AQA GCSE Combined Science - Trilogy | 8464

SPECIFICATION POINT 6.5.4.2.2

Newton's Second Law

Past-paper questions

Tier	**Higher**
Question groups	**5**
Available paper years	**2018–2023**

Using this booklet

1. Answer the questions in order and show your working.
2. Original question numbers and marks are retained.
3. Print at actual size (100%) for measuring questions.
4. Use the companion answer booklet to check your work.

Name: _____ **Date:** _____

Whole questions are retained for context, so some parts assess other specification points. Current and legacy sources are labelled. Continue on extra paper if needed.

6.5.4.2.2 Newton's Second Law

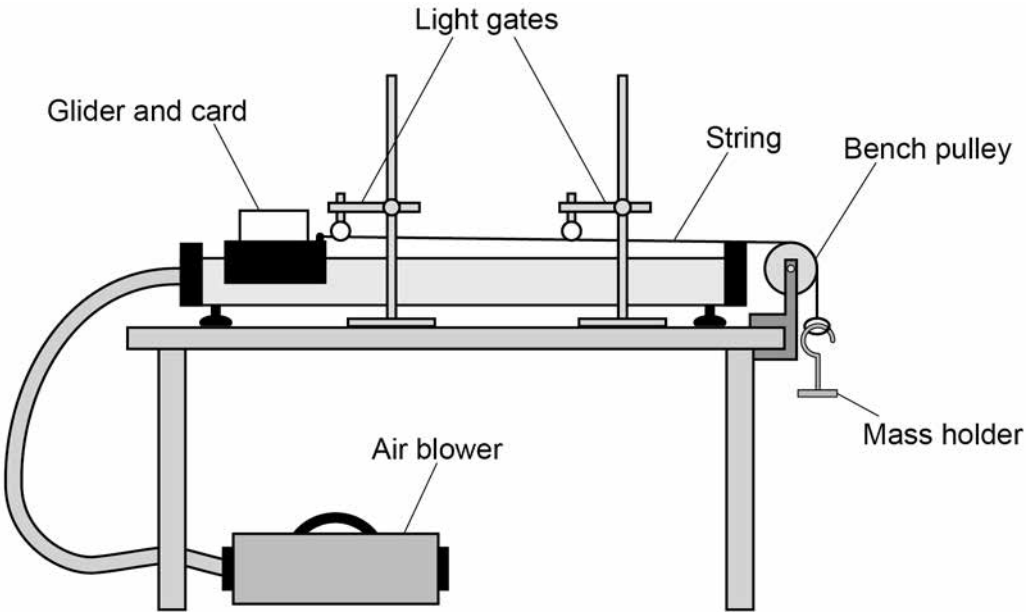
Question 01

0 1 A student investigated acceleration using gliders, an air track and light gates.

The air track reduces friction between the glider and the track to zero.

Figure 1 shows the apparatus.

Figure 1



The glider was released from rest and moved along the track.

The mass holder hit the ground before the card passed through the second light gate.

0 1 . 1 Which **two** statements describe the effect this would have on the glider?

[2 marks]

Tick **two** boxes.

Its acceleration would decrease to zero. ☐

Its acceleration would increase. ☐

The resultant force on it would decrease to zero. ☐

The resultant force on it would increase. ☐

Its speed would increase. ☐

6.5.4.2.2 Newton's Second Law

Question 01 · continued

0 1 . 2 The mass holder should **not** hit the ground before the card passes through the second light gate.

Suggest **one** way that the student could stop this happening.

[1 mark]

Question 1 continues on the next page

Question 01 · continued

The student increased the resultant force acting on the glider by adding more masses to the mass holder.

She calculated the acceleration of the glider for each resultant force.

Each test was done three times.

Table 1 shows the results.

Table 1

Resultant force in N	Acceleration in m/s^2			Mean acceleration in m/s^2
	Test 1	Test 2	Test 3	
0.20	1.3	1.2	1.3	1.26667
0.39	2.6	2.5	2.6	2.6
0.59	3.8	3.8	3.9	3.8
0.78	5.1	5.1	5.1	5.1
0.98	6.4	7.2	6.4	6.7

0 1 . 3 The student made **two** mistakes in the mean acceleration column.

Identify the mistakes the student made.

Suggest how each mistake can be corrected.

[4 marks]

Mistake _____

_____

Correction _____

_____

Mistake _____

_____

Correction _____

_____

6.5.4.2.2 Newton's Second Law

Question 01 · continued

0 1 . 4 Write a conclusion for this investigation.

