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I declare this is my own work.

AS

MATHEMATICS

Paper 1

7356/1

Thursday 18 May 2023 Afternoon

Time allowed: 1 hour 30 minutes

At the top of the page, write your surname and forename(s), your centre number, your candidate number and add your signature.

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MATERIALS

For this paper you must have:

- **the AQA Formulae for A-level Mathematics booklet**
- **a graphical or scientific calculator that meets the requirements of the specification.**

INSTRUCTIONS

- **Use black ink or black ball-point pen. Pencil should only be used for drawing.**
- **Answer ALL questions.**
- **You must answer each question in the space provided for that question.**
- **Do NOT write on blank pages.**
- **If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).**



- **Show all necessary working; otherwise, marks for method may be lost.**
- **Do all rough work in this book. Cross through any work you do not want to be marked.**

INFORMATION

- **The marks for questions are shown in brackets.**
- **The maximum mark for this paper is 80.**

ADVICE

- **Unless stated otherwise, you may quote formulae, without proof, from the booklet.**
- **You do not necessarily need to use all the space provided.**

DO NOT TURN OVER UNTIL TOLD TO DO SO



SECTION A

Answer ALL questions in the spaces provided.

1 At a point P on a curve, the gradient of the tangent to the curve is 10

State the gradient of the normal to the curve at P

Circle your answer. [1 mark]

–10

–0.1

0.1

10



2 Identify the expression below which is equivalent to $\left(\frac{2x}{5}\right)^{-3}$

Circle your answer. [1 mark]

$$\frac{8x^3}{125}$$

$$\frac{125x^3}{8}$$

$$\frac{125}{8x^3}$$

$$\frac{8}{125x^3}$$

[Turn over]



[Turn over]



[Turn over]



5 (a) Given that $y = x\sqrt{x}$, find $\frac{dy}{dx}$
[2 marks]



6 (a) The curve C_1 has equation
 $y = 2x^2 - 20x + 42$

Express the equation of C_1 in the form

$$y = a(x - b)^2 + c$$

**where a , b and c are integers.
[3 marks]**

[Turn over]



6 (b) Write down the coordinates of the minimum point of C_1 [1 mark]

6 (c) The curve C_1 is mapped onto the curve C_2 by a stretch in the y -direction.

The minimum point of C_2 is at $(5, -4)$

Find the equation of C_2
[2 marks]

[Turn over]



7 Points P and Q lie on the curve with equation $y = x^4$

The x -coordinate of P is x

The x -coordinate of Q is $x + h$

7 (a) Expand $(x + h)^4$ [2 marks]



- 7 (b)** Hence, find an expression, in terms of x and h , for the gradient of the line PQ [1 mark]

- 7 (c)** Explain how to use the answer from part (b) to obtain the gradient function of $y = x^4$ [2 marks]

[Turn over]





