



Surname \_\_\_\_\_

Forename(s) \_\_\_\_\_

Centre Number \_\_\_\_\_

Candidate Number \_\_\_\_\_

Candidate Signature \_\_\_\_\_

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.**

**[Turn over]**



**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]**

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

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

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

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



# 3

**The coefficient of  $x^2$  in the binomial expansion of  $(1 + ax)^6$  is  $\frac{20}{3}$**

**Find the two possible values of  $a$  [3 marks]**

[illegible]

**[Turn over]**



4

**4 (a)**

[illegible]

**4(b) Hence, or otherwise, solve the equation**

$$5\cos^2\theta - 4\sin^2\theta = 0$$

**giving all solutions of  $\theta$  to the nearest  $0.1^\circ$  in the interval  $0^\circ \leq \theta \leq 360^\circ$  [2 marks]**

[illegible]

**[Turn over]**



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

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**5 (b)** The line,  $L$ , has equation  $6x - 2y + 5 = 0$

$L$  is a tangent to the curve with equation  $y = x\sqrt{x} + k$

Find the value of  $k$  [5 marks]

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**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]

[illegible]

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

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- 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]

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[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]

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

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

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[Turn over]



**8 (a) Show that**

$$\int_1^a \left( 6 - \frac{12}{\sqrt{x}} \right) dx = 6a - 24\sqrt{a} + 18 \quad [3 \text{ marks}]$$

[illegible]



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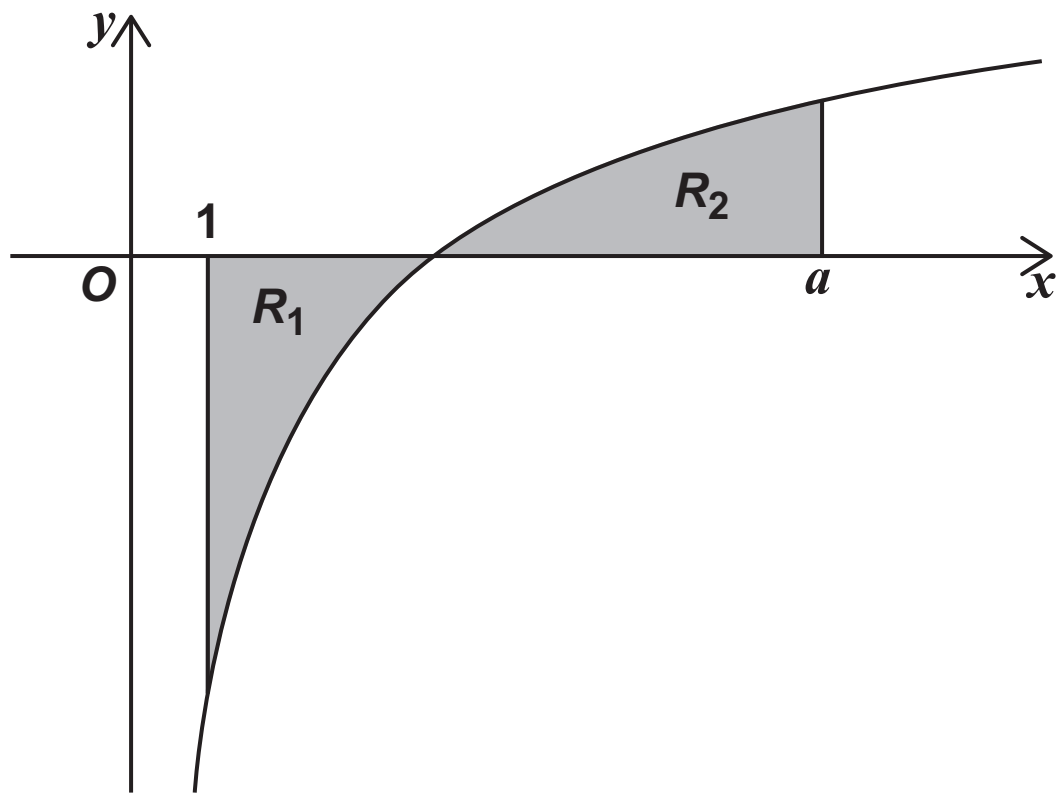
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- 8(b) The curve  $y = 6 - \frac{12}{\sqrt{x}}$ , the line  $x = 1$  and the line  $x = a$  are shown in the diagram below.

