1. Use your calculator to work out the value of

$$\frac{23 + 1.6^2}{\sqrt{43 - 2.5^3}}$$

(a) Write down the first 10 digits shown on your calculator.

Answer: 4.885216166 A1 [1]

(b) Write your answer to (a) rounded to 3 decimal places.

Answer: 4.885 A1 [1]

(c) Write your answer to (a) rounded to 2 significant figures

Answer: 4.9 A1 [1]

Page Total 3

2. (a) A car was bought on January 1st 2010 for £16,000. By January 1st 2011, its value had fallen by 20%.

(i) Calculate the value of the car on January 1st 2011.

0.8×16000

A1

Answer: £ 12 800 [1]

(ii) In each subsequent year, the value of the car fell by 15%. Calculate its value on January 1st 2013.

12800×0.85^2

M1

A1

Answer: £ 9248 [2]

(b) A rare postage stamp was bought for £300 in 1980. Its value at that time was just 12% of its current value. Calculate the current value of the stamp.

$0.12x = 300$ M1

$x = \frac{300}{0.12}$

A1

Answer: £ 2500 [2]

Page Total 5

3. Below is a sequence of numbers:

5, 8, 11, 14, ...

(a) Calculate the 10^{th} term.

Answer: 32 (A1) [1]

(b) Calculate the 75^{th} term.

(M1) $3n + 2$ (n^{th} term)

$3(75) + 2$

Answer: 227 (A1) [2]

(c) David saves 5p on Sunday 1st December, 8p on Monday 2nd December, 11p on Tuesday 3rd December, and so on according to the sequence above. Calculate the day and date on which David will save 77p.

$3n + 2 = 77$ (M1)

$n = 25$

Day: Wednesday (A1)

Date: 25th Dec. (A1) [3]

Page Total 6

4. a) Adam and Brian share £544 in the ratio 7 : 9. How much does Brian receive?

$\frac{9}{16} \times 544$ (M1)

Answer: £ 306 (A1) [2]

b) Last month a local shop found that its total revenue from selling calculators and pens could be expressed in the ratio $c : p$. That total revenue was £150, with the greater portion coming from calculator sales. In terms of c and p, what is the difference between the revenues for calculators and pens?

$\frac{c}{c+p} \cdot 150 - \frac{p}{c+p} \cdot 150 = \left(\frac{c-p}{c+p}\right) \times 150$

(M1) for sensible attempt at finding appropriate fractions of the total

Answer: $\frac{150(c-p)}{c+p}$ (A1) ← or equivalent [2]

c) Given that $a : b = 5 : 32$ and $b : c = 24 : 31$, find the ratio $a : b : c$, giving your answer where a, b and c are whole numbers.

$a : b = 5 : 32 = \frac{5}{32} : 1$

$b : c = 24 : 31 = 1 : \frac{31}{24}$

(M1) sensible attempt at relating ratios of all three

$\therefore a : b : c = \frac{5}{32} : 1 : \frac{31}{24} = 15 : 96 : 124$

(A1)

Answer: 15 : 96 : 124 (A1) [3]

Page Total 7

5. Simplify the following:

(a) $8ab - 11a + 14b + 12a - 5ba - b$

[Award A1 if exactly two terms correct]

Answer: $3ab + a + 13b$ A2 [2]

(b) $7(2 - 4x)$

Answer: $14 - 28x$ A1 [1]

(c) $6t - 4(2t - 5) + 8$

$6t - 8t + 20 + 8$ A1

Answer: $28 - 2t$ A1 [2]

(d) $(y - 3)(2y + 9)$

$2y^2 + 9y - 6y - 27$ M1 at least three terms correct

Answer: $2y^2 + 3y - 27$ A1 [2]

