Surname	Centre Number	Candidate Number
Other Names		0

GCSE – NEW

3300U60-1

A16-3300U60-1

MATHEMATICS
UNIT 2: CALCULATOR-ALLOWED
HIGHER TIER

THURSDAY, 10 NOVEMBER 2016 – MORNING

1 hour 45 minutes

ADDITIONAL MATERIALS

A calculator will be required for this paper.

A ruler, a protractor and a pair of compasses may be required.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen. Do not use gel pen or correction fluid.

You may use a pencil for graphs and diagrams only.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** the questions in the spaces provided.

If you run out of space, use the continuation page(s) at the back of the booklet, taking care to number the question(s) correctly.

Take π as 3·14 or use the π button on your calculator.

INFORMATION FOR CANDIDATES

You should give details of your method of solution when appropriate.

Unless stated, diagrams are not drawn to scale.

Scale drawing solutions will not be acceptable where you are asked to calculate.

The number of marks is given in brackets at the end of each question or part-question.

In question **8**, the assessment will take into account the quality of your linguistic and mathematical organisation, communication and accuracy in writing.

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**4**	
2.	**2**	
3.	**3**	
4.	**4**	
5.	**6**	
6.	**5**	
7.	**4**	
8.	**7**	
9.	**7**	
10.	**3**	
11.	**2**	
12.	**5**	
13.	**4**	
14.	**5**	
15.	**2**	
16.	**6**	
17.	**3**	
18.	**8**	
Total	**80**	

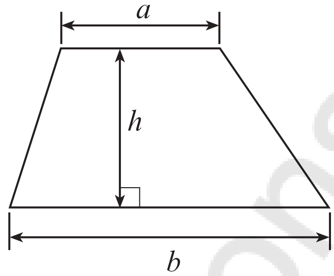
3300U601
01

mathvault.io Solutions

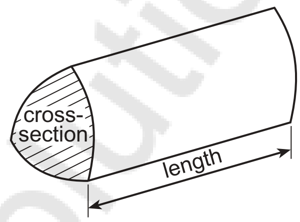
© WJEC CBAC Ltd.

Formula List - Higher Tier

Area of trapezium = $\frac{1}{2}(a + b)h$

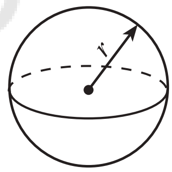


Volume of prism = area of cross-section × length



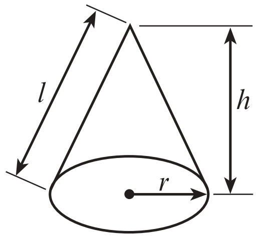
Volume of sphere = $\frac{4}{3}\pi r^3$

Surface area of sphere = $4\pi r^2$



Volume of cone = $\frac{1}{3}\pi r^2 h$

Curved surface area of cone = $\pi r l$

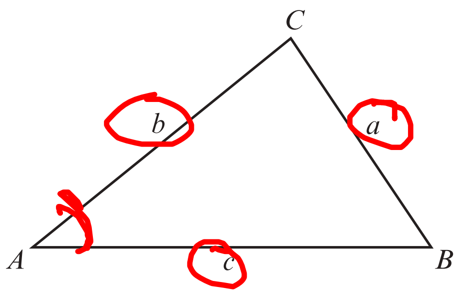


In any triangle ABC

Sine rule $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$

Cosine rule $a^2 = b^2 + c^2 - 2bc \cos A$

Area of triangle = $\frac{1}{2}ab \sin C$



The Quadratic Equation

The solutions of $ax^2 + bx + c = 0$ where $a \neq 0$ are given by $x = \frac{-b \pm \sqrt{(b^2 - 4ac)}}{2a}$

Annual Equivalent Rate (AER)

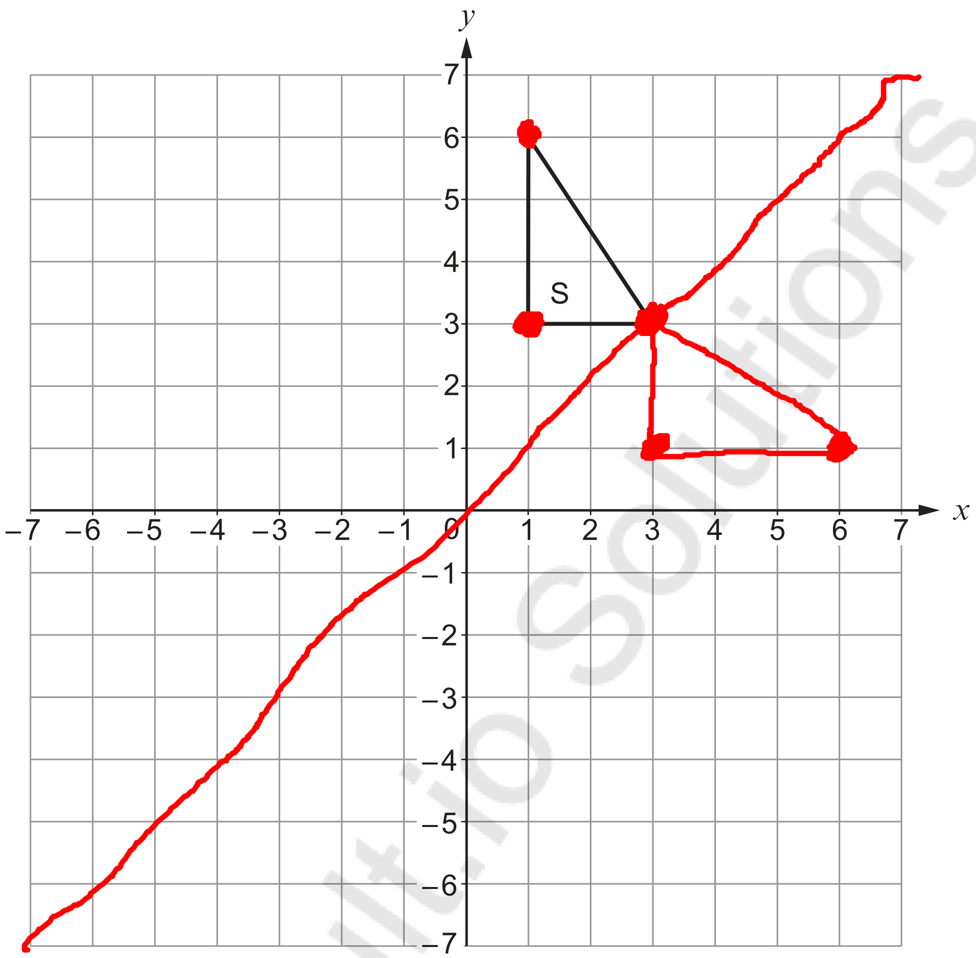
AER, as a decimal, is calculated using the formula $\left(1 + \frac{i}{n}\right)^n - 1$, where i is the nominal interest rate per annum as a decimal and n is the number of compounding periods per annum.