Use the data in **Table 1**

[1 mark]

Question 1 continues on the next page

0 1 . 5 The student used a constant resultant force to accelerate the glider.

The student changed the mass of the glider and calculated the new acceleration.

She repeated this for different masses of the glider, keeping the resultant force constant.

The results are shown in **Table 2**

Table 2

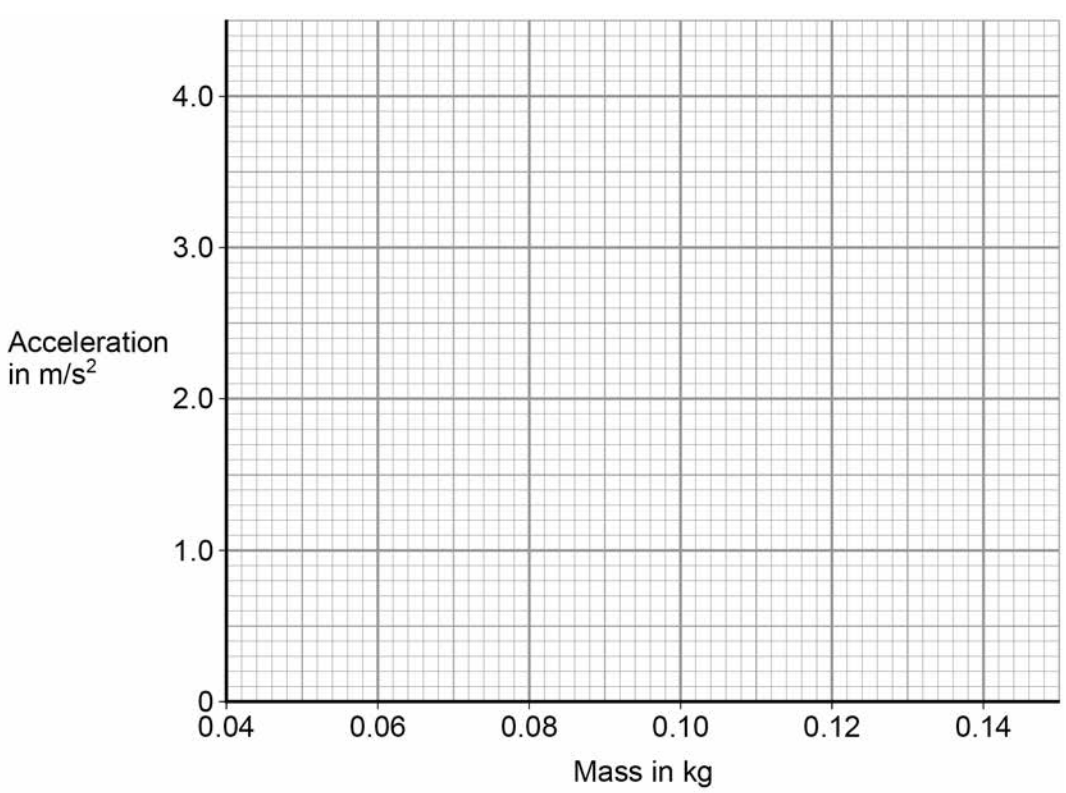
Mass of the glider in kg	Acceleration in m/s^2
0.060	3.5
0.080	2.6
0.10	2.0
0.12	1.7
0.14	1.4

Plot the results on **Figure 2**

Draw a line of best fit.

[3 marks]

Figure 2



6.5.4.2.2 Newton's Second Law

Question 01 · continued

0 1 . 6 Describe the relationship between mass and acceleration.

[1 mark]

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Turn over for the next question

6.5.4.2.2 Newton's Second Law

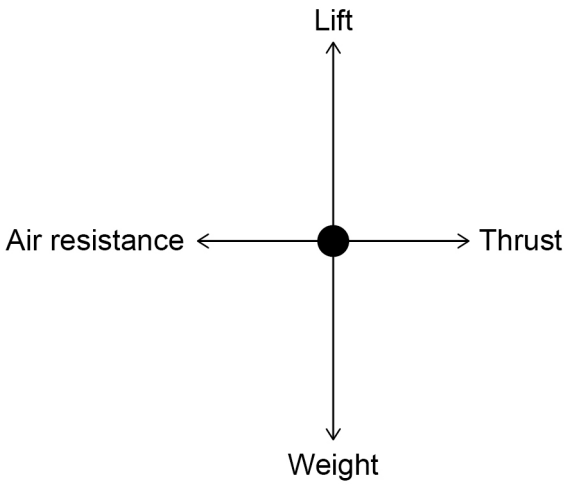
Question 02

June 2019 | 8464/P/2H | Original Q6

0 6 **Figure 9** shows a free body diagram for an aeroplane flying at a constant speed and at a constant height.