(e) $\dfrac{36a^3b^2}{24a^4bc}$

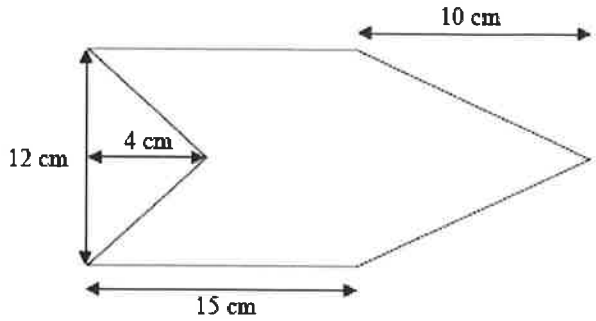
Answer: $\dfrac{3b}{2ac}$ [2]

A1 correct $\frac{3}{2}$

A1 correct $\frac{b}{ac}$

Page Total 9

6. The diagram, which is not drawn to scale, shows a shape with one line of symmetry.



Calculate the area of this shape.

$(12 \times 15) - \left(\frac{1}{2} \times 12 \times 4\right) + \left(\frac{1}{2} \times 12 \times 10\right)$ (M1) for a correct splitting of the figure

(M1) for at least two correct (and appropriate) areas calculated

Answer: 216 (A1) cm^2 [3]

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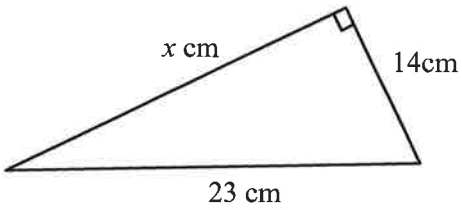
7. Calculate the length of the side marked x, giving your answer correct to 2 decimal places.



$23^2 = x^2 + 14^2$

$x^2 = 23^2 - 14^2 = 333$ } (M1)

