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中正中學

CHUNG CHENG HIGH SCHOOL (MAIN)

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Parent's Signature

**PRELIMINARY EXAMINATION 2022
SECONDARY 4**

MATHEMATICS

4048/01

Paper 1

Wednesday 14 September 2022

2 hours

Candidates answer on the Question Paper.

Solutions

Mathematical Formulae

Compound interest

$$\text{Total amount} = P \left(1 + \frac{r}{100} \right)^n$$

Mensuration

$$\text{Curved surface area of a cone} = \pi r l$$

$$\text{Surface area of a sphere} = 4 \pi r^2$$

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

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

$$\text{Area of triangle } ABC = \frac{1}{2} a b \sin C$$

$$\text{Arc length} = r \theta, \text{ where } \theta \text{ is in radians}$$

$$\text{Sector area} = \frac{1}{2} r^2 \theta, \text{ where } \theta \text{ is in radians}$$

Trigonometry

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

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

Statistics

$$\text{Mean} = \frac{\sum f x}{\sum f}$$

$$\text{Standard deviation} = \sqrt{\frac{\sum f x^2}{\sum f} - \left(\frac{\sum f x}{\sum f} \right)^2}$$

Answer **all** the questions.

1	<p>Evaluate $\frac{9.45 \times \sqrt{36.03}}{\sqrt[3]{-26.9}}$, correct to 3 significant figures.</p> $\frac{9.45 \times \sqrt{36.03}}{\sqrt[3]{-26.9}} = -18.931\dots$ $= -18.9 \text{ (3sf)}$ <p style="text-align: right;"><i>Answer</i> [1]</p>
2	<p>Simplify $\frac{16a - 12b}{32a^2 - 18b^2}$.</p> $\frac{16a - 12b}{32a^2 - 18b^2} = \frac{4(4a - 3b)}{2(16a^2 - 9b^2)}$ $= \frac{4(4a - 3b)}{2(4a + 3b)(4a - 3b)}$ $= \frac{2}{4a + 3b}$ <p style="text-align: right;"><i>Answer</i> [2]</p>
3	<p>Ken drives at an average speed of 85 km/h on the expressway for the first stage of his journey. After exiting the expressway, he continues to drive at an average speed of 60 km/h on the city roads for the second stage of his journey.</p> <p>If the average speed of his entire journey is 75 km/h, find the ratio of the time taken for the first stage of his journey to the time taken for the second stage of his journey.</p> <p>Let time taken for first and second part of journey be x and y hours respectively.</p> <p>total distance travelled = $(85x + 60y)$ km, total time = $(x + y)$ hours</p> $\frac{85x + 60y}{x + y} = 75$ $85x + 60y = 75(x + y)$ $85x + 60y = 75x + 75y$ $10x = 15y$ $\frac{x}{y} = \frac{3}{2}$ <p>Ratio = 3: 2</p> <p style="text-align: right;"><i>Answer</i> [2]</p>
4	<p>Factorise completely $2x^2 + 3x - 12y - 8xy$.</p> $2x^2 + 3x - 12y - 8xy = x(2x + 3) - 4y(3 + 2x)$ $= (x - 4y)(2x + 3)$ <p style="text-align: right;"><i>Answer</i> [2]</p>