The speed of the aeroplane is much greater than the speed at which the aeroplane lands.

Figure 9



0 6 . 1 Explain how the forces need to change so the aeroplane can land.

[4 marks]

Question 6 continues on the next page

6.5.4.2.2 Newton's Second Law

Question 02 · continued

0 6 . 2 The aeroplane lands at a speed of 80 m/s

After landing, the aeroplane takes 28 s to decelerate to a speed of 10 m/s

The mean resultant force on the aeroplane as it decelerates is 750 000 N

Calculate the mass of the aeroplane.

[5 marks]

Mass = _____ kg

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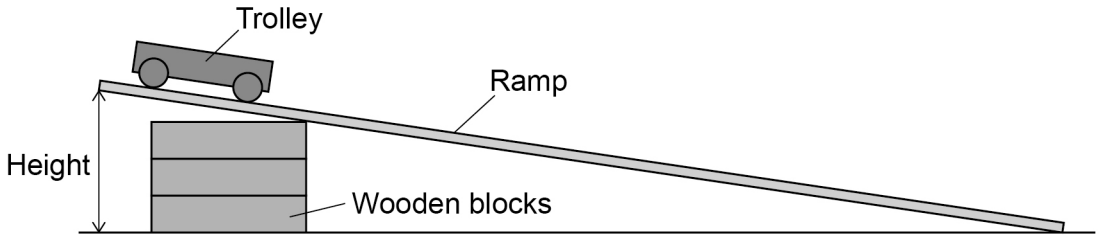
6.5.4.2.2 Newton's Second Law

Question 03

0 2 A student investigated how the height of a ramp affects the acceleration of a trolley down the ramp.

Figure 3 shows some of the equipment used.

Figure 3



0 2 . 1 Plan an investigation to determine how the height of the ramp affects the acceleration of the trolley.

[6 marks]

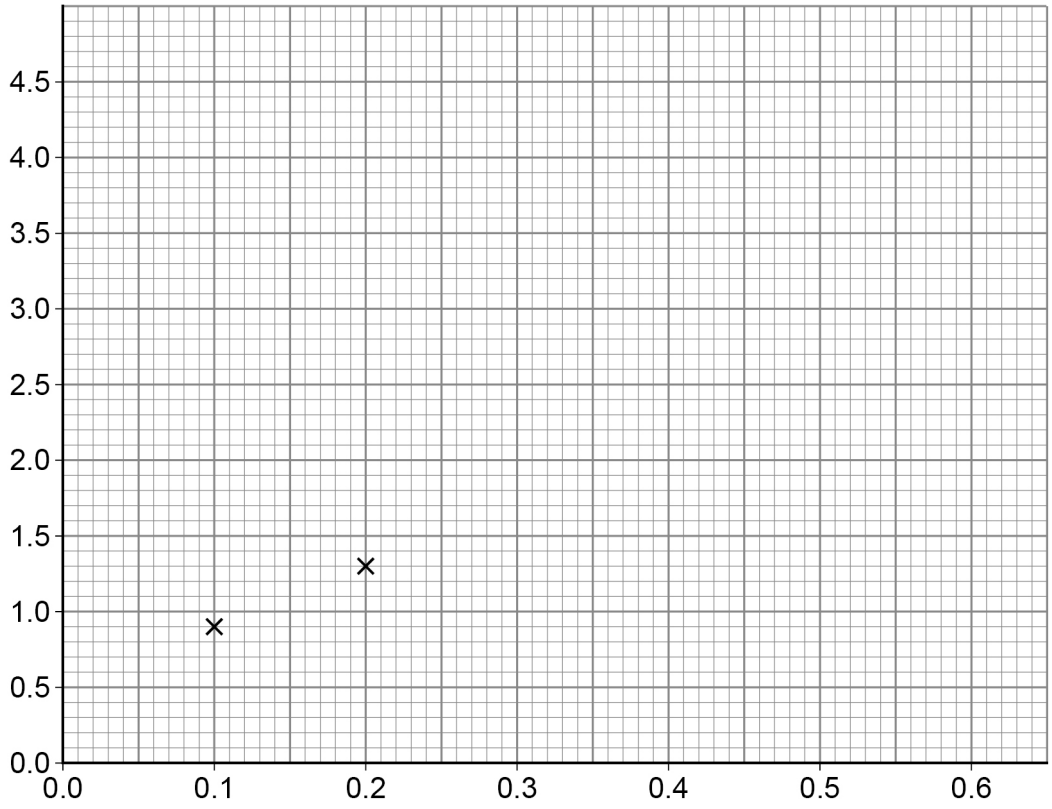
Table 1 shows the results.

