DULWICH COLLEGE
FOUNDED 1619

Year 9 Entrance and Scholarship Examination Mathematics

MARK SCHEME

Specimen Paper B

TIME allowed for this paper: 90 minutes

Instructions

- Use a calculator where appropriate.
- Answer all the questions.
- Show all your working.
- Marks for questions are shown in square brackets [ ].
- There are 125 marks in total
- You must not write in the squares at the bottom right of each page

1. Use your calculator to work out the value of

$$\sqrt{\frac{3+\sqrt{2}}{4}}$$

(a) Write down all of the digits shown on your calculator:

Answer: 1.050501495 [1] B1

(b) Write your answer to (a) rounded to 1 decimal place:

Answer: 1.1 [1] B1ft

(c) Write your answer to (a) rounded to 4 significant figures:

Answer: 1.051 [1] B1ft only if there is a zero to the right of dp.

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2. (a) 140 students sat a Mathematics examination. 7 forgot their calculators. Calculate the percentage of students who forgot their calculators.

$\frac{7}{140} \times 100$ M1

Answer: 5 % [2] A1

(b) A teacher has purchased some calculators from a shop for £12 each and decides to sell these calculators to those forgetful students. For each calculator sold the teacher decides to make a 25% profit. Calculate how much each student pays for a calculator.

3 or 1.25×12 M1

Answer: £ 15 [2] A1

(c) In fact, one fifth of the students failed to turn up to the examination. Calculate how many should have turned up in total given that 140 sat the examination.

$\frac{140}{0.8}$ M1

Answer: 175 [2] A1

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3. Simplify the following.

(a) $3ab \quad 4a + 6b \quad ab \quad 3a \quad 10b$

M1 for any correct

Answer: $2ab \quad 7a \quad 4b$ [2] A1 all correct

(b) $4(3x - 2)$

B1 B1

Answer: $12x - 8$ [2]

(c) $3 - (4x - 2) - 6x$

$= 3 - 4x + 2 - 6x$

B1 B1

Answer: $5 \quad -10x$ [2]

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

$= x^2 + 7x - 2x - 14$

B1 B1 B1

Answer: $x^2 + 5x - 14$ [3]

(e) $\frac{56ab^3}{8a^3b^2}$

$= \frac{7ab^3}{a^3b^2}$

$= \frac{7b^3}{a^2b^2}$

$= \frac{7b}{a^2}$

M1 for any of these steps correct

Answer: $\frac{7b}{a^2}$ [2] A1

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4. The diagram below shows two parallel lines and a triangle with two equal sides as indicated. Calculate the values of x and y.

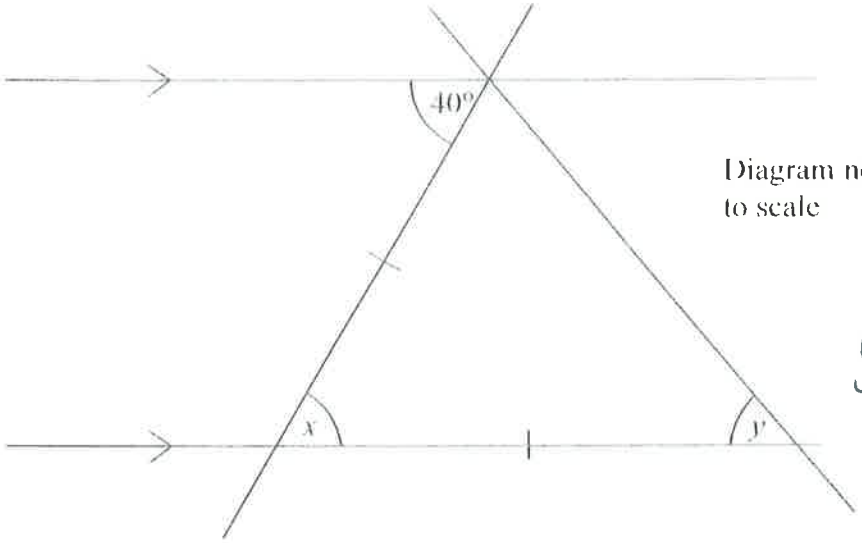


Diagram not drawn to scale

$y = \frac{180 - "40"}{2}$ M1 allow their x

Answer: x = 40 B1 y = 70 A1ft [3]

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5. The current world record for the men's 100 metre sprint is 9.58 seconds.