5	The mass of an electron is 9.11×10^{-28} g.
(a)	Write in standard form, the mass of an electron in kg.
	$9.11 \times 10^{-28} \text{ g} = 9.11 \times 10^{-28} \div 1000 \text{ kg}$ $= 9.11 \times 10^{-31} \text{ kg}$ <p style="text-align: right;"><i>Answer</i> kg [1]</p>
	The mass of a hydrogen atom is 1.66×10^{-27} kg.
(b)	Find the number of electrons that will have the same mass as 1 hydrogen atom, giving your answer to the nearest whole number.
	$\text{No of electrons} = \frac{1.66 \times 10^{-27}}{9.11 \times 10^{-31}}$ $= 1822.1734$ $= 1822 \text{ (nearest whole number)}$ <p style="text-align: right;"><i>Answer</i> [1]</p>
6	<p>Teacher: The length of a certain rectangle is decreased by 20%, whereas its breadth is increased by 20%.</p> <p>Student: The area of the rectangle will remain the same as the percentage decrease of the length is equal to the percentage increase of the breadth. Therefore, there is a 0% change in the area.</p> <p>Is the student's statement correct? Support your answer with mathematical calculations.</p> <p>Let the original length and breadth of the rectangle be x and y respectively. New length = $0.8x$, New breadth = $1.2y$</p> <p>Original Area of rectangle = xy New Area of rectangle = $(0.8x)(1.2y)$ $= 0.96xy$</p> <p>The student's statement is incorrect. There is a change in the area and the new area of rectangle is 0.96 of the original area.</p> <p style="text-align: right;">.....[2]</p>
7	<p>Find the range of values of x which satisfy the inequalities</p> $\frac{x-2}{9} \leq \frac{2x+5}{15} \leq \frac{x+4}{6}$ $\frac{x-2}{9} \leq \frac{2x+5}{15} \quad \text{and} \quad \frac{2x+5}{15} \leq \frac{x+4}{6}$ $15(x-2) \leq 9(2x+5) \quad 6(2x+5) \leq 15(x+4)$ $15x-30 \leq 18x+45 \quad 12x+30 \leq 15x+60$ $-3x \leq 75 \quad -3x \leq 30$ $x \geq -25 \quad x \geq -10$ <p style="text-align: center;">$\therefore x \geq -10$</p> <p style="text-align: right;"><i>Answer</i> [3]</p>

8	<p>Solve the equation $x(x+1) = 6$.</p> $x(x+1) = 6$ $x^2 + x = 6$ $x^2 + x - 6 = 0$ $(x+3)(x-2) = 0$ $x = -3 \text{ or } x = 2$ <p style="text-align: right;"><i>Answer</i> $x = \dots\dots\dots$ or $\dots\dots\dots$ [2]</p>
9	<p>Given that $x = \sqrt{\frac{2a-3y}{b+2y}}$,</p>
(a)	<p>calculate x when $a = 5$, $b = -2$ and $y = 3$,</p>
	$x = \sqrt{\frac{2(5)-3(3)}{-2+2(3)}}$ $= \frac{1}{2}$ <p style="text-align: right;"><i>Answer</i> $x = \dots\dots\dots$ [1]</p>
(b)	<p>express y in terms of a, b and x.</p>
	$x = \sqrt{\frac{2a-3y}{b+2y}}$ $x^2 = \frac{2a-3y}{b+2y}$ $x^2(b+2y) = 2a-3y$ $bx^2 + 2x^2y = 2a-3y$ $3y + 2x^2y = 2a - bx^2$ $y(3+2x^2) = 2a - bx^2$ $y = \frac{2a - bx^2}{3+2x^2}$ <p style="text-align: right;"><i>Answer</i> $y = \dots\dots\dots$ [3]</p>

- 10** A company manufactures two sizes of the same brand of shampoo. The prices of the two sizes are indicated in the table below.

Shampoo Size (ml)	Price (\$)
330	7.95
620	14.35

Which shampoo size is a better value for money? Explain your answer clearly.

Answer

$$\begin{aligned} \text{Price/ml for 330ml shampoo} &= \frac{\$7.95}{330} \\ &= \$0.02409\dots \end{aligned}$$

$$\begin{aligned} \text{Price/ml for 620ml shampoo} &= \frac{\$14.35}{620} \\ &= \$0.02314\dots \end{aligned}$$

[Can also find amount of shampoo per dollar (**41.509...** vs **43.205...**), etc for comparison]

Since the price/ml for the 620ml shampoo is lower than the 330ml shampoo

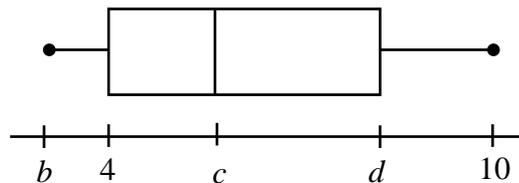
(\$0.02314... < \$0.02409...), the 620 ml shampoo is a better value for money.

