Q1-17: Alan
Q18-23: Yan Jin

XINMIN SECONDARY SCHOOL
新民中学
SEKOLAH MENENGAH XINMIN
Preliminary Examination 2024

CANDIDATE NAME Answer scheme.

CLASS | | | | INDEX NUMBER | |

MATHEMATICS 4052/01

Secondary 4 Express

21 August 2024

Setter: Ms Low Yan Jin
Vetter: Ms Vanessa Chia
Moderator: Mr Johnson Chua

2 hour 15 minutes

Candidates answer on the Question Paper

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class in the spaces at the top of this page.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.

Answer **all** the questions.
The number of marks is given in brackets [ ] at the end of each question or part question.

If working is needed for any question it must be shown in the space below the question.
Omission of essential working will result in loss of marks.
The total of the marks for this paper is **90**.

The use of an approved scientific calculator is expected, where appropriate.
If the degree of accuracy is not specified in the question and if the answer is not exact, give the answer to three significant figures. Give answers in degrees to one decimal place.
For π, use either your calculator value or 3.142.

Errors	Qn No.	Errors	Qn No.
Accuracy		Simplification	
Brackets		Units	
Geometry		Marks Awarded	
Presentation		Marks Penalised	

For Examiner's Use
90

Parent's/Guardian's Signature:

This document consists of **20** printed pages.

[Turn over

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Mathematical Formulae

Compound Interest

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

Mensuration

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

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

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

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

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

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

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

Trigonometry

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

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

Statistics

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

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

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Answer **all** the questions.

1 Evaluate

(a) $\dfrac{8.75}{\sqrt{4.86}+0.982}$, correct to 2 decimal places,

$= 2.7459$

$= 2.75$ *

Answer ..... 2.75. — (B1) ..... [1]

(b) $\left(5.87\times10^{6}\right)\div\left(3.94\times10^{-2}\right)$, leaving your answer in standard form, correct to 3 significant figures.

$= 1.4898 \times 10^{8}$

$= 1.49 \times 10^{8}$ *

Answer ..... 1.49×10^{8} — (B1) ..... [1]

---

2 **(a)** Express 540 as a product of its prime factors.

$540 = 2^2 \times 3^3 \times 5$

Answer ..... $2^2 \times 3^3 \times 5$ — (B1) ..... [1]

(b) The number $\dfrac{540x}{y}$ is a perfect square, where x and y are prime numbers and $x > y$. Find the value of x and of y.

Answer $x =$ ..... 5 .....

$y =$ ..... 3 ..... (B1) [1]

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3 **(a)** Simplify $24a^2b^5 \div 8a^6b^{-2}$. Leave your answer in positive index form.

$= 3a^{-4}b^7$

$= \frac{3b^7}{a^4}$ #

↑ penalise under simplification.
* Note that this is usually not the case - will be OM.

Answer $\frac{3b^7}{a^4}$ — (B1) ..... [1]

(b) Given that $9^k \times \frac{1}{729} = 3^k$, find the value of k.

$(3^2)^k \times \frac{1}{3^6} = 3^k$ — (M1) : both correct

$3^{2k} \times 3^{-6} = 3^k$

$3^{2k-6} = 3^k$

$2k - 6 = k$

$k = 6$ #

Answer $k =$ 6 — (A1) ..... [2]

---

4 During a school's anniversary, Joey sold x cookies at 50 cents each and $(x + 30)$ chocolates at 90 cents each. Form an inequality in x and solve it to find the minimum value of x in order for her to receive at least \$152 from the sales.

$50x + 90(x+30) \geq 15200$ — (M1): correct inequality

$50x + 90x + 2700 \geq 15200$

$140x \geq 12500$

$x \geq 89.285$ — (M1): for simplification

$x = 90$ #

↳ If students put $\geq$, penalise under presentation at cover page

OR:

$0.5x + 0.9(x+30) \geq 152$ — [M1].

