Surname _____

Forename(s) _____

Centre Number _____

Candidate Number _____

Candidate Signature _____

I declare this is my own work.

AS

MATHEMATICS

Paper 1

7356/1

Thursday 16 May 2024 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]

JUN247356101

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.**
- **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).**
- **Do NOT write on blank pages.**

- **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 It is given that $\tan \theta° = k$, where k is a constant.

Find $\tan (\theta + 180)°$

Circle your answer. [1 mark]

$-k$ $\quad$ $-\frac{1}{k}$ $\quad$ $\frac{1}{k}$ $\quad$ k

2 Curve C has equation

$$y = \frac{1}{(x-1)^2}$$

State the equations of the asymptotes to curve C

Tick (✓) ONE box. [1 mark]

☐ $x = 0$ and $y = 0$

☐ $x = 0$ and $y = 1$

☐ $x = 1$ and $y = 0$

☐ $x = 1$ and $y = 1$

3 Express $\dfrac{\sqrt{3} + 3\sqrt{5}}{\sqrt{5} - \sqrt{3}}$

in the form $a + \sqrt{b}$,

where a and b are integers.

Fully justify your answer.

[4 marks]

[Turn over]

4 (a) (i) By using a suitable trigonometric identity, show that the equation

$\sin\theta \tan\theta = 4\cos\theta$

can be written as

$\tan^2\theta = 4$ [1 mark]

4 (a) (ii) Hence solve the equation

$\sin\theta \tan\theta = 4\cos\theta$

where $0° < \theta < 360°$

Give your answers to the nearest degree. [3 marks]

4 (b) Deduce all solutions of the equation

$\sin 3\alpha \tan 3\alpha = 4 \cos 3\alpha$

where $0° < \alpha < 180°$

Give your answers to the nearest degree. [3 marks]

[Turn over]

5 A student is looking for factors of the polynomial $f(x)$

They suggest that $(x - 2)$ is a factor of $f(x)$

The method they use to check this suggestion is to calculate $f(-2)$

They correctly calculate that $f(-2) = 0$

They conclude that their suggestion is correct.

5 (a) Make ONE comment about the student's METHOD. [1 mark]

5 (b) **Make TWO comments about the student's CONCLUSION. [2 marks]**

1 _____

_____

2 _____

6 Determine the set of values of x which satisfy the inequality

$$3x^2 + 3x > x + 6$$

Give your answer in exact form using set notation. [4 marks]

[Turn over]

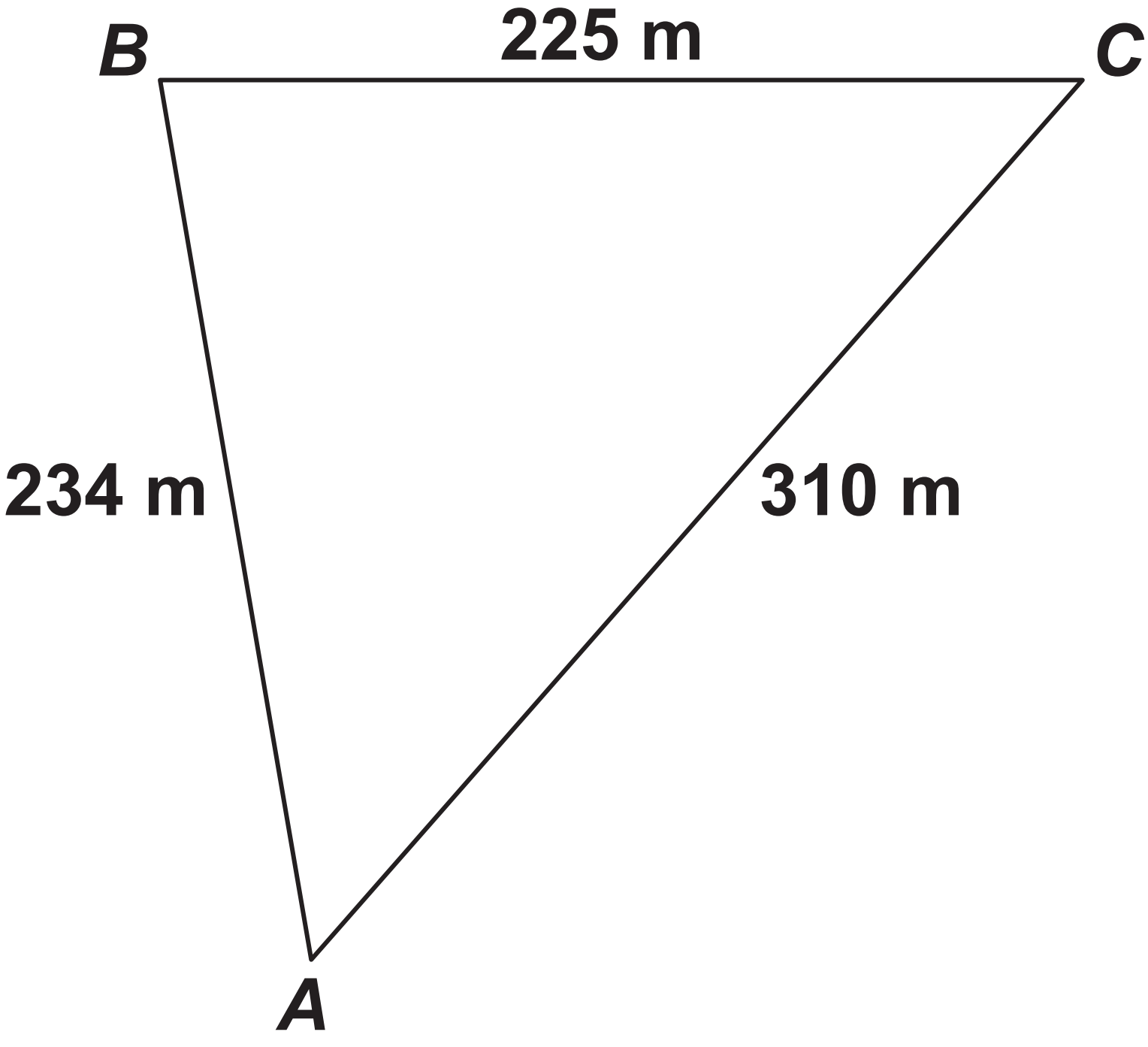
7 **A triangular field of grass, *ABC*, has boundaries with lengths as follows:**

