



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

CANDIDATE
NAME

CENTRE
NUMBER

S				
---	--	--	--	--

INDEX
NUMBER

--	--	--	--

MATHEMATICS

4052/01

Paper 1

For examination from 2023

SPECIMEN PAPER

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

© UCLES & MOE 2021

[Turn over

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

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

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

Answer **all** the questions.

- 1 Solve $7 - 8x = 25$.

$$7 - 25 = 8x$$

$$-18 = 8x$$

$$\therefore x = \frac{-18}{8} = \underline{-\frac{9}{4}} \text{ or } -2.25 \quad \text{Answer } x = \dots\dots\dots \underline{-\frac{9}{4}} \quad [1]$$

- 2 (a) Find the lowest common multiple (LCM) of 112 and 168.

$$\begin{array}{r|l} 2 & 112, 168 \\ \hline 2 & 56, 84 \\ 2 & 28, 42 \\ 7 & 14, 21 \\ & 2, 3 \end{array}$$

$$\begin{aligned} \text{LCM} &= 2^4 \times 3 \times 7 \\ &= \underline{336} \end{aligned}$$

$$\text{Answer } \dots\dots\dots \underline{336} \quad [2]$$

- (b) Find the highest common factor (HCF) of 112 and 168.

$$\begin{aligned} \text{HCF} &= 2^3 \times 7 \\ &= \underline{56} \end{aligned}$$

$$\text{Answer } \dots\dots\dots \underline{56} \quad [1]$$

- 3 (a) Calculate $\frac{302.6^2}{12.76 - 10.84}$.
Write your answer correct to 4 significant figures.

$$\text{Answer } \dots\dots\dots \underline{47\,690} \quad [1]$$

- (b) Write your answer to **part (a)** in standard form.

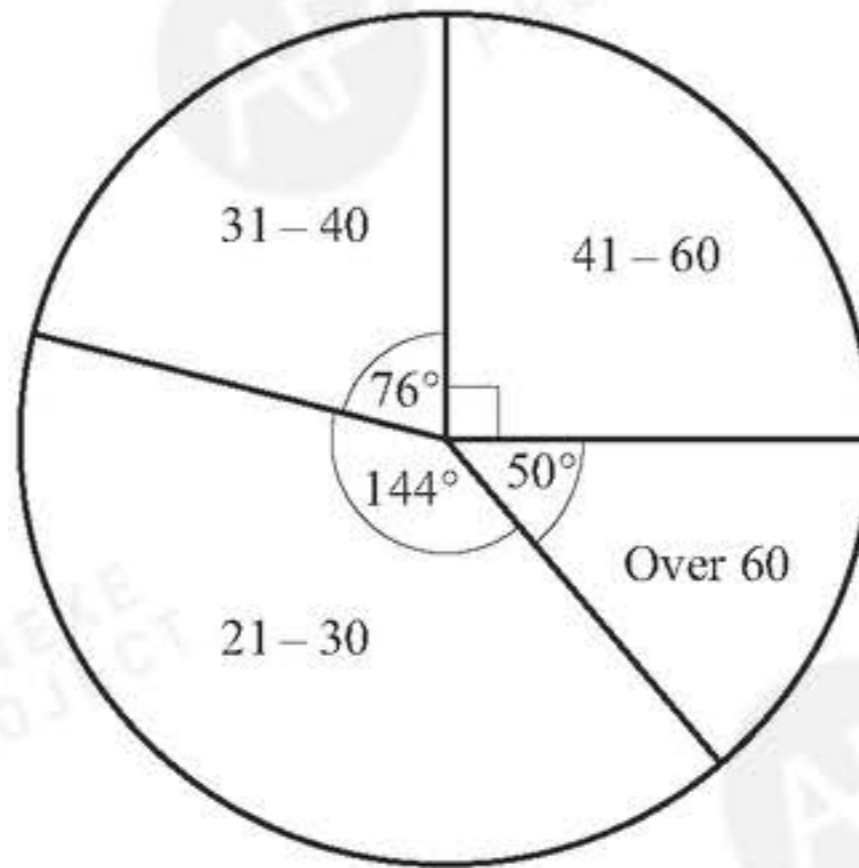
$$\text{Answer } \dots\dots\dots \underline{4.769 \times 10^4} \quad [1]$$

- 4 Expand and simplify $(3x - y)(2x + 3y)$.

$$\begin{aligned} &= 6x^2 + 9xy - 2xy - 3y^2 \\ &= 6x^2 + 7xy - 3y^2 \end{aligned}$$

$$\text{Answer } \dots\dots\dots \underline{6x^2 + 7xy - 3y^2} \quad [2]$$

- 5 A number of adults took part in a parachute jump.
This pie chart shows the age groups (in years) of the adults that took part in the jump.