$0.5x + 0.9x + 27 \geq 152$

$1.4x \geq 125$

$x \geq 89.285$ — [M1]

$x = 90$

Answer $x =$ 90 — (A1) ..... [3]

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5 Solve the simultaneous equations.

$$x+3y=29$$
$$2x=5y-30$$

Elimination:

$2x + 6y = 58$ — ①

$2x - 5y = -30$ — ②

① − ②: $(2x+6y)-(2x-5y) = 58-(-30)$ } M1 : elimination

$11y = 88$

$y = 8$ #

$2x - 5(8) = -30$

$2x = 10$

$x = 5$. #

Substitution:

$x = 29-3y$ — ①

$2x = 5y-30$ — ②

sub ① into ②,

$2(29-3y) = 5y-30$ — M1 : substitution

$58-6y = 5y-30$

$11y = 88$

$y = 8$ #

$x = 29-3(8)$

$= 5$ #

Answer $x =$ 5 — A1

$y =$ 8 — A1 [3]

---

6 Rearrange the formula $10+y=\dfrac{x^2+k}{x^2}$ to make x the subject.

$x^2(10+y) = x^2+k$ — M1

$10x^2+yx^2 = x^2+k$

$9x^2+yx^2 = k$

$x^2(9+y) = k$

$x^2 = \dfrac{k}{9+y}$ — M1

$x = \pm\sqrt{\dfrac{k}{9+y}}$ #

[Alt]:

$10+y = 1+\dfrac{k}{x^2}$ — [M1]

$9+y = \dfrac{k}{x^2}$

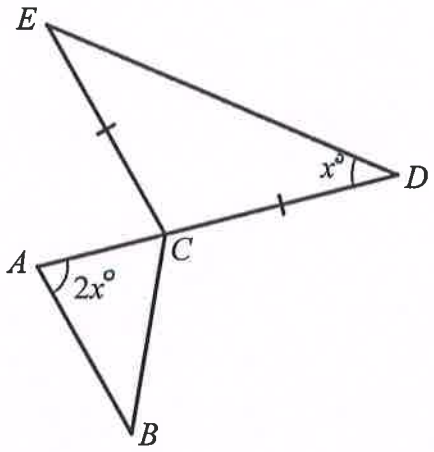
$x^2 = \dfrac{k}{9+y}$ — [M1]

$x = \pm\sqrt{\dfrac{k}{9+y}}$

Answer $x = \pm\sqrt{\dfrac{k}{9+y}}$ — A1 [3]

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7 In the figure, ACD is a straight line and $CD = CE$.
Angle $CDE = x°$ and angle $CAB = 2x°$.
Determine if AB is parallel to CE, stating your reasons clearly.



Answer

$\angle CED = x°$ (base $\angle$s of isos. $\triangle$)
$\angle ECA = 2x°$ (ext. $\angle$ of $\triangle$) — (M1)

note: –1m from qns if reasons are wrong/missing.

Since $\angle ECA = \angle CAB = 2x°$, by alternate $\angle$s, // lines, AB // CE. — (A1)

..... [2]

---

8 Simplify.

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

$= 15x - 10y - 2x - 8y$ — (M1): either correct
$= 13x - 18y$

Answer $13x - 18y$ — (A1) [2]

(b) $12p^2+8-(3p-2)^2$

$= 12p^2 + 8 - (9p^2 - 12p + 4)$ — (M1)
$= 12p^2 + 8 - 9p^2 + 12p - 4$
$= 3p^2 + 12p + 4$ #

Answer $3p^2 + 12p + 4$ — (A1) [2]

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9 A map of Mount Fuji has a scale of 1 : 25 000.

(a) The length of a trail on the map is 52.2 cm.
Calculate the actual length, in kilometres, of the trail.

1 : 25 000
52.2 : 1305 000. — M1
1305 000 cm = 13.05 km #

Answer ..... 13.05 — A1 ..... km [2]

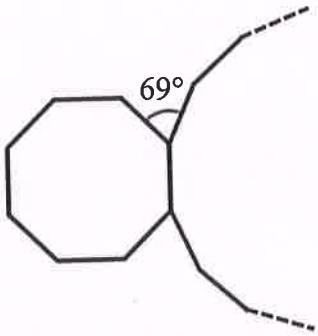
(b) A lake at the base of Mount Fuji has an actual area of 6.57 km^2.
Calculate the area, in square centimetres, of the lake on the map.

1cm : 0.25 km.
1cm^2 : 0.0625 km^2 — M1
105.120cm^2 : 6.57 km^2 #

Answer ..... 105.12 — A1 ..... cm^2 [2]

---

10 The diagram shows a regular octagon (8-sided) and a *n*-sided polygon. (part of regular)



Find the value of *n*.

Each int. ∠ = $\frac{(8-2)\times 180^\circ}{8}$ — M1
= 135°.

n-sided int ∠ = 360° − 69° − 135° — M1 (ecf)
= 156°.