Writing your answers to 3 significant figures, calculate the average speed of the world record holder in:

(a) metres per second,

$S = \frac{D}{T} = \frac{100}{9.58}$ M1

Answer: 10.4 m/s [2] A1

(b) kilometres per hour,

$S = \frac{100 \div 1000}{9.58 \div 3600}$ M1 M1 $= \frac{0.1}{0.002611...}$

Answer: 37.6 A1 km/h [3]

(c) miles per hour (note that one kilometre is roughly 0.621 miles).

"(b)" x 0.621 M1

Answer: 23.3 miles/h [2] A1

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6. (a) State the largest number less than 25 which is:

(i) a prime number,

Answer: 23 [1] B1

(ii) a square number,

Answer: 16 [1] B1

(iii) a triangular number.

Answer: 21 [1] B1

(b) For the sequence of numbers:

3, 7, 11, 15, ...

calculate:

(i) the 6^{th} term in the sequence,

Answer: 23 [1] B1

(ii) the n^{th} term in the sequence,

B1 B1

n^{th} term = $4n-1$ [2]

(iii) the term of the sequence which has a value of 3999.

$4n-1 = 3999$
$4n = 4000$
$n = \frac{4000}{4}$

M1 for sensible method using their (ii)

Answer: 1000 [2] A1

7.

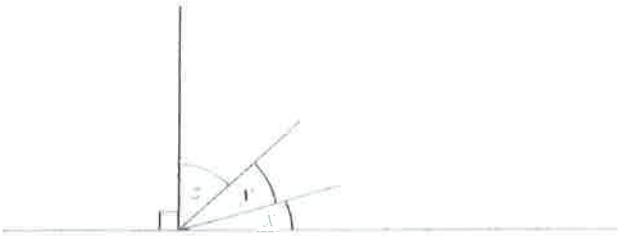


Diagram not drawn to scale

In the diagram shown above you are told that the angle marked y is twice as big as the angle marked x and the angle marked z is three times as big as that marked x.

Calculate the size of the angles marked x, y and z.

$x + 2x + 3x = 90$] M1

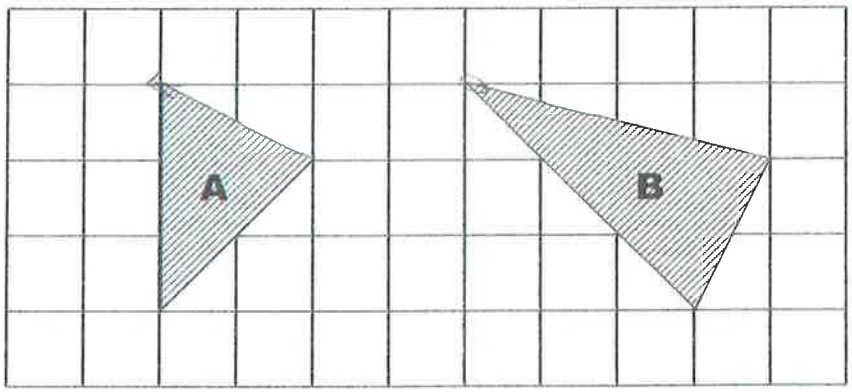
$6x = 90$

$x = \frac{90}{6}$

A1 A1 A1

Answer: x = 15 , y = 30 , z = 45 [4]

8.



