Collisions and Monentum GCSE AQA Higher Physics Past Papers Questions

01. The stopping distance of a car is the sum of the thinking distance and the braking distance.

Table 4 shows how the thinking distance and braking distance vary with speed.

Table 4

Speed in m/s	Thinking distance in m	Braking distance in m
10	6	6.0
15	9	13.5
20	12	24.0
25	15	37.5
30	18	54.0

1 What is meant by the braking distance of a vehicle?

[1 mark]

_____

_____

2 The data in **Table 4** refers to a car in good mechanical condition driven by an alert driver.

Explain why the stopping distance of the car increases if the driver is very tired.

[2 marks]

_____

3 A student looks at the data in **Table 4** and writes the following:

thinking distance $\propto$ speed

braking distance $\propto$ speed

Explain whether the student is correct.

[2 marks]

Applying the brakes with too much force can cause a car to skid.

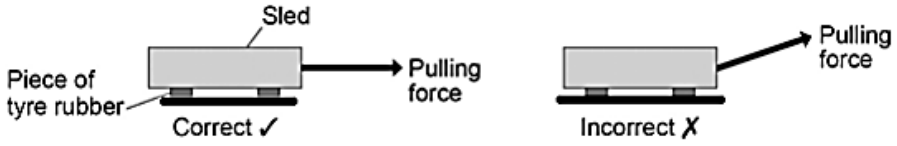
The distance a car skids before stopping depends on the friction between the road surface and the car tyres and also the speed of the car.

Friction can be investigated by pulling a device called a 'sled' across a surface at constant speed.

Figure 16 shows a sled being pulled correctly and incorrectly across a surface.

The constant of friction for the surface is calculated from the value of the force pulling the sled and the weight of the sled.

Figure 16



4 Why is it important that the sled is pulled at a constant speed?

[1 mark]

Tick **one** box.

If the sled accelerates it will be difficult to control. ☐

If the sled accelerates the value for the constant of friction will be wrong. ☐

If the sled accelerates the normal contact force will change. ☐

5 If the sled is pulled at an angle to the surface the value calculated for the constant of friction would not be appropriate.

Explain why.

[2 marks]

6 By measuring the length of the skid marks, an accident investigator determines that the distance a car travelled between the brakes being applied and stopping was 22 m.

The investigator used a sled to determine the friction. The investigator then calculated that the car decelerated at 7.2 m/s^2.

Calculate the speed of the car just before the brakes were applied.

Give your answer to two significant figures.

Use the correct equation from the Physics Equation Sheet.

[3 marks]

Speed = _____ m/s

02.

1 An adult of mass 80 kg has more inertia than a child of mass 40 kg

What is inertia?

[1 mark]

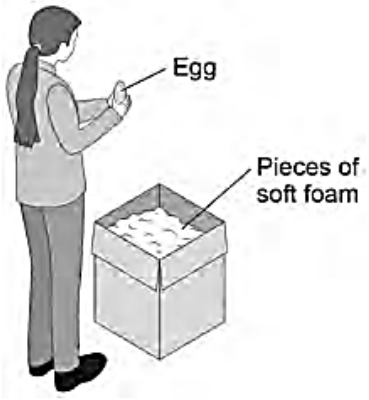
2 A teacher demonstrated the idea of a safety surface.

She dropped a raw egg into a box filled with pieces of soft foam.

The egg did not break.

Figure 10 shows the demonstration.

Figure 10

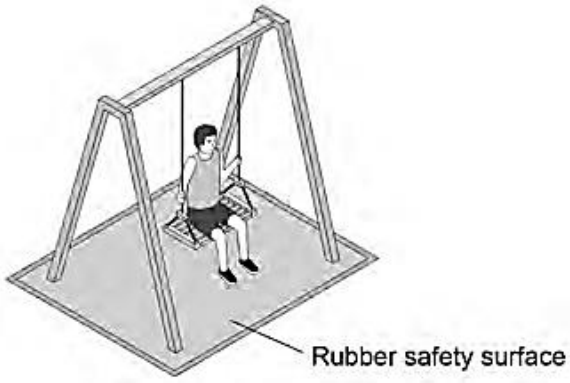


Explain why the egg is less likely to break when dropped onto soft foam rather than onto a concrete floor.

[3 marks]

3 **Figure 11** shows a child on a playground swing. The playground has a rubber safety surface.

Figure 11



A child of mass 32 kg jumped from the swing.

When the child reached the ground she took 180 milliseconds to slow down and stop.

During this time an average force of 800 N was exerted on her by the ground.

Calculate the velocity of the child when she first touched the ground.

Use the Physics Equations Sheet.

[4 marks]

Velocity = _____ m/s

8

03. **Figure 7** shows two ice hockey players moving towards each other.

They collide and then move off together.

Figure 7

Before the collision

Player A
Mass = 78 kg
Velocity = +7.5 m/s

Player B
Mass = 91 kg
Velocity = –5.5 m/s

During the collision, the total momentum of the players is conserved.

1 What is meant by 'momentum is conserved'?

[1 mark]

_____

_____

2 Immediately after the collision the two players move together to the right.

Calculate the velocity of the two players immediately after the collision.

[4 marks]

_____

_____

_____

_____

_____

_____

_____

_____

Velocity = _____ m/s

3 The ice hockey players wear protective pads filled with foam.

Explain how the protective pads help to reduce injury when the players collide.

[3 marks]

8

04. **Figure 14** shows some bumper cars.

Bumper cars are designed to withstand collisions at low speeds.

Figure 14

. 1 During a collision between a bumper car and the barrier, the bumper car and barrier act as a closed system.

What is meant by a 'closed system'?

[1 mark]

2 How does Newton's Third Law of motion apply to the collision between the bumper car and the barrier?

[1 mark]

3 During the collision, the change in momentum of the bumper car is 700 kg m/s.

The time taken for the collision is 0.28 s.

Calculate the force on the bumper car during the collision.

Use the Physics Equations Sheet.

[2 marks]

Force = _____ N

4 The bumper car has a flexible bumper.

Explain how the flexible bumper reduces the risk of injury to the people in the bumper car during the collision.

[3 marks]

5 A bumper car moved with an initial constant velocity and then accelerated at 2.0 m/s^2.

While accelerating, the bumper car travelled a distance of 1.5 m.

The final velocity of the bumper car was 2.5 m/s.

Calculate the initial constant velocity of the bumper car.

Use the Physics Equations Sheet.

[3 marks]

Initial constant velocity = _____ m/s

10