Each ext. ∠ = 180° − 156°
= 24°.

$n = \frac{360^\circ}{24^\circ}$ — M1 (ecf)
= 15 #

[M1]:

$\frac{(n-2)\times 180^\circ}{n} = 156$ — [M1] (ecf)

$(n-2)\times 180 = 156n$
$180n - 360 = 156n$
$24n = 360$
$n = 15.$

Answer n = ... 15 — A1 ..... [4]

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11 The force, F Newtons, between two particles is inversely proportional to the square of the distance, d cm, between them.
If the force is 5.5 Newtons when the distance between the two particles is 2 cm, find

(a) an equation connecting F and d,

$F = \frac{k}{d^2}$

$5.5 = \frac{k}{2^2}$ — (M1)

$k = 22$.

$\therefore F = \frac{22}{d^2}$ #

Answer $F = \frac{22}{d^2}$ — (A1) [2]

(b) the distance between two particles when the force is 3 Newtons.

$3 = \frac{22}{d^2}$

$d^2 = \frac{22}{3}$

$d = \sqrt{\frac{22}{3}}$

$= 2.7080$

$= 2.71$ #

Answer 2.71 — (B1) cm [1]

---

12 **(a)** Factorise $6x^3 + 11x^2 - 7x$.

$= x(6x^2 + 11x - 7)$ — (M1)

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

$3x$	7	$14x$
$2x$	-1	$-3x$
$6x^2$	-7	$11x$

Answer $x(3x+7)(2x-1)$ — (A1) [2]

(b) Write as a single fraction in its simplest form $\frac{2x}{4x^2-25} + \frac{3}{2x-5}$.

$\frac{2x}{(2x+5)(2x-5)} + \frac{3}{2x-5}$ — (M1): factorise $4x^2-25$.

$= \frac{2x + 3(2x+5)}{(2x+5)(2x-5)}$ — (M1): combining both fractions

$= \frac{2x + 6x + 15}{(2x+5)(2x-5)}$

$= \frac{8x+15}{(2x+5)(2x-5)}$ #

[ALT]:

$\frac{2x(2x-5) + 3(4x^2-25)}{(4x^2-25)(2x-5)}$ — [M1]

$= \frac{4x^2 - 10x + 12x^2 - 75}{(2x+5)(2x-5)(2x-5)}$ — [M1]

$= \frac{16x^2 - 10x - 75}{(2x+5)(2x-5)^2}$

$= \frac{(8x+15)(2x-5)}{(2x+5)(2x-5)^2}$

$= \frac{8x+15}{(2x+5)(2x-5)}$

Answer $\frac{8x+15}{(2x+5)(2x-5)}$ — (A1) or $\left(\frac{8x+15}{4x^2-25}\right)$ [3]

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13 (a) Express $x^2 - 6x - 7$ in the form $(x-p)^2 - q$.

$x^2 - 6x - 7 = x^2 - 2(x)(3) + 3^2 - 3^2 - 7$

$= (x-3)^2 - 16$. ✱

[ALT]:

$(x-p)^2 - q$

$= x^2 - 2px + p^2 - q$

$\therefore -2px = -6x$, $p^2 - q = -7$

$p = 3$ $3^2 - q = -7$

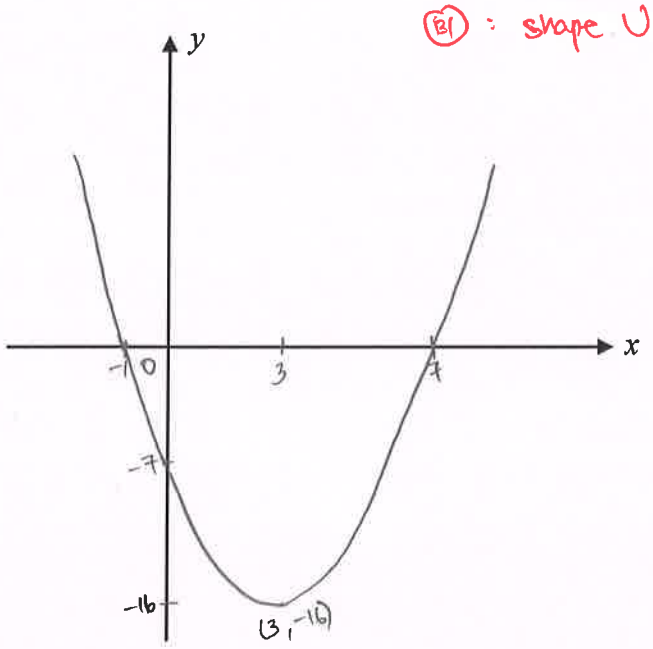
$q = 16$.

