NAME_____

Momentum in Two Dimensions Assignment 1

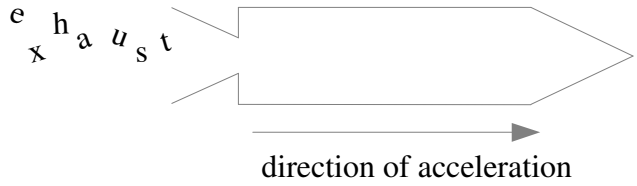
1. A ball of mass m = 200g is initially at rest. The ball is then hit with a bat. After being hit, the ball travels to the right with a horizontal speed of $12 ms^{-1}$.

(a) Calculate the magnitude of the momentum of the ball immediately after being hit. /2

(b) The ball is in contact with the bat for 6×10^{-3}s. Calculate the average force exerted by the bat on the ball. /3

(c) State the average force exerted by the ball on the bat, and write an equation which supports your answer. /2

2. A stick drawing of a firework rocket is propelled by the expulsion of burning "exhaust" letters. The direction of the thrust is shown below:

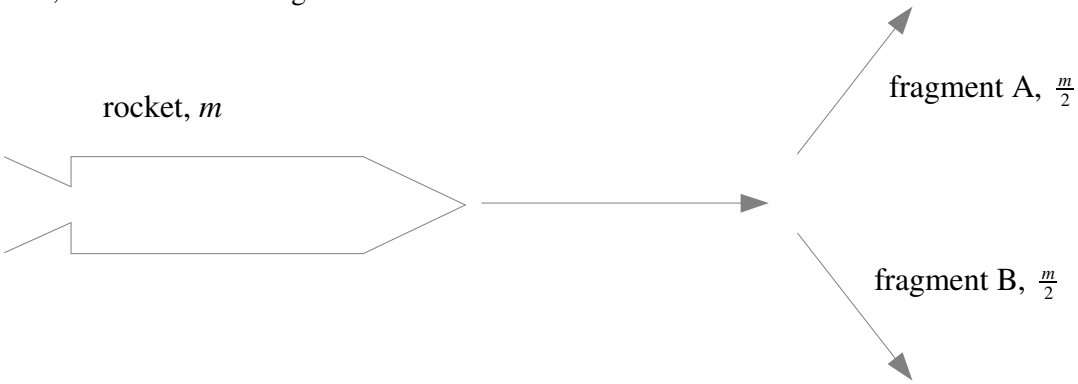


(a) State the law of conservation of momentum. /1

(b) Use this law to explain why the rocket experiences constant acceleration (assuming the mass of the rocket stays constant, the exhaust letters are of equal mass and are expelled at a constant rate). /3

The firework (of mass m) is travelling at speed v when it explodes and breaks into two identical fragments, each of mass $\frac{m}{2}$.

The two fragments, fragment A and fragment B, each travel at an angle of 60° to the rocket's initial direction of motion, as shown in the diagram below:



(c) Determine the speed of fragment A in terms of v. Give reasons for your answer. /3

3. Derive Newton's second law in terms of momentum $\vec{F} = \frac{\Delta \vec{p}}{\Delta t}$. /2

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Momentum in Two Dimensions Assignment 2

1.

a) Derive the equation $\Delta\vec{p}_1 + \Delta\vec{p}_2 = 0$ expressing the conservation of momentum for two interacting particles. /2

b) Hence state an equation expressing the conservation of momentum for three interacting particles. /1

2.

If you inflate a balloon and then let it go, it will fly around the room. If the air is leaving the balloon at $10ms^{-1}$ and flowing at $100gs^{-1}$, determine the magnitude of the average force being applied to the balloon. /2

3.

A particle of mass 2.0kg moving at $3.0ms^{-1}$ collides with a stationary mass of 3.0kg. After the collision the masses move off at right angles to each other, with the 2.0kg mass having a velocity of $2.0ms^{-1}$.

Calculate the speed of the 3.0kg mass after the collision. /4

4.

a) Explain in terms of the law of conservation of momentum, how the momentum of light particles (photons) can be used to accelerate a solar sail. /2

b) Explain, using vector diagrams, whether absorbed photons or reflected photons would give a craft with a solar sail more acceleration. /3

TOTAL /14

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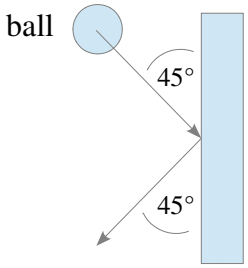
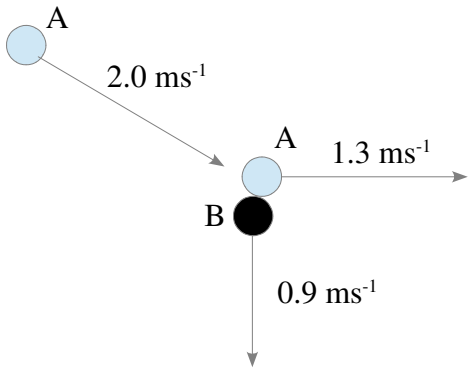
Momentum in Two Dimensions Assignment 3

1. A ball of mass 0.53 kg is moving at a speed of 4.1 ms^{-1} when it collides with a wall.
The ball bounced off the wall without a change of speed.
The ball is moving at 45° to the wall before and after the collision, as shown in the diagram below:



Determine the magnitude and direction of the change in momentum of the ball. /4

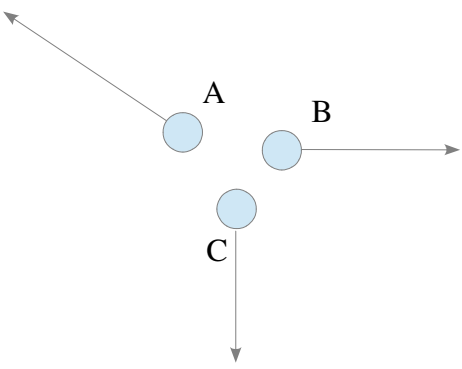
2. Ball A, with mass *m* is moving at speed 2.0 ms^{-1} and collides with ball B of mass 0.25 kg which is stationary. After the collision, the balls are moving away at right angles to each other, as shown below:



Determine the mass of ball A.

/4

3. A stationary object explodes into three fragments, A, B and C, as shown below.
Fragment A has a mass of 0.10 kg
Fragment B has a mass of 0.13 kg and a speed of 0.29 ms^{-1}
Fragment C has a mass of 0.095 kg and a speed of 0.32 ms^{-1}
Fragments B and C are moving away at right angles to each other



Determine the speed and direction of fragment A. /5

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