



MINISTRY OF EDUCATION, SINGAPORE
in collaboration with
CAMBRIDGE ASSESSMENT INTERNATIONAL EDUCATION
General Certificate of Education Ordinary Level

CANDIDATE
NAME



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MATHEMATICS

4052/01

Paper 1

October/November 2023

2 hours 15 minutes

Candidates answer on the Question Paper.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, index number and name on all the work you hand in.
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.
DO NOT WRITE ON ANY BARCODES.

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 with the answer.
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.

This document consists of **19** printed pages and **1** blank page.



Singapore Examinations and Assessment Board



Cambridge Assessment
International Education



Mathematical Formulae

Compound interest

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

Mensuration

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

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

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

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

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

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

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

Trigonometry

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

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

Statistics

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

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





Answer all the questions.

- 1 Sima and Ken share \$480 in the ratio 9 : 7.

Find the amount each receives.

$$\begin{aligned} 16 \text{ units} &= \$480 \\ 1 \text{ unit} &= \$30 \\ \therefore 9 \text{ units} &= \$30 \times 9 = \$270 \\ 7 \text{ units} &= \$30 \times 7 = \$210 \end{aligned}$$

Answer Sima \$.....270.....

Ken \$.....210.....

[2]

- 2 (a) $\sin x^\circ = 0.9301$

Find two possible values of x in the range $0 \leq x \leq 180$.

$$\begin{aligned} \text{Basic angle for } x &= 68.5^\circ \\ \therefore x &= 68.5^\circ \text{ or } 180^\circ - 68.5^\circ \\ &= 111.5^\circ \end{aligned}$$

Answer68.5° or111.5° [2]

- (b) Convert 1.36 radians into degrees.

$$1.36 \times \frac{180^\circ}{\pi} = 77.9^\circ$$

Answer77.9° [1]

- 3 (a) Simplify $(2c^3d^2)^3$.

$$2^3 c^9 d^6 = 8c^9d^6$$

Answer8c⁹d⁶ [1]

- (b) $16 \times 5^4 + 9 \times 25^2 = 5^k$

Use the laws of indices to find the value of k .
Show your working.

$$\begin{aligned} 16 \times 5^4 + 9 \times (5^2)^2 &= 5^k \\ (16 \times 5^4) + (9 \times 5^4) &= 5^k \\ 25 \times 5^4 &= 5^k \\ 5^2 \times 5^4 &= 5^k \end{aligned}$$

$$\begin{aligned} \therefore 5^6 &= 5^k \\ \rightarrow k &= 6 \end{aligned}$$

Answer $k =$ 6 [2]





- 4 (a) $M = p^{16} \times q^8 \times r^{12}$ where p , q and r are prime numbers.

Explain why M is a perfect square.

8, 12 and 16 are divisible by 2 and M can be expressed as $M = (p^8 q^4 r^6)^2$. [1]

- (b) The number $S = 2^8 \times 7^{10} \times 11^{15}$.

- (i) The number $N = S \times k$ is a perfect cube.

Find the smallest possible integer value of k .

Give your answer as a product of its prime factors.

For N to be a perfect cube number,
 $N = (2^8 \times 7^{10} \times 11^{15}) \times (2 \times 7^2)$

Answer $k = \dots\dots\dots 2 \times 7^2 \dots\dots\dots$ [1]

- (ii) The number $T = 2^{20} \times 7^8 \times 11^{15}$.

Find the lowest common multiple (LCM) of S and T as a product of its prime factors.

$$S = 2^8 \times 7^{10} \times 11^{15}$$

$$T = 2^{20} \times 7^8 \times 11^{15}$$

$$\text{LCM} = 2^{20} \times 7^{10} \times 11^{15}$$

Answer $\dots\dots\dots 2^{20} \times 7^{10} \times 11^{15} \dots\dots\dots$ [1]

- 5 Ravi invests \$4500 at a rate of 0.25% per month compound interest.

- (a) Explain why the first year's interest is not 3% of \$4500.

The principal sum increases every month after interest is added. Hence, the first year's interest is more than 3% of \$4500. [1]

- (b) Calculate the value of his investment at the end of 12 months.

$$\begin{aligned} A &= P \left(1 + \frac{r}{100}\right)^n \\ &= 4500 \left(1 + \frac{0.25}{100}\right)^{12} \\ &= \$4636.87 \end{aligned}$$

Answer \$ $\dots\dots\dots 4636.87 \dots\dots\dots$ [2]

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6 The expression $x^2 - 14x + b$ is equivalent to $(x+a)^2 - 25$.

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

$$x^2 - 14x + b = (x - 7)^2 - 7^2 + b$$

$$\text{By comparison, } a = -7$$

$$-7^2 + b = -25$$

$$b = -25 + 49 = 24$$

$$\text{Answer } a = \dots -7 \dots$$

$$b = \dots 24 \dots$$

[2]

(b) The curve $y = x^2 - 14x + b$ is drawn.

Write down the equation of the line of symmetry of the curve.

$$\text{Answer } \dots x = 7 \dots [1]$$

7 (a) Adrian has 550 stamps in his collection.
He increases his number of stamps by 18%.

Find the number of stamps in his collection now.

$$\frac{118}{100} \times 550 = 649$$

$$\text{Answer } \dots 649 \dots [2]$$

(b) Mai collects postcards.
28% of the postcards are from Australia.
55% of the remaining postcards are from Europe.
The other 81 postcards are from Asia.