Answer $(x-3)^2 - 16$ — B1 [1]

(b) Hence, or otherwise sketch the graph of $y = x^2 - 6x - 7$ in the axes below.
Indicate clearly the values where the graph crosses the axes and the coordinates of the turning point on the curve.

B1 : x and y-int
B1 : turning point
B1 : shape U.

Answer [3]



$y = (x-3)^2 - 16$

when $x = 0$,

$y = -7$

when $y = 0$,

$(x-3)^2 - 16 = 0$

$(x-3)^2 = 16$

$x - 3 = \pm 4$

$x = 7$ or $x = -1$.

$TP = (3, -16)$.

[ALT]:

$y = (x-7)(x+1)$

when $y = 0$,

$x = 7$ or $x = -1$.

$x_{TP} = \frac{7 + (-1)}{2}$

$= 3$.

$y_{TP} = 3^2 - 6(3) - 7$

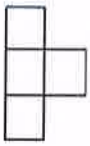
$= -16$.

$\therefore TP = (3, -16)$

when $x = 0$, $y = -7$

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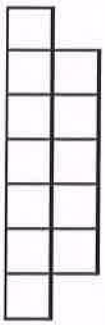
14 A F-1 block is made up of 4 squares of sides 2 cm each.
The F-1 blocks can be combined to form more blocks and F-2 and F-3 blocks are shown below.



F-1



F-2



F-3

(a) Complete the table.

Block	F-1	F-2	F-3	F-4
Perimeter (cm)	20	28	36	44

B1 [1]

(b) Write down an expression, in terms of n, for the perimeter of a F-n block.

Answer $8n + 12$ — B1 cm [1]

(c) Hence, explain if it is possible to have a block with a perimeter of 100 cm.

Answer

$8n + 12 = 100$
$8n = 88$
$n = 11$. } M1

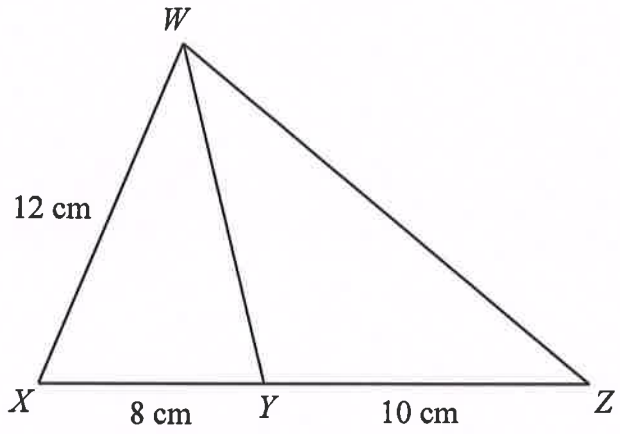
A1

Since n is an integer, it is possible to have a block with perimeter of 100 cm, F-11 block. [2]

[AH]:
It is possible to have a block with a perimeter of 100cm. It happens in F-11 blocks.
[A1].

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15 In the diagram, WXZ is a triangle. $WX = 12$ cm, $XY = 8$ cm and $YZ = 10$ cm.



(a) Show that triangles WXY and ZXW are similar.

Answer

$\frac{XY}{XW} = \frac{8}{12} = \frac{2}{3}$

$\angle WXY = \angle ZXW$ (common $\angle$) } M1

$\frac{XW}{XZ} = \frac{12}{18} = \frac{2}{3}$.

$\therefore \triangle WXY$ is similar to $\triangle ZXW$ (SAS similarity).

A1

[2]

(b) If the area of triangle ZXW is x cm^2, find the area of triangle WYZ in terms of x.

$\frac{A_S}{A_B} = \frac{B_S}{B_B}$

$\frac{A_S}{x} = \frac{10}{18}$ — M1

$A_S = \frac{10}{18}x$

$= \frac{5}{9}x$ #

[Alt]:

Let the height of $\triangle ZXW$ be h.

