



# 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] *BI*

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

Answer: 1.1 [1] *BIft*

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

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

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.

$$3 \text{ or } 1.25 \times 12$$
 *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*

Page total:

9

3. Simplify the following:

(a)  $3ab - 4a + 6b - ab - 3a - 10b$

M1 for any correct

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

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

Answer:  $12x - 8$  [2]

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

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

Answer:  $5 - 10x$  [2]

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

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

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

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

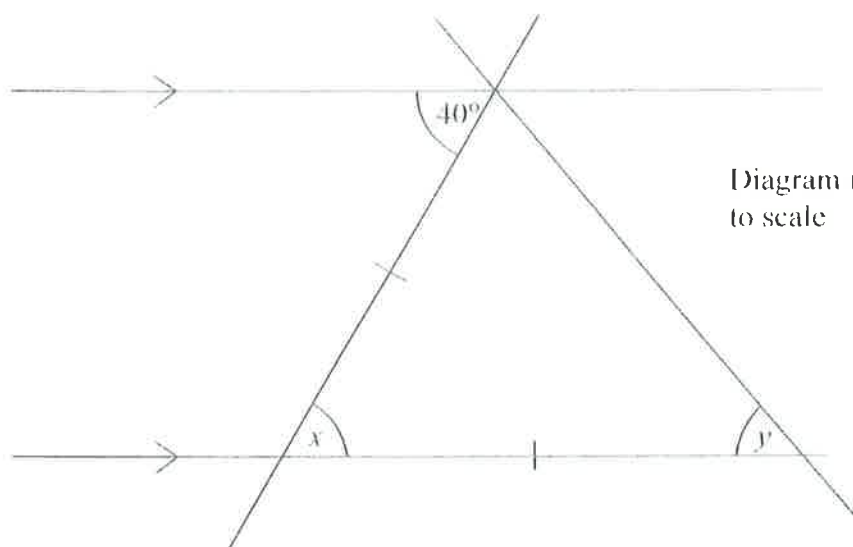


Diagram not drawn to scale

$$y = \frac{180 - 40}{2} \text{ m1}$$

allow their x

Answer:  $x = 40$  <sup>B1</sup>  $y = 70$  <sup>A1ft</sup> [3]

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,

$$S = \frac{D}{T} = \frac{100}{9.58} \text{ m1}$$

Answer: 10.4 m/s [2] <sup>A1</sup>

- (b) kilometres per hour,

$$S = \frac{100 \div 1000 \text{ m1}}{9.58 \div 3600 \text{ m1}} = \frac{0.1}{0.002611...}$$

Answer: 37.6 <sup>A1</sup> km/h [3]

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

$$\text{"(b)" } \times 0.621 \text{ m1}$$

Answer: 23.3 miles/h [2] <sup>A1</sup>

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<sup>th</sup> term in the sequence,

Answer: 23 [1] *B1*

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

$$n^{\text{th}} \text{ term} = \overbrace{4n-1}^{B1} \quad [2]$$

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

$$\begin{aligned} 4n-1 &= 3999 \\ 4n &= 4000 \\ n &= \frac{4000}{4} \end{aligned} \quad \left. \begin{array}{l} \\ \\ \end{array} \right\} \begin{array}{l} \text{M1 for} \\ \text{sensible method} \\ \text{using their (ii)} \end{array}$$

Answer: = 1000 [2] *A1*

Page total:

8

7.

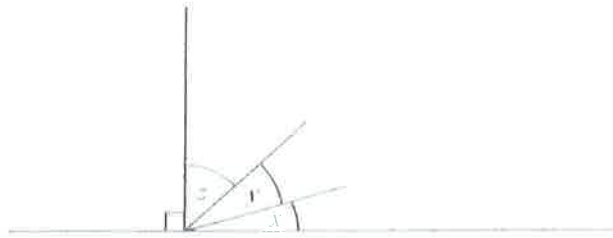


Diagram not drawn to scale

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  $z$ .

