 230 g
mass of body <b>B</b> .....	= 160 g
velocity $u$ .....	= $0.53 \text{ ms}^{-1}$
velocity $v$ .....	= $0.32 \text{ ms}^{-1}$

Draw a labelled diagram of the apparatus used in the experiment.

What adjustments did the student make to the apparatus so that body **A** would move at constant velocity? (15)

How did the student know that body **A** was moving at constant velocity?

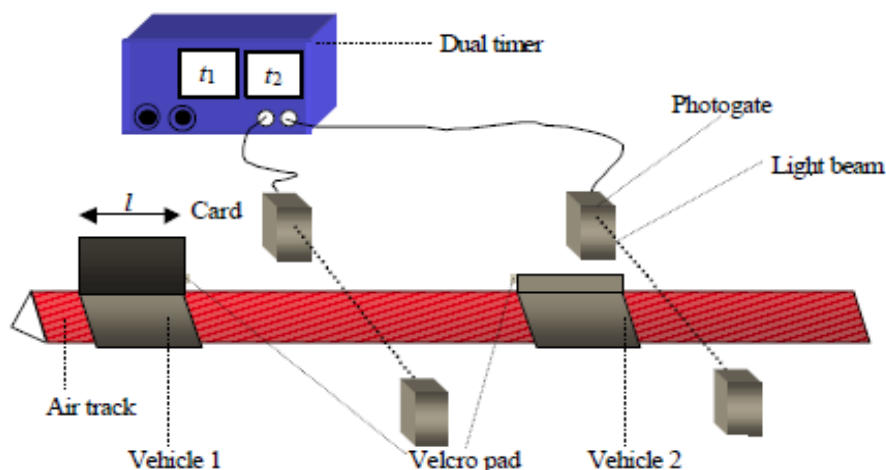
Describe how the student measured the velocity  $v$  of the bodies after the collision. (15)

Using the recorded data, show how the experiment verifies the principle of conservation of momentum.

How could the accuracy of the experiment be improved? (10)

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Draw a labelled diagram of the apparatus used in the experiment.



What adjustments did the student make to the apparatus so that body **A** would move at constant velocity? (15)

The student levelled the air track by means of levelling screws so that the vehicle remained stationary once the blower was switched on, and did not drift back or forth

How did the student know that body **A** was moving at constant velocity?

Before putting on vehicle 2 she sent vehicle 1 along the track. It took the same length of time to go through each light gate, so its velocity must have been constant.

Describe how the student measured the velocity  $v$  of the bodies after the collision. (15)

The timer recorded how long,  $t_2$ , it took the length  $l$  of card, attached to the two vehicles moving together, to pass through the second lightgate. The velocity  $v$ , was obtained by dividing  $l$  by  $t_2$ .

Using the recorded data, show how the experiment verifies the principle of conservation of momentum.

Total momentum before interaction of vehicles =	$0.230 \times 0.53$	+	$0.160 \times 0$	=	$0.12 \text{ kgms}^{-1}$
Total momentum after interaction of vehicles =	$(0.230 + 0.160)0.32$			=	$0.12 \text{ kgms}^{-1}$

In the absence of external forces, momentum was conserved in the collision, as it should be, according to the principle

of conservation of momentum.

How could the accuracy of the experiment be improved?

(10)

Its not strictly true that external forces were absent – there was friction between the vehicles and the air. If the experiment could be performed in a vacuum chamber, a better result would be obtained.  
A more sensitive timer could also lead to a more accurate result.