***AB* = 234 m**

***BC* = 225 m**

***AC* = 310 m**

The field is shown in the diagram below.



7 (a) Find angle *A* [2 marks]

7 (b) **Farmers calculate the number of sheep they can keep in a field, by allowing one sheep for every 1200 m^2 of grass.**

Find the maximum number of sheep which can be kept in the field *ABC* [3 marks]

[Turn over]

8 It is given that

$\ln x - \ln y = 3$

8 (a) Express x in terms of y in a form not involving logarithms. [3 marks]

[Turn over]

8 (b) Given also that

$x + y = 10$

find the exact value of y and the exact value of x [3 marks]

[Turn over]

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

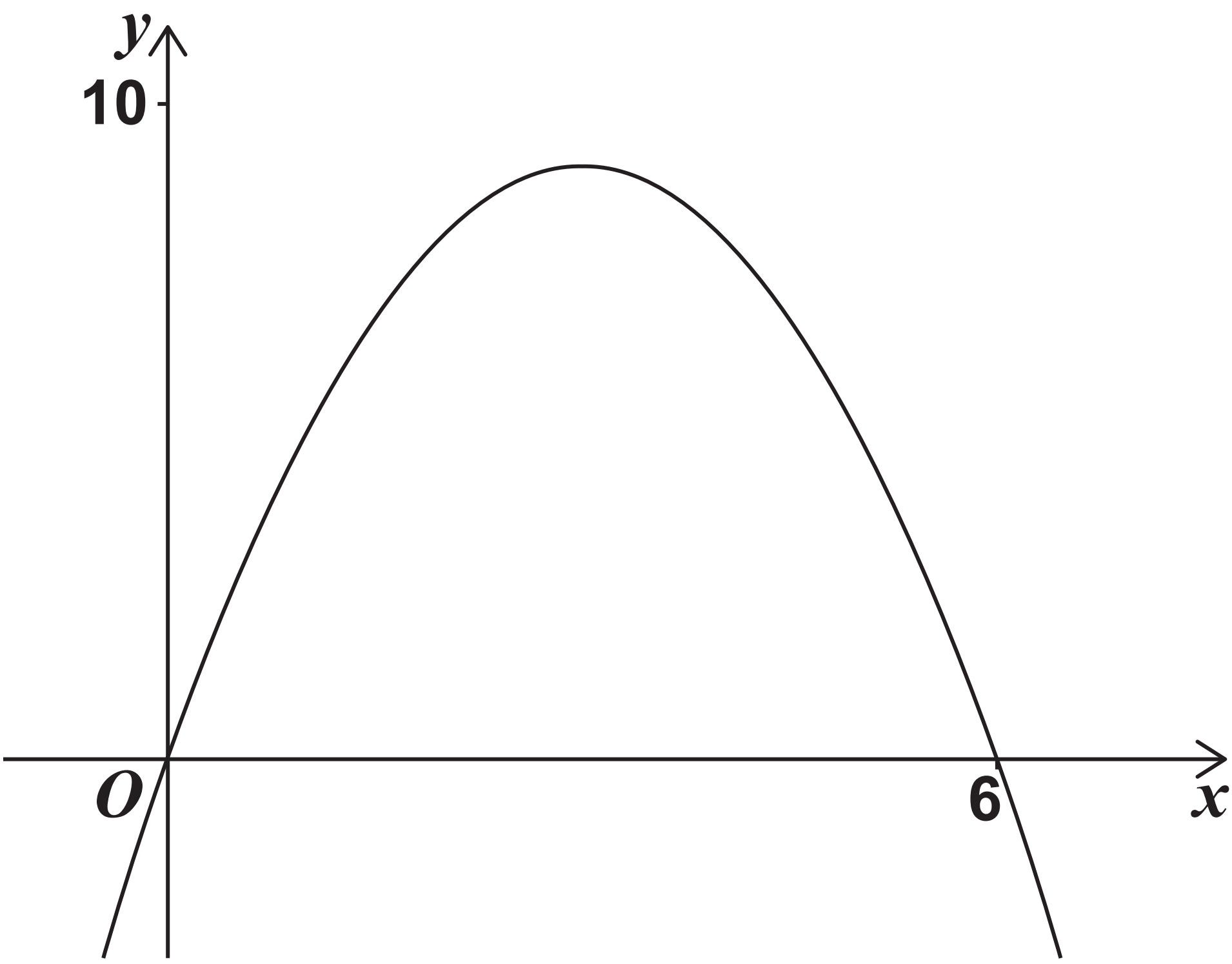
$f(x) = x(6 - x)$

9 (a) Find $f'(x)$ [2 marks]

9 (b) The diagram below shows the graph of $y = \mathrm{f}(x)$

On the same diagram sketch the gradient function for this curve, stating the coordinates of any points where the gradient function cuts the axes.

[3 marks]



10 It is given that

$$\frac{\mathrm{d}y}{\mathrm{d}x} = (x + 2)(2x - 1)^2$$

and when $x = 6$, $y = 900$

Find y in terms of x [6 marks]

[Turn over]

28

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[Turn over]

11 It is given that for the continuous function g

- $g'(1) = 0$
- $g'(4) = 0$
- $g''(x) = 2x - 5$

11 (a) Determine the nature of each of the turning points of g

Fully justify your answer.
[3 marks]

[Turn over]

11 (b) Find the set of values of x for which g is an increasing function. [2 marks]

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[Turn over]

12 The monthly mean temperature of a city, T degrees Celsius, may be modelled by the equation

$$T = 15 + 8\sin(30m - 120)°$$

where m is the month number, counting January = 1, February = 2, through to December = 12

12 (a) Using this model, calculate the monthly mean temperature of the city for May, the fifth month. [2 marks]

[Turn over]

12 (b) **Using this model, find the month with the highest mean temperature. [2 marks]**

12 (c) Climate change may affect the parameters, 8, 30, 120 and 15, used in this model.

12 (c) (i) State, with a reason, which parameter would be increased because of an overall rise in temperatures. [1 mark]

12 (c) (ii) State, with a reason, which parameter would be increased because of the occurrence of more extreme temperatures.
[1 mark]

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[Turn over for Section B]

SECTION B

Answer ALL questions in the spaces provided.

13 A particle is moving in a straight line with constant acceleration a m s^{-2}

The particle's velocity, v m s^{-1}, varies with time, t seconds, so that

$$v = 3 - 4t$$

Deduce the value of a

Circle your answer. [1 mark]

-4 -1 3 4

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[Turn over]