Calculate the total number of postcards in her collection.

$$55\% \times 0.72 = 0.396$$

39.6% of her postcards are from Europe.

$$100\% - 28\% - 39.6\% = 32.4\% \text{ from Asia.}$$

$$32.4\% = 81 \text{ postcards}$$

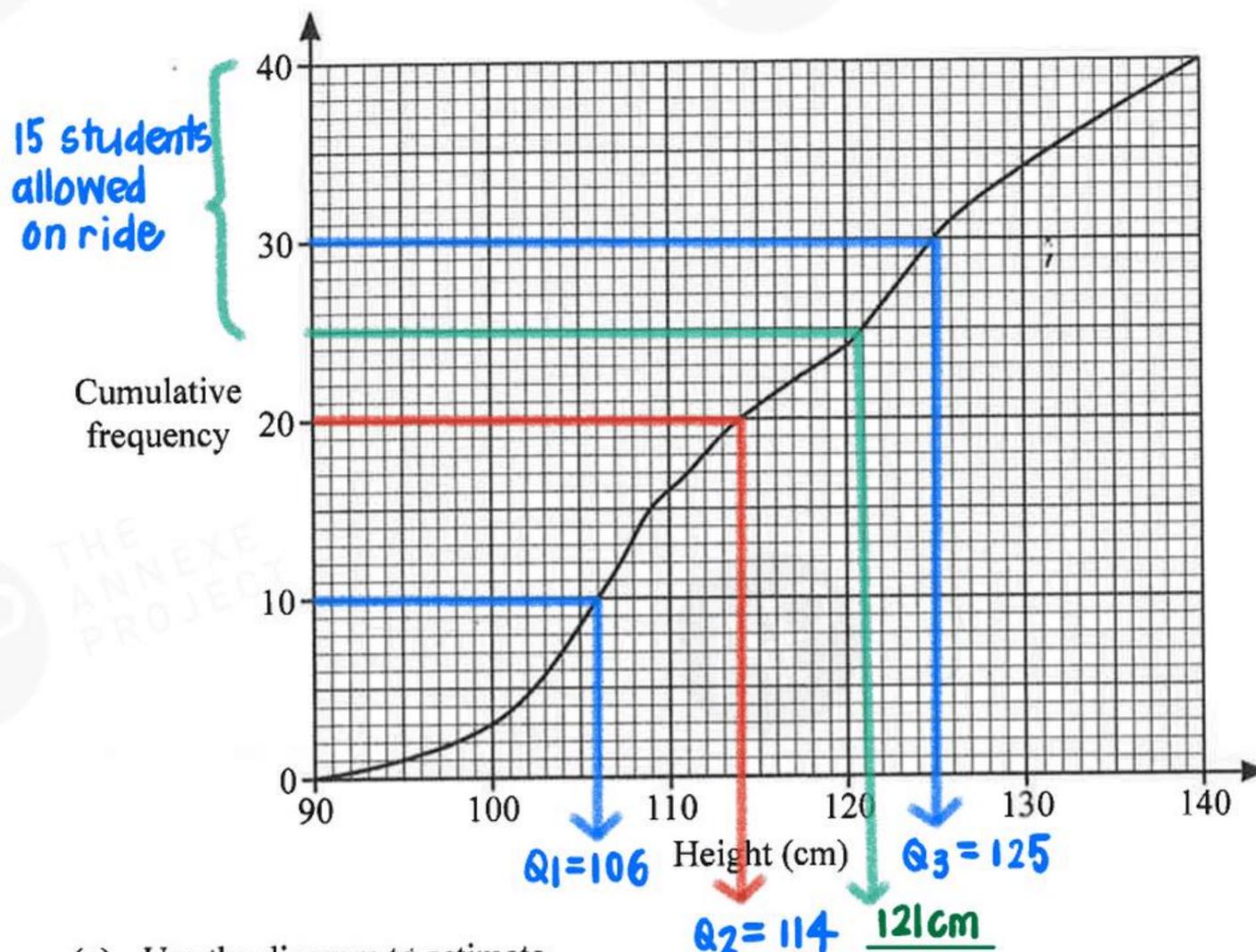
$$100\% = \frac{81}{32.4} \times 100 = 250$$

$$\text{Answer } \dots 250 \dots [3]$$





- 8 A group of 40 children visit a theme park. The cumulative frequency diagram represents their heights.



- (a) Use the diagram to estimate
 (i) the median height of the children,

Answer 114 cm [1]

- (ii) the interquartile range of the heights.

$125 - 106 = 19$

Answer 19 cm [2]

- (b) To be allowed on a particular ride at the theme park, children must be of a minimum height, h cm. Only 15 of these children are allowed on the ride.

Find the value of h .

• Refer to working on graph above.

Answer $h =$ 121 cm [1]

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(c) The information on the cumulative frequency diagram is shown in this table.

Height (H cm)	$90 < H \leq 100$	$100 < H \leq 110$	$110 < H \leq 120$	$120 < H \leq 130$	$130 < H \leq 140$
Frequency	3	13	8	10	6

(i) Calculate an estimate of the mean height of the children.

$$\frac{(3 \times 95) + (13 \times 105) + (8 \times 115) + (10 \times 125) + 6(135)}{40} = 115.75$$

Answer 115.75 cm [1]

(ii) Calculate an estimate of the standard deviation of the heights.

$$\text{Standard deviation} = \sqrt{\frac{\sum fx^2}{\sum f} - \left(\frac{\sum fx}{\sum f}\right)^2} = \sqrt{\frac{541800}{40} - \left(\frac{4630}{40}\right)^2} = 12.122$$

Answer 12.122 cm [1]

9 Anhaa travels from Singapore to France.

She wants to change 780 Singapore dollars (\$) into euros (€).
She would receive €1 more if she changes the money in Singapore.