Table 1

Height of ramp in metres	0.1	0.2	0.3	0.4	0.5	0.6
Acceleration in m/s^2	0.9	1.3	2.1	3.2	3.9	4.3

The first two results have been plotted on **Figure 4**.

Figure 4



0 2 . 2 Complete **Figure 4**.

You should:

- label the axes
- plot the remaining results from **Table 1**
- draw a line of best fit.

[4 marks]

Question 2 continues on the next page

6.5.4.2.2 Newton's Second Law

Question 03 · continued

0 2 . 3 Write down the equation that links acceleration (a), mass (m) and resultant force (F).

[1 mark]

0 2 . 4 When the resultant force on the trolley was 0.63 N the acceleration of the trolley was 2.1 m/s^2

Calculate the mass of the trolley.

[3 marks]

Mass of trolley = _____ kg

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6.5.4.2.2 Newton's Second Law

Question 04

0 2 Professional rugby players wear a tracking device that measures their velocity and acceleration.

Figure 2 shows a player wearing a tracking device.

The player is tackling another player who is running with the ball.

Figure 2



0 2 . 1 Velocity and acceleration are both vector quantities.

What is a vector quantity?

[1 mark]

Tick (✓) **one** box.

A quantity with both magnitude and direction ☐

A quantity with direction only ☐

A quantity with magnitude only ☐

6.5.4.2.2 Newton's Second Law

Question 04 · continued

0 2 . 2 Which of the following is a vector quantity?

[1 mark]

Tick (✓) **one** box.

- Displacement ☐
- Distance ☐
- Time ☐
- Work done ☐

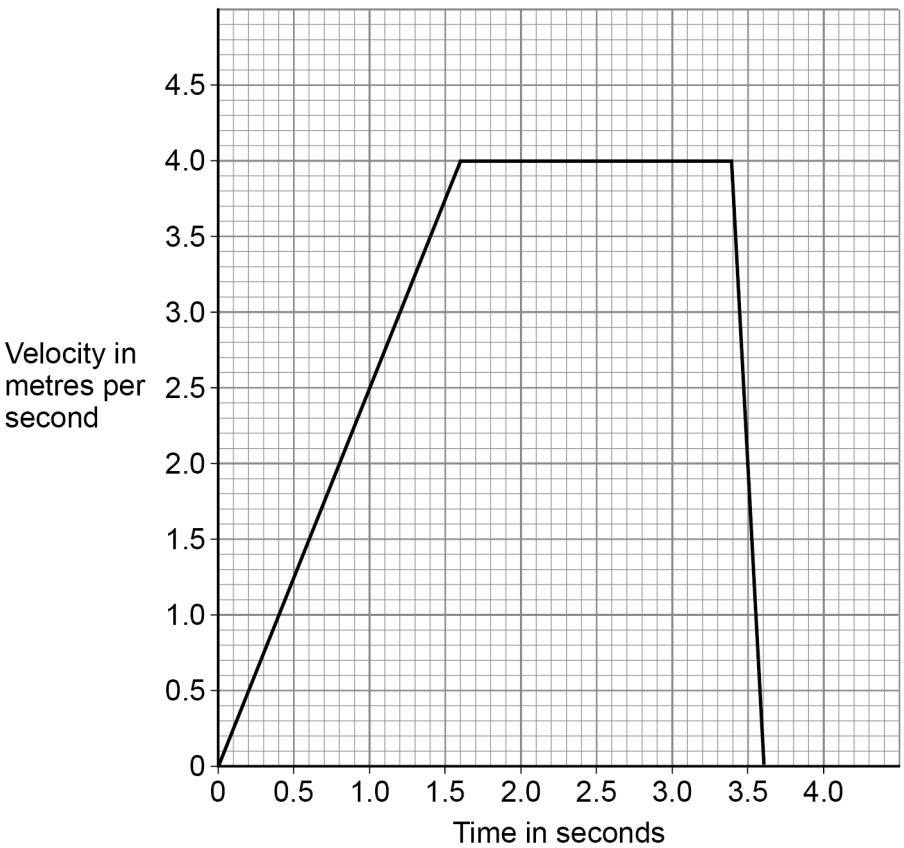
Question 2 continues on the next page

6.5.4.2.2 Newton's Second Law

Question 04 · continued

Figure 3 shows a velocity–time graph for the player running with the ball.

