5.7 Momentum

Question Paper

Course	AQA GCSE Physics
Section	5. Forces
Topic	5.7 Momentum
Difficulty	Medium

Time allowed: 60

Score: /47

Percentage: /100

Question 1a

Higher Only

At a paintballing party, a group of children fire paint balls at each other using paintball guns.

The paintball guns have a mass of 0.5 kg each.

Each paintball inside the gun has a mass of 2.5 g.

(a)
Describe and explain the momentum of the paintball before the gun is fired.

Use the information above to support your answer.

[2 marks]

[2 marks]

Question 1b

Higher Only

(b)
The gun fires the paintball forwards at a velocity of 70 m / s.

The paintball has a mass of 2.5 g

Calculate the momentum of the paintball just after the gun is fired.

[2 marks]

[2 marks]

Question 1c

Higher Only

(c)
Compare the total momentum of the gun and paintball before and after the gun is fired, assuming no other forces were acting on the objects.

Use information from (a) and (b) above in your answer.

[2 marks]

[2 marks]

Question 2a

(a)
Momentum is a vector quantity.

Explain why.

[2 marks]

[2 marks]

Question 2b

Higher Only

(b)
Some skateboarders are skateboarding in a park.

One of the skateboarders is moving at 0.3 m/s when he collides with a stationary skateboarder.

The first skateboarder slows down and stops in 0.50 seconds.

The total mass of the moving skateboarder and his skateboard is 60.5 kg.

Calculate the average force exerted by the moving skateboarder on the stationary skateboarder during the collision.

Show clearly how you work out your answer.

[3 marks]

[3 marks]

Question 2c

Higher Only

(c)

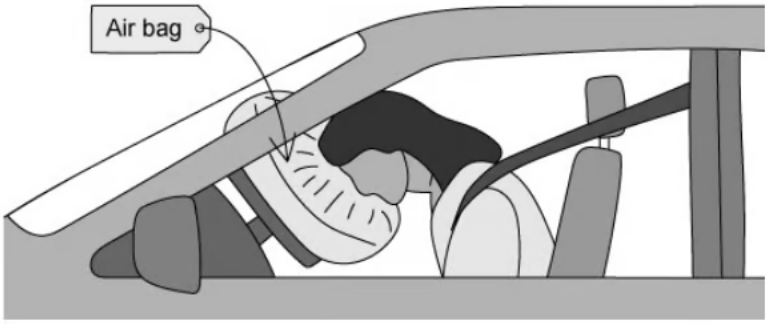
Cars have airbags which deflate when a collision occurs.

A moving car collides with a stationary lorry.

Within 0.05 s of the car hitting the back of the lorry, the car driver's airbag inflates, as shown in **Figure 3.**

The airbag deflates when it is hit by the driver's head.

Figure 3



Explain why the airbag reduces the risk of the driver sustaining a serious head injury.

[3 marks]

[3 marks]

Question 3a

In **Figure 1**, a boulderer is at rest while climbing. His foot then slips and he lands on a crash pad containing foam.

Figure 1

He takes 1.01 s to fall.

(a)
Calculate the boulderer's speed before hitting the crash pad.

Acceleration due to gravity = 9.81 m/s^2.

Give your answer to 3 significant figures.

[3 marks]

Speed (3 significant figures) = ... m/s

[3 marks]

Question 3b

Higher Only

The boulderer has a mass of 75.5 kg.

From the moment he makes contact with the crash pad, he comes to rest in 0.00925 s.

(b)
Calculate the force the crash pad exerts on the boulderer.

Give your answer to 3 significant figures.

[3 marks]

Force (3 significant figures) = ... N

[3 marks]

Question 3c

(c)
While landing, the boulderer bends his knees.

Explain how this reduces the chance of injury.

[2 marks]

[2 marks]

Question 4a

Higher Only

Car **A** has a mass of 600 kg and is travelling at at 30 miles per hour (miles/hour) to the right.

Car **B** is behind car **A** and is travelling at 40 miles/hour to the right.

(a)
The total momentum of the system is 58 000 kg miles/hour.

Calculate the mass of car **B**.

Give your answer to 2 significant figures.

[4 marks]

Mass of car **B** (2 significant figures) = ... kg

[4 marks]

Question 4b

Higher Only

The driver of car **B** is on their phone and they crash into the back of car **A**.

After the collision, both cars stick together and travel forward at the same speed.

(b)
Calculate the combined speed of the cars, giving the unit.

Give your answer to 2 significant figures.

[4 marks]

Combined speed (2 significant figures) = ... Units .....

[4 marks]

Question 4c

Higher Only

(c)
Show that kinetic energy is **not** conserved in this collision.

[5 marks]

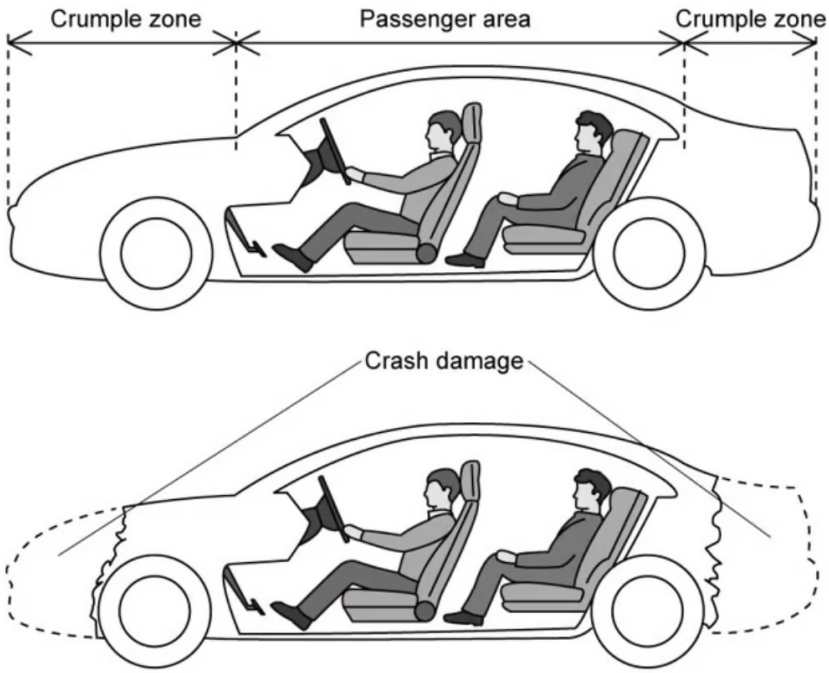
[5 marks]

Question 5a

Higher Only

Modern cars all feature crumple zones, which are designed to buckle and break in the event of a crash, as shown in **Figure 1**.

Figure 1



(a)

Derive the equation $F = \frac{\Delta p}{t}$ from the equations $a = \frac{\Delta v}{t}$, $p = mv$ and $F = ma$, where F is force, Δp is change in momentum, t is time, a is acceleration, Δv is change in velocity and m is mass.

[3 marks]

[3 marks]

Question 5b

(b)
Explain how the crumple zone of the car reduces the risk of injury in a crash.

[2 marks]

[2 marks]

Question 5c

(c)
Using the equation relating force and momentum given in part **(a)**, explain why driving at a lower velocity is generally safer.

[3 marks]

[3 marks]

Question 5d

(d)
Explain whether it is safer for the passenger to crash into a wall or a parked vehicle.

[4 marks]

[4 marks]