

Worksheet: Newton's Second Law

TIME 35 min	TOTAL 32 marks	CALCULATOR Allowed	DIFFICULTY Easy, Medium
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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
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0	1	.	1
---	---	---	---

resultant force = mass $\times$ acceleration

.....

.....

.....

.....

.....

Resultant force = N

[2 marks]

0	1	.	2
---	---	---	---

It is greater

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[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 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 2 . 1

Write a hypothesis for this investigation.

.....

.....

[1 mark]

0 2 . 2

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

.....

.....

.....

.....

.....

.....

[3 marks]

0 2 . 3

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

.....

.....

.....

.....

[2 marks]

0 3

A loaded lorry of mass 8500 kg accelerates at 0.2 m/s^2 .

0 3 . 1

Calculate the resultant force on the lorry.

Use the equation:

resultant force = mass $\times$ acceleration

.....

.....

.....

.....

Resultant force = N

[2 marks]

0 4

0 4 . 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 4 . 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

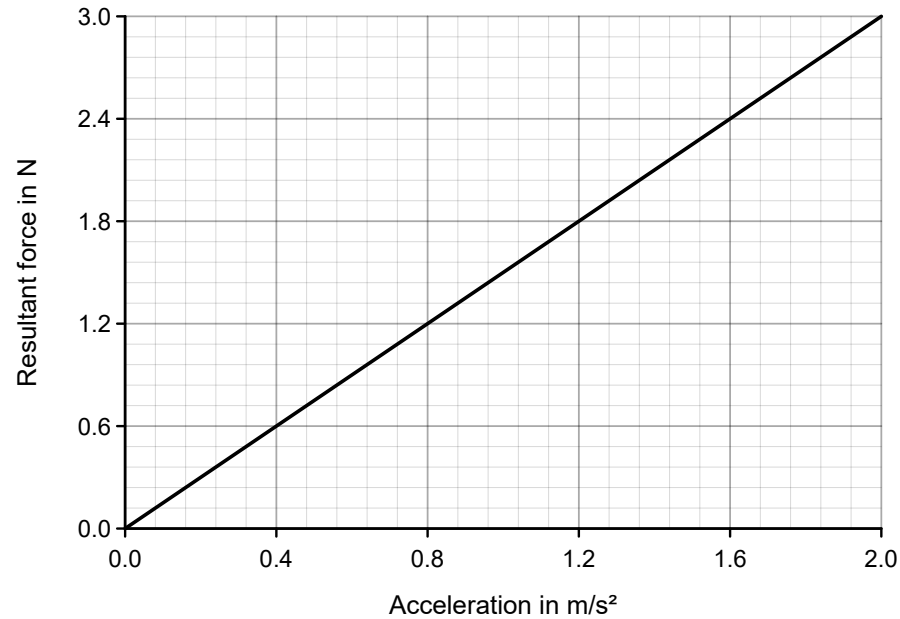
☐

[1 mark]

0 5

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

Figure 1



0 5 . 1

Use Figure 1 to determine the mass of the trolley.

.....

.....

.....

.....

Mass = kg

[2 marks]

0 5 . 2

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

.....

.....

.....

.....

Resultant force = N

[2 marks]

0 6

The symbol $\sim$ means 'approximately'.

A family car accelerates from rest to motorway speed.

0 6 . 1

Estimate the mass of a typical family car.

.....

.....

[1 mark]

0 6 . 2

The car reaches a speed of $\sim 30 \text{ m/s}$ in $\sim 10 \text{ s}$.

Estimate the acceleration of the car.

.....

.....

.....

Acceleration = m/s^2

[1 mark]

0 6 . 3

Use your estimates to estimate the resultant force on the car.

.....

.....

.....

.....

[2 marks]

0 6 . 4

Explain why the driving force needed is greater than your answer to the previous part.

.....

.....

[1 mark]

0 7

A resultant force of 60 N acts on a cyclist and bicycle of mass 60 kg.

0 7 . 1

Calculate the acceleration of the cyclist and bicycle.

.....

.....

.....

.....

Acceleration = m/s²

[2 marks]

0 8

0 8 . 1

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

.....

.....

[1 mark]

0 8 . 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 8 . 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]

END OF QUESTIONS

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

Mark scheme

GCSE Physics · 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 (6 marks)

02.1 [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)

02.2 [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)

02.3 [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 3 (2 marks)

03.1 [2 marks]

Answer: 1700 N

- $F = 8500 \times 0.2$ (1)
- 1700 (N) (1)

Question 4 (2 marks)

04.1 [1 mark]

Correct: acceleration = resultant force $\div$ mass

04.2 [1 mark]

Correct: It halves

Question 5 (4 marks)

05.1 [2 marks]

Answer: 1.5 kg

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

05.2 [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 6 (5 marks)

06.1 [1 mark]

Answer: About 1500 kg (1000–2000 kg).

- any value from 1000 kg to 2000 kg (1)

06.2 [1 mark]

Answer: $\sim 3 \text{ m/s}^2$

- $\sim 3 \text{ (m/s}^2\text{)}$ (1)

06.3 [2 marks]

Answer: About 4500 N (for a 1500 kg car).

- $F = (\text{estimated mass}) \times 3$ (1)
- correct answer for the estimated mass, e.g. $\sim 4500 \text{ N}$ for 1500 kg (allow 3000–6000 N) (1)

06.4 [1 mark]

Answer: Resistive forces such as air resistance must also be overcome.

- resistive forces (air resistance and friction) also act on the car and must be overcome (1)
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Question 7 (2 marks)

07.1 [2 marks]

Answer: 1 m/s^2

- $a = 60 \div 60$ (1)
 - $1 \text{ (m/s}^2\text{)}$ (1)
-

Question 8 (7 marks)

08.1 [1 mark]

Answer: $F = m a$

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

08.2 [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)
-

08.3 [2 marks]

Answer: 5.0 m/s^2

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