The exchange rate in France is €1 = \$1.5953.

Calculate the exchange rate in Singapore.
Give your answer in euros per Singapore dollar.

In France, she receives $\frac{780}{1.5953} = €488.94$.

In Singapore, she would have received €489.94.

$$\begin{aligned} \rightarrow \$780 &= €489.94 \\ \$1 &= €0.62684 \end{aligned}$$

Answer \$1 = €..... 0.62684 [2]

10 A is the point $(-2, 3)$ and B is the point (p, q) .

The gradient of the line AB is $\frac{1}{3}$.

Find p in terms of q .
Give your answer in its simplest form.

$$\begin{aligned} \frac{q-3}{p-(-2)} &= \frac{1}{3} \\ 3q-9 &= p+2 \\ p &= 3q-11 \end{aligned}$$

Answer $p =$ 3q-11 [2]





11 Write as a single fraction in its simplest form $\frac{3a}{4a-1} - \frac{2}{3a+1}$.

$$\begin{aligned} \frac{3a}{4a-1} - \frac{2}{3a+1} &= \frac{3a(3a+1) - 2(4a-1)}{(4a-1)(3a+1)} \\ &= \frac{9a^2 + 3a - 8a + 2}{(4a-1)(3a+1)} \\ &= \frac{9a^2 - 5a + 2}{(4a-1)(3a+1)} \end{aligned}$$

$$\text{Answer } \frac{9a^2 - 5a + 2}{(4a-1)(3a+1)} \quad [2]$$

12 (a) Factorise completely.

(i) $x^3y + xy^3 = xy(x^2 + y^2)$

$$\text{Answer } xy(x^2 + y^2) \quad [1]$$

(ii) $15cd - 10ce + 12d^2 - 8de$

$$\begin{aligned} &= 5c(3d - 2e) + 4d(3d - 2e) \\ &= (5c + 4d)(3d - 2e) \end{aligned}$$

$$\text{Answer } (5c + 4d)(3d - 2e) \quad [2]$$

(b) Expand and simplify $(2x + 3a)(5x - 2a)$.

$$\begin{aligned} (2x + 3a)(5x - 2a) &= 10x^2 - 4ax + 15ax - 6a^2 \\ &= 10x^2 + 11ax - 6a^2 \end{aligned}$$

$$\text{Answer } 10x^2 + 11ax - 6a^2 \quad [2]$$





13 A bag contains 12 red marbles, 7 white marbles and 6 blue marbles.

A further n white marbles are added to the bag.

The probability of picking a white marble is now $\frac{3}{5}$.

Find the value of n .

$$\frac{7+n}{25+n} = \frac{3}{5}$$

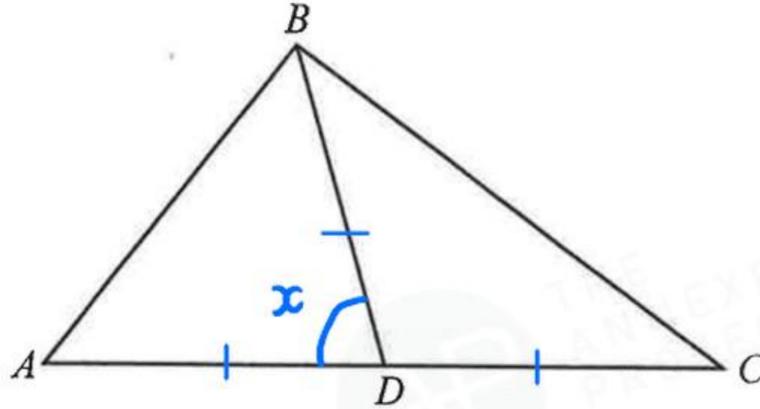
$$35 + 5n = 75 + 3n$$

$$2n = 40$$

$$n = 20$$

Answer $n = \dots\dots\dots 20 \dots\dots\dots$ [2]

14



ABC is a triangle.

D is a point on AC such that it is equidistant from A , B and C .

Explain why angle ABC is a right angle.

$$AD = BD = DC.$$

$$\text{Let } \angle ADB = x^\circ, \text{ then } \angle ABD = \frac{180^\circ - x^\circ}{2} = \left(90 - \frac{x}{2}\right)^\circ \text{ (base } \angle\text{s of an isos. } \triangle)$$

$$\angle BDC = 180^\circ - x^\circ \text{ (} \angle\text{s on a straight line)}$$

$$\angle CBD = \frac{180^\circ - (180^\circ - x^\circ)}{2} = \frac{x^\circ}{2} \text{ (base } \angle\text{s of an isos. } \triangle)$$

$$\angle ABC = \angle ABD + \angle CBD = \left(90 - \frac{x}{2}\right)^\circ + \frac{x}{2}^\circ = 90^\circ.$$

[2]