[2]

- 11** The numbers of hours spent daily online by 10 students are recorded in ascending order.

3, 4, 4, 4, 5, 6, 7, 8, 9, a

The data is presented as a box and whisker plot shown below.



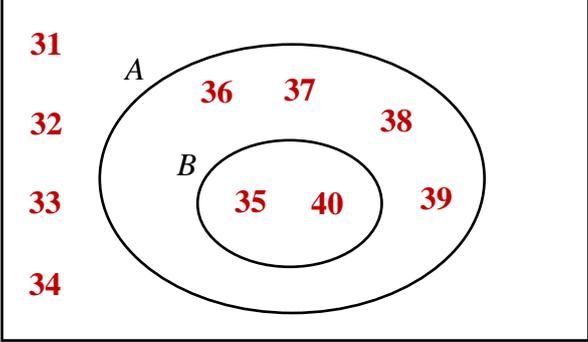
Find the values of a , b , c and d .

$$a = 10, b = 3$$

$$c = \text{median} = \frac{5+6}{2} = 5.5$$

$$d = \text{Upper quartile} = 8$$

Answer $a = \dots 10$, $b = \dots 3$, $c = \dots 5.5$, $d = \dots 8$ [2]

12	$\xi = \{\text{integers } x: 30 < x \leq 40\}$ $A = \{x : \frac{1}{2}x - 7 > 10\}$ $B = \{x : x \text{ is a multiple of } 5\}$	$\xi = \{31, 32, 33, 34, 35, 36, 37, 38, 39, 40\}$ $\frac{1}{2}x > 17 \Rightarrow x > 34 \quad A = \{35, 36, 37, 38, 39, 40\}$ $B = \{35, 40\}$
	<p>(a) Draw a Venn Diagram to illustrate this information.</p> <p>Answer ξ</p>  <p style="text-align: right;">[2]</p>	
	<p>(b) List the elements in $A \cup B$.</p> <p style="text-align: right;">Answer $\{31, 32, 33, 34, 35, 40\}$ [1]</p>	
	<p>(c) Given also that $C = \{\text{prime numbers}\}$ and $D = \{\text{multiples of } 20\}$, complete the following statements. $C = \{31, 37\}, D = \{40\}$</p>	
	(i)	Sets B and C are disjoint sets because $B \cap C = \phi$ [1]
	(ii)	Set D is a subset of B because $B \cap D = D$ [1]

13	A map is drawn to scale of 4 cm: 1 km.
	<p>(a) Write this scale in the form 1 : n.</p> <p><u>Map scale</u> = 4 cm: 1 km = 4 cm: 100 000 cm = 1 cm : 25 000 cm = 1 : 25 000</p> <p style="text-align: right;"><i>Answer</i> [1]</p>
	<p>(b) A park on the map has an area of 8 cm². Find the actual area of the park.</p> <p><u>Area scale</u> = (4 cm)²: 1 km² = 16 cm²: 1 km² = 8 cm²: 0.5 km²</p> <p>Actual area = 0.5 km²</p> <p style="text-align: right;"><i>Answer</i> km² [2]</p>
14	<p>(a) Express 550 as the product of its prime factors.</p> <p>550 = 2 × 5² × 11</p> <p style="text-align: right;"><i>Answer</i> [1]</p>
	<p>(b) x is an odd number. The lowest common multiple of 10, 55 and x is 550. Find the two possible values of x.</p> <p>550 = 2 × 5² × 11 10 = 2 × 5 55 = 5 × 11</p> <p style="text-align: center;">$x = 5^2$ or $x = 5^2 \times 11$ = 25 = 275</p> <p style="text-align: right;"><i>Answer</i> $x =$ or [2]</p>
	<p>(c) Find the smallest integer, p, such that $550p$ is a perfect square.</p> <p>For $2 \times 5^2 \times 11 \times p$ to be a perfect square, $p = 2 \times 11$ = 22</p> <p style="text-align: right;"><i>Answer</i> [1]</p>