Given that the above grid is made of squares with sides of 1 cm, calculate the area of:

(a) triangle A, $\frac{1}{2} \times 3 \times 2$

or $(2 \times 3) - \frac{1}{2} \times 2 \times 1 - \frac{1}{2} \times 2 \times 2$] M1 or attempt to use $\frac{1}{2} \times b \times h$

Answer: 3 cm^2 [2] A1

(b) triangle B.

$(3 \times 4) - \frac{1}{2} \times 1 \times 4 - \frac{1}{2} \times 1 \times 2 - \frac{1}{2} \times 3 \times 3$

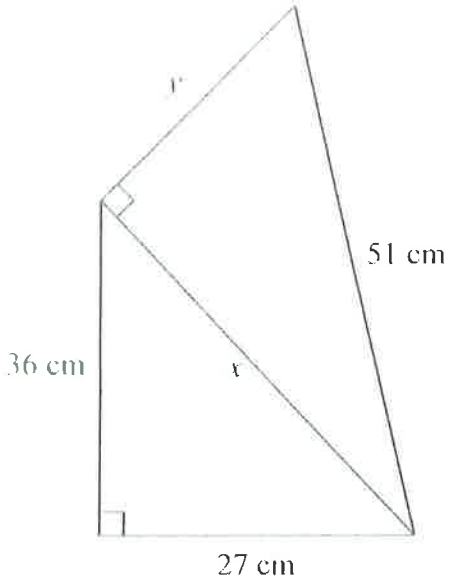
$= 12 - 2 - 1 - 4.5$

Answer: 4.5 cm^2 [2] A1

M1 for 12 − "something"

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9. The diagram below shows two right angled triangles. Calculate x and y.



$x^2 = 27^2 + 36^2$] m1

$= 729 + 1296$

$= 2025$

$x = \sqrt{2025}$

$y^2 + x^2 = 51^2$] m1 allow their x

$y^2 = 51^2 - x^2$

$= 51^2 - 2025$

$= 2601 - 2025$

$= 576$

$y = \sqrt{576}$

Answer: $x =$ 45 A1 cm, $y =$ 24 A1 cm [4]

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10. 2, 2, 2, 3, 4, 5

For the data above calculate:

(a) the median,

Answer: 2.5 [1]

(b) the mean. $\frac{2+2+2+3+4+5}{6}$

$= \frac{18}{6}$

Answer: 3 [2]

Two more values, x and y, are added to the data list. The range of the new data list is 6 and its new mean is 3.75.

(c) Calculate the values of x and y.

$\frac{18+x+y}{8} = 3.75$]

$x + y = 12$] m1 either line

A1 A1

$x =$ 4 or 8, $y =$ 8 or 4 [3]

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11. (a) Complete the tables of values for the following straight lines.

