AQA

Please write clearly in block capitals.

Centre number | | | | | | Candidate number | | | | |

Surname _____

Forename(s) _____

Candidate signature _____

I declare this is my own work.

AS MATHEMATICS

Paper 1

Thursday 16 May 2024 Afternoon Time allowed: 1 hour 30 minutes

Materials
- You must have the AQA Formulae for A-level Mathematics booklet.
- You should have 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.
- Fill in the boxes at the top of this page.
- 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 outside the box around each page or 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 that 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.

For Examiner's Use	
Question	Mark
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TOTAL	

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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 $y = 1$ ☐

Do not write outside the box

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 for the next question

Do not write outside the box

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]

Do not write outside the box

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 for the next question

Do not write outside the box

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

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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]

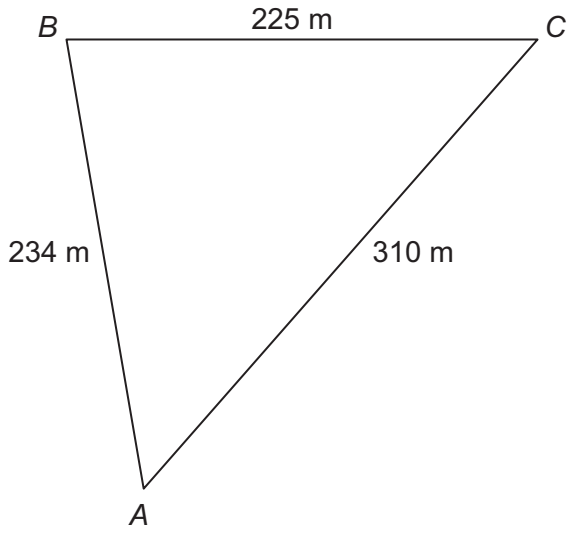
Turn over for the next question

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

$AB = 234$ m $\quad BC = 225$ m $\quad AC = 310$ m

The field is shown in the diagram below.



7 (a) Find angle A

[2 marks]

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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 for the next question

Do not write outside the box

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]

8 (b) Given also that

$$x + y = 10$$

find the exact value of y and the exact value of x

[3 marks]

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

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

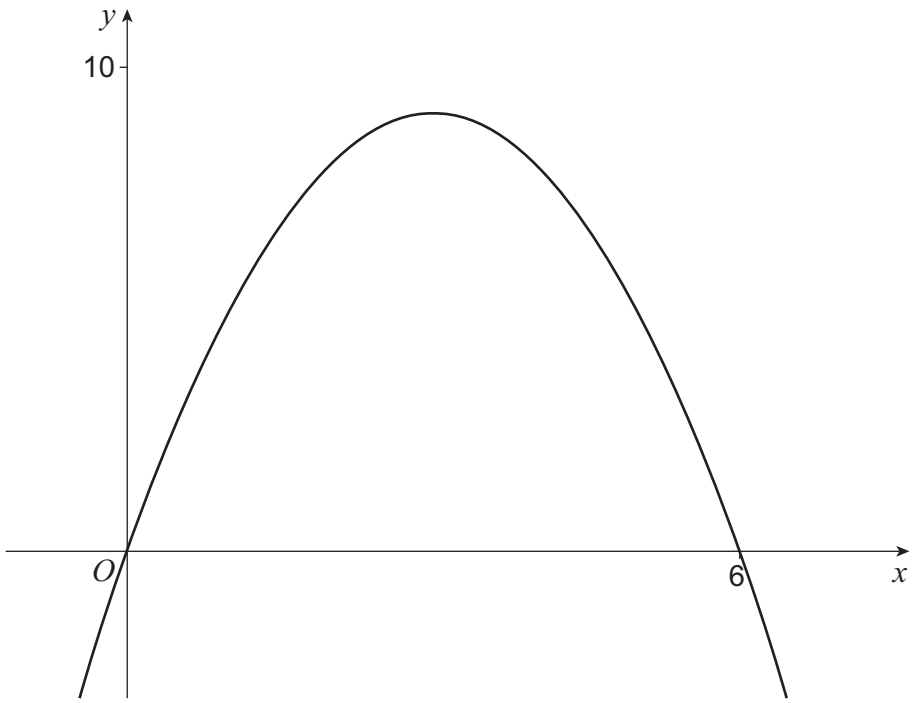
9 (a) Find $f'(x)$

[2 marks]

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

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]



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10 It is given that

$$\frac{dy}{dx} = (x + 2)(2x - 1)^2$$

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

Find y in terms of x

[6 marks]

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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]

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

[2 marks]

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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]

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]

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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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END OF SECTION A

Turn over for Section B

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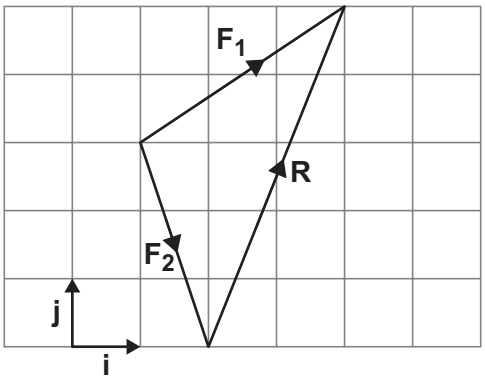
14 Two forces, $\mathbf{F_1} = 3\mathbf{i} + 2\mathbf{j}$ newtons and $\mathbf{F_2} = \mathbf{i} - 3\mathbf{j}$ newtons, are added together to find a resultant force, **R** newtons.

