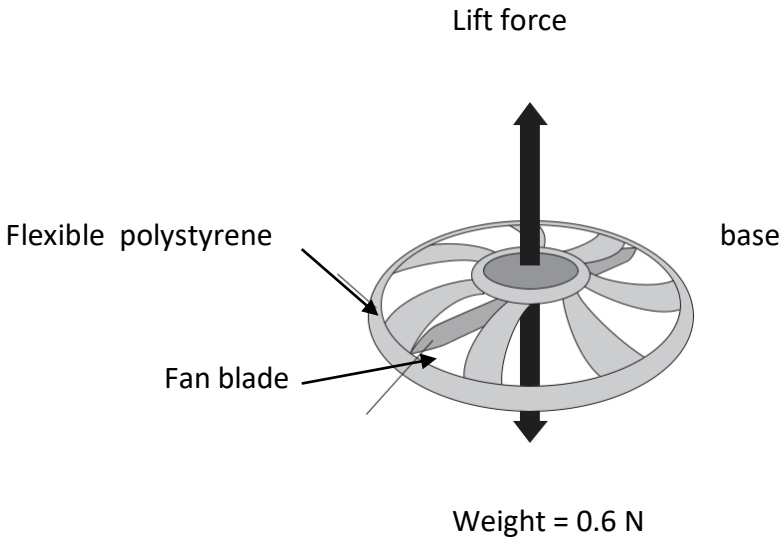
MOMENTUM 1

Q:1 The diagram shows a small, radio-controlled, flying toy. A fan inside the toy pushes air downwards creating the lift force on the toy.



When the toy is hovering in mid-air, the fan is pushing 1.5 kg of air downwards every 10 seconds. Before the toy is switched on, the air is stationary.

(a) Use the equations in the box to calculate the velocity of the air when the toy is hovering.

momentum = mass × velocity

$$\text{force} = \frac{\text{change in momentum}}{\text{time taken for the change}}$$

Show clearly how you work out your answer.

Velocity = ———————— m/s

(3 marks)

(b) Explain why the toy accelerates upwards when the fan rotates faster.

(2 marks)

(c) The toy is not easy to control so it often falls to the ground.

Explain how the flexible polystyrene base helps to protect the toy from being damaged when it crashes into the ground.

(3 marks)

Q:2 The diagram shows a child on a playground swing. The playground has a rubber safety surface.

(a) The child, with a mass of 35 kg, falls off the swing and hits the ground at a speed of 6 m/s.

(a) (i) Use the equation in the box to calculate the momentum of the child as it hits the ground.

momentum = mass × velocity

Show clearly how you work out your answer and give the unit.

Momentum = _____

(3 marks)

(a)(ii)After hitting the ground, the child slows down and stops in 0.25 s.

Use the equation in the box to calculate the force exerted by the ground on the child.

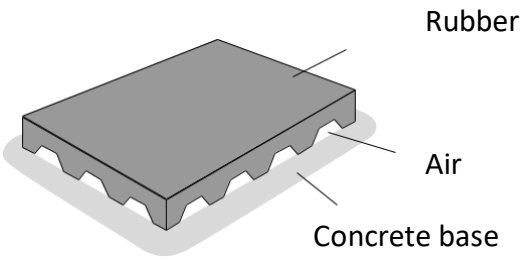
$$\text{force} = \frac{\text{change in momentum}}{\text{time taken for the change}}$$

Show clearly how you work out your answer.

Force = _____ N

(2 marks)

(b) The diagram shows the type of rubber tile used to cover the playground surface.



Explain how the rubber tiles reduce the risk of children being seriously injured when they fall off the playground equipment.