(i) $y = 2x - 2$

x	2	0	4
y	-6	-2	6

B1 both correct

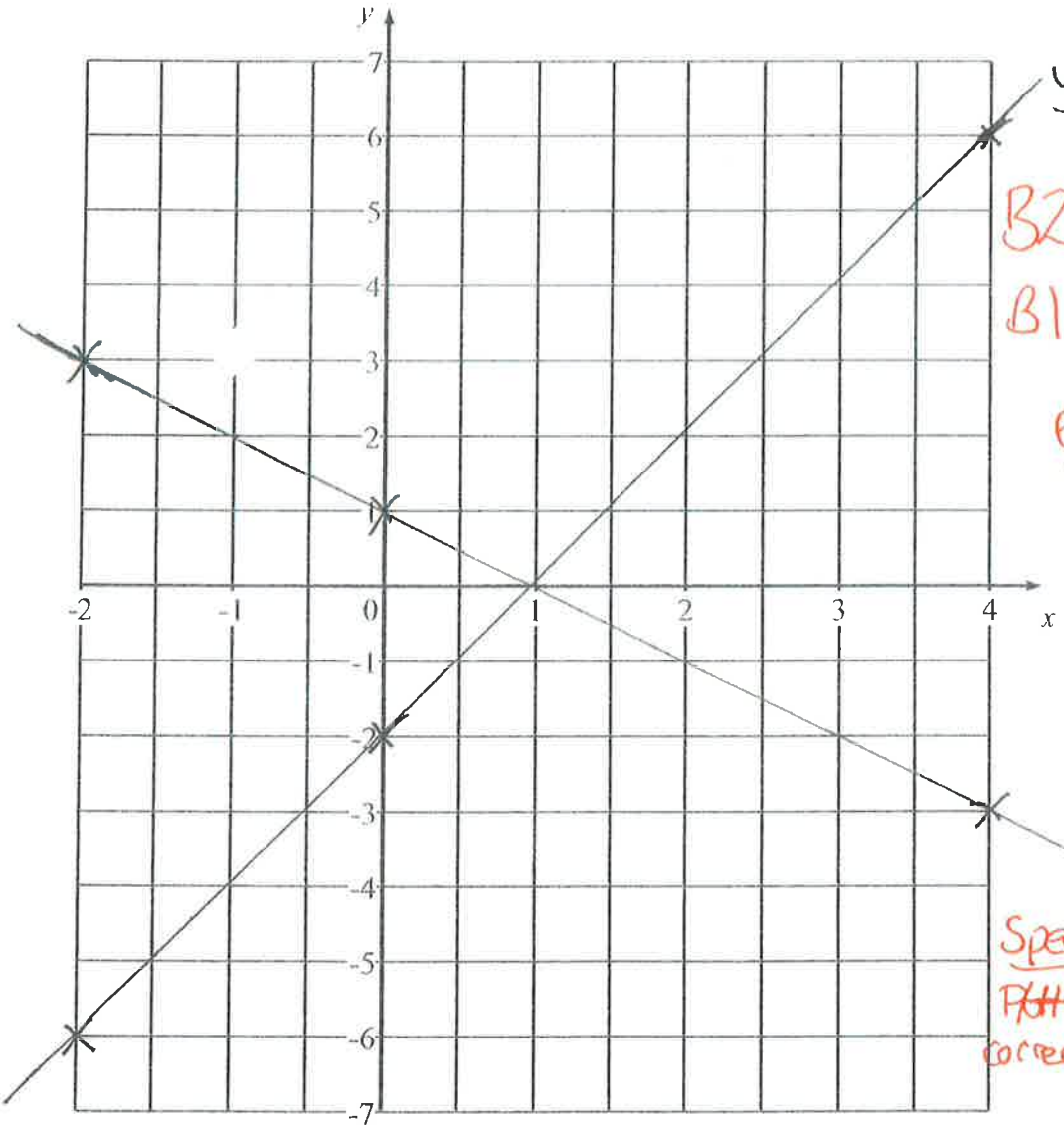
(ii) $y = 1 - x$

x	2	0	4
y	3	1	-3

B1 both correct

[2]

(b) Plot the lines $y = 2x - 2$ and $y = 1 - x$ on the grid below.



y = 2x - 2

B2 - all correct

B1 - single mistake e.g. line misses cross or coord not plotted correctly.

y = 1 - x

Special case

Plotting their (i) or (ii) correctly can score B1 B0

[2]

(c) Write down the coordinates of where the two lines cross.