mathvault.io Solutions

© WJEC CBAC Ltd.

Examiner only

1. *(a)* Reflect the triangle S in the line $y = x$. [2]



When reflecting over line $y = x$

$(x, y) \longrightarrow (y, x)$

Point 1 $(3,3) \longrightarrow (3,3)$

Point 2 $(1,3) \longrightarrow (3,1)$

Point 3 $(1,6) \longrightarrow (6,1)$

mathvault.io Solutions

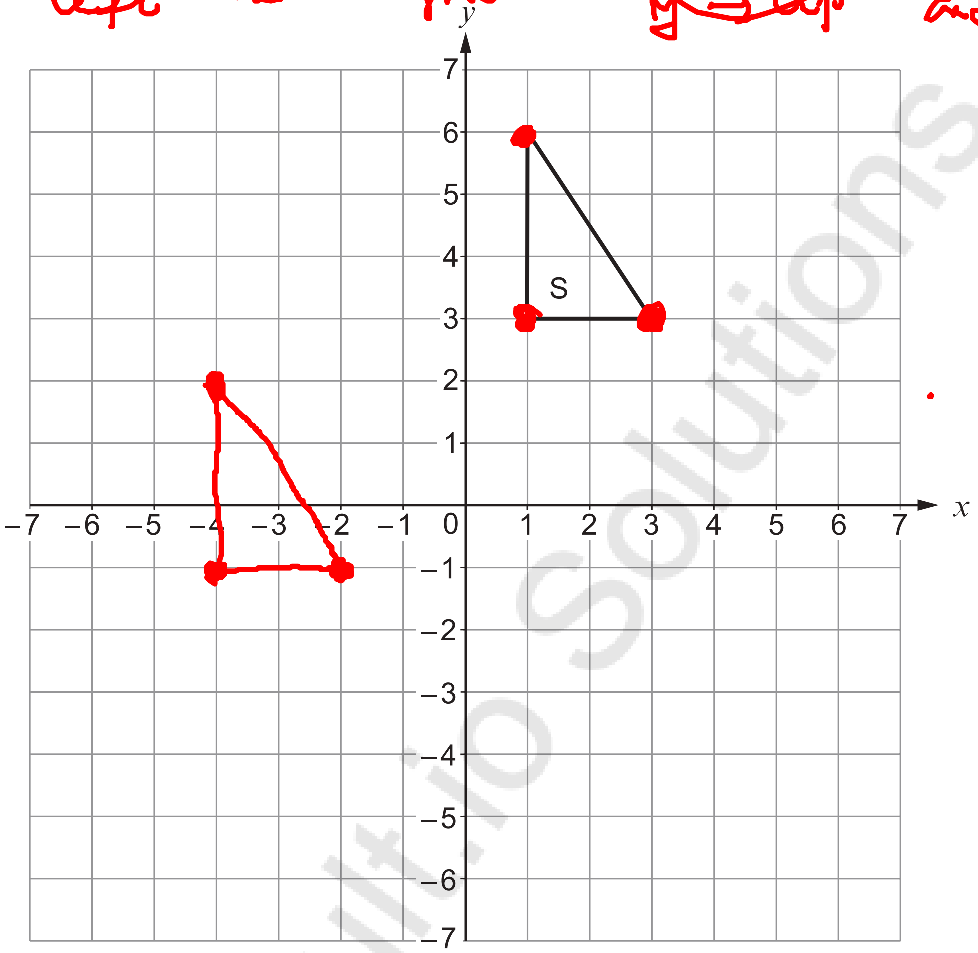
3300U601 03

© WJEC CBAC Ltd.

Examiner only

(b) (i) Translate the triangle S using the column vector $\begin{pmatrix} -5 \\ -4 \end{pmatrix}$. [1]

$x \rightarrow$ left and Right $y \rightarrow$ up and down



(ii) Write down the column vector that will reverse the translation in part (i). [1]

Vector in part i is $\begin{pmatrix} -5 \\ -4 \end{pmatrix}$

reverse translation is $-\begin{pmatrix} -5 \\ -4 \end{pmatrix}$

$= \begin{pmatrix} 5 \\ 4 \end{pmatrix}$

mathvault.io Solutions

© WJEC CBAC Ltd. (3300U60-1)

Examiner only

2. The nth term of a sequence is given by $n^2 + 7$.

Write down the first three terms of this sequence. [2]

nth term n^2+7

1st term $n=1$ $1^2+7=1+7=8$

2nd term $n=2$ $2^2+7=4+7=11$

1st term = 8 2nd term = 11 3rd term = 16

3rd term $n=3$ $3^2+7=9+7=16$

3. Circle the correct answer for each of the following.

(a) $x^3 \times x^6 =$ [1]

x^{36} $x^{0 \cdot 5}$ x^2 x^9 x^{18}

$x^3 \times x^6 = x^{3+6} = x^9$

(b) $(7x - 5y) - (3x + 2y) =$ $a^m \times a^n = a^{m+n}$ [1]