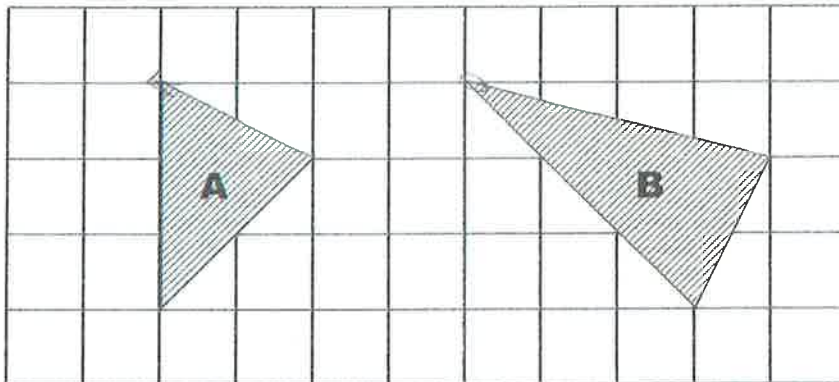
$$x + 2x + 3x = 90 \quad ] \text{ m1}$$

$$6x = 90$$

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

Answer:  $x = 15$  <sup>A1</sup>,  $y = 30$  <sup>A1</sup>,  $z = 45$  [4]

8.



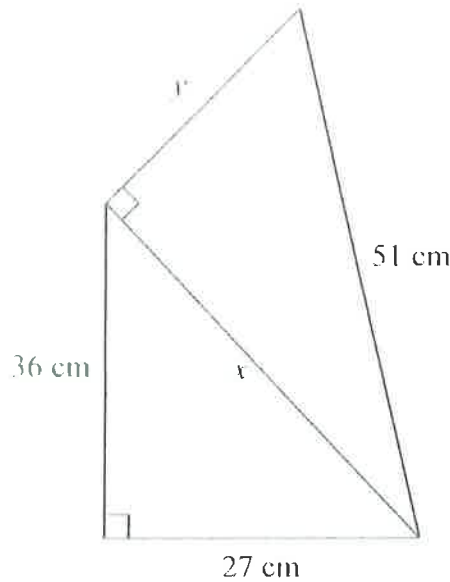
Given that the above grid is made of squares with sides of 1 cm, calculate the area of:

(a) triangle A,  $\frac{1}{2} \times 3 \times 2$  } m1 or attempt to use  $\frac{1}{2} \times b \times h$   
 or  $(2 \times 3) - \frac{1}{2} \times 2 \times 1 - \frac{1}{2} \times 2 \times 2$  Answer: 3 cm<sup>2</sup> [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<sup>2</sup> [2] A1

m1 for 12 - "something"

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



$$x^2 = 27^2 + 36^2 \quad ] \text{ m1}$$

$$= 729 + 1296$$

$$= 2025$$

$$x = \sqrt{2025}$$

$$y^2 + x^2 = 51^2 \quad ] \text{ m1}$$

$$y^2 = 51^2 - x^2 \quad \text{allow their } x$$

$$= 51^2 - 2025$$

$$= 2601 - 2025$$

$$= 576$$

$$y = \sqrt{576}$$

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

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  $y$ .

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

$$x+y = 12 \quad ] \text{ m1 either line}$$

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

or  $x = 8$ ,  $y = 4$

Page total:

10

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

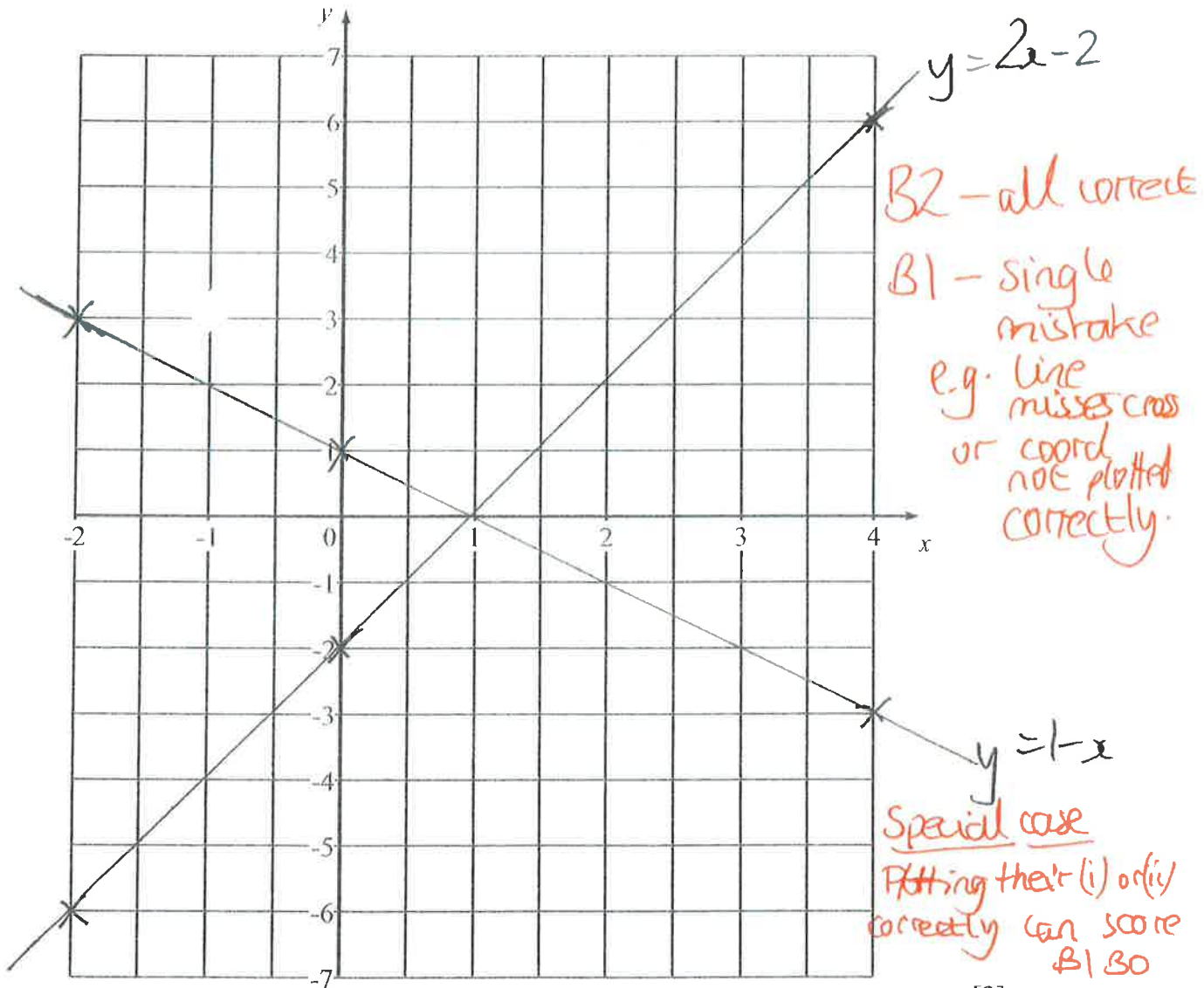
(ii)  $y = 1 - x$

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.



[2]

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

Answer: ( 1 , 0 ) [2]



12. Solve the following equations:

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

$$\begin{aligned} 5x - 5 &= 4 \\ 5x &= 9 \end{aligned} \left. \vphantom{\begin{aligned} 5x - 5 &= 4 \\ 5x &= 9 \end{aligned}} \right\} \text{M1 for a single correct step}$$

$x = \frac{9}{5}$  [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)  $(2x - 1)(3x + 2) = 6x^2 - x + 2$

$$\overbrace{6x^2 + 4x - 3x - 2}^{\text{M1}} = 6x^2 - x + 2$$

$$x - 2 = -x + 2$$

$$2x - 2 = 2$$

$$2x = 4$$

} M1 for cancelling  $x^2$ 's and a sensible method which follows

$x = 2$  [3] A1

13. Factorise fully:

(a)  $40x^2 + 10$

Answer:  $\overbrace{10}^{\text{B1}} \overbrace{(4x^2 + 1)}^{\text{B1}}$  [2]