_____

_____

_____

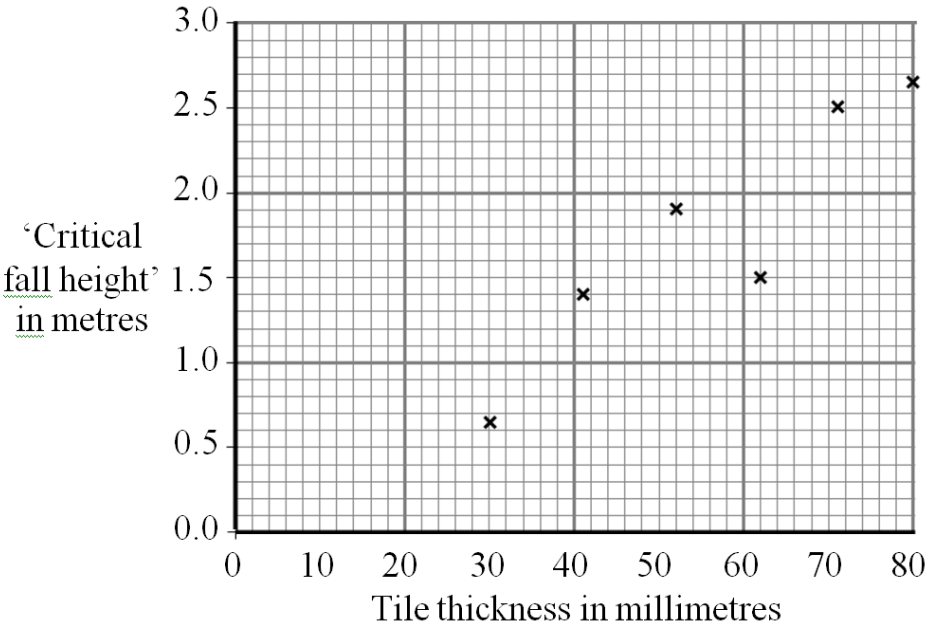
_____

(3 marks)

(c) The 'critical fall height' is the height that a child can fall and not be expected to sustain a life-threatening head injury.

A new type of tile, made in a range of different thicknesses, was tested in a laboratory using test dummies and the 'critical fall height' measured. Only one test was completed on each tile.

The results are shown in the graph.



The 'critical fall height' for playground equipment varies from 0.5 m to 3.0 m.

Suggest two reasons why more tests are needed before this new type of tile can be used in a playground.

1 . _____

_____

2 . _____

_____

(2 marks)

(d) Developments in technology allow manufacturers to make rubber tiles from scrap car tyres.

Suggest why this process may benefit the environment.

_____

_____

(1 mark)

Q:3 In any collision, the total momentum of the colliding objects is usually conserved.

(a)(i) What is meant by the term 'momentum is conserved'?

_____

_____

(1 mark)

(a)(ii) In a collision, momentum is not always conserved.Why?

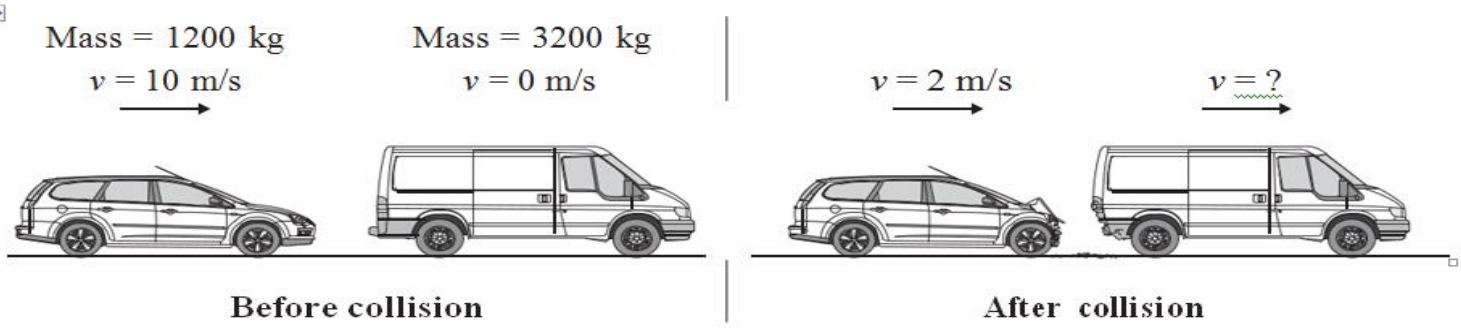
_____

_____

_____

(1 mark)

(b) The diagram shows a car and a van, just before and just after the car collided with the van.



(b) (i) Use the information in the diagram and the equation in the box to calculate the change in the momentum of the car.

Momentum=mass × velocity

Show clearly how you work out your answer and give the unit.

Change in momentum———————————

(3 marks)

(b) (ii) Use the idea of conservation of momentum to calculate the velocity of the van when it is pushed forward by the collision.

Show clearly how you work out your answer.

Velocity ——————————— m/s forward

(2 marks)

TOTAL MARKS=25 MARKS