$4x - 3y$ $4x - 7y$ $4x + 3y$ $-4x + 7y$ $-4x - 7y$

$(7x-5y)-(3x+2y)$

$7x-5y-3x-2y = 7x-3x-5y-2y$

$= 4x-7y$

(c) A car travels x miles in 30 minutes.
Its average speed in miles per hour is [1]

$\frac{x}{2}$ $\frac{x}{30}$ $2x$ $\frac{2}{x}$ $30x$

Distance = x miles

time = 30 minutes $= \frac{30}{60} = \frac{1}{2}$ hr

$A \cdot S = \frac{D}{t} = \frac{x}{\frac{1}{2}} = x \div \frac{1}{2} = x \times \frac{2}{1} = 2x$

© WJEC CBAC Ltd.

Examiner only

4. A solution to the equation

$$2x^3 - 3x - 17 = 0$$

lies between 2 and 3.

Use the method of trial and improvement to find this solution correct to 1 decimal place.
You must show all your working. [4]

$2x^3 - 3x - 17 = 0$

$2 \leq x \leq 3$

2, 2·1, 2·2, 2·3, 2·4, 2·5, 2·6, 2·7, 2·8,
2·9, 3.

$x = 2$ $\quad 2(2)^3 - 3(2) - 17 = 16 - 6 - 17 = -7$

$x = 2{\cdot}1$ $\quad 2(2{\cdot}1)^3 - 3(2{\cdot}1) - 17 = -4{\cdot}778$

$x = 2{\cdot}2$ $\quad 2(2{\cdot}2)^3 - 3(2{\cdot}2) - 17 = -2{\cdot}304$

$\boxed{x = 2{\cdot}3 \quad 2(2{\cdot}3)^3 - 3(2{\cdot}3) - 17 = 0{\cdot}434}$

$x = 2{\cdot}4$ $\quad 2(2{\cdot}4)^3 - 3(2{\cdot}4) - 17 = 3{\cdot}448$

$x = 2{\cdot}5$ $\quad 2(2{\cdot}5)^3 - 3(2{\cdot}5) - 17 = 12$

$x = 2{\cdot}6$ $\quad 2(2{\cdot}6)^3 - 3(2{\cdot}6) - 17 = 10{\cdot}352$

$x = 2{\cdot}7$ $\quad 2(2{\cdot}7)^3 - 3(2{\cdot}7) - 17 = 14{\cdot}166$

$x = 2{\cdot}8$ $\quad 2(2{\cdot}8)^3 - 3(2{\cdot}8) - 17 = 18{\cdot}504$

$x = 2{\cdot}9$ $\quad 2(2{\cdot}9)^3 - 3(2{\cdot}9) - 17 = 23{\cdot}078$

$x = 3$ $\quad 2(3)^3 - 3(3) - 17 = 28$

$x = 2{\cdot}3$

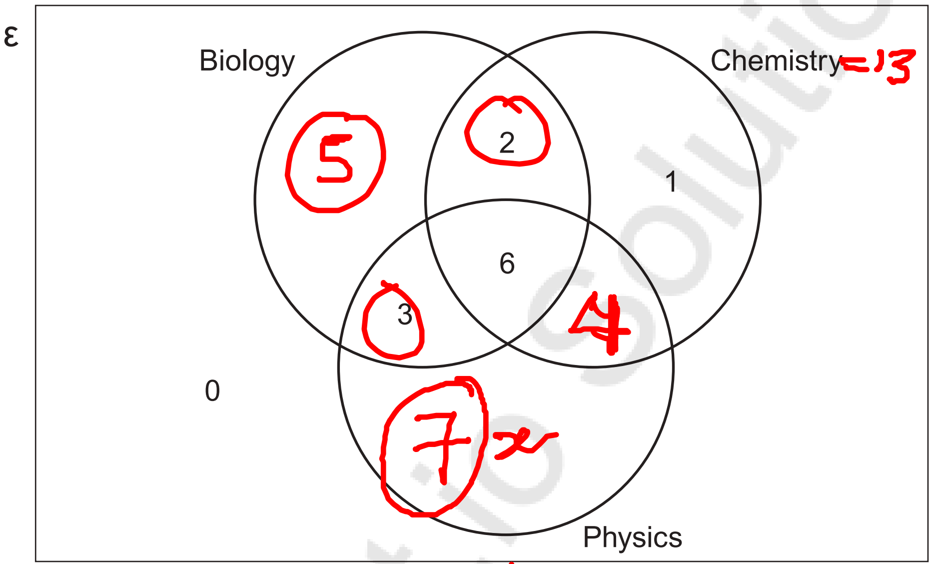
© WJEC CBAC Ltd. (3300U60-1)

Examiner only

5. At a college, a total of 28 students study one or more of the science subjects: Biology, Chemistry and Physics.
The 28 students form the universal set, ε.
Some parts of the Venn diagram below have already been completed.