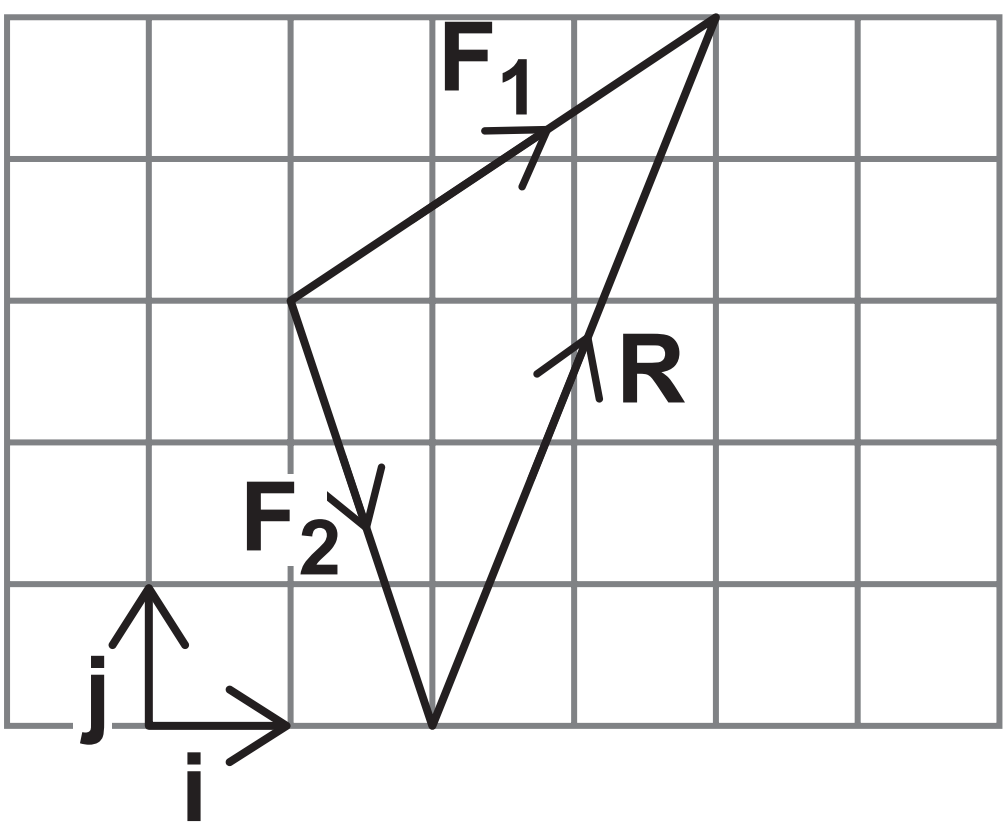
14 Two forces, $F_1 = 3i + 2j$ newtons and $F_2 = i - 3j$ newtons, are added together to find a resultant force, R newtons.

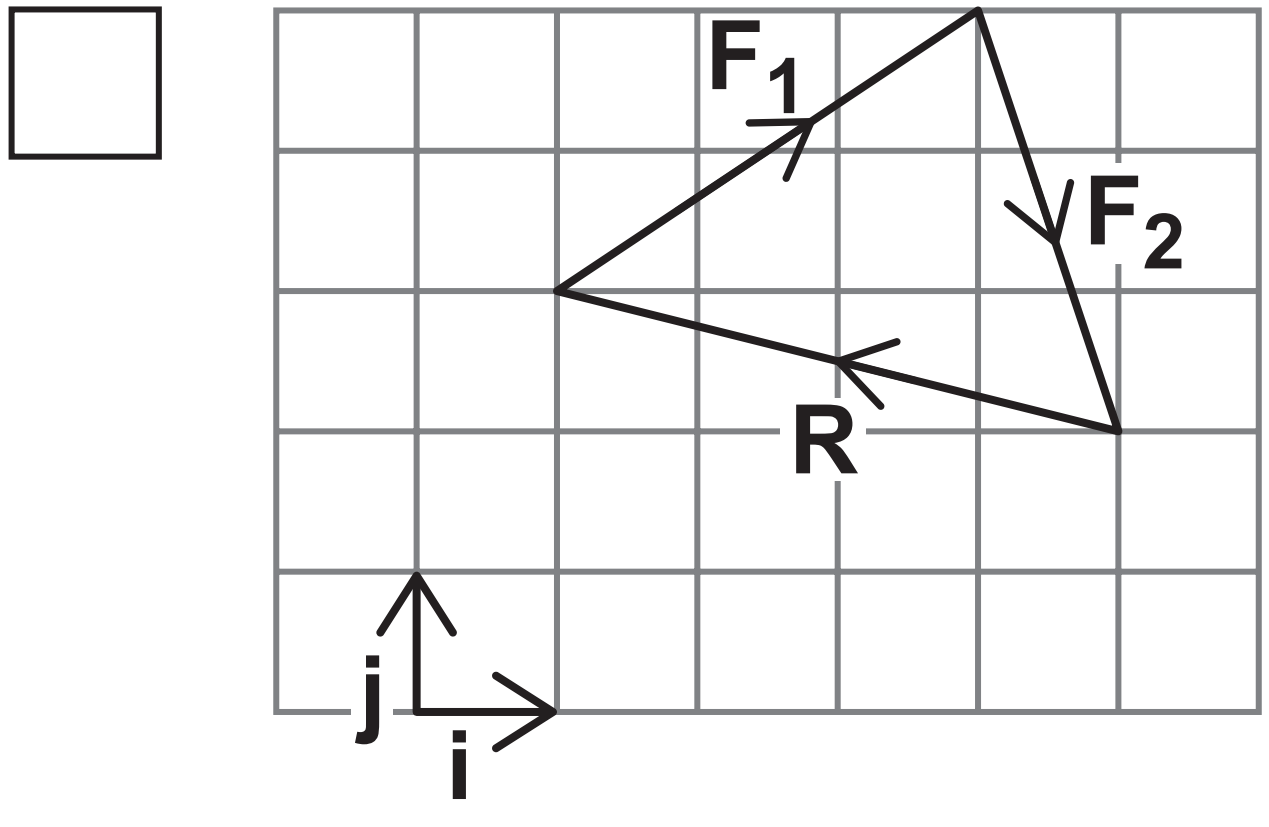
This vector addition can be represented using a diagram.