- (a) Find the percentage of adults who are 21–30 years old, that took part in the parachute jump.

$$\frac{144^\circ}{360^\circ} \times 100\% = 40\%$$

Answer 40 % [1]

- (b) Explain why it is not possible to calculate the number of adults over 60 years old that took part in the parachute jump.

The number of adults of any age group is not given or the total number of adults is unknown. [1]

- 6 The expression $x^2 - 12x + 17$ can be written in the form $(x - 6)^2 + n$.

- (a) Find the value of n .

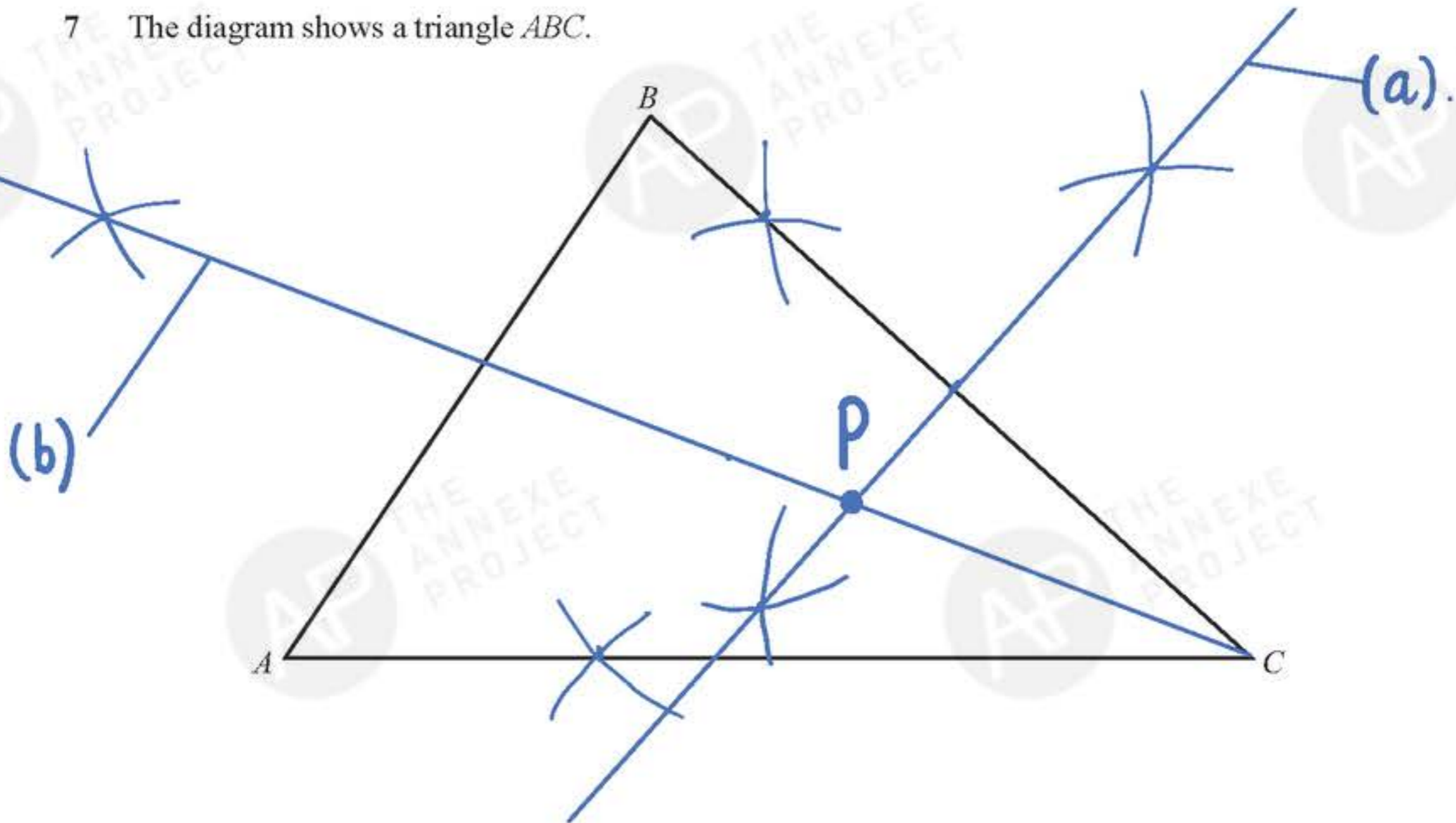
$$\begin{aligned} x^2 - 12x + 17 \\ = (x - 6)^2 - 6^2 + 17 \\ = (x - 6)^2 - 19 \end{aligned}$$