B1 B1

Answer: (1 , 0) [2]

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12. Solve the following equations:

(a) $3x - 5 = 4 - 2x$

$5x - 5 = 4$
$5x = 9$
M1 for a single correct step

$x = \frac{9}{5}$ [2] A1

(b) $\frac{x}{3} - 1 = 7$

$\frac{x}{3} = 8$

or

$x - 3 = 21$

M1 for either step

$x = 24$ [2] A1

(c) $(2x - 1)(3x + 2) = 6x^2 - x + 2$

M1
$6x^2 + 4x - 3x - 2 = 6x^2 - x + 2$
$x - 2 = -x + 2$
$2x - 2 = 2$
$2x = 4$
M1 for cancelling x^2's and a sensible method which follows

$x = 2$ [3] A1

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13. Factorise fully:

(a) $40x^2 + 10$

B1 B1
Answer: $10(4x^2 + 1)$ [2]

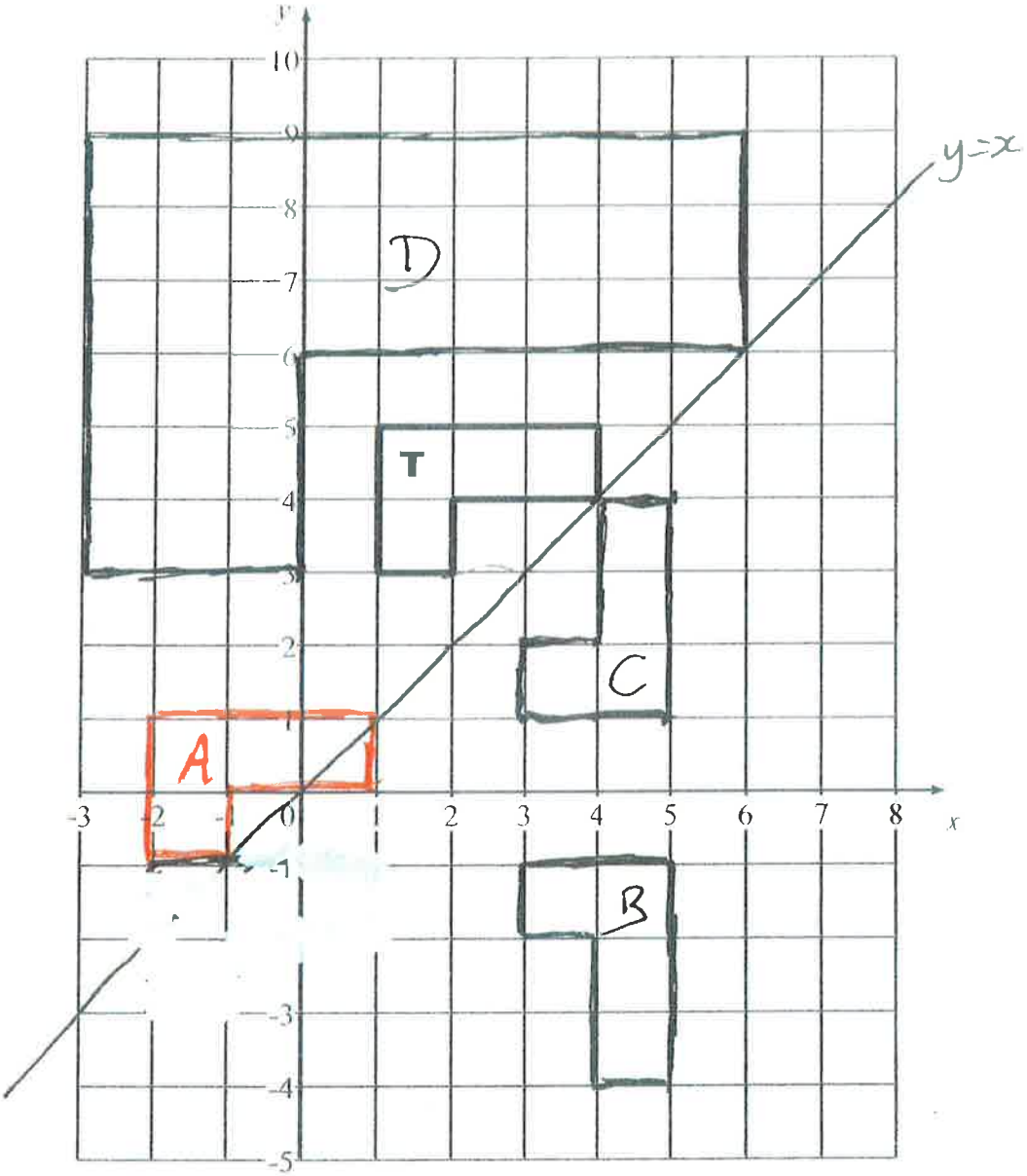
(b) $35abc - 45a^2c^3$

Special case: Partial correct factorisation scores B1 B0

B1 B1
Answer: $5ac(7b - 9ac^2)$ [2]

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14.



On the grid above draw the result of:

(a) translating shape T by the vector $\begin{pmatrix} -3 \\ -4 \end{pmatrix}$ labelling your answer A, [2]

B1 Horizontal correct
B1 Vertical correct

(b) rotating shape T 90° clockwise about (0,0) labelling your answer B, [2]

B1 Rotation
B1 Location

(c) reflecting shape T in the line $y = x$ labelling your answer C, [2]

B2

(d) enlarging shape T by a scale factor of 3 with centre of enlargement (3, 3) labelling your answer D. [2]

B1 Enlargement
B1 Location

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15. (a) Calculate the size of an exterior angle of a regular pentagon

$= \frac{360}{5}$ M1

Answer: 72 [2] A1

(b) Calculate how many sides a regular polygon has if its interior angle is equal to the exterior angle of an equilateral triangle.

$180 - \frac{360}{n} = 120$] M1 for LHS or RHS

$\frac{360}{n} = 60$] M1 for a sensible method.