It is also known that:
- 5 students study only Biology
- 13 students study Chemistry

(a) Complete the Venn diagram. $U = 28$ [3]



Chemistry = 13
$y + 6 + 2 + 1 = 13$
$y + 9 = 13$
$y = 13 - 9$

$\varepsilon = 28$
$x + 4 + 6 + 3 + 5 + 2 + 1 = 28$
$x + 21 = 28$
$x = 28 - 21 = 7$

(b) How many students study Biology and Chemistry but not Physics? [1]

2

(c) One of the students is chosen at random.
What is the probability that this student studies Biology? [2]

$\Pr(\text{Biology}) = \dfrac{\text{no of student that study Biology}}{\text{Total number of student}}$

$\Pr(\text{Biology}) = \dfrac{16}{28} = \dfrac{4}{7}$

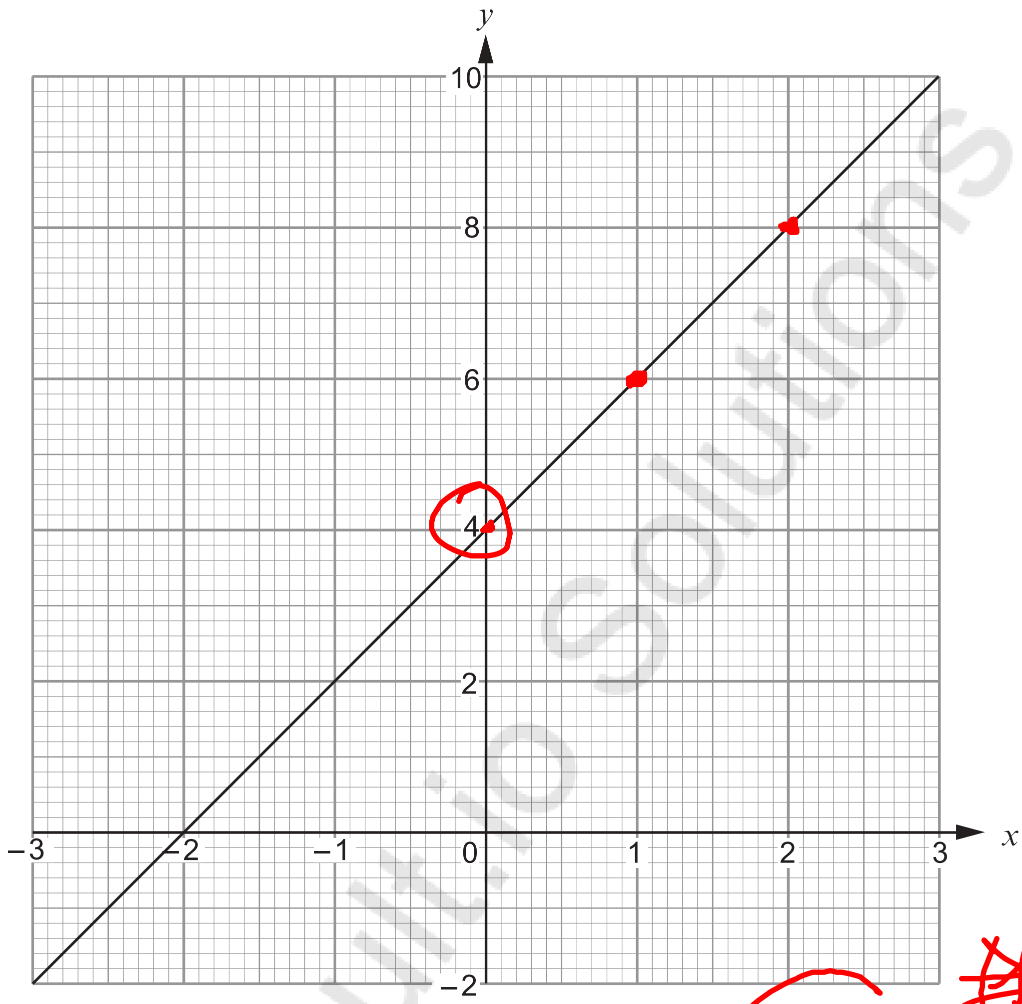
3300U601
07

mathsvault.io Solutions

© WJEC CBAC Ltd. (3300U60-1) Turn over.

Examiner only

6. *(a)* The diagram below shows the graph of a straight line for values of x from −3 to 3.



$m = \frac{\Delta y}{\Delta x}$

$m = \frac{y_2 - y_1}{x_2 - x_1}$

$(x_1, y_1) = (2, 8)$

$(x_2, y_2) = (1, 6)$

$m = \frac{6-8}{1-2}$

$m = \frac{-2}{-1}$

(i) Write down the gradient of the above line. [1]

$m = 2$

$y = mx + c$

(ii) Write down the equation of the line in the form $y = mx + c$, where m and c are whole numbers. [2]

$y = mx + c$ $\quad m = 2 \quad c = 4$

$y = 2x + 4$

(b) Without drawing, show that the line $2y = 5x - 3$ is parallel to the line $4y = 10x + 7$.
You must show working to support your answer. [2]