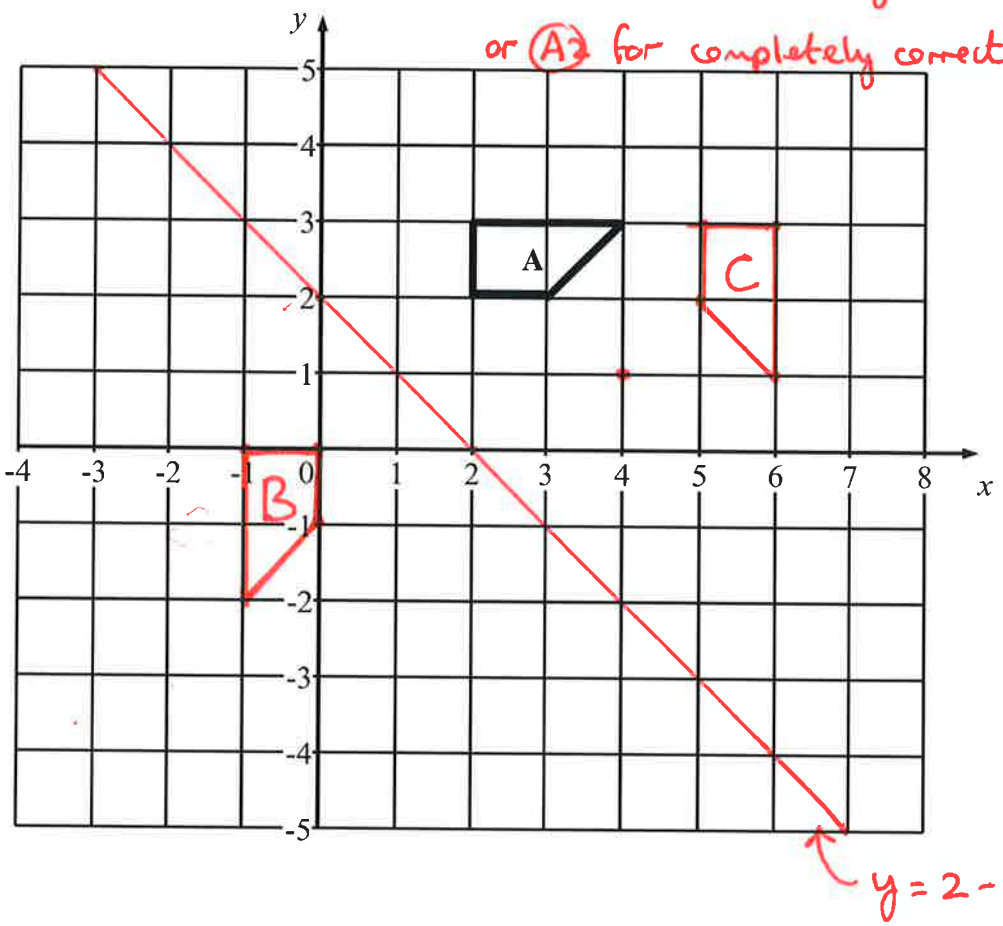
$x = \sqrt{333}$

Answer: 18.25 (A1) cm [2]

8. (a) On the axes below, draw the line given by the equation $y = 2 - x$.

(A1) Line with grad. of -1 but incorrect y-int. [2]

or (A2) for completely correct.



(b) Reflect shape **A** in the line $y = 2 - x$ and label that reflection B.

(A2) completely correct [2]

or (A1) for correct shape and orientation but in incorrect location.

(c) Rotate shape **A** through 90° in the clockwise direction about the point (4,1) and label the resulting shape C.

(A2) completely correct [2]

or (A1) for correct shape and orientation but in incorrect location.

allow full FT marks if at least (A1) given in part (a).

9. Solve the following equations for x:

(a) $4(x + 5) = 2x + 10$

$4x + 20 = 2x + 10$ M1

$2x = -10$

Answer: $x =$ -5 A1 [2]

(b) $2x(3x + 7) - 12 = x(6x + 10)$

$6x^2 + 14x - 12 = 6x^2 + 10x$ M1

$14x - 12 = 10x$ M1

$4x = 12$

Answer: $x =$ 3 A1 [3]

(c) $8 - \frac{5x}{3} = 2$

$6 = \frac{5x}{3}$

$5x = 18$ } either equation M1

Answer: $x =$ $\frac{18}{5}$ A1 o.e. [2]

(d) $\frac{16}{2x-1} + 7 = 11$

$\frac{16}{2x-1} = 4 \Rightarrow 16 = 4(2x - 1)$ M1

$\Rightarrow 4 = 2x - 1$ M1

$\Rightarrow 2x = 5$

Answer: $x =$ $\frac{5}{2}$ A1 [3]

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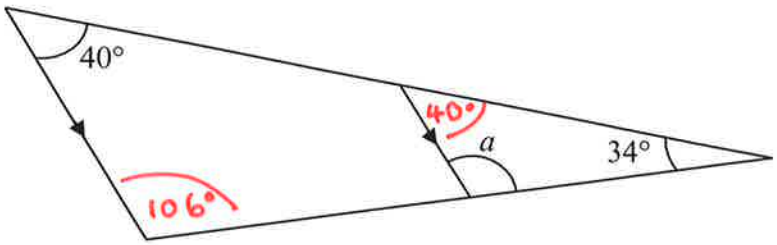
10. Find the values of a, b and c in the diagrams below.

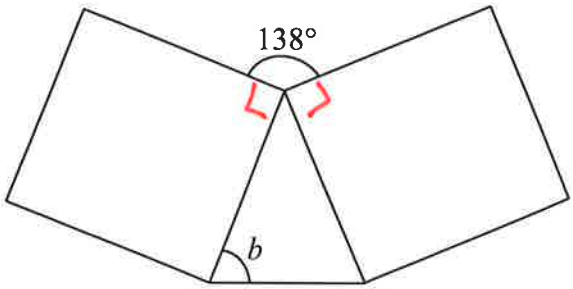
(a)



M1 for identifying either 40° or 106° in diagram

Answer a = 106 A1 ° [2]

(b) The diagram below shows two identical squares meeting at one of their corners.