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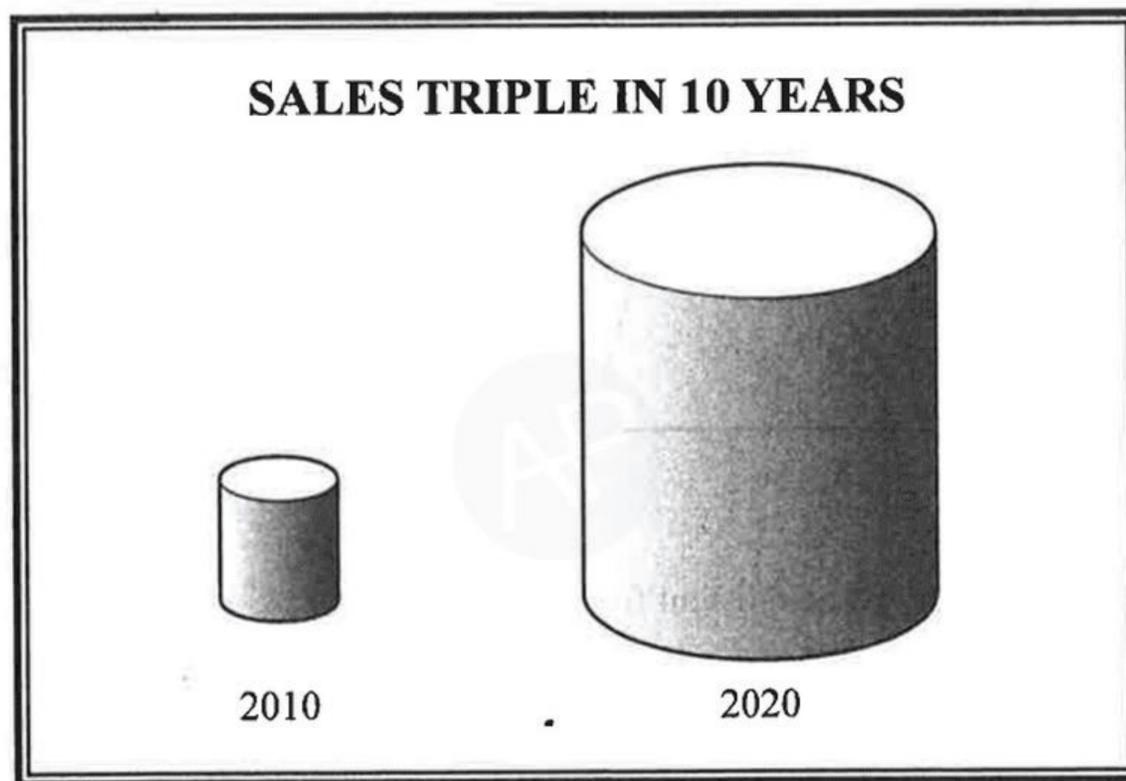
- 15 Explain why $(2n-1)^2 - 2(n-5)(2n-1)$ is a multiple of 3 for all integer values of n .

Answer

$$\begin{aligned}
 (2n-1)^2 - 2(n-5)(2n-1) &= 4n^2 - 4n + 1 - 2(2n^2 - 11n + 5) \\
 &= 4n^2 - 4n + 1 - 4n^2 + 22n - 10 \\
 &= 18n - 9 \\
 &= 3(6n - 3)
 \end{aligned}$$

Since $(2n-1)^2 - 2(n-5)(2n-1) = 3(6n-3)$, it is divisible by 3 and it is a multiple of 3 for all integer values of n . [3]

- 16 A company sells tinned food.
The company displays the sales figures with this chart.



The chart shows drawings of two geometrically similar solids. The dimensions of the tin for 2020 are three times the corresponding dimensions of the tin for 2010.

The chart is misleading.

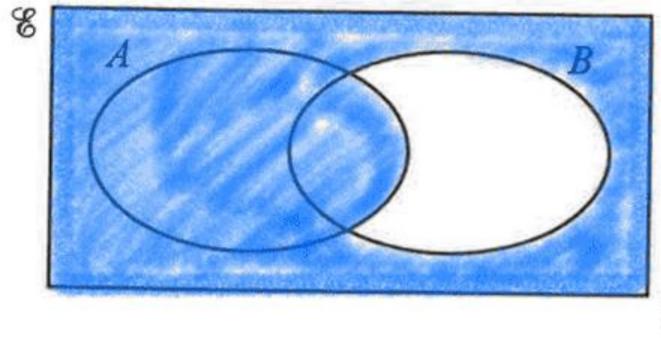
Explain what it implies about the company's sales of tinned food.

Length ratio of 1:3 implies that volume ratio is 1:27.
Hence, the diagram could mislead consumers to believing that sales could have been 27 times of 2010 in 2020! [1]



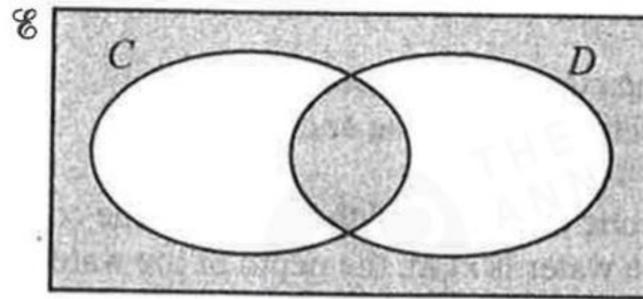


17 (a) On the Venn diagram, shade the region which represents $A \cup B'$.



[1]

(b) Use set notation to describe the shaded region.