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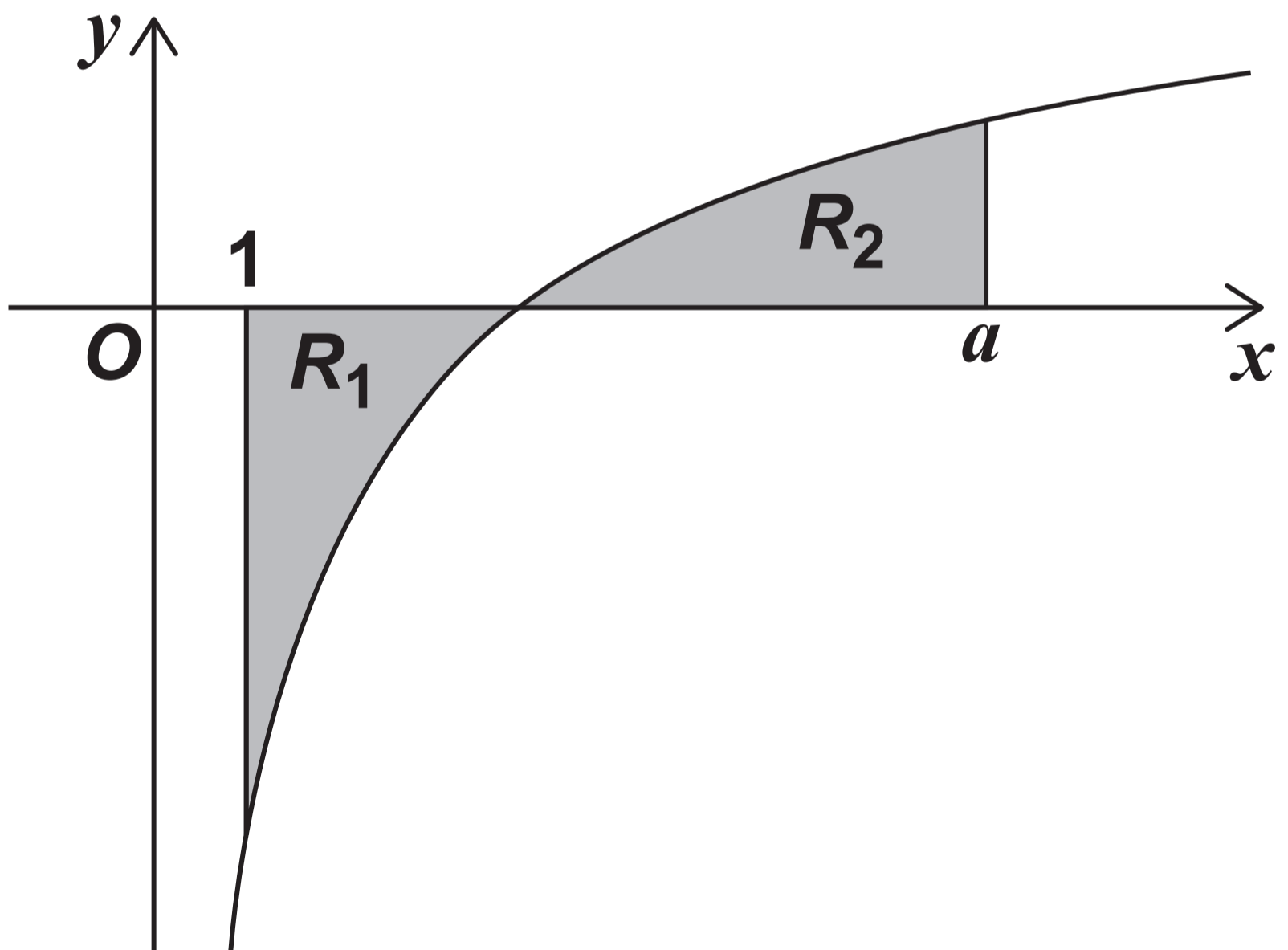
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8 (b) The curve $y = 6 - \frac{12}{\sqrt{x}}$, the line $x = 1$ and the line $x = a$ are shown in the diagram below.

The shaded region R_1 is bounded by the curve, the line $x = 1$ and the x -axis.

The shaded region R_2 is bounded by the curve, the line $x = a$ and the x -axis.



25

It is given that the areas of R_1 and R_2 are equal.

Find the value of a

**Fully justify your answer.
[4 marks]**

[Turn over]



9 A continuous curve has equation $y = f(x)$

The curve passes through the points $A(2, 1)$, $B(4, 5)$ and $C(6, 1)$

It is given that $f'(4) = 0$

Jasmin made two statements about the nature of the curve $y = f(x)$ at the point B :