$\frac{1}{2}(h)(18) = x$

$h = \frac{x}{9}$ — [M1]

$\therefore$ Area of $\triangle WYZ = \frac{1}{2}(10)\left(\frac{x}{9}\right)$

$= \frac{5}{9}x$ #

[Alt]:

$\frac{A_S}{A_B} = \left(\frac{2}{3}\right)^2$

$= \frac{4}{9}$ — [M1]

$\frac{A_S}{x} = \frac{4}{9}$

$A_S = \frac{4}{9}x$

area of $\triangle WYZ = x - \frac{4}{9}x$

$= \frac{5}{9}x$

[Alt]:

$A_S : A_B$

$4 : 9$

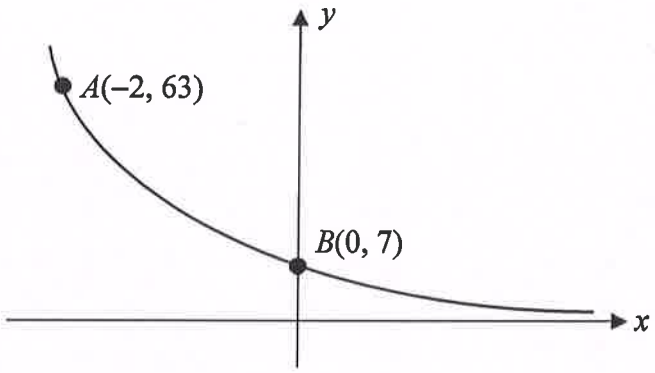
$9u \longrightarrow x$

$5u \longrightarrow \frac{5}{9}x$

Answer ..... $\frac{5}{9}x$ — A1 ..... cm^2 [2]

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16 The sketch shows the graph of $y = ka^{-x}$. The points $A(-2, 63)$ and $B(0, 7)$ lie on the graph.



(a) Find the values of k and of a.

$7 = ka^{-0}$

$k = 7$ ✱

$\therefore y = 7a^{-x}$

$63 = 7a^{-(-2)}$ — M1 (eqn)

$63 = 7a^2$

$a^2 = 9$

$a = 3$ ✱

Answer $k =$ 7 — B1

$a =$ 3 — M1 [3]

(b) Find the equation of the line AB.

$m_{AB} = \frac{63-7}{-2}$ — M1

$= -28$

$\therefore y = -28x + 7$ ✱

Answer $y = -28x + 7$ — A1 [2]

(c) Write down a possible equation of a line that does not intersect the line AB.

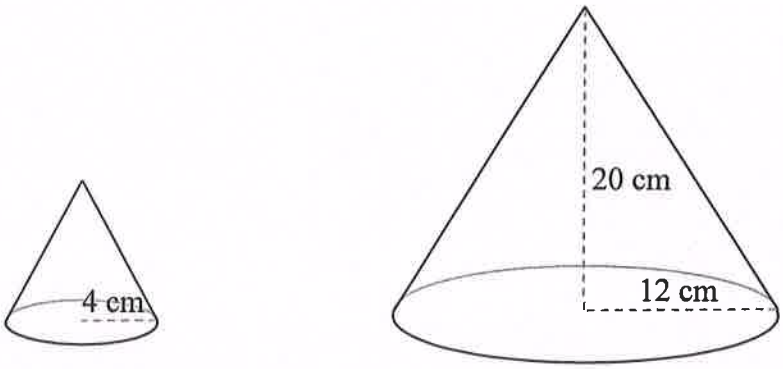
Answer $y = -28x + K$ — B1 [1]

where $K \in \mathbb{R}$, $K \neq 7$.

eg. $y = -28x + 1$.

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17 Cone A has a radius of 4 cm and a volume of 40π cm^3.
Cone B has a radius of 12 cm and a height of 20 cm.



Cone A Cone B

(a) Calculate the volume of Cone B, leaving your answer in exact form.

Volume $= \frac{1}{3}\pi(12)^2(20)$ — M1
$= 960\pi$.

Answer 960π — A1 cm^3 [2]

(b) Hence, determine if Cone A is similar to Cone B. Explain your answer.

Answer

$\left(\frac{L_A}{L_B}\right)^3 = \left(\frac{4}{12}\right)^3$ — M1
$= \frac{1}{27}$

$\frac{V_A}{V_B} = \frac{40\pi}{960\pi}$ — M1 (eqn)
$= \frac{1}{24}$

[ANA]:
$\frac{1}{3}\pi(4)^2 h = 40\pi$
$h = 7.5$. — [M1]

$\frac{r_A}{r_B} = \frac{4}{12} = \frac{1}{3}$.
$\frac{H_A}{H_B} = \frac{7.5}{20} = \frac{3}{8}$.
} [M1].

since $\frac{r_A}{r_B} \neq \frac{H_A}{H_B}$, cone A is not similar to cone B. [A1].

or $\frac{1}{27} \neq \frac{1}{24}$.