Answer $(C \cup D)' \cup (C \cap D)$ [1]



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18

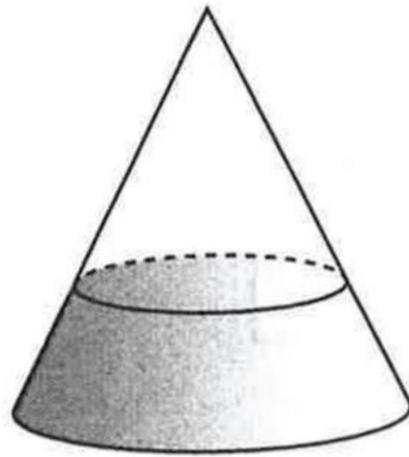


Diagram A

12

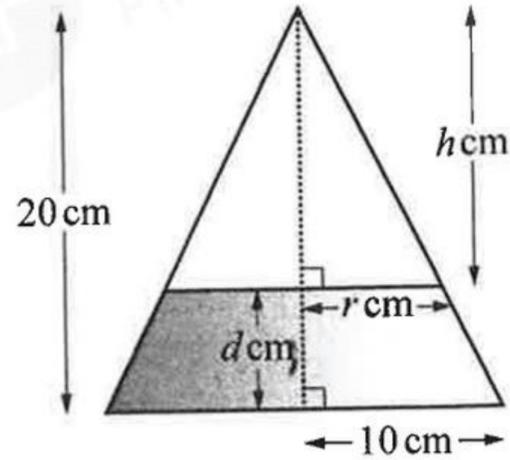


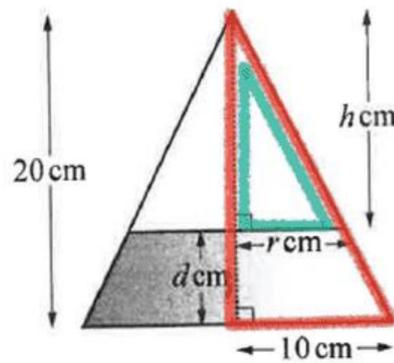
Diagram B

Diagram A shows a sealed cone containing some water.
Diagram B shows the cross-section of the cone and water.

The radius of the base of the cone is 10 cm and the height of the cone is 20 cm.
The radius of the surface of the water is r cm, the depth of the water is d cm and the surface of the water is h cm below the top of the cone.

- (a) Show that the depth of the water, d , is $20 - 2r$.

Answer

By similar \triangle s:

$$\frac{20-d}{20} = \frac{r}{10}$$

$$200 - 10d = 20r$$

$$d = \frac{200 - 20r}{10} = 20 - 2r$$

[1]

- (b) The volume of water in the cone is equal to the volume of the empty space in the cone.

Calculate d .

$$2 \times \frac{1}{3} \pi r^2 h = \frac{1}{3} \pi (10)^2 (20)$$

$$r^2 h = 1000$$

$$r^2 (20 - d) = 1000$$

$$r^2 [20 - (20 - 2r)] = 1000$$

$$r^2 (2r) = 1000$$

$$r^3 = 500$$

$$r = \sqrt[3]{500} = 7.9370$$

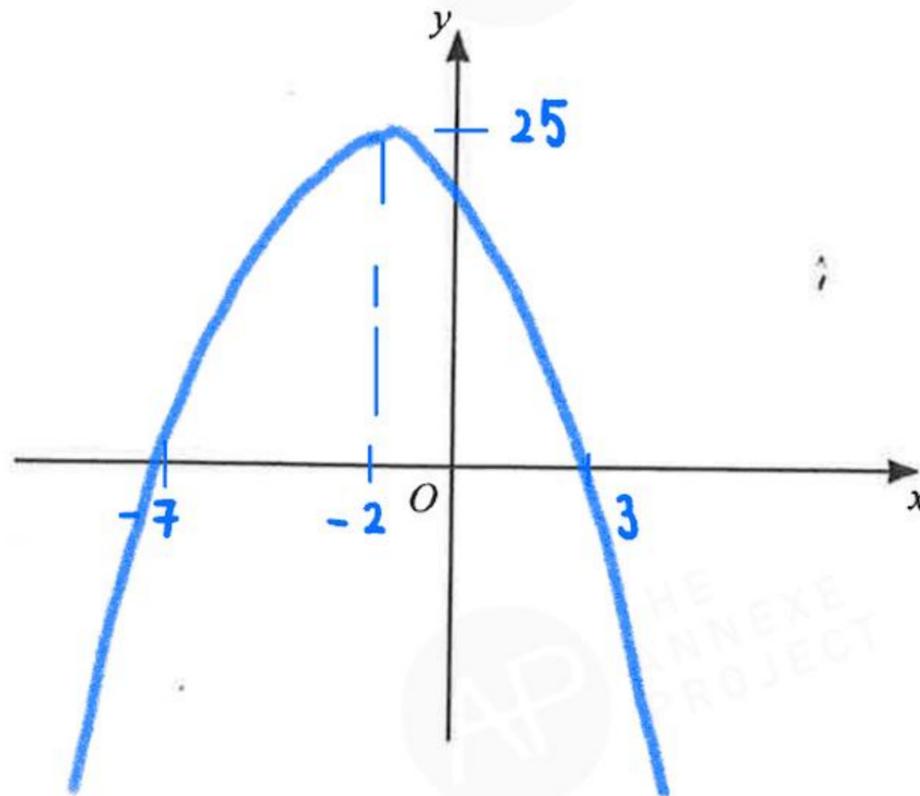
$$\therefore d = 20 - 2(7.9370) = 4.1260 = 4.13 \text{ cm}$$

Answer $d = \dots\dots\dots 4.13 \text{ cm} \dots\dots\dots$ [3]





- 19 Sketch the graph of $y = -(x-3)(x+7)$ on the axes below. Indicate clearly the points where the graph crosses the axes.