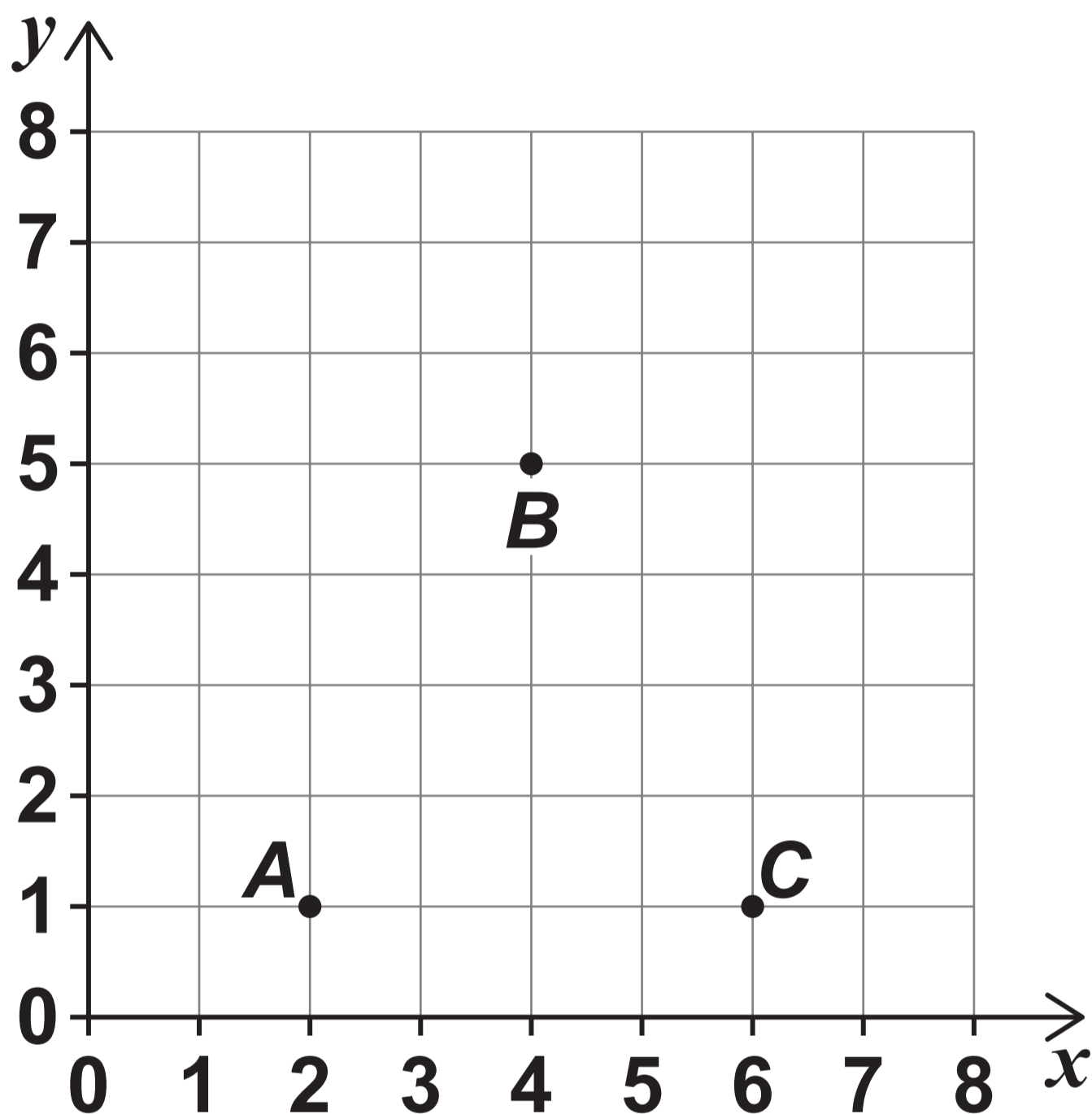
Statement 1: There is a turning point at B