Identify the diagram below and on the opposite page, which correctly represents this vector addition.

Tick (✓) ONE box. [1 mark]

☐




F1
F2
R
j
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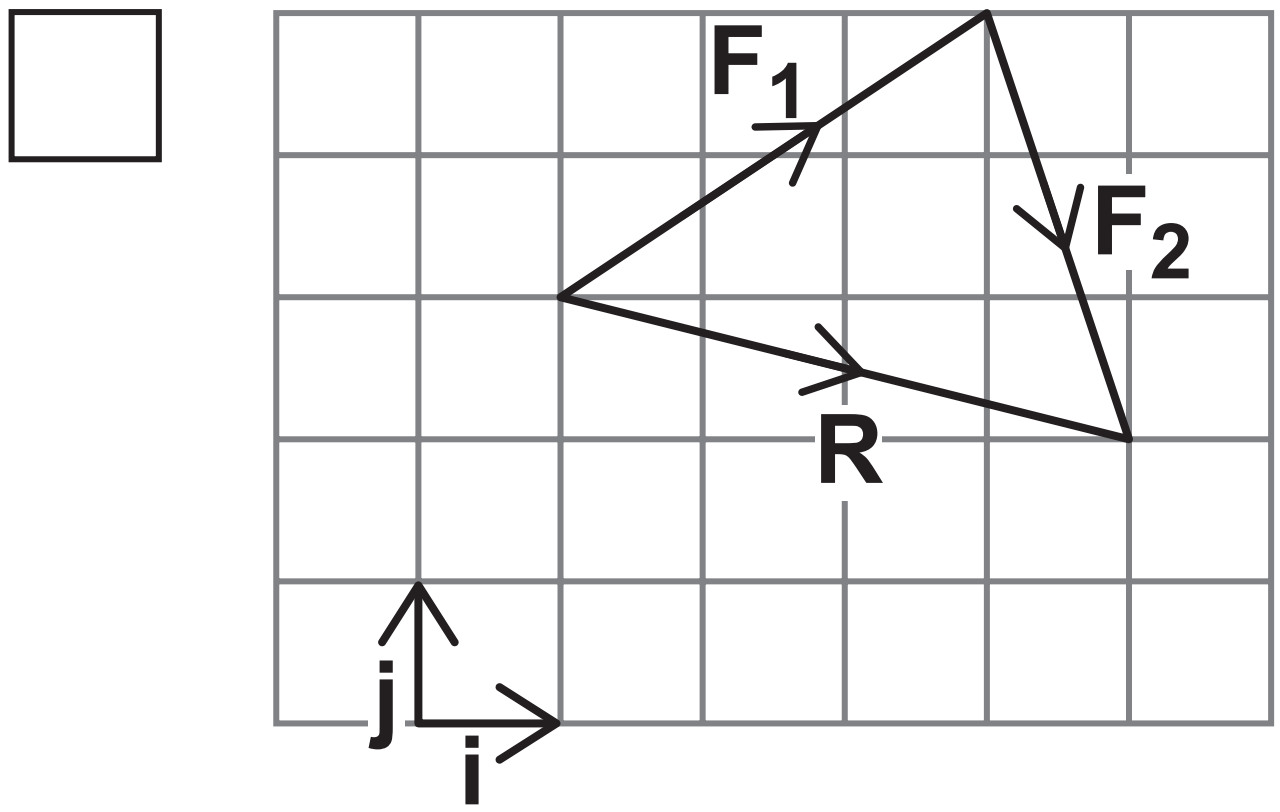
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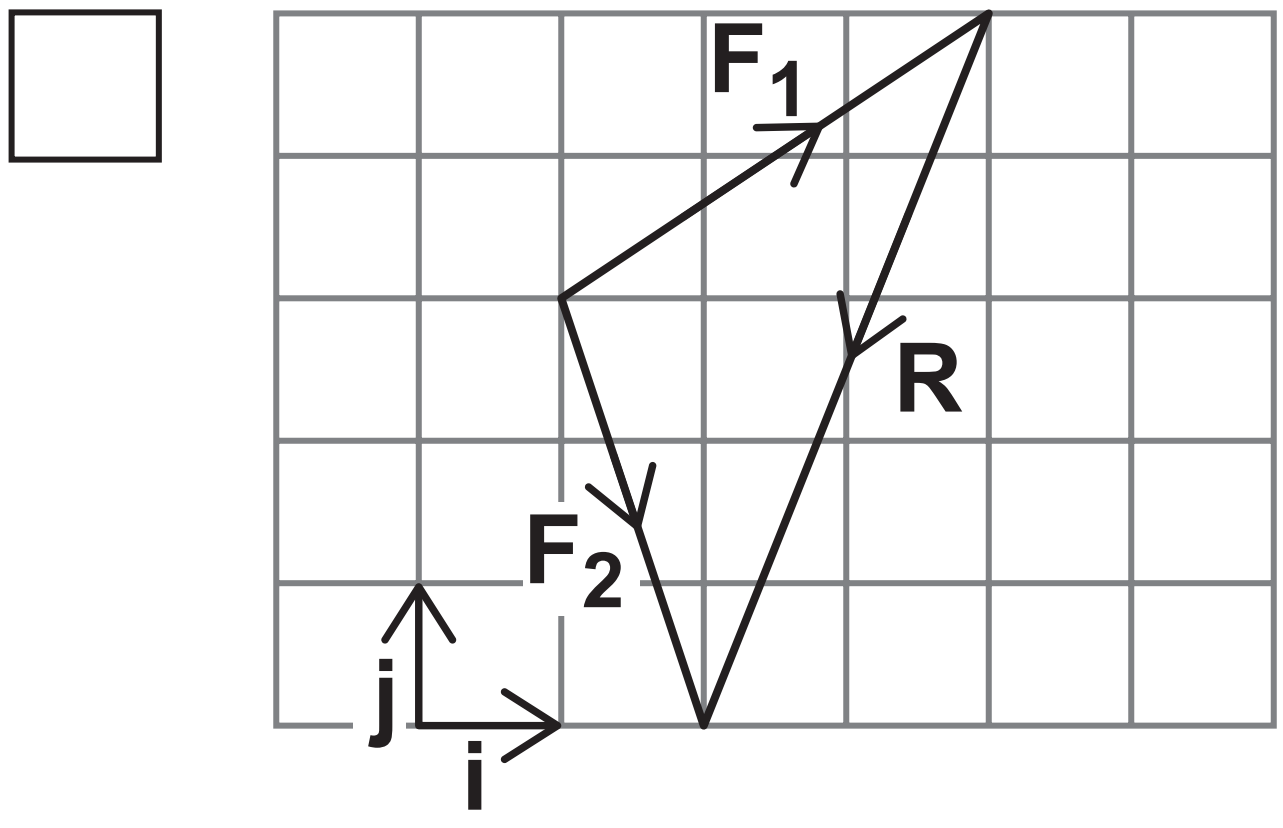
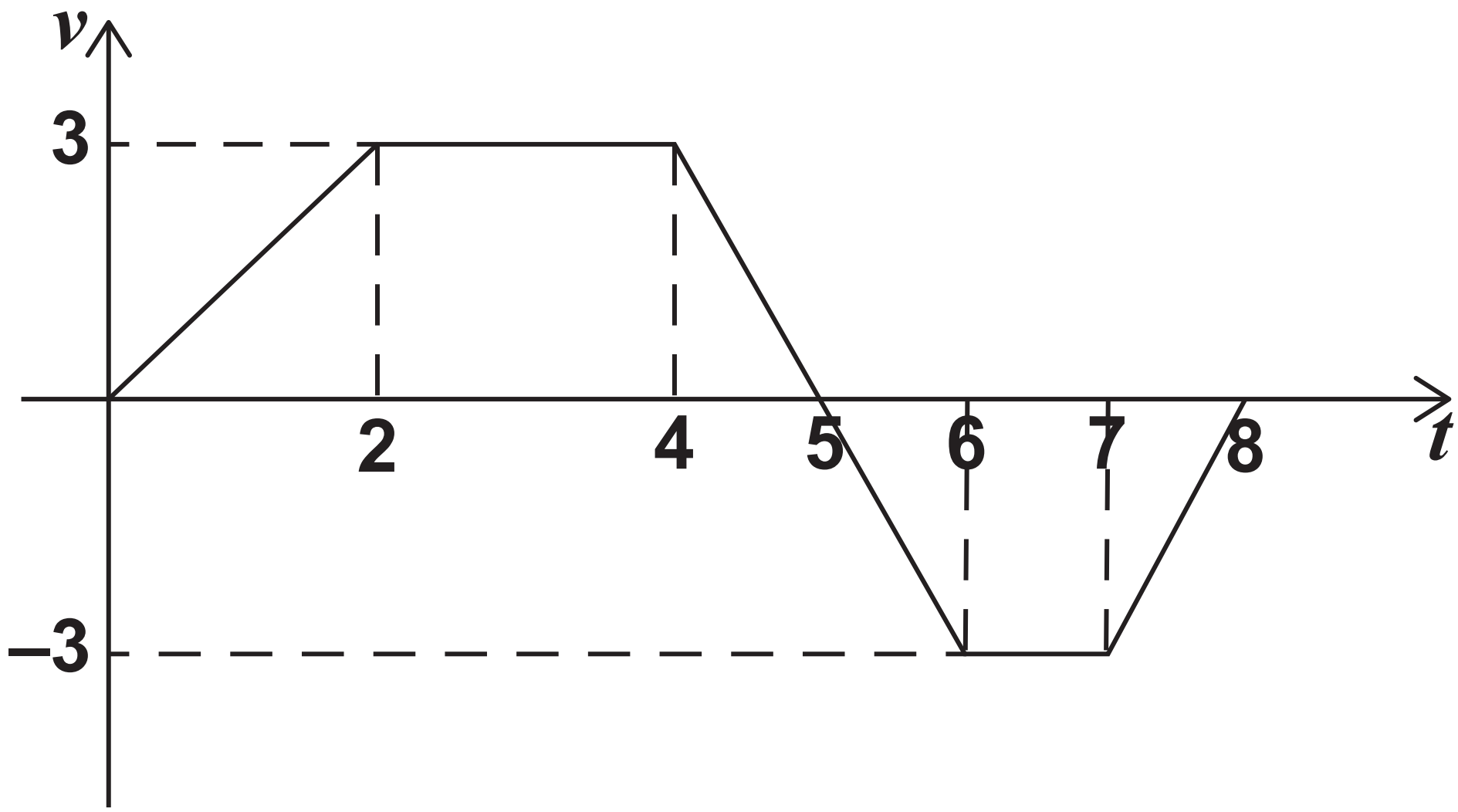