[2]

- 20 Simplify $\frac{3x^2 - 8x - 16}{(2x+1)^2 - (x+3)^2}$.

$$\begin{aligned} \frac{3x^2 - 8x - 16}{(2x+1)^2 - (x+3)^2} &= \frac{(3x+4)(x-4)}{[(2x+1)+(x+3)][(2x+1)-(x+3)]} \\ &= \frac{\cancel{(3x+4)}(x-4)}{\cancel{(3x+4)}(x-2)} = \frac{(x-4)}{(x-2)} \end{aligned}$$

Answer [3]



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- 21 A shop sells bags of groundnuts and walnuts.

A bag of groundnuts contains 25.8 g of protein, 49.2 g of fat and 16.1 g of carbohydrate and costs \$1.60.
A bag of walnuts contains x g of protein, 68.5 g of fat and 4.2 g of carbohydrate and costs \$2.80.

The contents of the bags can be represented by the matrix $A = \begin{pmatrix} 25.8 & 49.2 & 16.1 \\ x & 68.5 & 4.2 \end{pmatrix}$.

2×3

Namita buys 4 bags of groundnuts and 3 bags of walnuts.
Sian buys 5 bags of groundnuts and 2 bags of walnuts.

This information can be represented by the matrix $B = \begin{pmatrix} 4 & 3 \\ 5 & 2 \end{pmatrix}$.

2×2

- (a) Find, in terms of x , the matrix $T = BA$.

$$T = \begin{pmatrix} 4 & 3 \\ 5 & 2 \end{pmatrix} \begin{pmatrix} 25.8 & 49.2 & 16.1 \\ x & 68.5 & 4.2 \end{pmatrix} = \begin{pmatrix} 4 \times 25.8 + 3x & 4 \times 49.2 + 3 \times 68.5 & 4 \times 16.1 + 3 \times 4.2 \\ 5 \times 25.8 + 2x & 5 \times 49.2 + 2 \times 68.5 & 5 \times 16.1 + 2 \times 4.2 \end{pmatrix}$$

$$= \begin{pmatrix} 103.2 + 3x & 402.3 & 77 \\ 129 + 2x & 383 & 88.9 \end{pmatrix}$$

2×3 matrix

[2]

- (b) The nuts bought by Namita contain 5.6 g more protein than Sian's nuts.

Find the value of x .

$$103.2 + 3x = 129 + 2x + 5.6$$

$$x = 31.4$$

Answer $x = \dots\dots\dots 31.4 \dots\dots\dots$ [2]

- (c) The elements of the matrix M , where $M = BD$, represent the total cost, in dollars, of the bags of nuts bought by Namita and Sian.

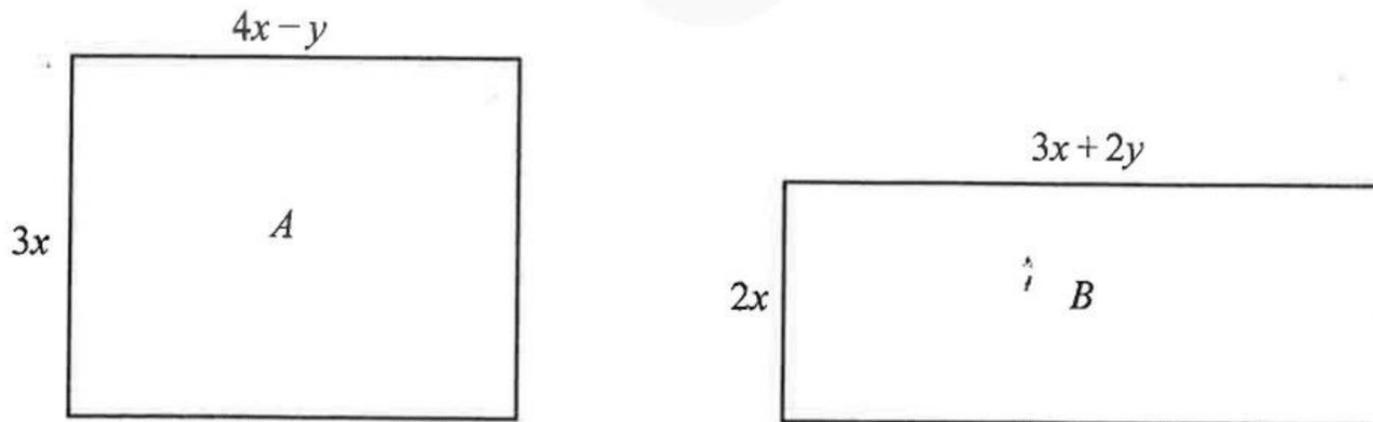
Write down the matrix D .

Answer $D = \begin{pmatrix} 1.60 \\ 2.80 \end{pmatrix}$ [1]





- 22 The diagram shows two rectangles, A and B .
The dimensions, in centimetres, of the two rectangles are shown.



- (a) The two rectangles have equal areas.

Find y in terms of x .

Give your answer in its simplest form.

$$(4x - y)(3x) = (3x + 2y)(2x)$$

$$12x^2 - 3xy = 6x^2 + 4xy$$

$$6x^2 = 7xy$$

$$y = \frac{6}{7}x$$

Answer $y = \dots\dots\dots \frac{6}{7}x \dots\dots\dots$ [2]

- (b) The perimeter of rectangle B is 16 cm more than the perimeter of rectangle A .