$n = \frac{360}{60}$

Answer: 6 [3] A1

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16. The faces of a cube are painted so that any two faces which have an edge in common are painted different colours. Find the smallest number of colours needed to paint the cube.

Answer: 3 [2] M1A1

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17. A bag contains n balls which are red, green or blue. The probability of picking a red ball at random from the bag is $\frac{1}{6}$ and of picking a green ball is $\frac{3}{10}$. Calculate the smallest possible value of n.

Special case
Any multiple of
30 scores M1 A0
i.e. 60, 90, 120, ...

LCM (6, 10) M1

Answer: 30 [2] A1

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18. A *palindromic* number is one which reads the same forwards as backwards.

For example, 1551 is palindromic, as is 12321.

(a) Find the next palindromic number after 1551.

Answer: 1661 [1] B1

(b) Find the next palindromic number after 12321.

Answer: 12421 [1] B1

(c) Calculate the sum of all of the palindromic numbers between 100 and 200.

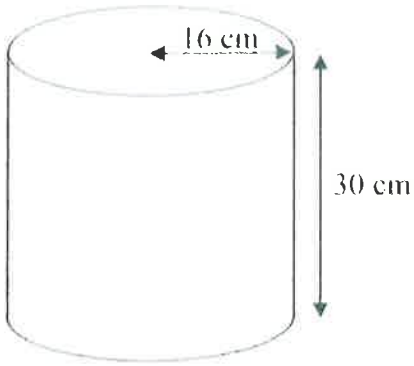
101
111
121
131
141
151
161
171
181
191

M1 for
seeing 4 or more
of these numbers

Answer: 1460 [2] A1

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19. A cylindrical paint tin has a radius of 16 cm and a height of 30 cm



(a) Calculate the circumference of the base, giving your answer to 1 decimal place.

$2 \times \pi \times 16$ M1

Answer: 100.5 cm [2] A1

(b) Calculate the volume of the cylinder, giving your answer to the nearest whole number.

$(\pi \times 16^2) \times 30$ M1

Answer: 24127 cm^3 [2] A1

(c) Calculate the number of litres of paint that this tin contains, giving your answer to 1 decimal place.