Statement 2: There is a maximum point at B

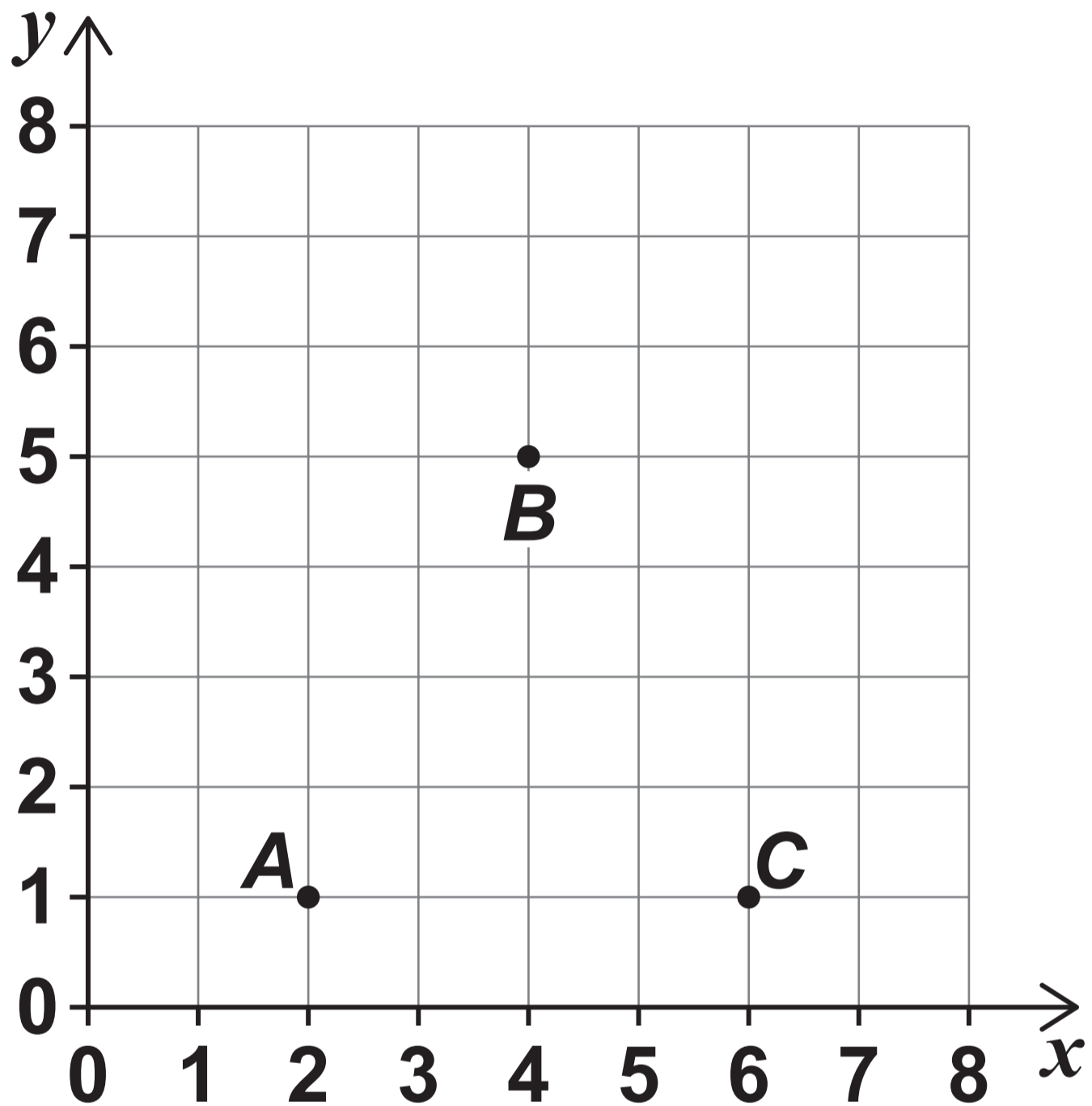
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- 9 (a) Draw a sketch of the curve $y = f(x)$ such that Statement 1 is correct and Statement 2 is correct. [1 mark]