Find the value of x .

$$2(3x + 2y + 2x) - 2(4x - y + 3x) = 16$$

Perimeter B Perimeter A

$$(10x + 4y) - (14x - 2y) = 16$$

$$-4x + 6y = 16$$

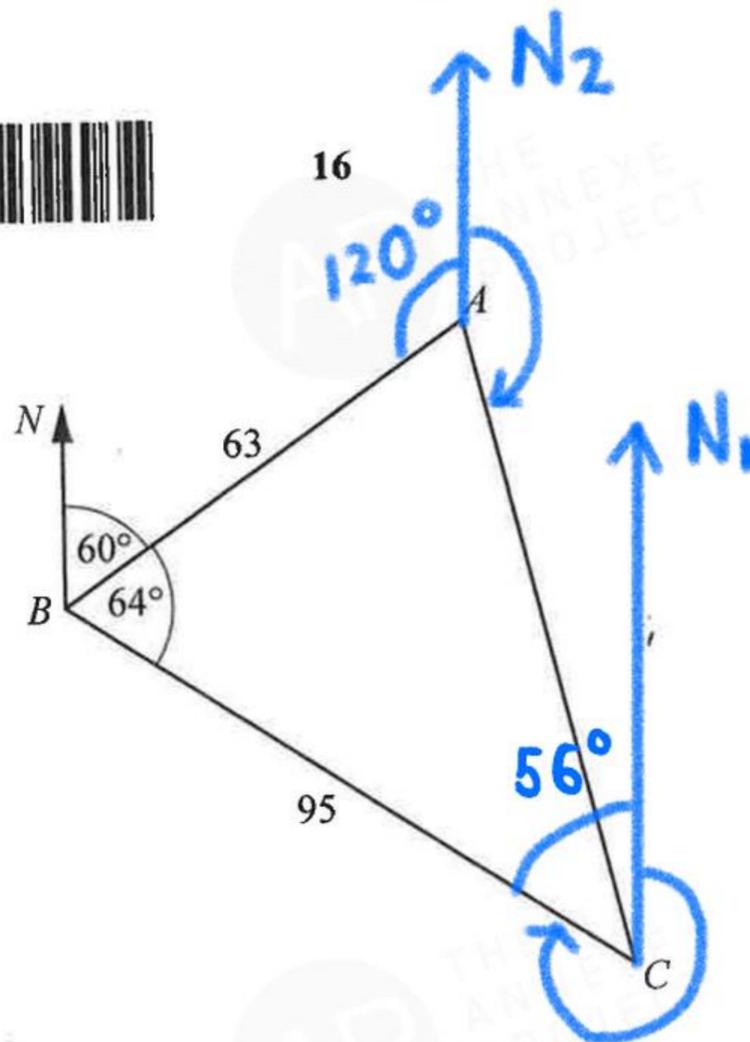
$$-4x + 6\left(\frac{6}{7}x\right) = 16$$

$$\frac{8}{7}x = 16$$

$$x = 14$$

Answer $x = \dots\dots\dots 14 \dots\dots\dots$ [3]





A , B and C are three points on horizontal ground.
 $BA = 63$ m and the bearing of A from B is 060° .
 $BC = 95$ m and angle $ABC = 64^\circ$.

$$\angle BCN_1 = 180^\circ - (60^\circ + 64^\circ) = 56^\circ$$

- (a) Find the bearing of B from C .

$$\text{Bearing of } B \text{ from } C = 360^\circ - 56^\circ = 304^\circ$$

Answer [1]

- (b) Calculate the distance AC .

$$AC^2 = 95^2 + 63^2 - 2(95)(63)\cos 64^\circ$$

$$AC = 88.015 \\ = 88.0 \text{ m}$$

Answer $AC = 88.0$ m [3]

- (c) Calculate the bearing of C from A .

$$\angle BAN_2 = 180^\circ - 60^\circ = 120^\circ$$

By Sine Rule:

$$\frac{88.015}{\sin 64^\circ} = \frac{95}{\sin \angle BAC}$$

$$\therefore \angle BAC = 75.959^\circ$$

$$\therefore \text{bearing of } C \text{ from } A \\ = 360^\circ - 120^\circ - 75.959^\circ \\ = 164.0^\circ$$

Answer [3]



24 The intensity, I watts/m², of radiation from the Sun is inversely proportional to the square of the distance, D million km, from the Sun.

- (a) The average distance of Mars from the Sun is 228 million km.
The average distance of Earth from the Sun is 150 million km.
The intensity of the Sun's radiation at the Earth is approximately 1370 watts/m².

When Mars is at its average distance from the Sun, calculate the approximate intensity of the Sun's radiation.

$$I = \frac{K}{D^2}$$

$$1370 = \frac{K}{150^2}$$

$$\therefore K = 30\,825\,000$$

$$I = \frac{30\,825\,000}{228^2}$$

$$= 592.97$$

$$= 593 \text{ watts/m}^2$$

Answer **593** watts/m² [2]

- (b) Explain what happens to the intensity of the Sun's radiation when the distance from the Sun is doubled.

Intensity will decrease to $\frac{1}{4}$ of the original value. [1]

25 The **sum** of the first n terms of a linear sequence is $\frac{1}{2}n(5n+1)$.

- (a) Find the first 3 terms of the sequence.

$$S_n = \frac{1}{2}n(5n+1)$$

$$S_1 = T_1 = \frac{1}{2}(1)(5+1) = \underline{3}$$

$$S_2 = \frac{1}{2}(2)(10+1) = 11$$

$$\therefore S_2 = T_1 + T_2$$

$$11 = 3 + T_2$$

$$\therefore T_2 = \underline{8}$$

$$S_3 = \frac{1}{2}(3)(15+1) = \underline{24}$$

$$S_3 = T_1 + T_2 + T_3$$

$$24 = 3 + 8 + T_3$$

$$\therefore T_3 = 13$$

Answer **3** **8** **13** [2]

- (b) Find, in terms of n , an expression for the n th term of the sequence.