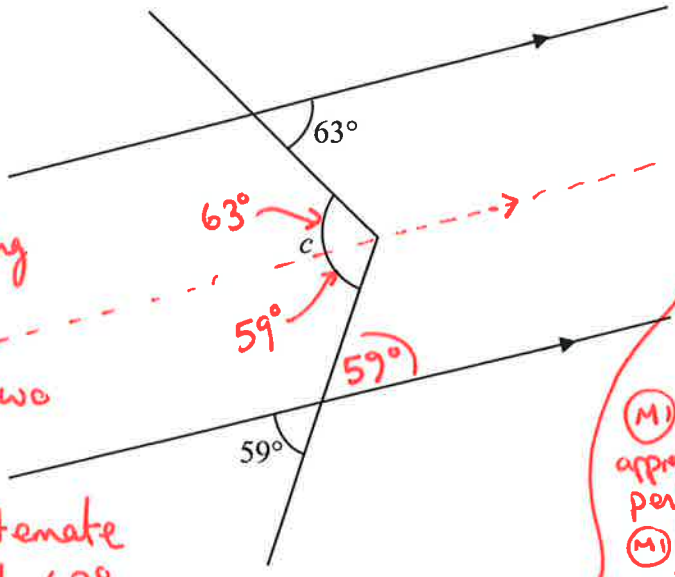


360 − 138 − 90 − 90 = 42° } M1

$\frac{180 - 42}{2}$

Answer b = 69 A1 ° [2]

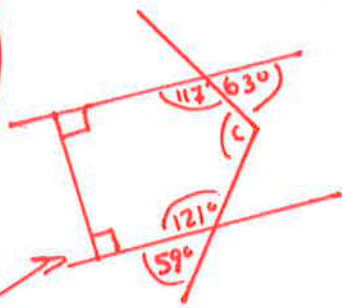
(c)



M1 for considering a third line parallel to the original two

M1 for using alternate angles to find 63° and 59°

or, for example,



M1 for appropriate pentagon

M1 for identifying 121° and 117°

$c = 540 - 121 - 117 - 180$

A1

Answer c = 122 ° [3]

Page Total 7

11. Factorise the following expression fully:

$$9c + 3c^3d - 12c^2d$$

[A0 for $3(3c + c^3d - 4c^2d)$]

Answer: $3c(3 + c^2d - 4cd)$ [2]

A1 A1

---

12. While taking part in a 10 km race, a runner completed the first 6500 m in 26 minutes.

(a) Calculate the average speed of the runner, in km per hour, over this section of the course.

$S = \frac{D}{T} = \frac{6.5}{26/60}$

M1 (including appropriate conversion of units)

Answer: 15 A1 km/hr [2]

The runner's target was to complete the entire race is under 40 minutes. For the remaining 3500 m his average speed was 16 km per hour.

(b) **Show your working and conclusion clearly**, determine whether the runner was successful in achieving his target.

$T = \frac{D}{S} = \frac{3.5}{16} = \frac{7}{32}$ hours M1

i.e. $\frac{7}{32} \times 60 = 13.125$ minutes M1

$26 + 13.125 = 39.125$ minutes

$39.125 < 40$ } A1

Circle one: Successful Not successful [4]

A1

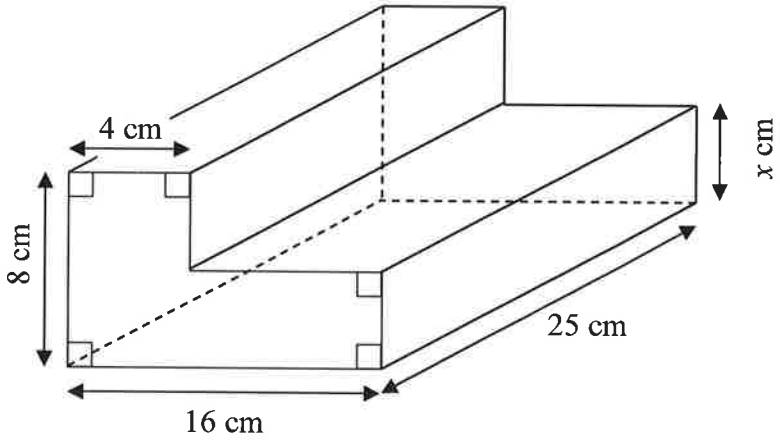
only if follows from clear (sensible) working

Page Total 8

13. The volume of the prism below is 2450 cm^3.

Calculate the length marked x in the diagram.