$2y = 5x - 3$

$y = \frac{5x - 3}{2}$

$y = \frac{5}{2}x - \frac{3}{2}$

$m = \frac{5}{2}$

$4y = 10x + 7$

$y = \frac{10x + 7}{4}$

$y = \frac{10x}{4} + \frac{7}{4}$

$y = \frac{5}{2}x + \frac{7}{4}$

$m = 5/2$

mathsvault.io Solutions

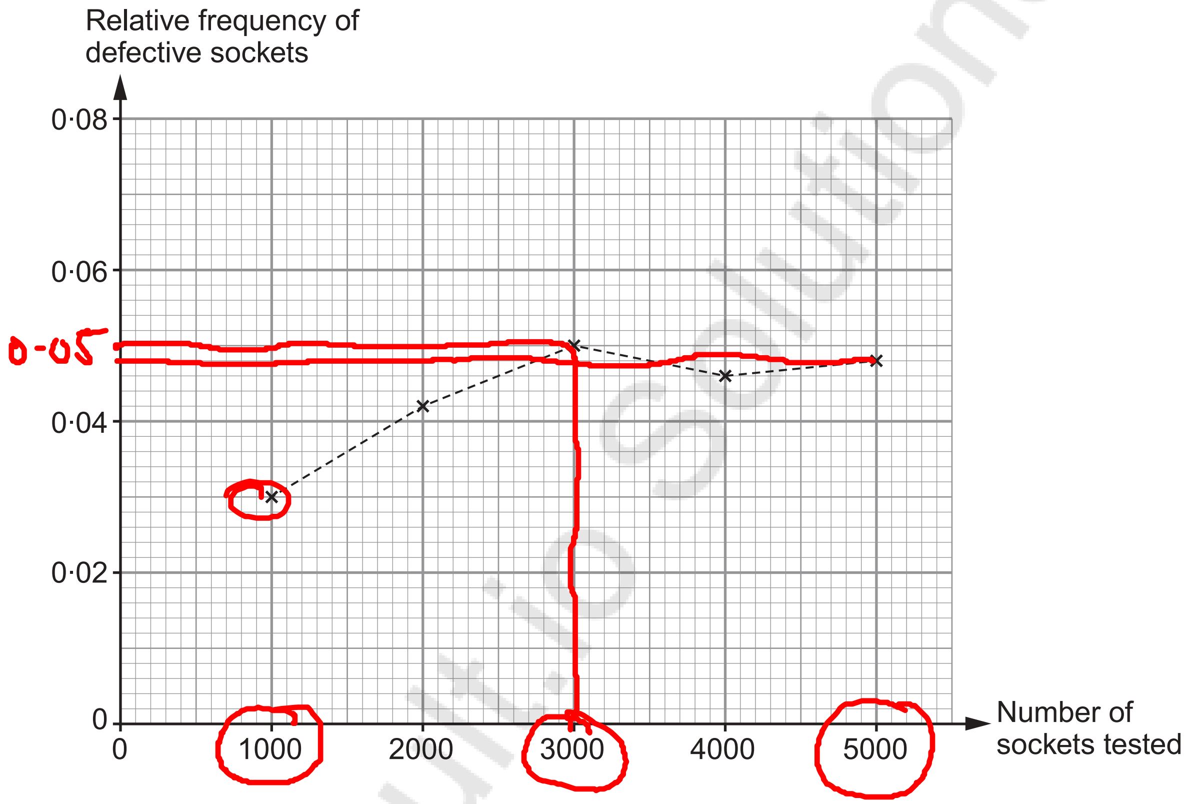
© WJEC CBAC Ltd.

Since Line 1 and Line 2 have equal slope Thus they are parallel.

Examiner only

7. A factory uses a machine to produce electrical sockets.
The manager carries out a survey to investigate the probability of the machine producing a defective socket.

The relative frequency of defective sockets produced was calculated after testing a total of 1000, 2000, 3000, 4000 and 5000 sockets.
The results are plotted on the graph below.



(a) How many of the first 3000 sockets tested were defective? [2]

Rf = 0·05
Defective = Rf × 3000 = 0·05 × 3000
Defective = 150

(b) Write down the best estimate for the probability that one socket, selected at random, will be defective.
You must give a reason for your choice. [2]

Probability: 0·048 or 4·8%

Reason: It has a lot of sample space.

mathvault.io Solutions

3300U601
09

© WJEC CBAC Ltd.

Examiner only

8. *In this question, you will be assessed on the quality of your organisation, communication and accuracy in writing.*

Points A, B, C and D lie on the circumference of a circle, centre O.
BD is a diameter of the circle.
The straight line $BC = 4{\cdot}7\,\text{cm}$ and $B\hat{A}C = 28°$.

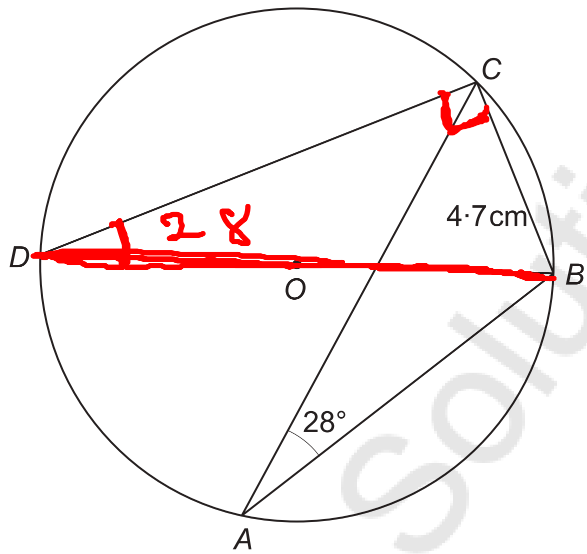
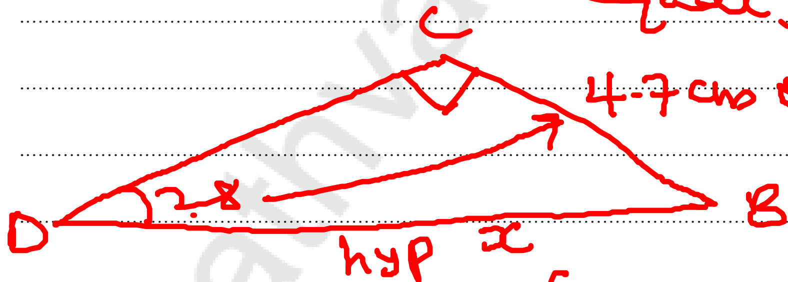


Diagram not drawn to scale

Write down the size of $B\hat{D}C$.
Hence, calculate the length BD.
You must show all your working. [5 + 2 OCW]

BCD = 28° [Angle suspended by the same segment is equal]



∠BCD = 90° [Angle suspended by a diameter or semicircle]

Applying SOH CAH TOA

$\sin 28 = \dfrac{4.7}{x}$

$x \sin 28 = 4.7$

$x = \dfrac{4.7}{\sin 28} = \dfrac{4.7}{0.4695}$

$x = \underline{10.01\,\text{cm}}$

mathvault.io Solutions

BD = 10 cm //

Examiner only

9. *(a)* Factorise $x^2 - 2x - 24$, and hence solve $x^2 - 2x - 24 = 0$. [3]