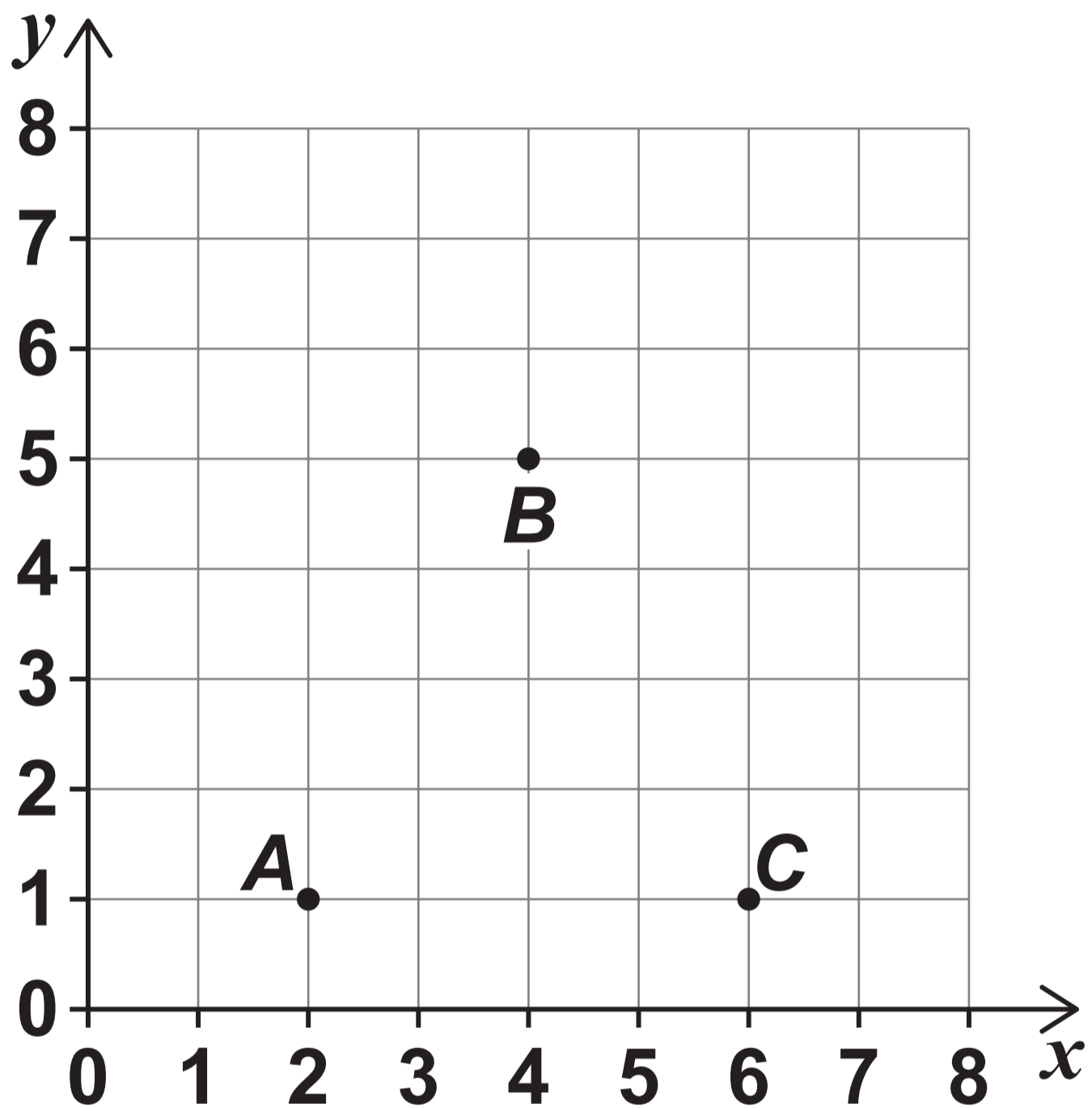
- 9 (b) Draw a sketch of the curve $y = f(x)$ such that Statement 1 is correct and Statement 2 is NOT correct. [1 mark]



[Turn over]



- 9 (c) Draw a sketch of the curve $y = f(x)$ such that Statement 1 is NOT correct and Statement 2 is NOT correct. [1 mark]



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10 Charlie buys a car for £18 000 on 1 January 2016.

The value of the car decreases exponentially.

The car has a value of £12 000 on 1 January 2018.

10 (a) Charlie says:

- because the car has lost £6000 after two years, after another two years it will be worth £6000.

Charlie's friend Kaya says:

- because the car has lost one third of its value after two years, after another two years it will be worth £8000.

Explain whose statement is correct, justifying the value they have stated. [2 marks]



-
-
- 10 (b)** The value of Charlie's car, £ V , t years after 1 January 2016 may be modelled by the equation

$$V = Ae^{-kt}$$

where A and k are positive constants.

Find the value of t when the car has a value of £10 000, giving your answer to two significant figures. [5 marks]





- 10 (c)** Give a reason why the model, in this context, will not be suitable to calculate the value of the car when $t = 30$ [1 mark]

[Turn over]



