

GCSE Combined Science: Trilogy

Worksheet: Newton's Second Law

TIME 35 min	TOTAL 32 marks	CALCULATOR Allowed	DIFFICULTY Easy, Medium
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Topics: Newton's Second Law

NAME _____	CLASS _____	DATE _____
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- Use black ink or black ball-point pen. Pencil should only be used for drawing.
- Answer all questions in the spaces provided.
- In all calculations, show clearly how you work out your answer.
- The marks for questions are shown in brackets.

0 1

0 1 . 1

A car of mass 1200 kg accelerates at 2.5 m/s^2 .

Calculate the resultant force on the car.

Use the equation:

resultant force = mass $\times$ acceleration

.....

.....

.....

.....

Resultant force = N

[2 marks]

0 1 . 2

The same resultant force acts on a van with a greater mass than the car.

How does the acceleration of the van compare with the acceleration of the car?

Tick (✓) **one** box.

It is smaller

☐

It is the same

☐

It is greater

☐

[1 mark]

0 1 . 3

Complete the sentence.

The acceleration of an object is to the resultant force acting on the object.

Tick (✓) **one** box.

directly proportional

☐

inversely proportional

☐

equal

☐

unrelated

☐

[1 mark]

0 2

A laboratory trolley of mass 0.7 kg accelerates at 0.2 m/s^2 .

0 2 . 1

Calculate the resultant force on the trolley.

Use the equation:

resultant force = mass $\times$ acceleration

.....

.....

.....

.....

Resultant force = N

[2 marks]

0 3

0 3 . 1

Which of these correctly rearranges resultant force = mass $\times$ acceleration to give acceleration?

Tick (✓) **one** box.

acceleration = mass $\times$ resultant force

☐

acceleration = resultant force $\div$ mass

☐

acceleration = mass $\div$ resultant force

☐

acceleration = resultant force $-$ mass

☐

[1 mark]

0 3 . 2

The mass of an object doubles. The resultant force acting on it stays the same.
What happens to its acceleration?

Tick (✓) **one** box.

It doubles

☐

It halves

☐

It stays the same

☐

It becomes zero

☐

[1 mark]

0 4

A student investigates how the acceleration of a trolley depends on the resultant force acting on it, using a trolley on a runway, a pulley and hanging masses to provide the force, and light gates connected to a data logger to measure velocity.

0 4 . 1

Write a hypothesis for this investigation.

.....

.....

[1 mark]

0 4 . 2

Identify the independent variable and the dependent variable, and state one variable that must be controlled.

.....

.....

.....

.....

.....

.....

[3 marks]

0 4 . 3

Give one hazard in this investigation and a suitable control measure.

.....

.....

.....

.....

[2 marks]

0 5

0 5 . 1

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

.....

.....

[1 mark]

0 5 . 2

A sprinter of mass 64 kg accelerates from rest to 8.0 m/s in 2.0 s.
Calculate the average resultant force on the sprinter.

.....

.....

.....

.....

.....

.....

Resultant force = N

[4 marks]

0 5 . 3

A second sprinter of the same mass experiences an average resultant force of 320 N.
Calculate the average acceleration of the second sprinter.

.....

.....

.....

.....

Acceleration = m/s²
[2 marks]

0 6

At a fixed resultant force, a student measures the acceleration of a trolley three times, obtaining 0.42 m/s², 0.46 m/s² and 0.44 m/s². A second group, using a different trolley and runway, obtains a mean acceleration of 0.52 m/s² under the same conditions.

0 6 . 1

Are the first student's three results repeatable? Justify your answer.

.....

.....

[1 mark]

0 6 . 2

Calculate the mean acceleration and its uncertainty, using the range of the readings.

.....

.....

.....

.....

.....

Mean acceleration = m/s²
[3 marks]

0 6 . 3

Does the second group's result show that the first student's result is reproducible? Justify your answer.

.....

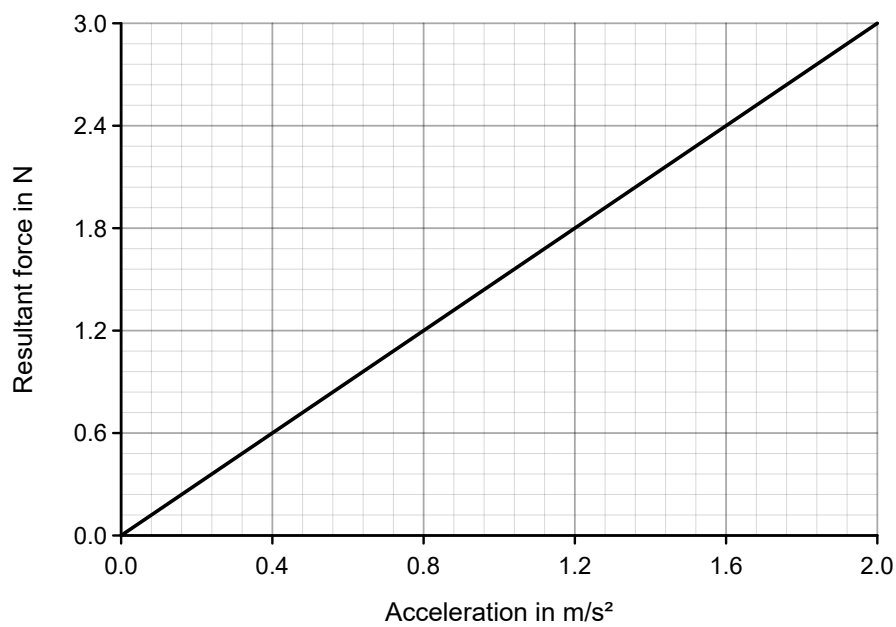
.....