$x^2 - 2x - 24$

$1 \times -24 = -24$

Factors of -24	Add
$2 \times -12 = -24$	$2 - 12 = -10$
$-2 \times 12 = -24$	$-2 + 12 = 10$
$6 \times -4 = -24$	$6 - 4 = 2$
$-6 \times 4 = -24$	$-6 + 4 = -2$

$x^2 - 6x + 4x - 24$

$x(x-6) + 4(x-6)$

$(x-6)(x+4)$

$x^2 - 2x - 24 = 0$

$(x-6)(x+4) = 0$

$x - 6 = 0$ OR $x + 4 = 0$

$x = 6$ OR $x = -4$

(b) Solve the equation $\frac{4x-3}{2} + \frac{7x+1}{6} = \frac{29}{2}$. [4]

$\frac{4x-3}{2} + \frac{7x+1}{6} = \frac{29}{2}$

Find LCM of denominator

LCM = 6

$\frac{4x-3}{\cancel{2}_1} \times \cancel{6}^3 + \frac{7x+1}{\cancel{6}} \times \cancel{6} = \frac{29}{\cancel{2}} \times \cancel{6}^3$

$3(4x-3) + 7x+1 = 87$

$12x - 9 + 7x + 1 = 87$

$12x + 7x - 9 + 1 = 87$

$19x - 8 = 87$

$+8 \quad +8$

$19x = 95$

$x = \frac{95}{19}$

$x = 5$

3300U601
11

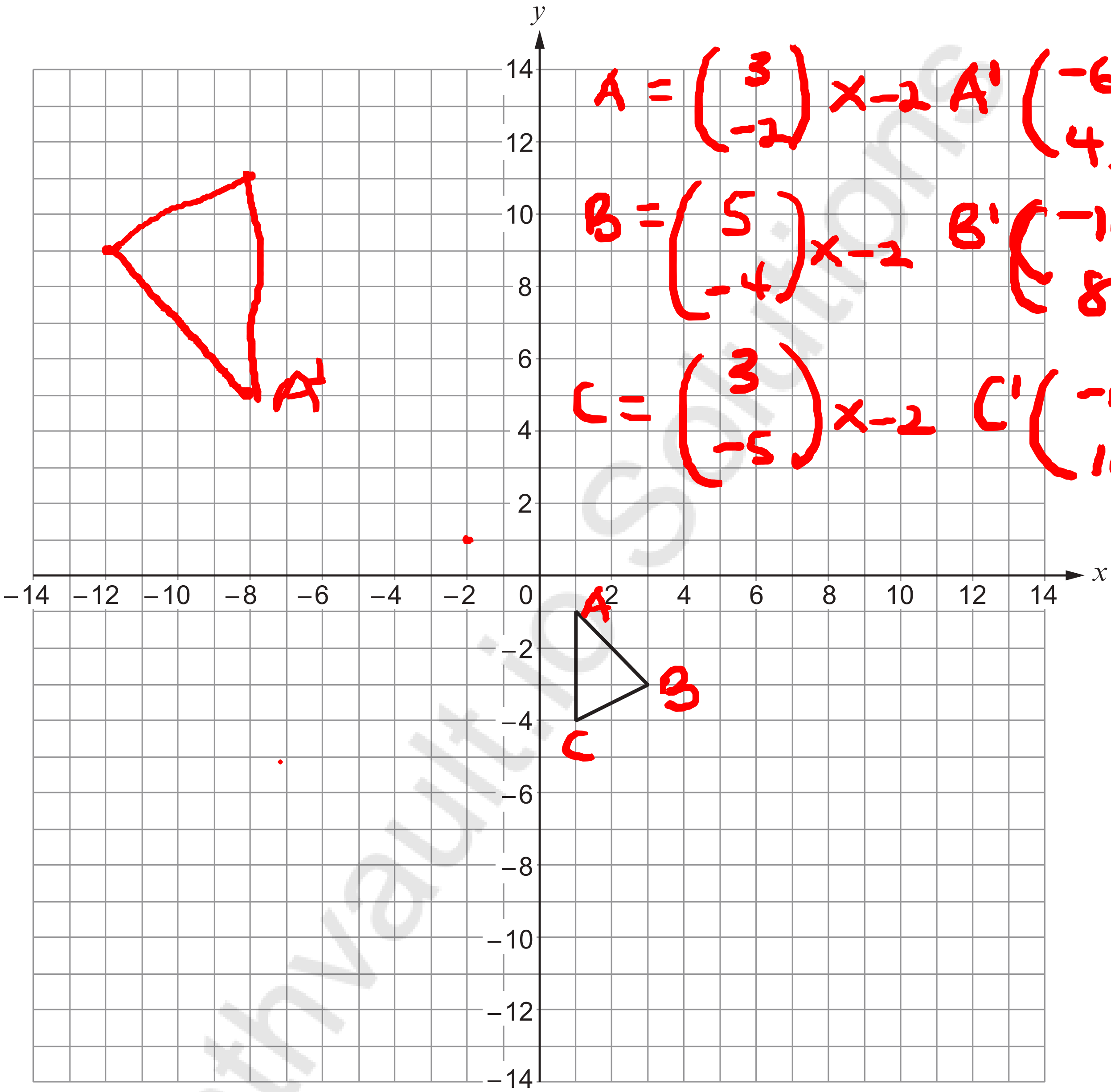
© WJEC CBAC Ltd.

Turn over.

Examiner only

10. Draw the enlargement of the given triangle, using
- a scale factor of -2,
- $(-2, 1)$ as the centre of enlargement. [3]

$(-2, 1)$



$A = \begin{pmatrix} 3 \\ -2 \end{pmatrix} \times -2 \quad A' \begin{pmatrix} -6 \\ 4 \end{pmatrix}$

$B = \begin{pmatrix} 5 \\ -4 \end{pmatrix} \times -2 \quad B' \begin{pmatrix} -10 \\ 8 \end{pmatrix}$

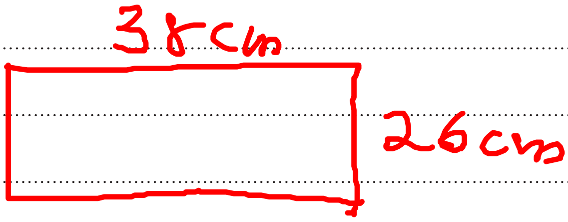
$C = \begin{pmatrix} 3 \\ -5 \end{pmatrix} \times -2 \quad C' \begin{pmatrix} -6 \\ 10 \end{pmatrix}$

mathvault.io Solutions

© WJEC CBAC Ltd.