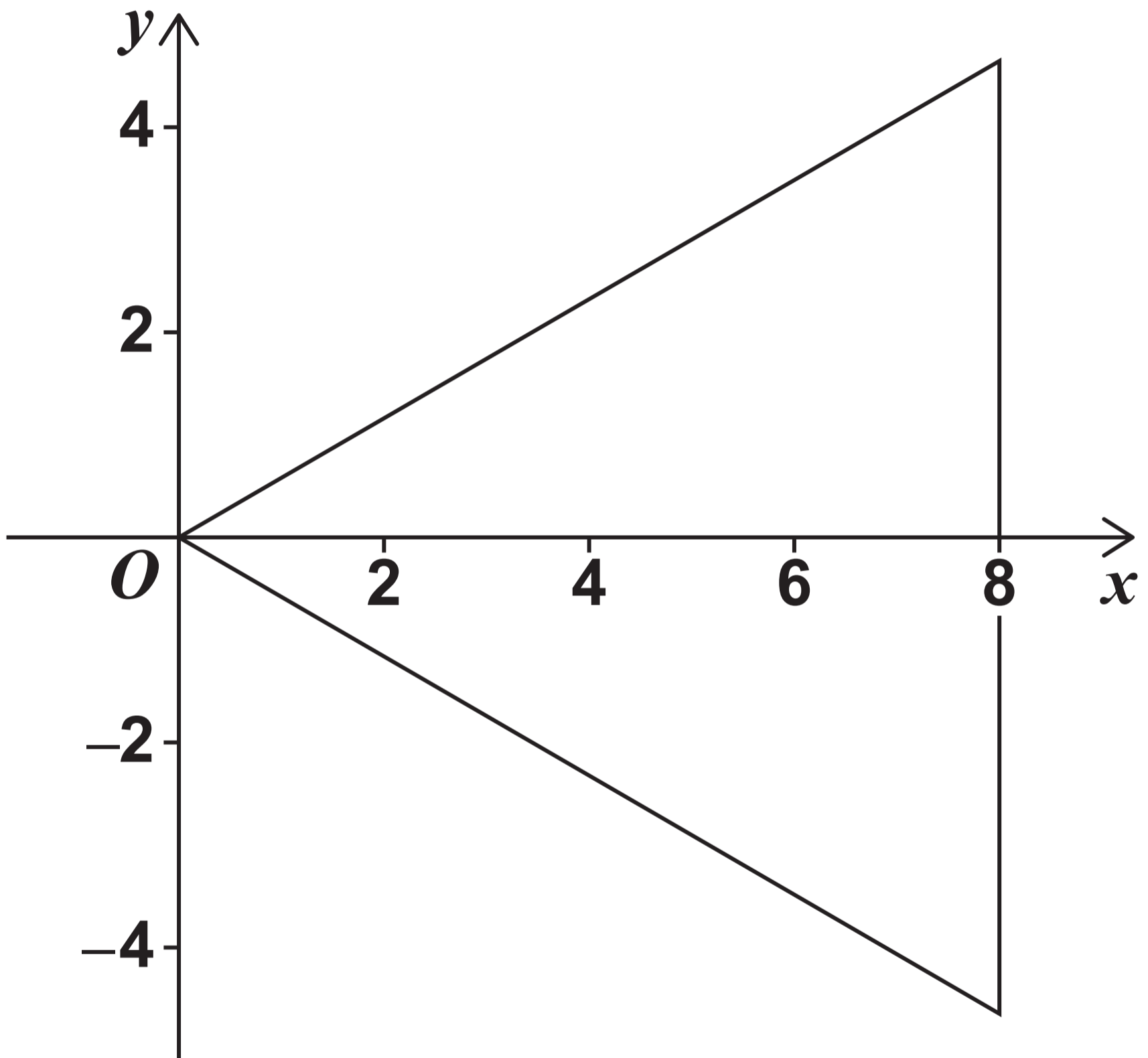
11 (a) A circle has equation

$$x^2 + y^2 - 10x - 6 = 0$$

Find the centre and the radius of the circle. [2 marks]



- 11 (b) An equilateral triangle has one vertex at the origin, and one side along the line $x = 8$, as shown in the diagram below.



[Turn over]



11 (b) (i) Show that the vertex at the origin lies inside the circle $x^2 + y^2 - 10x - 6 = 0$ [1 mark]

11 (b) (ii) Prove that the triangle lies completely within the circle $x^2 + y^2 - 10x - 6 = 0$ [4 marks]



SECTION B

Answer ALL questions in the spaces provided.

12

A particle, initially at rest, starts to move forward in a straight line with constant acceleration, $a \text{ ms}^{-2}$

After 6 seconds the particle has a velocity of 3 ms^{-1}

Find the value of a

Circle your answer. [1 mark]

-2**-0.5****0.5****2**

13 A resultant force of $\begin{bmatrix} -2 \\ 6 \end{bmatrix}$ N acts on a particle.

The acceleration of the particle is $\begin{bmatrix} -6 \\ y \end{bmatrix}$ ms⁻²

Find the value of y

Circle your answer. [1 mark]

2

3

10

18

[Turn over]



14 A ball, initially at rest, is dropped from a vertical height of h metres above the Earth's surface.

After 4 seconds the ball's height above the Earth's surface is $0.2h$ metres.