Answer $n =$ -19 [1]

- (b) Explain why when $x = 6$, the expression $x^2 - 12x + 17$ has its minimum value.

The minimum value of $(x - 6)^2$ is 0 when $x = 6$.
Since -19 is a constant, $(x - 6)^2 - 19$ is a minimum value of -19 when $x = 6$. [1]

7 The diagram shows a triangle ABC .



- (a) Construct the perpendicular bisector of BC . [1]
- (b) Construct the bisector of angle ACB . [1]
- (c) Point P is equidistant from B and C **and** equidistant from AC and BC .

Mark the point P on the diagram and measure the length CP .

Answer $CP = \dots\dots\dots$ cm [1]

8 $2 - \frac{5}{x} = x(x+2)$ can be written as $x^3 + ax^2 + bx + 5 = 0$.

Find the value of a and the value of b .

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

$$2 - \frac{5}{x} = x^2 + 2x$$

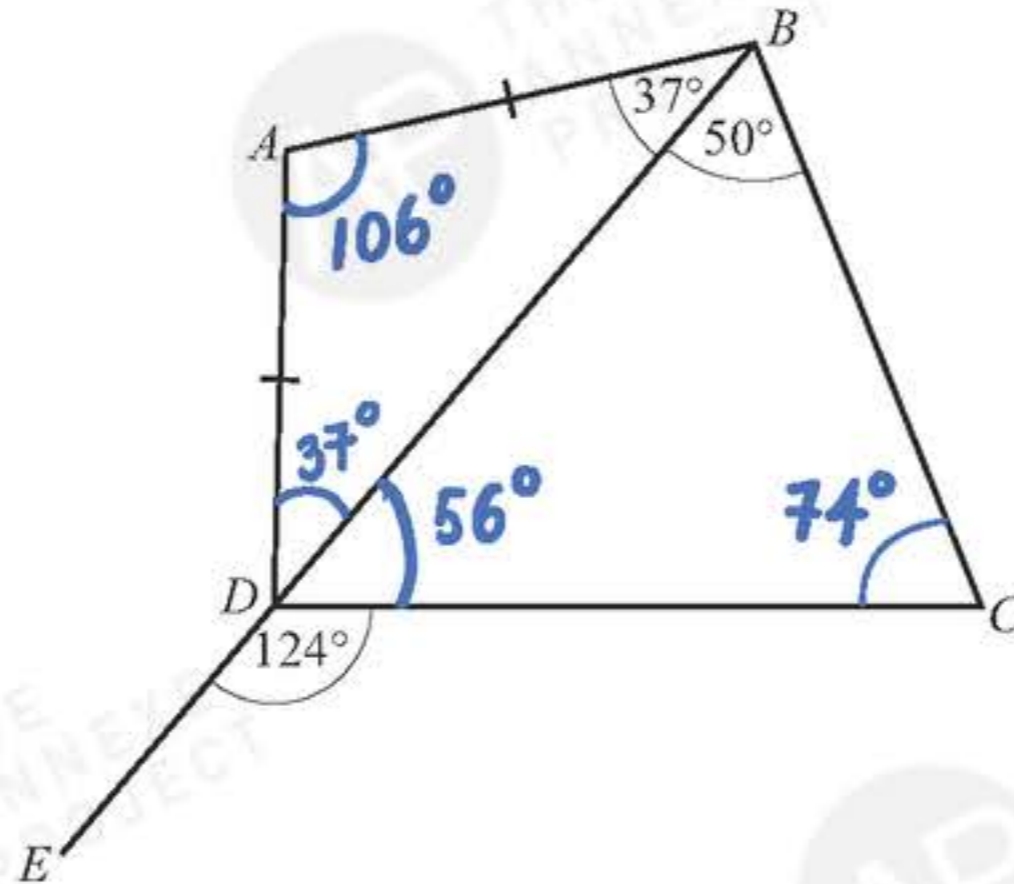
Multiply both sides by x :

$$2x - 5 = x^3 + 2x^2$$

$$x^3 + 2x^2 - 2x + 5 = 0$$

Answer $a = \dots\dots\dots 2$

$b = \dots\dots\dots -2$ [2]