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.



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]

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

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

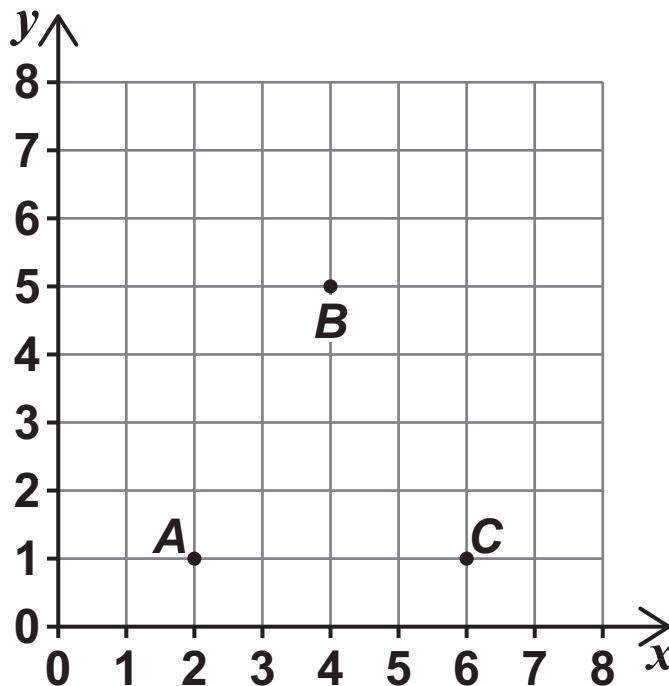
It is given that  $f'(4) = 0$

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

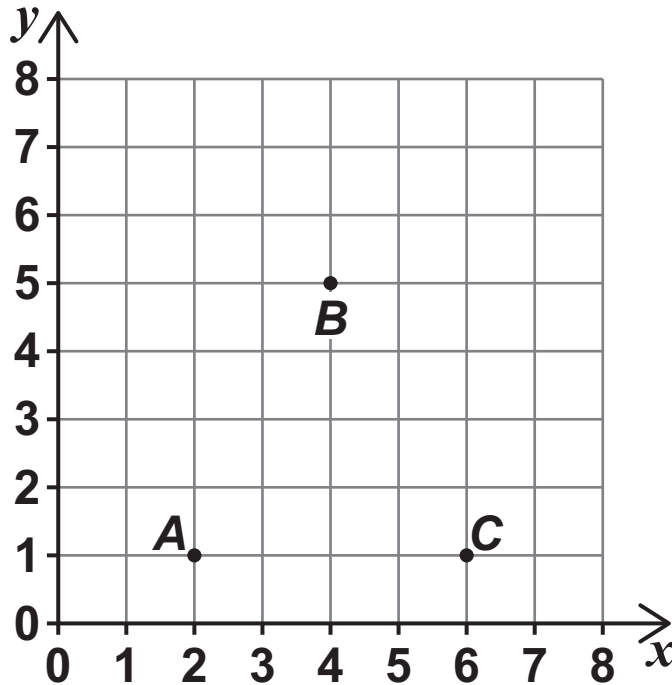
Statement 1: There is a turning point at  $B$