14 (a) Assuming air resistance can be ignored, show that

$$h = 10g \quad [3 \text{ marks}]$$



[Turn over]



14 (b) Assuming air resistance cannot be ignored, explain the effect that this would have on the value of h in part (a) on page 44. [1 mark]



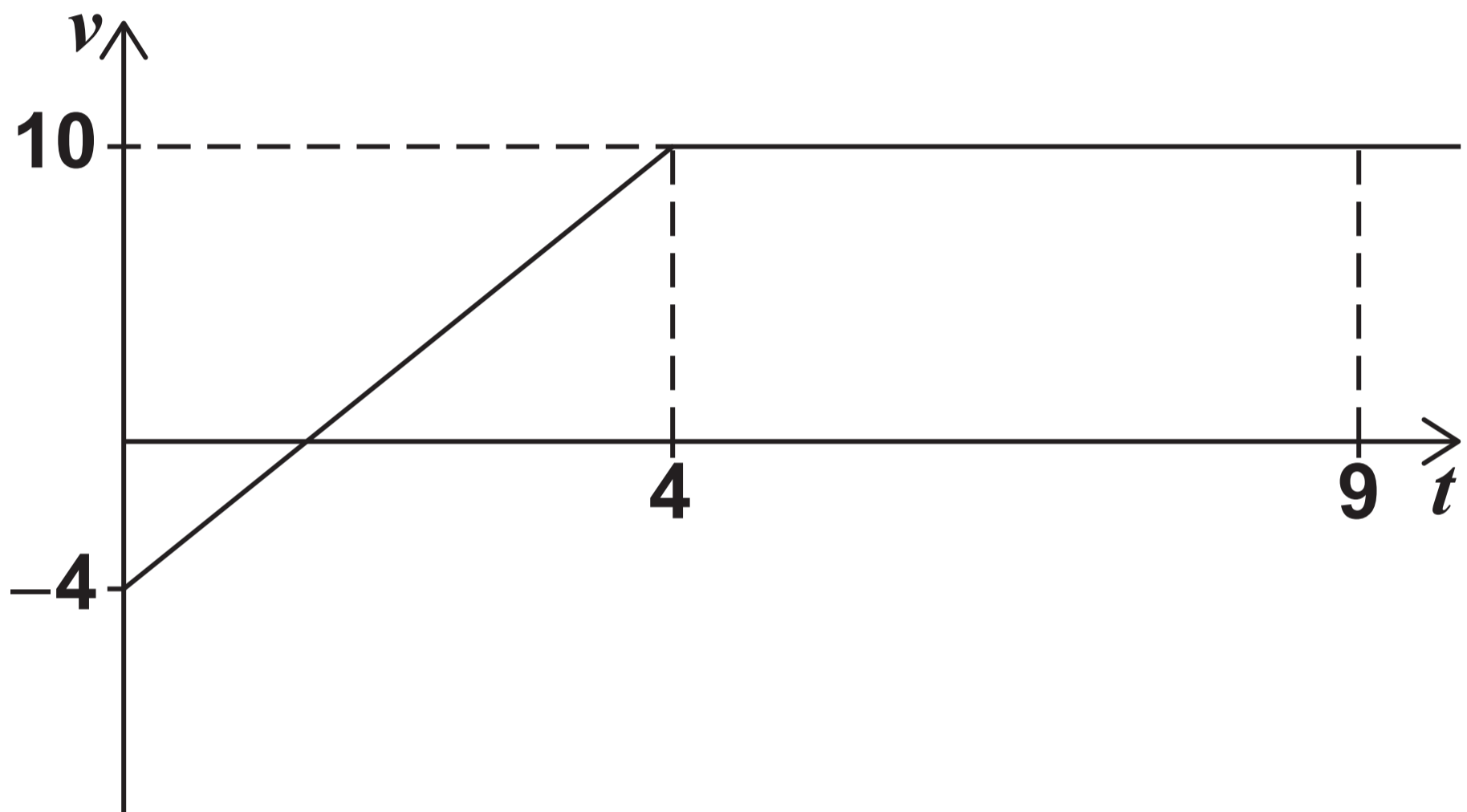
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15

A particle is moving in a straight line such that its velocity, $v \text{ ms}^{-1}$, changes with respect to time, t seconds, as shown in the graph below.



15 (a) Show that the acceleration of the particle over the first 4 seconds is 3.5 m s^{-2} [1 mark]

[Turn over]



[Turn over]



16

A toy remote control speed boat is launched from one edge of a small pond and moves in a straight line across the pond's surface.