F1
R
F2
j
i

15 A graph indicating how the velocity, v m s^{-1}, of a particle changes with respect to time, t seconds, is shown below.



15 (a) Find the total distance travelled by the particle over the 8 second period shown. [3 marks]

[Turn over]

15 (b) A student claims that

"The displacement of the particle is less than the distance travelled."

State the range of values of t for which this claim is true.

[1 mark]

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[Turn over]

16 **IN THIS QUESTION USE g = 9.8 m s^{-2}**

A ball is launched vertically upwards from the Earth's surface with velocity u m s^{-1}

The ball reaches a maximum height of 15 metres.

You may assume that air resistance can be ignored.

Find the value of u [3 marks]

[Turn over]

17 A particle moves in a straight line with acceleration a m s^{-2}, at time t seconds, where

$$a = 10 - 6t$$

The particle's velocity, v m s^{-1}, and displacement, r metres, are both initially zero.

Show that

$$r = t^2(5 - t)$$

Fully justify your answer.
[4 marks]

[Turn over]

18 It is given that two points, A and B, have position vectors

$$\overrightarrow{OA} = \begin{bmatrix} 5 \\ -1 \end{bmatrix} \text{ metres}$$

and $$\overrightarrow{OB} = \begin{bmatrix} 13 \\ 5 \end{bmatrix} \text{ metres.}$$

18 (a) Show that the distance from A to B is 10 metres. [3 marks]

[Turn over]

18 (b) A constant resultant force, of magnitude R newtons, acts on a particle so that it moves in a straight line passing through the same two points *A* and *B*

At *A*, the speed of the particle is 3 m s^{-1} in the direction from *A* to *B*

The particle takes 2 seconds to travel from *A* to *B*

The mass of the particle is 150 grams.