$24127\ cm^3 = 24127\ m\ell$

$= \frac{24127}{1000}\ \ell$ M1 for either (÷1000) or $1cm^3 = 1m\ell$

Answer: 24.1 litres [2] A1

(d) Each litre of paint covers 10 m^2. Calculate the area of wall this can of paint covers, giving your answer in m^2 and to the nearest whole number.

24.1×10 M1

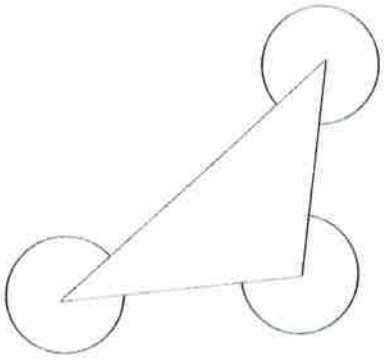
or $\frac{\text{"their (c)"} \times}{10}$

Answer: 241 m^2 [2] A1ft

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20. Calculate the sum of the angles shown in the diagrams:

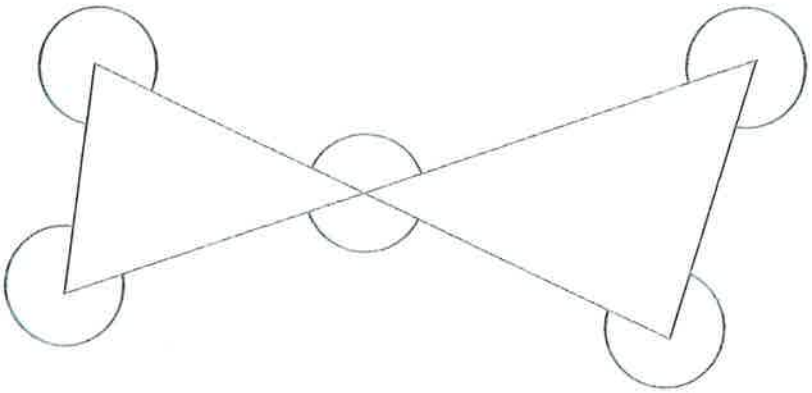
(a)



$3 \times 360 - 180$ M1

Answer: 900 [2] A1

(b)



$5 \times 360 - 180 - 180$ M1

Answer: 1440 [2] A1

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21. A new way to combine two numbers, written Λ, is defined as:

$$x \Lambda y = x^2 + y^2$$

For example, $3 \Lambda 5 = 34$ because $3^2 + 5^2 = 9 + 25 = 34$.

(a) Calculate:

(i) $2 \Lambda 3$,

$= 2^2 + 3^2 = 4 + 9$ M1

Answer: 13 [2] A1

(ii) $(-2) \Lambda (-3)$,

$= (-2)^2 + (-3)^2 = 4 + 9$ M1

Answer: 13 [2] A1

(iii) $3 \Lambda (4 \Lambda 2)$.