$$T_n = S_n - S_{n-1}$$

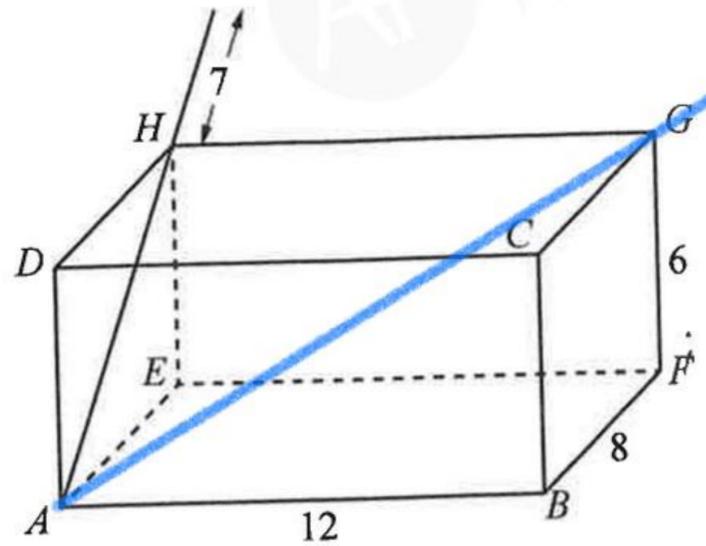
$$= \frac{1}{2}n(5n+1) - \frac{1}{2}(n-1)[5(n-1)+1]$$

$$= \frac{5}{2}n^2 + \frac{1}{2}n - \frac{1}{2}(n-1)(5n-4)$$

$$= \frac{5}{2}n^2 + \frac{1}{2}n - \frac{1}{2}(5n^2 - 9n + 4) = \underline{5n - 2}$$

Answer [1]





The diagram shows an open cuboid measuring 12 cm by 8 cm by 6 cm.

A rod is placed inside the cuboid against the face $AEHD$.
In this position, 7 cm of the rod is outside the cuboid.

The position of the rod is changed so that the length outside the cuboid is as short as possible.

Calculate this shortest length.

Step 1:

$$AH^2 = 6^2 + 8^2$$

$$AH = 10 \text{ cm.}$$

Step 2:

$$\text{Length of rod} = 10 + 7$$

$$= 17 \text{ cm.}$$

Step 3:

For shortest length of rod outside the cuboid, rod should be placed along AG .

Step 4:

$$AF^2 = 12^2 + 8^2$$

$$AF = \sqrt{208} \text{ cm.}$$

Step 5:

$$AG^2 = AF^2 + GF^2$$

$$AG^2 = 208 + 6^2$$

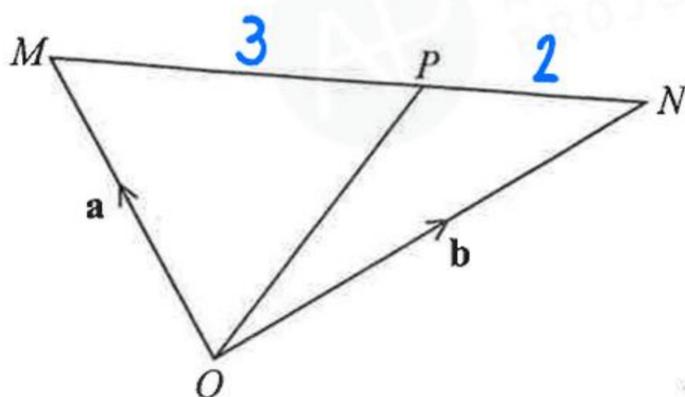
$$AG = 15.620 \text{ cm.}$$

$$17 - 15.620$$

$$= 1.38$$

Answer cm [4]





OMN is a triangle.

P is the point on MN such that $MP:PN = 3:2$.

$\vec{OM} = \mathbf{a}$ and $\vec{ON} = \mathbf{b}$.

(a) Show that $\vec{OP} = \frac{1}{5}(2\mathbf{a} + 3\mathbf{b})$.

Answer

$$\begin{aligned}\vec{MN} &= \vec{ON} - \vec{OM} \\ &= \mathbf{b} - \mathbf{a}\end{aligned}$$

$$\begin{aligned}\vec{MP} &= \frac{3}{5} \vec{MN} \\ &= \frac{3}{5} (\mathbf{b} - \mathbf{a})\end{aligned}$$

$$\vec{OP} = \vec{OM} + \vec{MP} = \mathbf{a} + \frac{3}{5}\mathbf{b} - \frac{3}{5}\mathbf{a} = \underline{\underline{\frac{1}{5}(2\mathbf{a} + 3\mathbf{b})}}$$

[2]

(b) Q is the point such that $\vec{MQ} = \frac{1}{5}(\mathbf{a} + 9\mathbf{b})$.

Explain why O , P and Q lie on a straight line.

Answer

$$\vec{MQ} = \vec{OQ} - \vec{OM}$$

$$\vec{OQ} = \vec{MQ} + \vec{OM}$$

$$= \frac{1}{5}\mathbf{a} + \frac{9}{5}\mathbf{b} + \mathbf{a} = \frac{6}{5}\mathbf{a} + \frac{9}{5}\mathbf{b} = \frac{3}{5}(2\mathbf{a} + 3\mathbf{b}) = 3\vec{OP}$$

if $\vec{OQ} = 3\vec{OP}$, $\vec{OQ} \parallel \vec{OP}$.

As O is the common point, O , P and Q must lie on a straight line.

[3]

