

# GCSE Physics

## Worksheet: Braking forces and deceleration

|                |                   |                       |                            |
|----------------|-------------------|-----------------------|----------------------------|
| TIME<br>35 min | TOTAL<br>31 marks | CALCULATOR<br>Allowed | DIFFICULTY<br>Easy, Medium |
|----------------|-------------------|-----------------------|----------------------------|

Topics: Braking forces and deceleration

|      |       |      |
|------|-------|------|
| NAME | CLASS | DATE |
|------|-------|------|

- 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.

01

01.1

As a car brakes to a stop, energy is transferred from the car’s kinetic energy store. To which energy store is most of this energy transferred?

Tick (✓) **one** box.

|                         |                          |
|-------------------------|--------------------------|
| Gravitational potential | <input type="checkbox"/> |
| Chemical                | <input type="checkbox"/> |
| Thermal (of the brakes) | <input type="checkbox"/> |
| Elastic potential       | <input type="checkbox"/> |

[1 mark]

01.2

A car’s brakes exert a force of 4500 N over a distance of 15 m.

Calculate the work done by the brakes.

Use the equation:

work done = force × distance

.....

.....

.....

.....

Work done = ..... J

[2 marks]

0 2

0 2 . 1

When the brakes of a moving car are applied, work is done by the friction force between the brakes and the wheels.

What happens to the kinetic energy of the car?

Tick (✓) **one** box.

It decreases

☐

It increases

☐

It stays the same

☐

[1 mark]

0 2 . 2

What happens to the temperature of the brakes?

.....

.....

.....

[1 mark]

0 2 . 3

The brakes of a car exert a braking force of 6000 N while the car travels 20 m.

Calculate the work done by the brakes.

Use the equation:

work done = force  $\times$  distance

.....

.....

.....

.....

Work done = ..... J

[2 marks]

0 3

The brakes of a family car exert a constant braking force of 9400 N while the car travels 39 m.

0 3 . 1

Calculate the work done by the brakes.

Use the equation:

work done = force  $\times$  distance

.....

.....

.....

.....

Work done = ..... J

**[2 marks]**

0 4

A lorry of mass 12 000 kg is travelling at 20 m/s. The brakes can exert a maximum braking force of 60 kN.

0 4 . 1

Calculate the maximum deceleration of the lorry.

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.....

.....

.....

Deceleration = ..... m/s<sup>2</sup>

**[2 marks]**

0 4 . 2

Calculate the minimum braking distance of the lorry.  
Use the Physics Equations Sheet.

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.....

.....

.....

Braking distance = ..... m

**[3 marks]**

0 4 . 3

The lorry is then loaded so that its total mass is 18 000 kg. The maximum braking force is the same.  
Calculate the new minimum braking distance from 20 m/s.

.....

.....

.....

.....

.....

Braking distance = ..... m

**[3 marks]**

0 5

A small lorry of mass 5750 kg, travelling at 12 m/s, brakes to a stop in a distance of 24 m.

0 5 . 1

Calculate the kinetic energy of the lorry before it brakes.

.....

.....

.....

.....

Kinetic energy = ..... J

**[2 marks]**

0 5 . 2

Calculate the average braking force.

.....

.....

.....

.....

.....

Braking force = ..... N

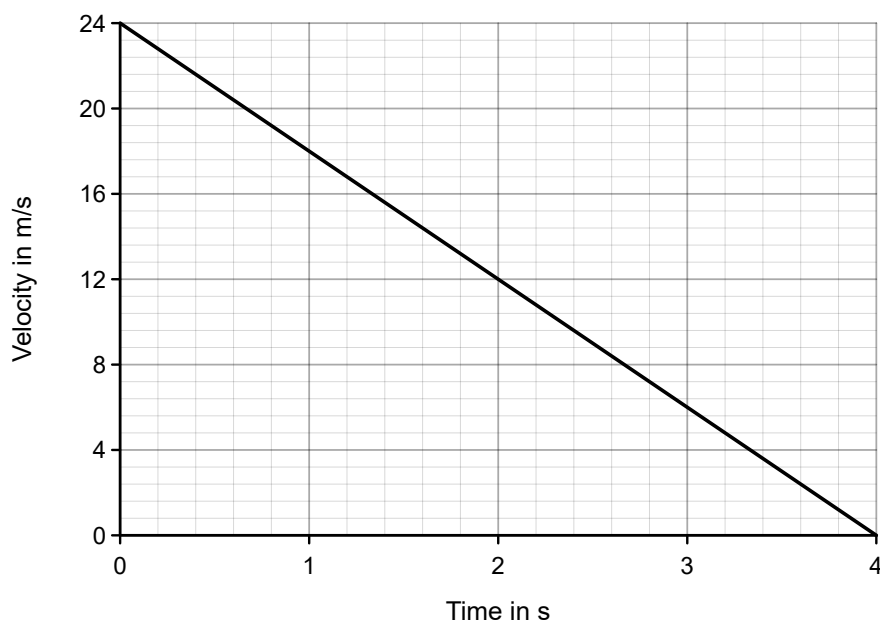
[3 marks]

.....