15 y is inversely proportional to $(x + 1)^n$, where n is a constant and $x > -1$.
 Given that $y = 9$ when $x = 0$ and that $y = 3$ when $x = 8$, find

(a) the value of n ,

$$y = \frac{k}{(x+1)^n}$$

When $x = 0, y = 9$

$$9 = \frac{k}{(1)^n}$$

$$k = 9$$

When $x = 8, y = 3$

$$3 = \frac{9}{(8+1)^n}$$

$$9^n = 3$$

$$3^{2n} = 3^1$$

$$n = \frac{1}{2}$$

OR

$$\frac{9}{3} = \frac{(8+1)^n}{(0+1)^n}$$

$$3 = \frac{9^n}{1^n}$$

$$3 = 9^n$$

$$3 = 3^{2n}$$

$$n = \frac{1}{2}$$

Answer $n = \dots\dots\dots$ [2]

(b) the equation connecting y and x .

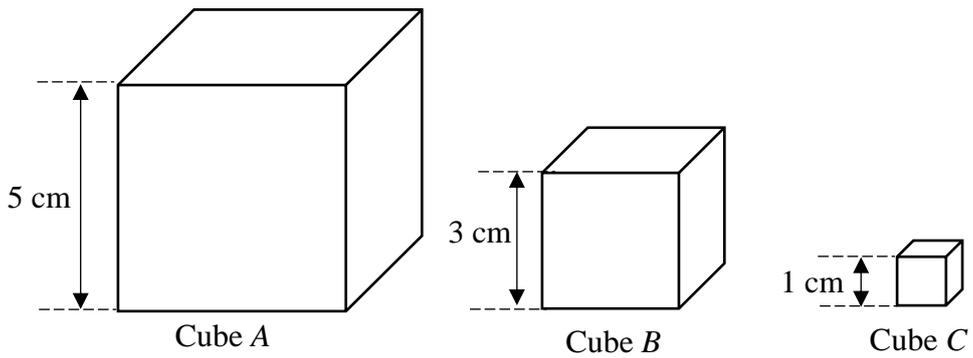
$$y = \frac{9}{\sqrt{x+1}} \quad \text{or} \quad y = \frac{9}{(x+1)^{\frac{1}{2}}}$$

Answer $\dots\dots\dots$ [1]

16 The weekly sales of three brands of chicken essence, A, B and C , are shown in the following table.

Chicken Essence	A	B	C
Weekly Sales (number of bottles)	500	300	100

Three cubes, labelled A, B and C , are used to represent the sales for brands A, B and C respectively.



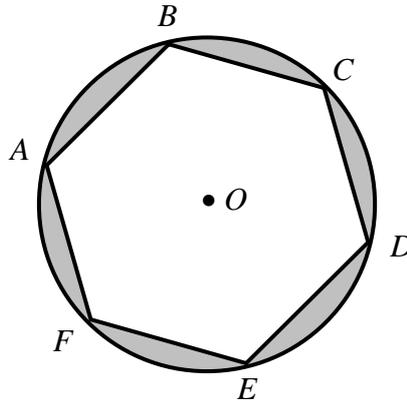
Explain why this representation is misleading.