Diagram **NOT** drawn to scale



Area of cross-section = $\frac{2450}{25} = 98\ cm^2$ (A1) (M1) correct method to find cross-sec. area

$\therefore\ 32 + 12x = 98$ (M1)

$12x = 66$

$x = \frac{66}{12}$

Answer: 5.5 (A1) cm [4]

Page Total 4

14. 1 gallon = 3.785 litres
1 cubic inch = 0.0164 litres

Convert 2.5 gallons to cubic inches, giving your answer to 2 decimal places.

(M1) 2·5 gallons = (2·5 × 3·785 =) 9·4625 litres

(M1) 9·4625 litres = (9·4625 / 0·0164 =) 576·9817... cubic inches

Answer: 576.98 (A1) cubic inches [3]

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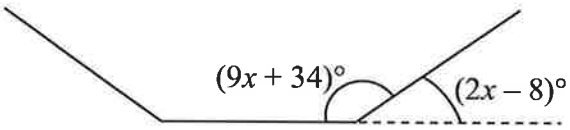
15. The diagram below, which is not drawn to scale, shows three sides of a regular polygon with n sides. Work out the value of n.



$9x + 34 + 2x - 8 = 180$ (M1)

$11x + 26 = 180$

$11x = 154$

$x = 14$

So $2x - 8 = 2(14) - 8$

$= 20$ (ext. angle) (A1)

No. sides $= \frac{360}{20}$

Answer: 18 (A1) [3]

16. The mean of 8 numbers is m. When one of these numbers is discarded, the mean of the remaining 7 numbers falls to $m - 4$. In terms of m, what was the value of the discarded number?

$x_1 + x_2 + \ldots + x_8 = 8m$

$x_1 + x_2 + \ldots + x_7 = 7(m-4)$

(M1) for attempt to find the two relevant sums

Discarded value is $8m - 7(m-4)$

$8m - 7m + 28$

(M1) for showing understanding that the required value is the difference between the two sums

Answer: $m + 28$ (A1) [3]

Page Total 3

17. A palindromic number is a number that remains the same when its digits are reversed. Examples are 27572 and 5826285.

If S is the set of all whole numbers greater than 100 and less than 301, and one whole number is randomly selected from S:

(a) what is the probability that the selected number is palindromic?

Number of elements in S = 200

Number of palindromic numbers = 20

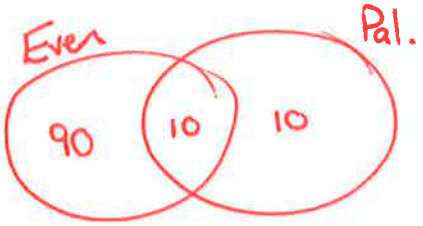
(M1) for either of these values

101
111
⋮
191

202
212
⋮
292

Answer: $\frac{20}{200}$ or $\frac{1}{10}$ (A1) [2]

(b) what is the probability that the selected number is palindromic or even?



90 + 10 + 10

$\frac{110}{200}$

(M1) for clear and sensible attempt at appropriate counting and understanding that Even ∩ Pal ≠ ∅

Answer: $\frac{11}{20}$ (A1) [2]

(c) If this process of selection was repeated 500 times, how many times would you expect to select a palindromic number?