Statement 2: There is a maximum point at  $B$

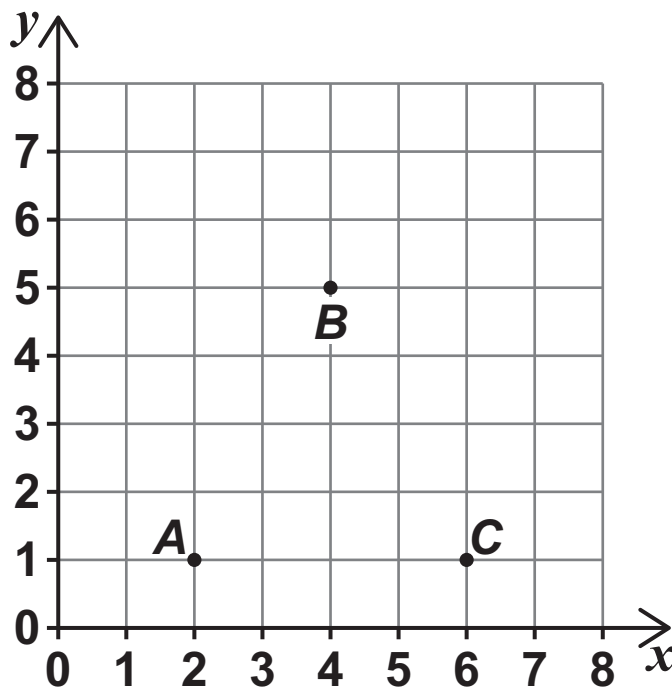
9 (a) Draw a sketch of the curve  $y = f(x)$  such that Statement 1 is correct and Statement 2 is correct. [1 mark]



- 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]



- 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]



[Turn over]



- 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]

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**[Turn over]**



- 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]

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- 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]**

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11 (a) A circle has equation

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

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

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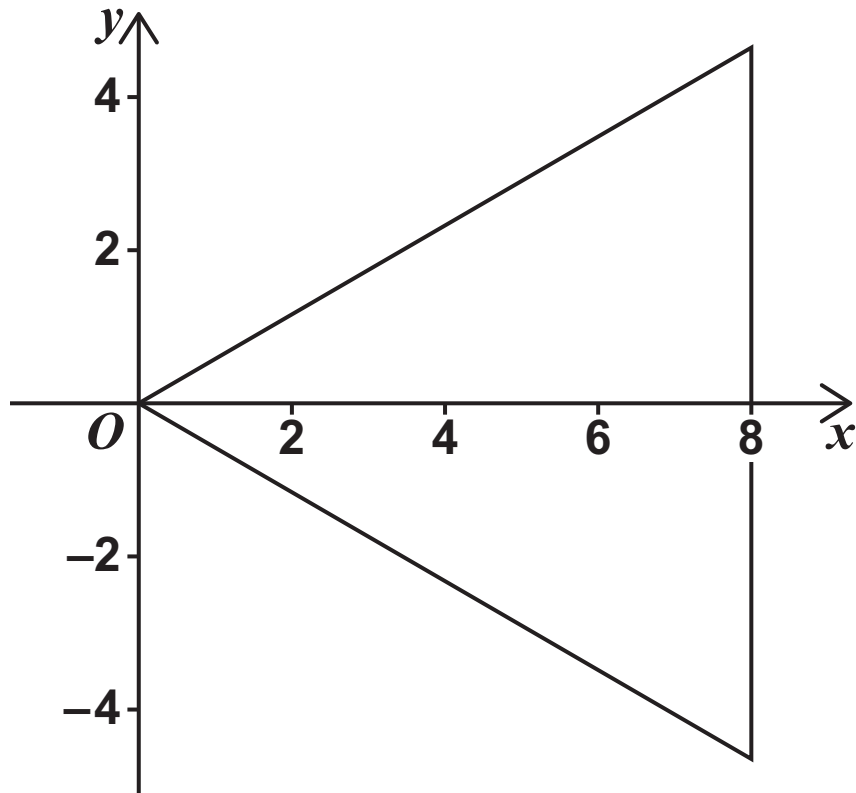
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- 11 (b) An equilateral triangle has one vertex at the origin, and one side along the line  $x = 8$ , as shown in the diagram below.



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

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

[illegible]

**[END OF SECTION A]**

**[Turn over for Section B]**



**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  $3 \text{ ms}^{-1}$**

**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<sup>-2</sup>

Find the value of  $y$

Circle your answer. [1 mark]

2

3

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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