The representation is misleading because it does not truly represent the weekly sales of the three brands of chicken essence. Volume of cube A: Volume of cube B : Volume of cube C = 125: 27 : 1 but ratio of sales of brands A, B & C = 5 : 3 : 1. [1]

<p>17</p>	<p>A bag contains 12 strawberry sweets and 6 blueberry sweets. 2 sweets are drawn from the bag at random without replacement.</p>
	<p>(a) Mary says the probability that one sweet is strawberry and the other is blueberry is $\left(\frac{12}{18}\right)\left(\frac{6}{17}\right) = \frac{4}{17}$. Explain what she has done wrong and give the correct answer.</p> <p>Mary calculated the probability based on the first sweet is strawberry and the second sweet is blueberry to get $\frac{12}{18} \times \frac{6}{17} = \frac{4}{17}$. For one sweet to be strawberry and the other to be blueberry, it can also be that the first sweet is blueberry and the second sweet is strawberry. Therefore, she has to also add the probability that the first sweet is blueberry and the second sweet is strawberry to get $\frac{12}{18} \times \frac{6}{17} + \frac{6}{18} \times \frac{12}{17} = \frac{8}{17}$. [2]</p>
	<p>(b) Find as a fraction in its simplest form, the probability that both sweets are strawberry.</p> $P(2 \text{ strawberry sweets}) = \frac{12}{18} \times \frac{11}{17}$ $= \frac{22}{51}$ <p style="text-align: right;"><i>Answer</i> [1]</p>

18	$\vec{PQ} = \begin{pmatrix} -3 \\ 4 \end{pmatrix}$, $\vec{QR} = \begin{pmatrix} 2 \\ 5 \end{pmatrix}$, $\vec{RS} = \begin{pmatrix} k \\ 11.6 \end{pmatrix}$.
	<p>(a) Find \vec{PR}, giving your answer correct to the nearest whole number.</p> $\vec{PR} = \vec{PQ} + \vec{QR}$ $= \begin{pmatrix} -3 \\ 4 \end{pmatrix} + \begin{pmatrix} 2 \\ 5 \end{pmatrix}$ $= \begin{pmatrix} -1 \\ 9 \end{pmatrix}$ $ \vec{PR} = \sqrt{(-1)^2 + 9^2}$ $= 9.0553\dots$ $= 9 \text{ (nearest whole number)}$ <p style="text-align: right;"><i>Answer</i> [2]</p>
	<p>(b) If Q is the point $(1, 7)$, find the position vector of P.</p> $\vec{OQ} = \begin{pmatrix} 1 \\ 7 \end{pmatrix}$ $\vec{PQ} = \vec{OQ} - \vec{OP}$ $\begin{pmatrix} -3 \\ 4 \end{pmatrix} = \begin{pmatrix} 1 \\ 7 \end{pmatrix} - \vec{OP}$ $\vec{OP} = \begin{pmatrix} 1 \\ 7 \end{pmatrix} - \begin{pmatrix} -3 \\ 4 \end{pmatrix}$ $= \begin{pmatrix} 4 \\ 3 \end{pmatrix}$ <p style="text-align: right;"><i>Answer</i> [2]</p>
	<p>(c) Given that \vec{RS} is parallel to \vec{PQ}, find the value of k.</p> $\begin{pmatrix} k \\ 11.6 \end{pmatrix} = a \begin{pmatrix} -3 \\ 4 \end{pmatrix}$ $4a = 11.6$ $a = 2.9$ $k = -3a$ $= -3(2.9)$ $= -8.7$ <div style="border: 1px solid black; padding: 5px; width: fit-content; margin-left: auto; margin-right: auto;"> <p>OR Using Gradient:</p> $\frac{11.6}{k} = \frac{4}{-3}$ $-34.8 = 4k$ $k = \frac{-34.8}{4}$ $= -8.7$ </div> <p style="text-align: right;"><i>Answer</i> [2]</p>

- 19** A regular hexagon $ABCDEF$, is inscribed in a circle with centre O . The length of each side of the hexagon is 7 cm.



Calculate

- (a) $\angle AOB$,

$$\begin{aligned}\angle AOB &= \frac{360^\circ}{6} \quad (\angle\text{s at a point}) \\ &= 60^\circ\end{aligned}$$

Answer $^\circ$ [1]

- (b) $\angle AFE$,

$$\begin{aligned}\angle AFE &= \frac{(6-2)180^\circ}{6} \\ &= 120^\circ\end{aligned}$$

Answer $^\circ$ [1]

- (c) the area of the shaded region.