Since $\frac{V_A}{V_B} \neq \left(\frac{L_A}{L_B}\right)^3$, Cone A is not similar to cone B.

A1

[3]

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18 A flower shop sells 3 different types of bouquets, consisting of different types of flowers, for various occasions. The number for each type of flowers in each bouquet is shown in the table below.

Occasion / Type of flowers	Tulip	Carnation	Hydrangea	Rose
Birthday	3	5	2	4
Promotion	5	4	1	3
Get Well Soon	5	7	0	2

The cost price of a stalk of tulip, carnation, hydrangea and rose is \$1.20, \$0.90, \$1.50 and \$1.70 respectively.

This information can be represented by the matrix $\mathbf{C} = \begin{pmatrix} 1.20 \\ 0.90 \\ 1.50 \\ 1.70 \end{pmatrix}$.

(a) Represent the number of each type of flowers in each bouquet in a 3×4 matrix **F**.

Answer $\mathbf{F} =$ $\begin{pmatrix} 3 & 5 & 2 & 4 \\ 5 & 4 & 1 & 3 \\ 5 & 7 & 0 & 2 \end{pmatrix}$ (B1) [1]

(b) Evaluate the matrix $\mathbf{P} = \mathbf{FC}$.

$$P = \begin{pmatrix} 3 & 5 & 2 & 4 \\ 5 & 4 & 1 & 3 \\ 5 & 7 & 0 & 2 \end{pmatrix} \begin{pmatrix} 1.20 \\ 0.90 \\ 1.50 \\ 1.70 \end{pmatrix}$$

$$= \begin{pmatrix} 14.90 \\ 16.20 \\ 15.70 \end{pmatrix}$$

Note: no need to penalise if no 2dp shown.

Answer $\mathbf{P} =$ $\begin{pmatrix} 14.90 \\ 16.20 \\ 15.70 \end{pmatrix}$ (B1) [1]

(c) State what the elements of **P** represent.

The elements of P represent the cost price of a Birthday, Promotion and Get well soon bouquet respectively. (B1) [1]

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(d) The flower shop wants to make a profit of 50%, 35% and 40% from the Birthday, Promotion and Get Well Soon bouquet respectively.
Using matrix multiplication only, find the selling price of each type of bouquet and represent it in a column matrix.

$$\begin{pmatrix} 1.5 & 0 & 0 \\ 0 & 1.35 & 0 \\ 0 & 0 & 1.4 \end{pmatrix}\begin{pmatrix} 17.90 \\ 16.20 \\ 15.70 \end{pmatrix} = \begin{pmatrix} 26.85 \\ 21.87 \\ 21.98 \end{pmatrix}$$

(M1) (ecf)

Answer $\begin{pmatrix} 26.85 \\ 21.87 \\ 21.98 \end{pmatrix}$ —(A1) [2]

↳ penalise accuracy if left in 10¢.

[A1]:

$$(17.90 \quad 16.20 \quad 15.70)\begin{pmatrix} 1.5 & 0 & 0 \\ 0 & 1.35 & 0 \\ 0 & 0 & 1.40 \end{pmatrix} = (26.85 \quad 21.87 \quad 21.98)$$ — NO [A1]

[M1] (ecf)

$$\begin{pmatrix} 17.9 & 0 & 0 \\ 0 & 16.2 & 0 \\ 0 & 0 & 15.7 \end{pmatrix}\begin{pmatrix} 1.5 \\ 1.35 \\ 1.4 \end{pmatrix} = \begin{pmatrix} 26.85 \\ 21.87 \\ 21.98 \end{pmatrix}$$

[M1] (ecf)

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19 The mass of some crystals were measured and the results are shown in the stem-and-leaf diagram.

1	5	7	7	8
2	1	3		
3	2	2	5	8
4	0	1		

Key 2 | 4 means 240 g

(a) Find the median mass.

Median = $\frac{230 + 320}{2}$

= 275 g #

Answer 275 — (B1) g [1]

(b) Find the standard deviation of the mass.