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

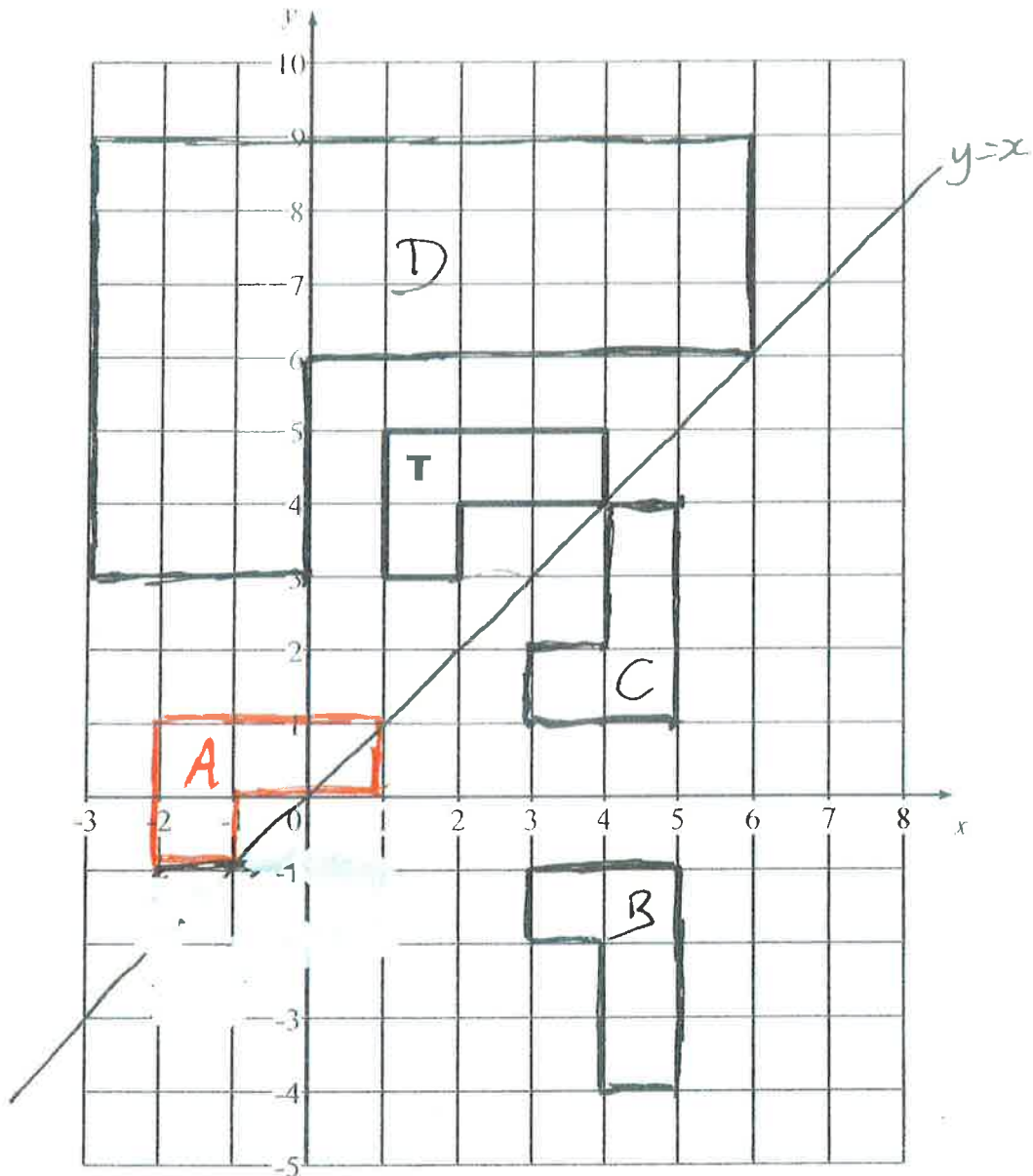
Answer:  $\overbrace{5ac}^{\text{B1}} \overbrace{(7b - 9ac^2)}^{\text{B1}}$  [2]

Special case:  
Partial correct  
Factorisation  
Scores B1 B0

Page total:

11

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, B1 Horizontal correct  
B1 Vertical correct
- (b) rotating shape T  $90^\circ$  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  
[2] B1 Location

Page total:

8

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

$$= \frac{360}{5} \text{ MI}$$

Answer: 72 [2] AI

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

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

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

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

Answer: 6 [3] AI

- 
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] MIAI

---

Page total:

7

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, ...

$$\text{LCM}(6, 10) \quad \text{M1}$$

Answer: 30 [2] A1

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

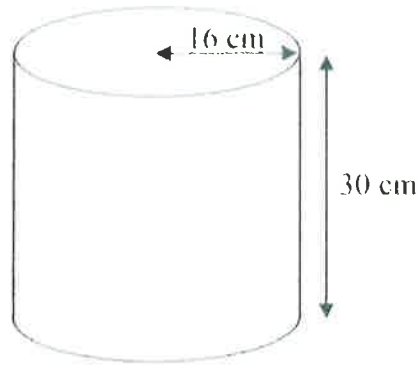
- (c) Calculate the sum of all of the palindromic numbers between 100 and 200.

101  
111  
121  
131  
141  
151  
161  
171  
181  
191

M1 for  
seeing 4 or more  
of these numbers

Answer: 1460 [2] A1

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.

$$2 \times \pi \times 16 \quad \text{ml}$$

Answer: 100.5 cm [2] *A1*

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

$$(\pi \times 16^2) \times 30 \quad \text{ml}$$

Answer: 24127 cm<sup>3</sup> [2] *A1*

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

$$\begin{aligned} 24127 \text{ cm}^3 &= 24127 \text{ ml} \\ &= \frac{24127}{1000} \text{ l} \quad \text{ml for either } (\div 1000) \\ &\quad \text{or } 1 \text{ cm}^3 = 1 \text{ ml} \end{aligned}$$

Answer: 24.1 litres [2] *A1*

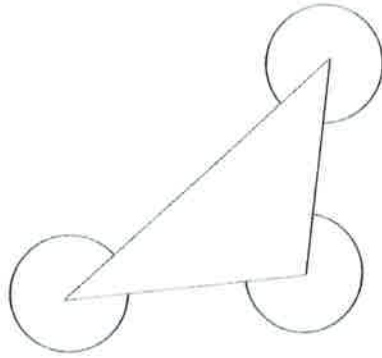
- (d) Each litre of paint covers 10 m<sup>2</sup>. Calculate the area of wall this can of paint covers, giving your answer in m<sup>2</sup> and to the nearest whole number.

$$\begin{aligned} &24.1 \times 10 \quad \text{ml} \\ \text{or } &\frac{24127}{10} \times \text{"their (c)"} \end{aligned}$$

Answer: 241 m<sup>2</sup> [2] *A1 ft*

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

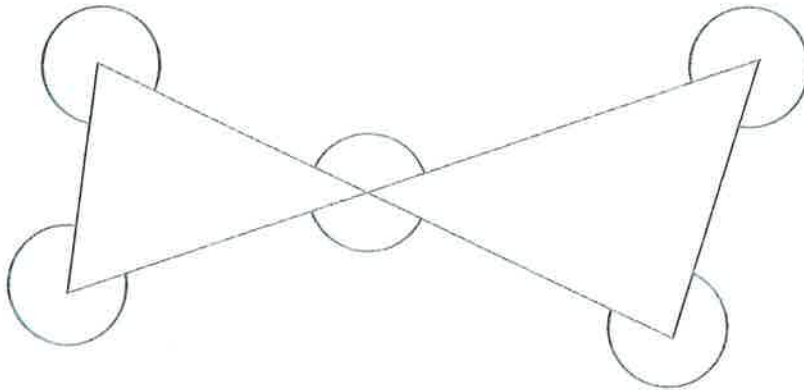
(a)



$$3 \times 360 - 180 \text{ MI}$$

Answer: 900 [2] A1

(b)



$$5 \times 360 - 180 - 180 \text{ MI}$$

Answer: 1440 [2] A1

21. A new way to combine two numbers, written  $\Delta$ , is defined as:

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

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

(a) Calculate:

(i)  $2 \Delta 3$ ,

$$= 2^2 + 3^2 = 4 + 9 \text{ M1}$$

Answer: 13 [2] A1

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

$$= (-2)^2 + (-3)^2 = 4 + 9 \text{ M1}$$

Answer: 13 [2] A1

(iii)  $3 \Delta (4 \Delta 2)$ ,

$$= 3 \Delta (4^2 + 2^2)$$

$$= 3 \Delta (20) \text{ M1}$$

$$= 3^2 + 20^2$$

$$= 9 + 400$$

Answer: 409 [2] A1

(b) Solve

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

$$3^2 + x^2 = 10 \text{ M1}$$

$$9 + x^2 = 10$$

$$x^2 = 1$$

$x = \underline{1}$  [2] A1

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

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

$$\left. \begin{aligned} x^2 + x^2 &= 242 \\ 2x^2 &= 242 \end{aligned} \right\} \text{M1}$$

$$x^2 = 121$$

$$x = \sqrt{121}$$

$x = \underline{11}$  [2] A1

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

$$\begin{array}{r}
 25b1 \\
 \hline
 7 \overline{) 1a78c}
 \end{array}$$

3
2
7

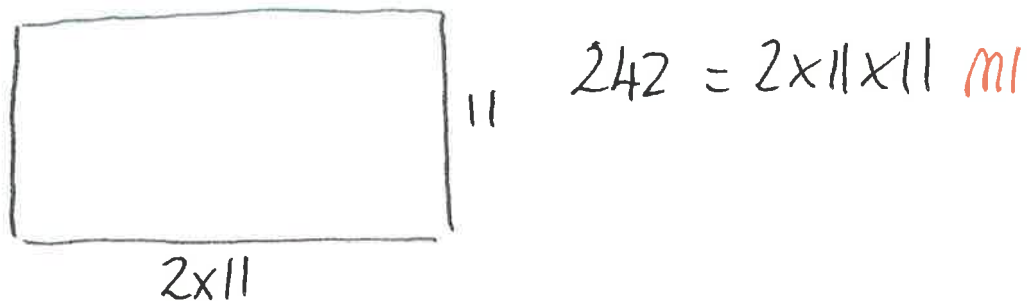
7
8
c

7
7

can deduce this straight away

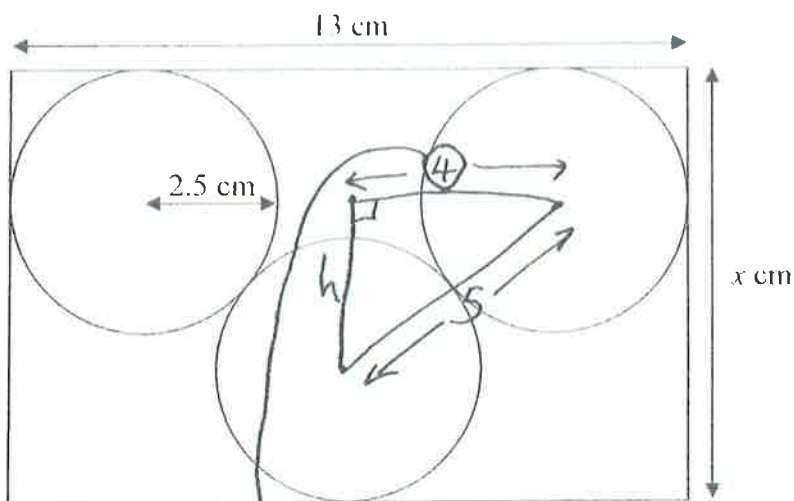
BI      BI      BI  
 $a = \underline{7}$        $b = \underline{4}$        $c = \underline{7}$  [3]

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





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  $x$

$$13 - 4 \times 2.5 = 3 \quad ] \text{ m1 for}$$

$$\frac{3}{2} + 2.5 = 4 \quad ] \text{ either line.}$$

$$h^2 + 4^2 = 5^2 \quad \text{m1}$$

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

$$= 9$$

$$h = \sqrt{9} = 3$$

$$x = 2.5 + 2.5 + 3$$

$$x = \underline{8} \text{ cm [3]} \quad \text{A1}$$

THE END

IF YOU HAVE TIME THEN GO BACK AND CHECK YOUR ANSWERS

Page total:

3