The regular hexagon $ABCDEF$ consists of 6 equilateral triangles with sides 7 cm.

$$\begin{aligned}\text{Area of hexagon} &= 6 \times \left(\frac{1}{2}\right)(7)^2 \sin 60^\circ \\ &= 127.3057\dots \text{ cm}^2\end{aligned}$$

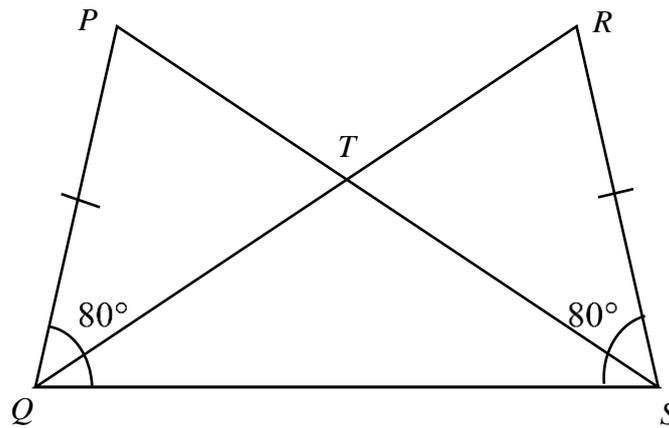
$$\begin{aligned}\text{Area of shaded region} &= \pi(7)^2 - 127.3057\dots \\ &= 153.938\dots - 127.3057\dots \\ &= 26.6323\dots \\ &= 26.6 \text{ cm}^2 \text{ (3sf)}\end{aligned}$$

Answer cm^2 [2]

20	(a)	<p>Express $y = x^2 + 5x + 15$ in the form $y = (x + a)^2 + b$.</p> $y = x^2 + 5x + 15$ $= x^2 + 5x + 2.5^2 - 2.5^2 + 15$ $= (x + 2.5)^2 - 6.25 + 15$ $= (x + 2.5)^2 + 8.75$ <p style="text-align: right;"><i>Answer</i> $y = \dots\dots\dots$ [2]</p>										
	(b)	<p>Write down the equation of the line of symmetry of $y = x^2 + 5x + 15$.</p> <p style="text-align: right;">$x = -2.5$ <i>Answer</i> $\dots\dots\dots$ [1]</p>										
21	<p>The maximum daily temperature, in $^{\circ}\text{C}$, was recorded throughout the month of April. The results are shown in the table below.</p> <table border="1" data-bbox="443 947 1222 1245" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>Temperature (T $^{\circ}\text{C}$)</th> <th>Number of days</th> </tr> </thead> <tbody> <tr> <td>$28 \leq T < 30$</td> <td>4</td> </tr> <tr> <td>$30 \leq T < 32$</td> <td>8</td> </tr> <tr> <td>$32 \leq T < 34$</td> <td>16</td> </tr> <tr> <td>$34 \leq T < 36$</td> <td>2</td> </tr> </tbody> </table> <p>Calculate an estimate for</p>		Temperature (T $^{\circ}\text{C}$)	Number of days	$28 \leq T < 30$	4	$30 \leq T < 32$	8	$32 \leq T < 34$	16	$34 \leq T < 36$	2
Temperature (T $^{\circ}\text{C}$)	Number of days											
$28 \leq T < 30$	4											
$30 \leq T < 32$	8											
$32 \leq T < 34$	16											
$34 \leq T < 36$	2											
	(a)	<p>the mean temperature,</p> $\text{Mean} = \frac{29(4) + 31(8) + 33(16) + 35(2)}{30}$ $= 32.0666\dots$ $= 32.1 \text{ }^{\circ}\text{C} \text{ (3sf)}$ <p style="text-align: right;"><i>Answer</i> $\dots\dots\dots^{\circ}\text{C}$ [1]</p>										
	(b)	<p>the standard deviation of the maximum daily temperature in April.</p> $\text{Standard Deviation} = 1.611107\dots$ $= 1.61 \text{ }^{\circ}\text{C} \text{ (3sf)}$ <p style="text-align: right;"><i>Answer</i> $\dots\dots\dots^{\circ}\text{C}$ [1]</p>										