0 6

Figure 1 shows the velocity–time graph for a motorbike of mass 220 kg braking to a stop.

**Figure 1**



0 6 . 1

Use Figure 1 to determine the deceleration of the motorbike.

.....

.....

.....

.....

Deceleration = ..... m/s<sup>2</sup>

**[2 marks]**

0 6 . 2

Calculate the braking force on the motorbike.

.....

.....

.....

.....

Braking force = ..... N

**[2 marks]**

0 7

0 7 . 1

Explain why a car travelling at a greater speed needs a greater braking force to stop in the same distance.

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[2 marks]

0 7 . 2

Explain why a greater braking force gives a greater deceleration.

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[1 mark]

0 7 . 3

Describe **two** dangers of very large decelerations of road vehicles.

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[2 marks]

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## 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: Braking forces and deceleration · 31 marks

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### Question 1 (3 marks)

01.1 [1 mark]

**Correct:** Thermal (of the brakes)

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01.2 [2 marks]

**Answer:** 67 500 J

- $W = 4500 \times 15$  (1)
  - 67 500 (J) (1)
- 

### Question 2 (4 marks)

02.1 [1 mark]

**Correct:** It decreases

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02.2 [1 mark]

**Answer:** It increases.

- it increases (1)
- 

02.3 [2 marks]

**Answer:** 120 000 J

- $W = 6000 \times 20$  (1)
  - 120 000 (J) (1)
- 

### Question 3 (2 marks)

03.1 [2 marks]

**Answer:** 366 600 J

- $W = 9400 \times 39$  (1)
  - 366 600 (J) (1)
-

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## Question 4 (8 marks)

### 04.1 [2 marks]

**Answer:**  $5.0 \text{ m/s}^2$

- $a = 60\,000 \div 12\,000$  (1)
  - $5.0 \text{ (m/s}^2\text{)} (1)$
- 

### 04.2 [3 marks]

**Answer:** 40 m

- $0 - 20^2 = 2 \times (-5.0) \times s$  (1)
  - $s = 400 \div 10$  (1)
  - 40 (m) (1)
- 

### 04.3 [3 marks]

**Answer:** 60 m

- $a = 60\,000 \div 18\,000 = 3.33 \text{ (m/s}^2\text{)} (1)$
  - $s = 400 \div (2 \times 3.33)$  (1)
  - 60 (m) (1)
- 

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## Question 5 (5 marks)

### 05.1 [2 marks]

**Answer:** 414 000 J

- $E_k = 0.5 \times 5750 \times 12^2$  (1)
  - 414 000 (J) (1)
- 

### 05.2 [3 marks]

**Answer:** 17 250 N

- work done by the brakes = kinetic energy lost = 414 000 (J) (1)
- $414\,000 = F \times 24$  (1)
- $F = 17\,250 \text{ (N)} (1)$

**Notes:** Allow ECF from the previous part.

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## Question 6 (4 marks)

### 06.1 [2 marks]

**Answer:**  $6.0 \text{ m/s}^2$

- $a = 24 \div 4$  (1)
- $6.0 \text{ (m/s}^2\text{)}$  (1)

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### 06.2 [2 marks]

**Answer:** 1320 N

- $F = 220 \times 6.0$  (1)
- 1320 (N) (1)

**Notes:** Allow ECF from the previous part.

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## Question 7 (5 marks)

### 07.1 [2 marks]

**Answer:** It has more kinetic energy, and to do more work in the same distance the force must be larger.

- the car has more kinetic energy (kinetic energy increases with the square of the speed) (1)
- work done = force  $\times$  distance, so for the same distance a greater force is needed to do more work (1)

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### 07.2 [1 mark]

**Answer:**  $F = m a$ , so for a fixed mass, larger force means larger deceleration.

- resultant force = mass  $\times$  acceleration, so for the same mass a greater force gives a greater deceleration (1)

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### 07.3 [2 marks]

**Answer:** The brakes may overheat, and the vehicle may skid so the driver loses control.

- the brakes may overheat (and become less effective) (1)
- the wheels may lock / the vehicle may skid, so the driver loses control (1)
- large forces act on the passengers, which may cause injury (1)

Any 2 of the points above.

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