Examiner only

11. A rectangle measures 38 cm by 26 cm.
Each measurement is correct to the nearest cm.
Calculate the least possible area of the rectangle. [2]



$A = L \times b$

$L = 38\text{cm} \simeq 37.5\text{cm}$

$B = 26\text{cm} \simeq 25.5\text{cm}$

$A = L \times B = 37.5 \times 25.5$

$A = 956.25\text{cm}^2$

mathvault.io Solutions

© WJEC CBAC Ltd.

Turn over.

Examiner only

12. *(a)* Factorise $(x-7)^2 + 2(x-7)$. [2]

$(x-7)^2 + 2(x-7)$

Let $x-7 = a$

$a^2 + 2a$

$a(a+2)$

$(x-7)(x-7+2)$

$(x-7)(x-5)$

(b) Factorise $12x^2 - 27y^2$. [3]

$12x^2 - 27y^2$

$3(4x^2 - 9y^2)$

$3((2x)^2 - (3y)^2)$

NOTE: $x^2 - y^2 = (x+y)(x-y)$

$3(2x+3y)(2x-3y)$

mathvault.ie solutions

© WJEC CBAC Ltd. (3300U60-1)

Examiner only

13. Make x the subject of the following formula. [4]

$$a(x - b) = x(c - d)$$

$a(x-b)=x(c-d)$

$ax-ab=xc-xd$

$ax-xc+xd=ab$

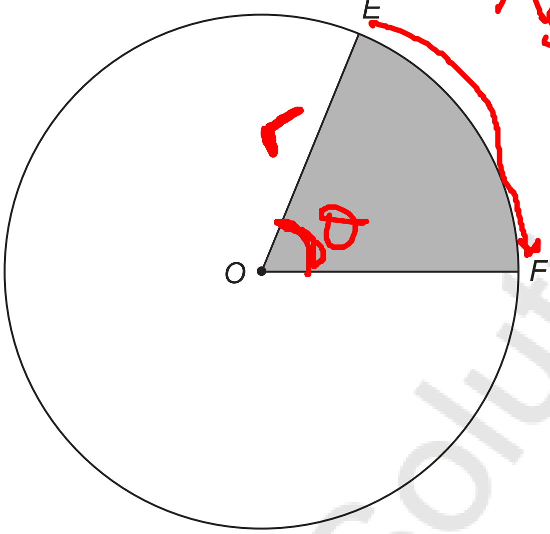
$x[a-c+d]=ab$

$x = \dfrac{ab}{a-c+d}$

mathvault.io Solutions

Examiner only

14. Points E and F lie on a circle, centre O.
The radius of the circle is 10 cm.
The area of the shaded sector is 65 cm^2.



$A_{Sector} = 65\,cm^2$

$r = 10\,cm$

Diagram not drawn to scale

(a) Calculate the size of $E\hat{O}F$. [3]

$A_S = \frac{\theta}{360} \times \pi r^2$

$65 = \frac{\theta}{360} \times \frac{22}{7} \times 10^2$

$65 = \frac{2200\,\theta}{2520}$

$65 \times 2520 = 2200\,\theta$

$\theta = \frac{65 \times 2520}{2200}$

$\theta = 74.45°$

(b) Hence, calculate the length of the arc EF. [2]

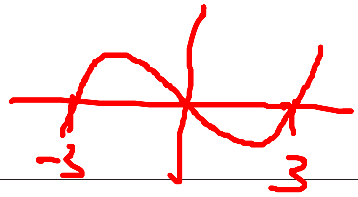
length of an arc $= \frac{\theta}{360} \times 2\pi r$

$S = \frac{74.45}{360} \times 2 \times \frac{22}{7} \times 10$

$S = 13\,cm$

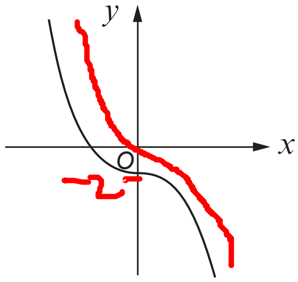
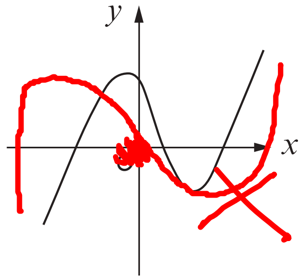
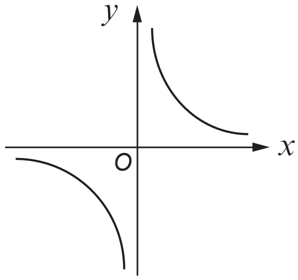
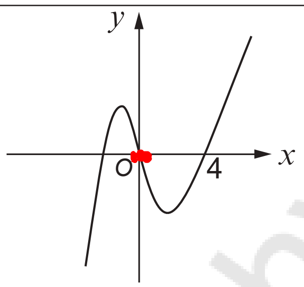
mathvault.io Solutions

© WJEC CBAC Ltd.