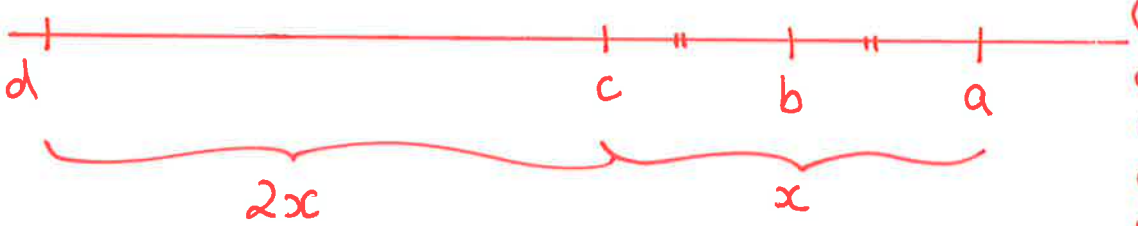
$\frac{1}{10} \times 500$

Answer: 50 (A1) [1]

18. Given that a, b, c and d are points on the number line such that

- $a > b$
- b is halfway between a and c
- the distance between a and d is three times the distance between a and c
- $d < c$,

calculate the value of $\frac{c-b}{b-d}$.



M1 for diagram showing correct relative positions

$$\frac{c-b}{b-d} = \frac{\frac{-x}{2}}{\frac{5x}{2}} = \frac{-1}{5}$$

M1 for correct quotient following from their diagram

Answer: $\frac{-1}{5}$ A1 [3]

19. Jack spends half of his money and gives one fifth of what remains to his friend. Jack is then left with £24. How much money did he start with?

x

$\frac{4}{5} \times \frac{1}{2} \times x = 24$ (M1)

$\frac{2}{5} x = 24$

Answer: £ 60 (A1) [2]

---

20. The operation $*$ is defined as

$$a * b = \begin{cases} a - b & \text{if } a \geq b \\ 0 & \text{if } a < b \end{cases}$$

(a) Evaluate $\frac{9}{16} * \frac{3}{8} + \frac{4}{7} * \frac{13}{21} + \frac{4}{5} * \frac{3}{4}$.

(M1) for clear attempts compare sizes of fractions

$\frac{9}{16} * \frac{6}{16} + \frac{12}{21} * \frac{13}{21} + \frac{16}{20} * \frac{15}{20}$

$= \frac{3}{16} + 0 + \frac{1}{20}$

Answer: $\frac{19}{80}$ (A1) [2]

(b) Given that $t < 0$, simplify $3t * 8t + 10t * 7t - 2t * 3t$.

$-5t + 0 - (-t)$

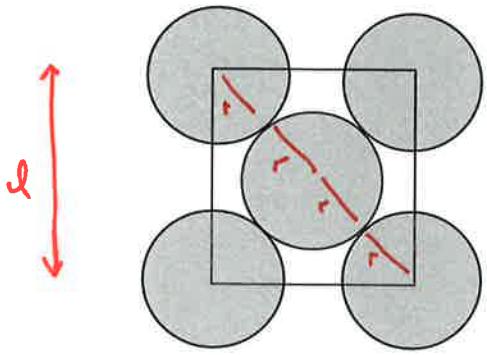
(M1) for showing understanding of implication of t being negative

Answer: $-4t$ (A1) [2]

Page Total 6

21. The diagram below shows five identical circles, each with radius r cm. A square is formed with its vertices (corners) at the centres of the four outer circles and the inner circle just touches each of the four outer circles. The **unshaded** area inside the square is $(72 - 18\pi)$ cm^2.

Showing clear working, calculate the radius r of each circle.



$l^2 + l^2 = (4r)^2$

$2l^2 = 16r^2$ } M1

$l^2 = 8r^2$

$\therefore$ unshaded area $= 8r^2 - 2\pi r^2$ M1

$= r^2(8 - 2\pi) = 72 - 18\pi$

so $r^2 = 9$ M1

$r = 3$

A1

Answer: 3 cm [4]

Page Total 4

22. When written out in full, how many digits are there in the number $16^{250} \times 25^{500}$?

$16^{250} \times 25^{500}$

$= (2^4)^{250} \times (5^2)^{500}$ (M1) for attempt to express in terms of powers of 2 and 5

$= 2^{1000} \times 5^{1000}$

$= 10^{1000}$ (M1) for arriving at a power of 10

Answer: 1001 (A1) [3]

END OF THE EXAMINATION
GO BACK AND CHECK YOUR ANSWERS