The boat's velocity, $v \text{ ms}^{-1}$, is modelled in terms of time, t seconds after the boat is launched, by the expression

$$v = 0.9 + 0.16t - 0.06t^2$$

16 (a)

Find the acceleration of the boat when $t = 2$ [3 marks]



[Turn over]



17

A particle, P , is initially at rest on a smooth horizontal surface.

A resultant force of $\begin{bmatrix} 12 \\ 9 \end{bmatrix}$ N is

then applied to P , so that it moves in a straight line.

17 (a)

Find the magnitude of the resultant force. [1 mark]



17 (b) Two fixed points A and B have position vectors

$$\vec{OA} = \begin{bmatrix} 3 \\ 7 \end{bmatrix} \text{ metres} \quad \text{and}$$

$$\vec{OB} = \begin{bmatrix} k \\ k - 1 \end{bmatrix} \text{ metres}$$

with respect to a fixed origin, O

P moves in a straight line parallel to \vec{AB}

17 (b) (i) Find \vec{AB} in terms of k [1 mark]

[Turn over]



17 (b) (ii) Find the value of k [2 marks]

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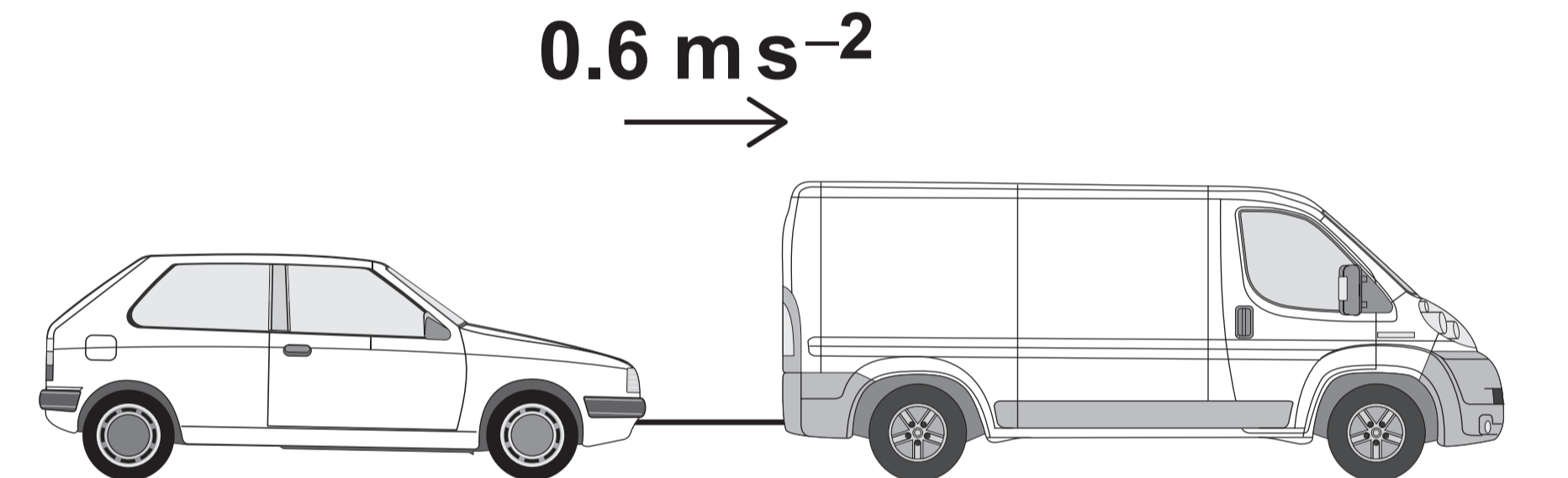
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18

A rescue van is towing a broken-down car by using a tow bar.

The van and the car are moving with a constant acceleration of 0.6 m s^{-2} along a straight horizontal road as shown in the diagram below.



The van has a total mass of 2780 kg

The car has a total mass of 1620 kg

The van experiences a driving force of D newtons.



The van experiences a total resistance force of R newtons.

The car experiences a total resistance force of $0.6R$ newtons.

- 18 (a) The tension in the tow bar, T newtons, may be modelled by

$$T = kD - 18$$

where k is a constant.

Find k [5 marks]

[Turn over]



18 (b) State one assumption that must be made in answering part (a), on page 61. [1 mark]

END OF QUESTIONS



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