Figure 3



0 2 . 3 Determine the acceleration of the player between 0 and 1.6 s.

[2 marks]

Acceleration = _____ m/s^2

0 2 . 4 Describe the motion of the player between 3.4 s and 3.6 s.

[1 mark]

6.5.4.2.2 Newton's Second Law

Question 04 · continued

The force exerted on the player when she is tackled causes her to accelerate.

0 2 . 5 Write down the equation which links acceleration (*a*), mass (*m*) and resultant force (*F*).

[1 mark]

0 2 . 6 The player accelerates at 25 m/s^2 when a resultant force of 1800 N acts on her.

Calculate the mass of the player.

[3 marks]

Mass = _____ kg

0 2 . 7 The tracking device sends data to a computer during the game.

Suggest **one** advantage of the data being sent during the game.

[1 mark]

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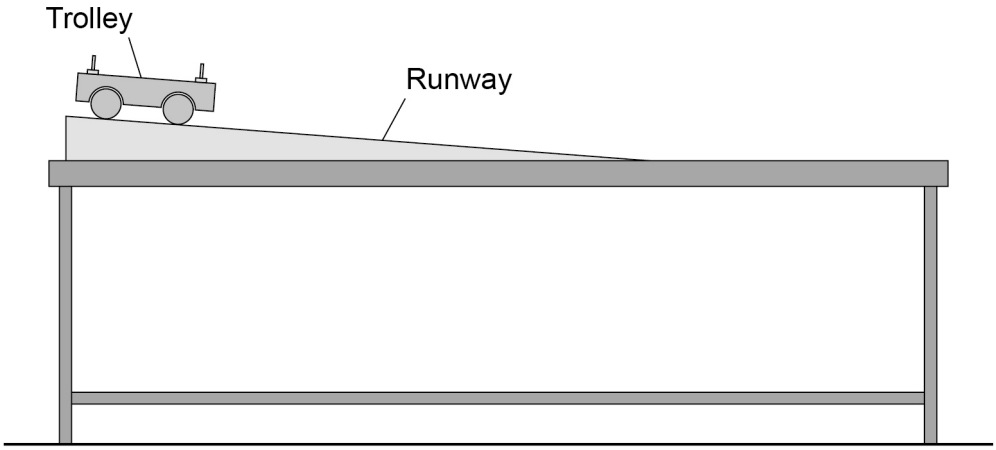
6.5.4.2.2 Newton's Second Law

Question 05

0 2 A student investigated how the acceleration of a trolley is affected by the force acting on the trolley.

Figure 3 shows some of the equipment used.

Figure 3



6.5.4.2.2 Newton's Second Law

Question 05 · continued

0 2 . 1 Describe a method the student could use.

Your answer should include any extra equipment needed.

[6 marks]

Question 2 continues on the next page

Table 1 shows one set of results for a similar investigation.

Table 1

Resultant force in newtons	Acceleration in m/s^2
1.2	1.6

0 2 . 2 Which of Newton's laws predicts that the acceleration of the trolley is proportional to the resultant force on the trolley?

[1 mark]

Tick (✓) **one** box.

First law ☐

Second law ☐

Third law ☐

0 2 . 3 Determine the acceleration of the trolley when the resultant force is 3.6 N.

Use **Table 1**.

[2 marks]

Acceleration = _____ m/s^2

6.5.4.2.2 Newton's Second Law

Question 05 · continued

Use the Physics Equations Sheet to answer questions **02.4** and **02.5**.

0 2 . 4 Write down the equation that links acceleration (*a*), mass (*m*) and resultant force (*F*).

[1 mark]

0 2 . 5 A resultant force of 0.42 N acts on a different trolley.

The acceleration of the trolley is 1.2 m/s^2.

Calculate the mass of the trolley.

[3 marks]

Mass of trolley = _____ kg

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