Answer 94.6 — (B1) g [1]

(c) A crystal is chosen at random. Calculate the probability of the crystal having a mass of at least 350 g.

$\frac{4}{12} = \frac{1}{3}$

Answer $\frac{1}{3}$ — (B1) [1]

(d) It was discovered that the mass has been measured incorrectly. The correct mass were all 20 g more than those recorded.
Explain how the median and standard deviation of the mass have been affected by this error.

(B1): either correct.
* Need to state the 'increase'

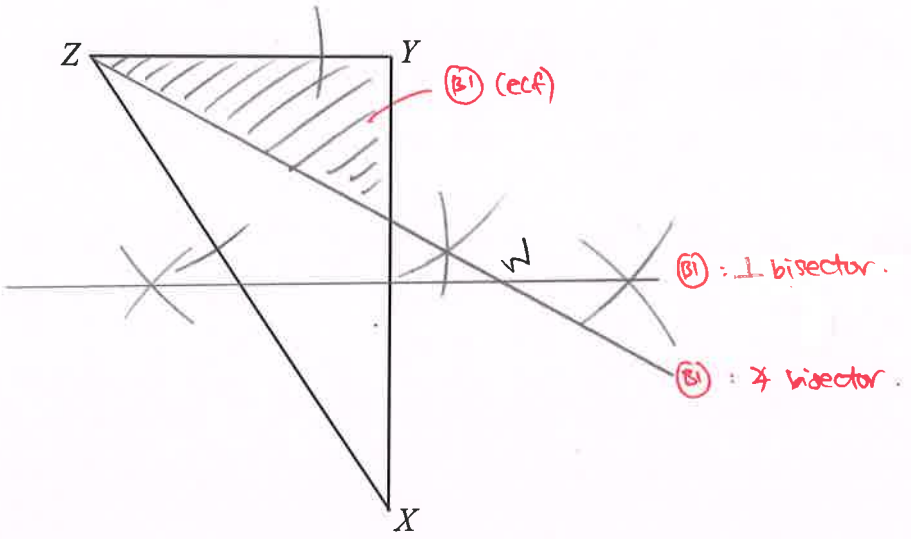
The median mass should be 20g more, which is 295g, but the standard deviation would remain unchanged.

(B1)

[2]

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20 The scale drawing below shows the locations of Village X, Y and Z.
The distance between Village X and Y is 600 m and XY is perpendicular to YZ.



(a) A waterfall is equidistant from the lines XZ and YZ, and equidistant from Village X and Y.
By constructing bisectors, find and label the position of the waterfall, W. [2]

(b) Shade the region inside triangle XYZ that is closer to YZ than XZ. [1]

(c) Calculate the **actual** area of the shaded region, giving your answer in square metres.

6cm = 600m
1cm = 100m
(±0.1) 2.2cm = 220m
(±0.1) 4cm = 400m ✓ M1: either correct

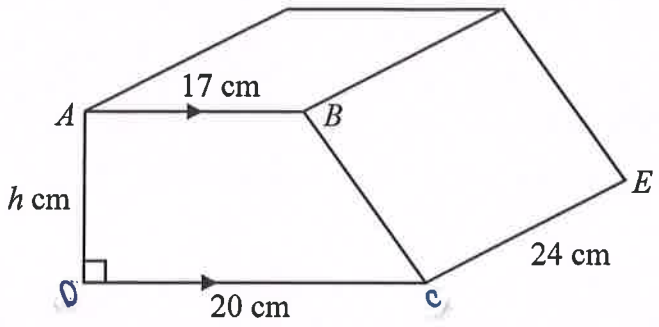
∴ Actual area = $\frac{1}{2}$ x 220 x 400
= 44 000 m²

[Alt]:
1cm : 100m
1cm² : 10000m² — [M1]
Area = $\frac{1}{2}$ x 4 x 2.2 = 4.4 cm² (±0.1)
Actual area = 4.4 x 10000
= 44 000 m² #

Answer 44 000 — A1 m² [2]
(accept: 40950/42000/42900/43050/44850/45100/46000/47150)

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21 The diagram shows a solid in the shape of a prism.
The cross-section of the prism is a trapezium $ABCD$ with height h cm.
$AB = 17$ cm, $CD = 20$ cm and $CE = 24$ cm. The volume of the prism is 6660 cm^3.



(a) Find the value of h.

Area of trapezium $= \frac{1}{2} \times (17 + 20) \times h$ — (M1) : area of trapezium.
$= 18.5h$.