Examiner only

15. Circle either TRUE or FALSE for each statement given below. [2]

GRAPH	STATEMENT		
	The equation of this graph could be $y = -x^3 - 2$. $x^2 - 3^2$	TRUE	FALSE
	$x(x^2-9)$ The equation of this graph could be $y = x^3 - 9x$. $x(x-3)(x+3)=0$ $\boxed{x=0}$ $x=3$ $x=3$	TRUE	FALSE
	The equation of this graph could be $y = x^{-1}$. $y = \frac{1}{x}$ 0	TRUE	FALSE
	The equation of this graph could be $y = x^3 + 4$. $x^3 + 4$	TRUE	FALSE

mathvault.io solutions

© WJEC CBAC Ltd. (3300U60-1) **Turn over.**

Examiner only

16. Use the quadratic formula to solve $(3x-1)^2 = x(2x+3) + 7$.
Give your answers correct to 2 decimal places. [6]

$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

$(3x-1)^2 = x(2x+3) + 7$

$3x(3x-1) - 1(3x-1) = 2x^2 + 3x + 7$

$9x^2 - 3x - 3x + 1 = 2x^2 + 3x + 7$

$9x^2 - 6x + 1 = 2x^2 + 3x + 7$

$9x^2 - 2x^2 - 6x - 3x + 1 - 7 = 0$

$7x^2 - 9x - 6 = 0$

$ax^2 + bx + c = 0$

$a = 7 \quad b = -9 \quad c = -6$

$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

$x = \frac{--9 \pm \sqrt{(-9)^2 - 4 \times 7 \times -6}}{2 \times 7}$

$x = \frac{9 \pm \sqrt{81 + 168}}{14}$

$x = \frac{9 \pm \sqrt{249}}{14}$

$x = \frac{9 \pm 15.78}{14}$

$x = \frac{9 + 15.78}{14}$

$x = 1.77$

OR

$x = \frac{9 - 15.78}{14}$

$x = -0.48$

mathsvault.io solutions

© WJEC CBAC Ltd. (3300U60-1)

$\sqrt{a \times m} = \sqrt{a} \times \sqrt{m}$

$\sqrt{5 \times 85^2} = \sqrt{5} \times \sqrt{85^2}$

17. Two similar shapes have areas of 700 cm^2 and 140 cm^2.
The perimeter of the smaller shape is 83 cm.
Calculate the perimeter of the larger shape. [3]

$85\sqrt{5}$

Examiner only

$A_b = 700\text{ cm}^2 \quad A_s = 140\text{ cm}^2$

$P_b = ? \quad P_s = 83\text{ cm}$

$\dfrac{A_s}{A_b} = \dfrac{P_s^2}{P_b^2}$

$\dfrac{140}{700} = \dfrac{83^2}{P_b^2}$

$\dfrac{1}{5} = \dfrac{83^2}{P_b^2}$

$1 \times P_b^2 = 5 \times 83^2$

$P_b^2 = 5 \times 83^2$

$P_b = \sqrt{5 \times 83^2}$

$P_b = 83\sqrt{5}\text{ cm}$

mathvault.ie Solutions

© WJEC CBAC Ltd.

Examiner only

18. A 9-pointed star, with centre O, is shown below.
Each side of the star is of length x cm.

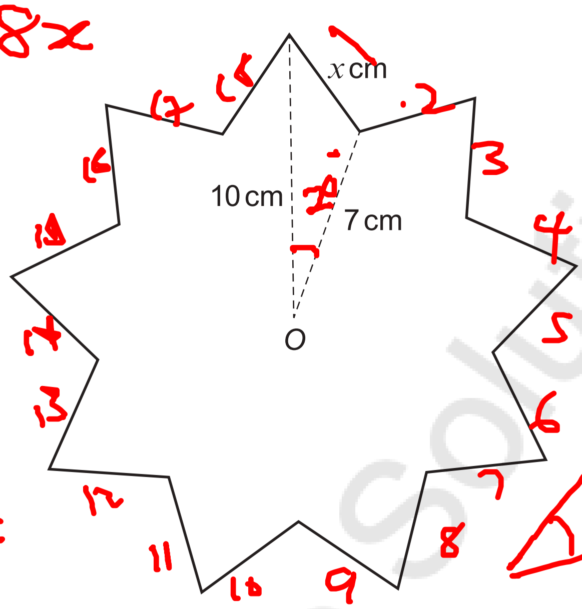
The distance from the centre to every **inner** vertex of the star is 7 cm.
The distance from the centre to every **outer** vertex of the star is 10 cm.

Perimeter $= 18x$

$P = 18x$

$P = 18 \times 4.18$

$P = \underline{\underline{75.24\text{cm}}}$



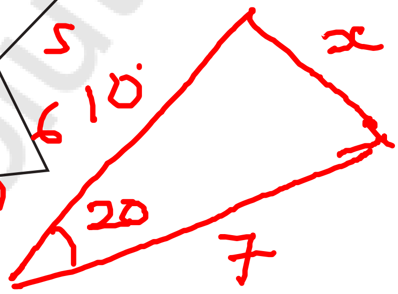


Diagram not drawn to scale

(a) Calculate the perimeter of the star. [5]

$\theta = \dfrac{360}{18} = 20^\circ$

Using cosine rule

$x^2 = 10^2 + 7^2 - 2 \times 10 \times 7 \cos 20$

$x^2 = 100 + 49 - 140 \cos 20$

$x^2 = 149 - 140 \cos 20$

$x^2 = 149 - 140 \times 0.9397$

$x^2 = 149 - 131.558$

$x^2 = 17.442$

$x = \sqrt{17.442} = 4.18\text{cm}$

mathsvault.io Solutions

© WJEC CBAC Ltd.

Examiner only

(b) Calculate the area of the star. [3]

END OF PAPER

mathvault.io Solutions

BLANK PAGE

PLEASE DO NOT WRITE ON THIS PAGE

mathvault.io Solutions

© WJEC CBAC Ltd.

Question number	Additional page, if required. Write the question number(s) in the left-hand margin.

Examiner only

mathvault.io Solutions

© WJEC CBAC Ltd.

BLANK PAGE

PLEASE DO NOT WRITE ON THIS PAGE

mathvault.io Solutions

© WJEC CBAC Ltd.