This vector addition can be represented using a diagram.

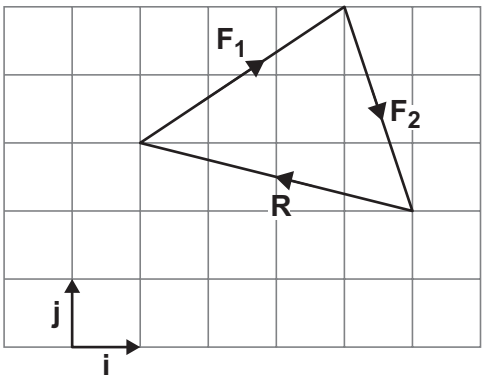
Identify the diagram below which correctly represents this vector addition.

Tick (✓) **one** box.

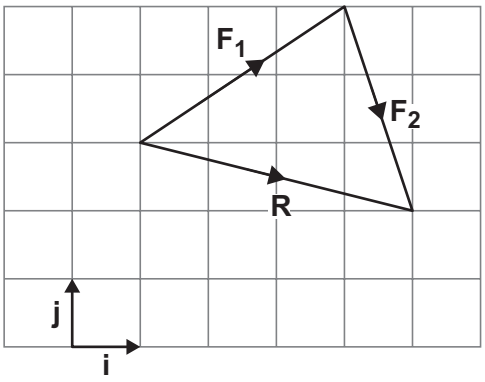
[1 mark]



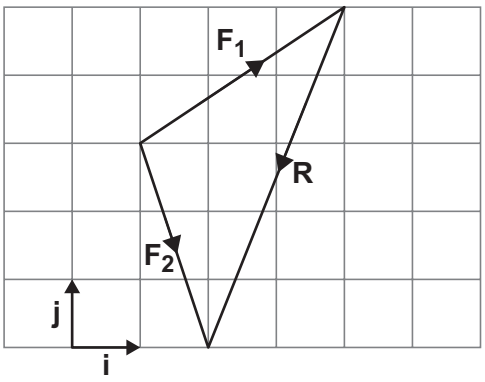
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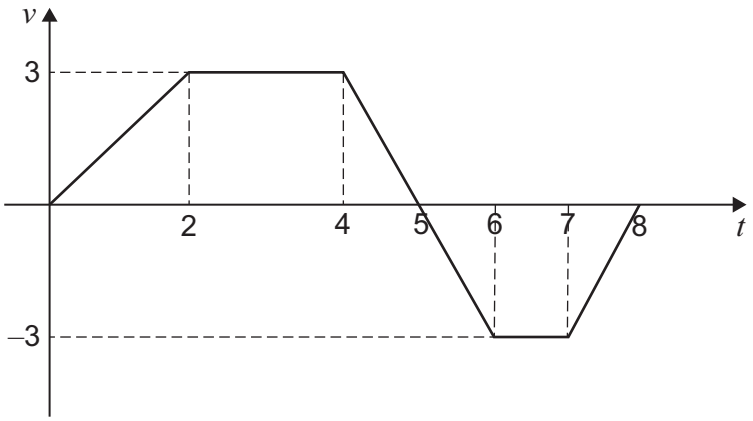


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Turn over for the next question

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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]

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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 for the next question

Do not write outside the box

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]

Do not write outside the box

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 for the next question

Do not write outside the box

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

$$\overrightarrow{OA} = \begin{bmatrix} 5 \\ -1 \end{bmatrix} \text{ metres} \qquad \text{and} \qquad \overrightarrow{OB} = \begin{bmatrix} 13 \\ 5 \end{bmatrix} \text{ metres.}$$

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

[3 marks]

Do not write outside the box

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 for the next question

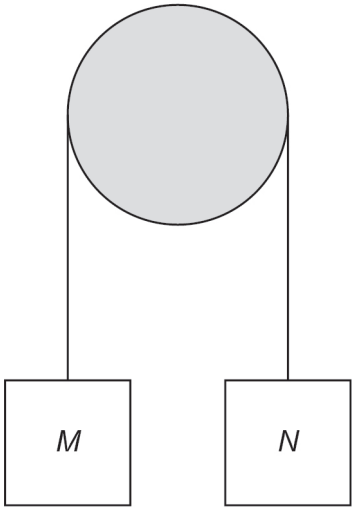
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19 Two objects, *M* and *N*, are connected by a light inextensible string that passes over a smooth peg.

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.

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]

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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]

END OF QUESTIONS

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