<p>22</p>	<p>A company sells necklaces, bracelets and rings at two of its outlets and the number of jewellery items sold in each outlet in July are shown in the table below.</p> <table border="1" data-bbox="301 315 1265 465"> <thead> <tr> <th></th> <th>Necklaces</th> <th>Bracelets</th> <th>Rings</th> </tr> </thead> <tbody> <tr> <th>Outlet 1</th> <td>227</td> <td>362</td> <td>172</td> </tr> <tr> <th>Outlet 2</th> <td>192</td> <td>257</td> <td>231</td> </tr> </tbody> </table>		Necklaces	Bracelets	Rings	Outlet 1	227	362	172	Outlet 2	192	257	231
	Necklaces	Bracelets	Rings										
Outlet 1	227	362	172										
Outlet 2	192	257	231										
<p>(a)</p>	<p>Represent the above data in a 2×3 matrix , A.</p> $\text{Answer } \mathbf{A} = \begin{pmatrix} 227 & 362 & 172 \\ 192 & 257 & 231 \end{pmatrix} \quad [1]$												
	<p>The cost of producing one necklace, one bracelet and one ring is \$15, \$8 and \$5 respectively. This information can be represented by the matrix $\mathbf{C} = \begin{pmatrix} 15 \\ 8 \\ 5 \end{pmatrix}$.</p> <p>Each necklace is sold at \$35, each bracelet is sold at \$21 and each ring is sold at \$12. The matrix $\mathbf{B} = \begin{pmatrix} 35 \\ 21 \\ 12 \end{pmatrix}$ shows the selling price of each jewellery item.</p>												
<p>(b)</p>	<p>Find $\mathbf{A}(\mathbf{B} - \mathbf{C})$.</p> $\begin{aligned} \mathbf{A}(\mathbf{B} - \mathbf{C}) &= \begin{pmatrix} 227 & 362 & 172 \\ 192 & 257 & 231 \end{pmatrix} \left[\begin{pmatrix} 35 \\ 21 \\ 12 \end{pmatrix} - \begin{pmatrix} 15 \\ 8 \\ 5 \end{pmatrix} \right] \\ &= \begin{pmatrix} 227 & 362 & 172 \\ 192 & 257 & 231 \end{pmatrix} \begin{pmatrix} 20 \\ 13 \\ 7 \end{pmatrix} \\ &= \begin{pmatrix} 227(20) + 362(13) + 172(7) \\ 192(20) + 257(13) + 231(7) \end{pmatrix} \\ &= \begin{pmatrix} 10450 \\ 8798 \end{pmatrix} \end{aligned}$ <p style="text-align: right;"><i>Answer</i> [2]</p>												
<p>(c)</p>	<p>Explain what your answer in (b) represents.</p> <p><u>Profit made from the sale of jewellery items in July for Outlet 1 and Outlet 2 respectively.</u>..... [1]</p>												

- 23 The diagram shows two triangles PQS and QRS . T is the point of intersection of PS and QR . $PQ = RS$ and $\angle PQS = \angle RSQ = 80^\circ$.



- (a) Show that triangle PQS and triangle RSQ are congruent.

Answer (a)

$PQ = RS$ (given)

$\angle PQS = \angle RSQ = 80^\circ$ (given)

QS is a common side of both triangles.

Triangle PQS is congruent to triangle RSQ . (SAS)

[3]

- (b) Explain why a circle can be drawn passing through the points P , Q , R and S .

Answer (b)

Since triangle PQS and triangle RSQ are congruent, $\angle QPS = \angle SRQ$.

Therefore, since $\angle QPS = \angle SRQ$, it satisfies the property **angles in the same**

segment, and a circle passing through the points P , Q , R and S can be drawn. [2]

- (c) Is T the centre of the circle passing through the points P , Q , R and S ?