$= 3 \Lambda (4^2 + 2^2)$
$= 3 \Lambda (20)$ M1
$= 3^2 + 20^2$
$= 9 + 400$

Answer: 409 [2] A1

(b) Solve

(i) $3 \Delta x = 10$,

$3^2 + x^2 = 10$ M1
$9 + x^2 = 10$
$x^2 = 1$

$x =$ 1 [2] A1

allow $x = -1$ or $x = \pm 1$

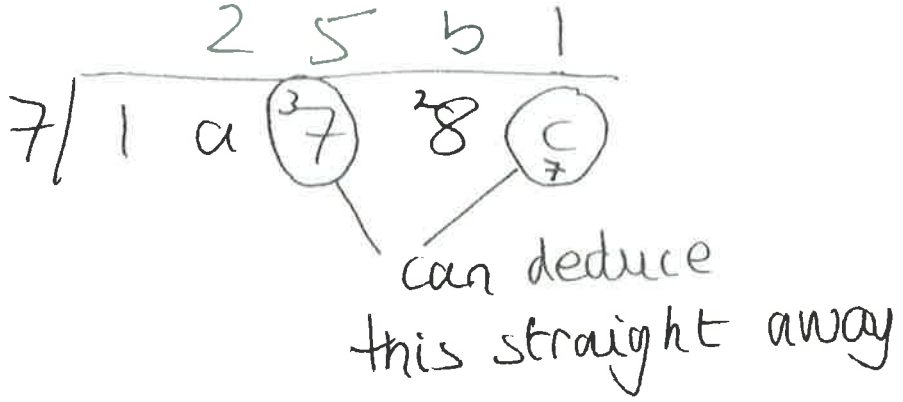
(ii) $x \Delta x = 242$.

$x^2 + x^2 = 242$
$2x^2 = 242$ M1
$x^2 = 121$
$x = \sqrt{121}$

$x =$ 11 [2] A1

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22. The 5 digit number $1a78c$ is divided by 7 and gives the 4 digit result $25b1$. Calculate the unknown digits a, b and c.

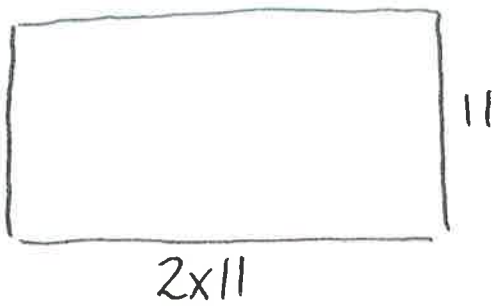


B1 B1 B1

$a =$ 7 $b =$ 4 $c =$ 7 [3]

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23. Work out the dimension of a rectangle with an area of 242 cm^2 if its length and breadth are both whole numbers of centimetres, one of which is an even number and the other a prime number.



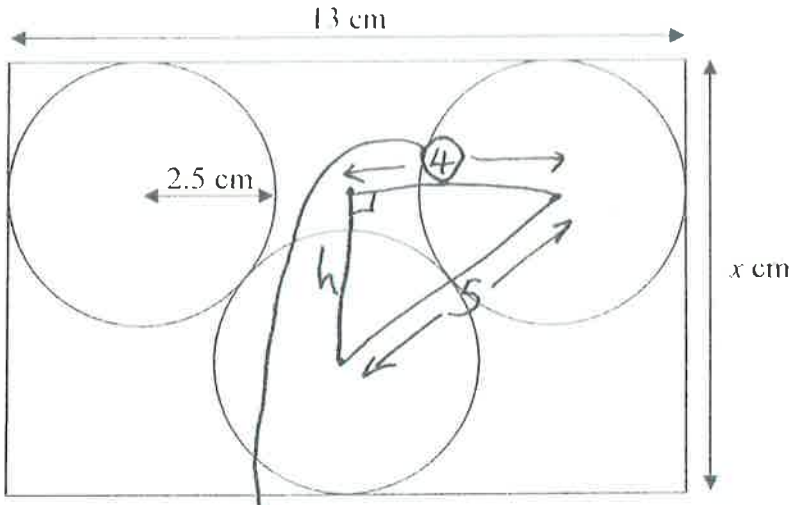
$242 = 2 \times 11 \times 11$ M1

B1 B1

Answer: 22 cm by 11 cm [3]

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24. The diagram below shows a rectangle containing three circles each with radius 2.5 cm. The rectangle has a width of 13 cm and a height of x cm.



Calculate the value of x

$13 - 4 \times 2.5 = 3$] M1 for either line.
$\frac{3}{2} + 2.5 = 4$]

$h^2 + 4^2 = 5^2$ M1

$\therefore h^2 = 5^2 - 4^2$

$= 9$

$h = \sqrt{9} = 3$

$x = 2.5 + 2.5 + 3$

$x =$ 8 cm [3] A1

THE END
IF YOU HAVE TIME THEN GO BACK AND CHECK YOUR ANSWERS

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