Force and change in momentum

Physics calculations (separate Physics only) | AQA GCSE Physics 8463 only (not Combined Science) | 12 questions, 38 marks

GCSE science calculations

Scan for the solutions

Equations for this topic (cover this box to practise recalling them)

- force = $\frac{\text{mass} \times \text{change in velocity}}{\text{time taken}}$ on the physics equation sheet
- force = $\frac{\text{change in momentum}}{\text{time taken}}$ on the physics equation sheet
- $(\text{final velocity})^2 - (\text{initial velocity})^2 = 2 \times \text{acceleration} \times \text{distance}$ on the physics equation sheet

Name: _____ **Date:** _____ **Score:** _____ **/ 38**

1 **Higher tier**

A trolley of mass 2.0 kg is pushed along a bench. Its velocity changes by 3.0 m/s in 0.50 s.

Calculate the resultant force on the trolley.

(2 marks)

Answer _____

2 **Higher tier**

Leah takes a penalty in a five-a-side football match. The ball has a mass of 0.45 kg and starts at rest. It leaves her boot at 24 m/s. Her boot is in contact with the ball for 0.010 s.

Calculate the average force of the boot on the ball.

(2 marks)

Answer _____

3 **Higher tier**

A rowing boat is pushed away from a jetty. The change in momentum of the boat is 36 kg m/s. The push lasts for 0.15 s.

Calculate the average force on the boat.

(2 marks)

Answer _____

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4 **Higher tier**

A fielder catches a cricket ball of mass 0.16 kg. The ball is moving at 30 m/s and is brought to rest in 20 ms.

Calculate the average force on the ball.

(3 marks)

Answer _____

5 **Higher tier**

Mohammed hits a golf ball off a tee at a driving range. The ball has a mass of 46 g. It starts at rest and leaves the club at 65 m/s. The club is in contact with the ball for 0.50 ms.

Calculate the average force of the club on the ball.

(3 marks)

Answer _____

6 **Higher tier**

In a safety test, a car of mass 1500 kg travelling at 54 km/h drives into a crash barrier filled with water. The car is brought to rest in 0.25 s.

1 m/s = 3.6 km/h

Calculate the average force of the barrier on the car.

(3 marks)

Answer _____

7 **Higher tier**

A gymnast of mass 50 kg jumps off a vaulting box that is 1.8 m high. She lands on a crash mat at 6.0 m/s and is brought to rest. While the mat stops her, the average resultant force on her is 1500 N.

Calculate the time it takes the mat to stop her.

(3 marks)

Answer _____

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8 **Higher tier**

A dynamics trolley of mass 0.80 kg is at rest on a level track. A constant resultant force of 4.0 N acts on it for 1.5 s.

Calculate the velocity of the trolley at the end of the 1.5 s. (3 marks)

Answer _____

9 **Higher tier**

A railway wagon rolls into the buffers at the end of a siding at 2.0 m/s. The buffers bring it to rest in 1.6 s with an average force of 25 000 N.

Calculate the mass of the wagon. (3 marks)

Answer _____

10 **Higher tier**

Kwame throws a tennis ball of mass 0.060 kg at a brick wall. The ball hits the wall at 12 m/s and bounces straight back at 8.0 m/s. The ball is in contact with the wall for 15 ms.

Calculate the average force of the wall on the ball. Show your working. (4 marks)

Answer _____

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11 **Higher tier**

Engineers test a cycle helmet with a model head. The cyclist and bike together have a mass of 85 kg. The model head has a mass of 4.5 kg.

In each test the model head hits the ground at 6.0 m/s and is brought to rest.

- Without a helmet the head stops in 3.0 ms.
- With the helmet the head stops in 12 ms.

a. Calculate the average force on the head without a helmet.

b. Calculate the average force on the head with the helmet.

c. How many times smaller is the force with the helmet? Show your working.

(5 marks)

Answer _____

12 **Higher tier**

Isla drops a basketball of mass 620 g from rest. It falls 1.6 m to the floor. Air resistance can be ignored and the acceleration of the ball as it falls is 9.8 m/s^2.

The ball bounces straight back up at 4.2 m/s. It is in contact with the floor for 18 ms.

a. Calculate the speed of the ball just before it hits the floor.

b. Calculate the average force of the floor on the ball. Give your answer to 2 significant figures. Show your working.

(5 marks)

Answer _____

End of questions | Total 38 marks

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