Find the value of R [3 marks]

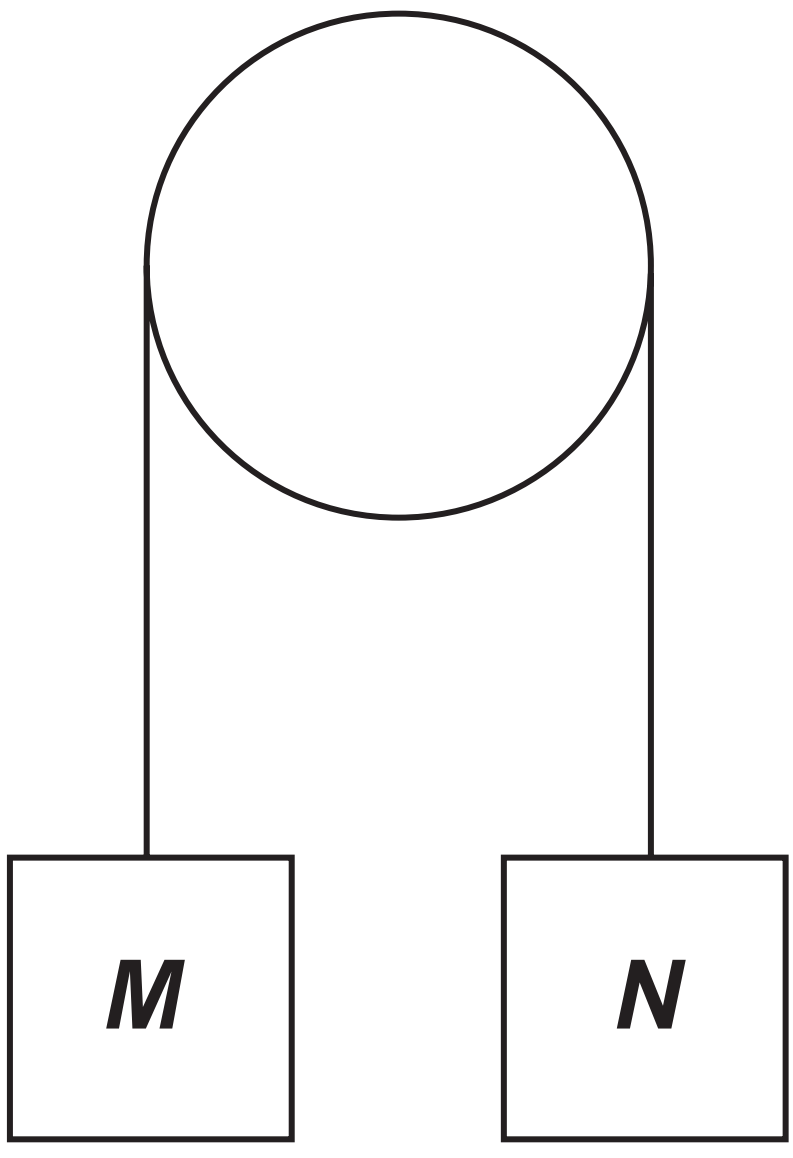
[Turn over]

19 **Two objects, *M* and *N*, are connected by a light inextensible string that passes over a smooth peg.**

***M* has a mass of 0.6 kilograms.**

***N* has a mass of 0.5 kilograms.**

***M* and *N* are initially held at rest, with the string taut, as shown in the diagram below.**



M **and** ***N*** **are released at the same instant and begin to move vertically.**

You may assume that air resistance can be ignored.

[Turn over]

19 (a) It is given that M and N move with acceleration a m s^{-2}

By forming two equations of motion show that

$a = \frac{1}{11}g$ [5 marks]

[Turn over]

19 (b) The speed of N, 0.5 seconds after its release,

is $\frac{g}{k}$ m s^{-1} where k is a constant.

Find the value of k [2 marks]

19 (c) State ONE assumption that must be made for the answer in part (b) to be valid. [1 mark]

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END OF QUESTIONS

Additional page, if required. Write the question numbers in the left-hand margin.

Additional page, if required. Write the question numbers in the left-hand margin.

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Question	Mark
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