Explain your answer.

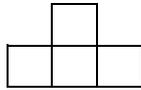
Answer (c)

No. Since $\angle PQS \neq 90^\circ$, it does not satisfy **right angle in semi-circle property**.

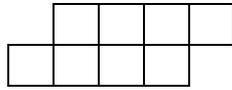
Therefore, T is not the centre of the circle as PS is not the diameter of the circle

passing through P , Q , R and S . [1]

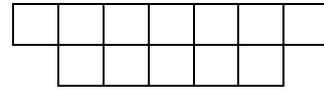
24 A 1-T block consists of 4 squares of 1 cm^2 each and it has a perimeter of 10 cm.
The following pattern shows 1-T blocks arranged to form a 2-T block and a 3-T block.



1-T block



2-T block



3-T block

The values for the perimeter of 1-T block and 2-T block are given below.

Block	1-T	2-T	3-T	4-T
Perimeter (cm)	10	14	a	b

(a) Find the value of a and of b .

Answer $a = \dots\dots\dots 18, b = \dots\dots\dots 22$ [2]

(b) Find the perimeter of a 7-T block.

Answer $\dots\dots\dots 34 \dots\dots\dots$ cm [1]

(c) Write down the perimeter of a n -T block in terms of n .

Answer $\dots\dots\dots 4n + 6 \dots\dots\dots$ cm [1]

(d) If the perimeter of a n -T block is 130 cm, find the number of squares in the given block.

$$4n + 6 = 130$$

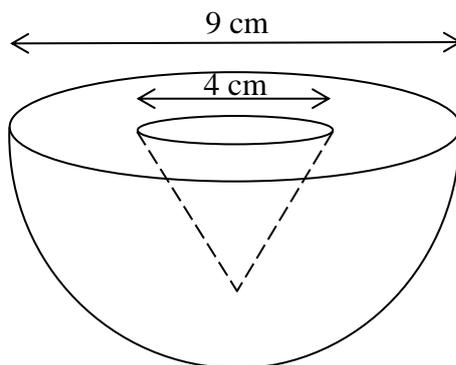
$$4n = 124$$

$$n = 31$$

Since each 1-T block consists of 4 squares,
Number of squares in T-31 block = $31(4)$
 $= 124$

Answer $\dots\dots\dots$ [2]

- 25 At a meteorological station, the meteorologists use a metallic container as shown in the diagram to collect rainwater samples. The container consists of a hemisphere of diameter 9 cm with a hollow in the form of an inverted circular cone of base diameter 4 cm.



The volume of the cone is $\frac{1}{15}$ of the volume of the hemisphere.

- (a) Show that the height of the cone is 3.0375 cm.

Let height of cone be h cm.

$$\frac{1}{3}\pi(2)^2h = \frac{1}{15}\left[\frac{2}{3}\pi(4.5)^3\right]$$

$$\frac{4}{3}\pi h = \frac{81}{20}\pi$$

$$\frac{4}{3}h = \frac{81}{20}$$

$$h = \frac{81}{20} \div \frac{4}{3}$$

$$= 3.0375$$

height of cone = 3.0375 cm (shown)

[2]

- (b) Find the total surface area of the metallic container, giving your answer correct to 2 decimal places.

$$\text{Slant height of cone} = \sqrt{2^2 + 3.0375^2}$$

$$= 3.6368\dots \text{ cm}$$

Total surface area

= curved surface area (hemisphere) + curved surface area (cone) + area of ring

$$= 2\pi(4.5)^2 + \pi(2)(3.6368\dots) + \pi(4.5)^2 - \pi(2)^2$$

$$= 40.5\pi + 22.8507\dots + 20.25\pi - 4\pi$$

$$= 127.2345\dots + 22.8507\dots + 51.0508\dots$$

$$= 201.136\dots$$

$$= 201 \text{ cm}^3 \text{ (3sf)}$$

Answer cm² [4]

~ End of Paper ~

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