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

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

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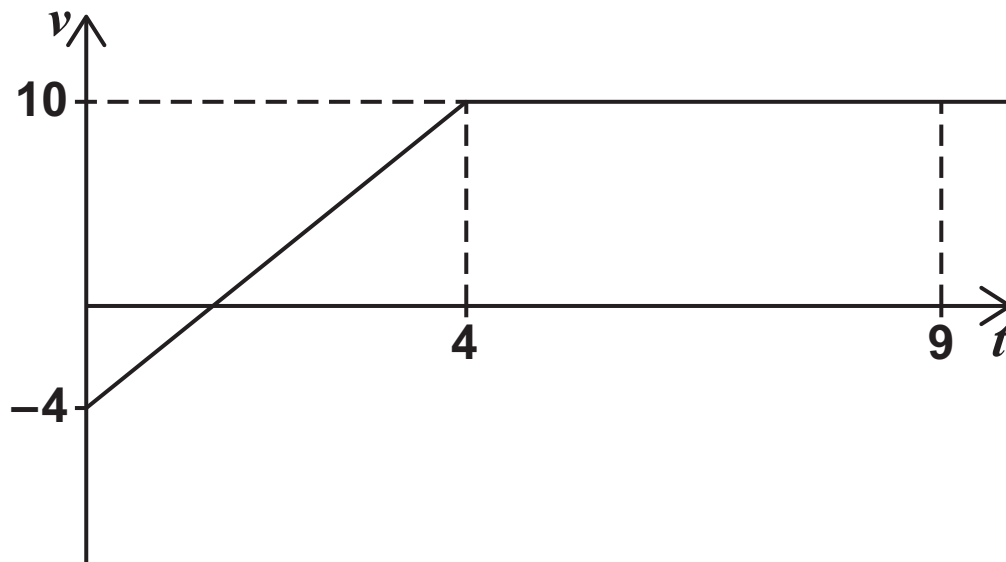
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15

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  $3.5 \text{ ms}^{-2}$  [1 mark]

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**15(b) The particle is initially at a fixed point  $P$**

**Show that the displacement of the particle from  $P$ , when  $t = 9$ , is 62 metres. [3 marks]**

[illegible]

**[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]

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**16 (b) Find the displacement of the boat, from the point where it was launched, when  $t = 2$**   
**[4 marks]**

[illegible]

**[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]

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- 17 (b) Two fixed points  $A$  and  $B$  have position vectors  
 $\vec{OA} = \begin{bmatrix} 3 \\ 7 \end{bmatrix}$  metres and  $\vec{OB} = \begin{bmatrix} k \\ k-1 \end{bmatrix}$  metres  
with respect to a fixed origin,  $O$   
 $P$  moves in a straight line parallel to  $\vec{AB}$



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

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

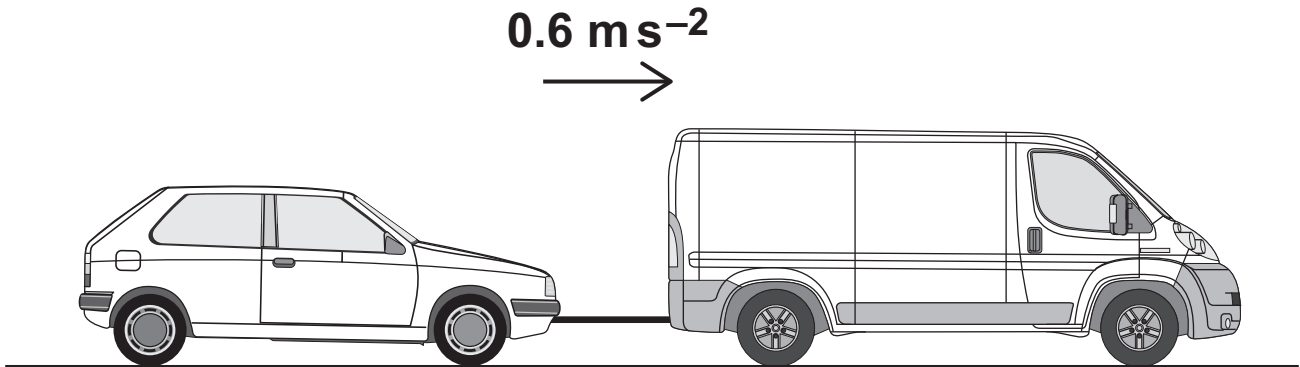
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**[Turn over]**



- 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  $0.6 \text{ m s}^{-2}$  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]**

[illegible]

**[Turn over]**



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

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**END OF QUESTIONS**



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