$18.5h \times 24 = 6660$ — (M1) : volume of prism.
$18.5h = 277.5$
$h = 15$ #

Answer $h =$ ..... 15 — (A1) ..... [3]

(b) The solid is made from a material with density 2500 g/m^3.
Calculate the mass of the solid, in grams.

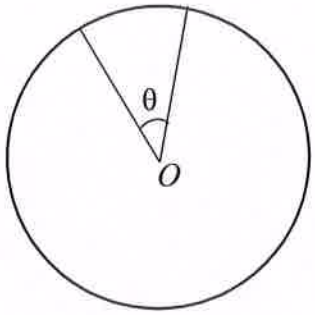
$1.0\text{m} = 0.01\text{m}$
$1\text{cm}^3 = 0.000\,001\,\text{m}^3$ — (M1)
$6660\text{cm}^3 = 0.00666\text{m}^3$
$\therefore$ Mass $= 2500 \times 0.00666$
$= 16.65\text{g}$ #

[ALT]:
2500g ⟶ $1\text{m}^3 = 1\,000\,000\text{cm}^3$ — [M1].
16.65g ⟶ 6660cm^3

Answer ..... 16.65 — (A1) ..... g [2]
(or $16\frac{13}{20}$)

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22 The diagram shows a circle with centre O. The angle of the minor sector is θ radians.



The perimeter of the major sector is three times the perimeter of the minor sector. Show that $\theta = 0.571$, correct to 3 significant figures.

Answer

Major sector $= r(2\pi - \theta) + 2r$. — M1

Minor sector $= r\theta + 2r$. — M1

$\therefore 3(r\theta + 2r) = r(2\pi - \theta) + 2r$. — M1 (eqf)

$3r\theta + 6r = 2\pi r - r\theta + 2r$

$4r\theta + 4r = 2\pi r$

$4r(\theta + 1) = 2\pi r$

$\theta + 1 = \frac{2\pi r}{4r}$

$\theta + 1 = \frac{\pi}{2}$

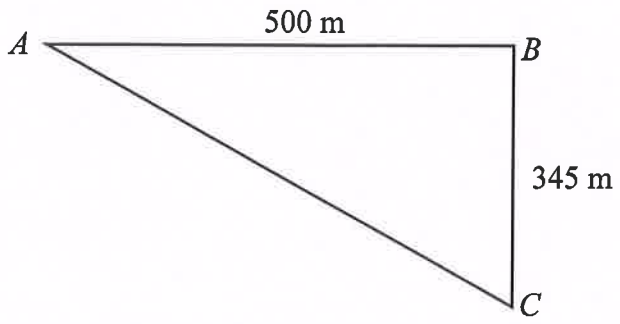
$\theta = 0.57079$

$\theta = 0.571$ (shown)# } A1

[4]

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23 The diagram shows the position of three landmarks A, B and C.
C is due South of B and B is due East of A. $AB = 500$ m and $BC = 345$ m.



(a) Find the bearing of C from A.

$\tan\theta = \frac{345}{500}$ — M1

$\theta = 34.605°$

Bearing $= 90° + 34.605°$

$= 124.60$

$= 124.6°$ #

* penalise accuracy if not in 1dp

Answer .....124.6..... — A1 ..... ° [2]

(b) There is a clock tower at landmark B. The height of the clock tower is 64 m.
Justin walks from landmark A to C.
Calculate the greatest angle of elevation of the clock tower from Justin.

$\sin 34.605° = \frac{opp}{500}$ — M1 (ecf)

$opp = 283.95$

$\tan\theta = \frac{64}{283.95}$ — M1 (ecf)

$\theta = \tan^{-1}\left(\frac{64}{283.95}\right)$

$= 12.701$

$= 12.7°$ #

[Alt]:
$\angle BCA = 180° - 90° - 34.605°$

$= 55.395°$.

$\sin 55.395° = \frac{opp}{345}$ — [M1] (ecf)

$opp = 345 \sin 55.395°$

$= 283.95$.

[Alt]:
Area of $\triangle ABC = \frac{1}{2} \times 500 \times 345$

$= 86250$.

$AC = \sqrt{500^2 + 345^2}$

$= 607.47$

$\frac{1}{2} \times 607.49 \times h = 86250$ — [M1]

$h = 283.96$

* penalise accuracy if not in 1dp.

Answer .....12.7..... — A1 ..... ° [3]

END OF PAPER

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