[1 mark]

0 7

Figure 1 shows how the resultant force on a trolley of constant mass varies with its acceleration.

Figure 1



0 7 . 1

Use Figure 1 to determine the mass of the trolley.

.....

.....

.....

.....

Mass = kg

[2 marks]

0 7 . 2

Calculate the resultant force needed to give the trolley an acceleration of 1.2 m/s^2 .

Resultant force = N

[2 marks]

0 8

A resultant force of 0.42 N acts on a trolley, giving an acceleration of 0.7 m/s^2 .

0 8 . 1

Calculate the mass of the trolley.

Mass = kg

[2 marks]

END OF QUESTIONS

Original practice questions written to match the specification. Not produced by, affiliated with or endorsed by AQA.

Mark scheme

GCSE Combined Science: Trilogy · Worksheet: Newton's Second Law · 32 marks

Question 1 (4 marks)

01.1 [2 marks]

Answer: 3000 N

- $F = 1200 \times 2.5$ (1)
 - 3000 (N) (1)
-

01.2 [1 mark]

Correct: It is smaller

01.3 [1 mark]

Correct: directly proportional

Question 2 (2 marks)

02.1 [2 marks]

Answer: 0.14 N

- $F = 0.7 \times 0.2$ (1)
 - 0.14 (N) (1)
-
-

Question 3 (2 marks)

03.1 [1 mark]

Correct: acceleration = resultant force $\div$ mass

03.2 [1 mark]

Correct: It halves

Question 4 (6 marks)

04.1 [1 mark]

Answer: The acceleration of the trolley is directly proportional to the resultant force acting on it, for a constant total mass.

- acceleration is directly proportional to the resultant force, for a constant (total) mass (1)

04.2 [3 marks]

Answer: Independent: the resultant force (the weight of the hanging masses). Dependent: the acceleration of the trolley. Control: the total mass being accelerated (trolley plus hanging masses) must stay the same.

- independent variable: the resultant force (the weight of the hanging masses) (1)
- dependent variable: the acceleration of the trolley (1)
- control variable: the total mass of the system (trolley + hanging masses) — masses should be transferred from the trolley to the hanger, not simply added (1)

04.3 [2 marks]

Answer: The falling hanging mass or the trolley could hit someone's foot; place a box or soft barrier to catch them, and stand clear of the runway and its ends.

- a hazard, e.g. the falling hanging mass could hit a foot, or the trolley could fly off the end of the runway (1)
 - a control measure that matches the hazard, e.g. place a box/soft barrier below the falling mass or at the end of the runway, and stand clear while it runs (1)
-

Question 5 (7 marks)

05.1 [1 mark]

Answer: $F = m a$

- $F = m a$ / resultant force = mass $\times$ acceleration (1)

05.2 [4 marks]

Answer: 256 N

- $a = 8.0 \div 2.0$ (1)
- $a = 4.0 \text{ (m/s}^2\text{)}$ (1)
- $F = 64 \times 4.0$ (1)
- 256 (N) (1)

05.3 [2 marks]

Answer: 5.0 m/s^2

- $a = 320 \div 64$ (1)
- $5.0 \text{ (m/s}^2\text{)}$ (1)

Question 6 (5 marks)

06.1 [1 mark]

Answer: Yes — the three readings are close together (within 0.04 m/s^2), obtained with the same equipment and method.

- yes — the three readings are close together, using the same equipment and method (they are repeatable) (1)

06.2 [3 marks]

Answer: 0.44 m/s^2 , uncertainty = $\pm 0.02 \text{ m/s}^2$

- mean = $(0.42 + 0.46 + 0.44) \div 3 = 0.44 \text{ (m/s}^2\text{)}$ (1)
- uncertainty = $\pm$ half the range = $\pm (0.46 - 0.42) \div 2$ (1)
- = $\pm 0.02 \text{ (m/s}^2\text{)}$ (1)

06.3 [1 mark]

Answer: No — the second group, using different equipment, obtained 0.52 m/s^2 , which is well outside $0.44 \pm 0.02 \text{ m/s}^2$.

- no — the second group's result (0.52 m/s^2), obtained with different equipment, is well outside $0.44 \pm 0.02 \text{ m/s}^2$, so the result is not reproducible (1)
-

Question 7 (4 marks)

07.1 [2 marks]

Answer: 1.5 kg

- mass = gradient of the graph = $3.0 \div 2.0$ (1)
 - 1.5 (kg) (1)
-

07.2 [2 marks]

Answer: 1.8 N

- $F = 1.5 \times 1.2$ (1)
- 1.8 (N) (1)

Notes: Allow ECF from the previous part.

Question 8 (2 marks)

08.1 [2 marks]

Answer: 0.6 kg

- $m = 0.42 \div 0.7$ (1)
 - 0.6 (kg) (1)
-