In the diagram, BDE is a straight line and $AB = AD$.
 Angle $ABD = 37^\circ$, angle $CBD = 50^\circ$ and angle $CDE = 124^\circ$.

Explain why it is possible to draw a circle that passes through A , B , C and D .
 Give reasons for each step of your working.

$\angle ADB = 37^\circ$ ($\triangle ABD$ is isos. / base \angle s of isos. \triangle)
 $\angle DAB = 180^\circ - (2 \times 37^\circ) = 106^\circ$ (sum of \angle s in \triangle)
 $\angle BDC = 180^\circ - 124^\circ = 56^\circ$ (\angle s on str. line)
 $\angle BCD = 180^\circ - 56^\circ - 50^\circ = 74^\circ$ (sum of \angle s in \triangle)
 $\angle DAB + \angle BCD = 180^\circ$, $\angle ADC + \angle ABC = 180^\circ$
 $ABCD$ is a cyclic quad, hence a circle can pass through A, B, C and D . [3]

- 10 Min and Ken each have an amount of money.
 The ratio Min's amount : Ken's amount = 5 : 3.

Min gives Ken \$22.

The new ratio Min's amount : Ken's amount = 3 : 4.

Find how much money Min has now.

Let Min have $\$5x$. Then Ken has $\$3x$.

$$\frac{5x - 22}{3x + 22} = \frac{3}{4}$$

$$20x - 88 = 9x + 66$$

$$11x = 154$$

$$x = 14$$

$$5x - 22 = 5(14) - 22 = \$48$$

Answer \$..... **48** [4]

- 11 In a group of 20 people, 12 are males and 8 are females.
The mean weight of the group is 78kg.
The mean weight of the males is 84kg.

(a) Calculate the total weight of the group.

$$78 \times 20 = \underline{1560 \text{ kg}}$$

Answer 1560 kg [1]

(b) Calculate the mean weight of the females.

$$\frac{1560 - (84 \times 12)}{8} = \underline{69 \text{ kg}}$$

Answer 69 kg [2]

12 Simplify $\frac{4y^2 - 7y - 15}{y^3 - 9y} = \frac{(4y+5)(y-3)}{y(y^2-9)}$

$4y$	5	$5y$
y	-3	$+$
$4y^2$	-15	$-12y$
		$-7y$

$$= \frac{(4y+5)(y-3)}{y(y+3)(y-3)}$$

$$\frac{(4y+5)}{y(y+3)}$$

Answer $\frac{(4y+5)}{y(y+3)}$ [3]

13 Solve $\frac{x+1}{2} - \frac{x^2+1}{2x+3} = \frac{9}{2}$

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

$$\frac{2x^2 + 5x + 3 - 2x^2 - 2}{4x + 6} = \frac{9}{2}$$

$$2(5x + 1) = 9(4x + 6)$$

$$10x + 2 = 36x + 54$$

$$-52 = 26x$$

$$\therefore \underline{x = -2}$$

Answer $x =$ -2 [3]

14 Find the equation of the straight line passing through $(-2, 11)$ and $(5, -10)$.

$$\begin{aligned} \text{Step 1: gradient} &= \frac{-10 - 11}{5 - (-2)} \\ &= \frac{-21}{7} \\ &= \underline{-3} \end{aligned}$$

$$\begin{aligned} \text{Step 2: } y &= mx + c \\ -10 &= -3(5) + c \\ \therefore c &= \underline{5} \end{aligned}$$

Answer $y = -3x + 5$ [3]

15 (a) Simplify.

$$(i) \quad 9x^3 \times x^9 = 9x^{3+9} = \underline{9x^{12}}$$

Answer $9x^{12}$ [1]

$$\begin{aligned} (ii) \quad (16x^8)^{\frac{3}{4}} &= (2^4 x^8)^{\frac{3}{4}} \\ &= (2^4)^{\frac{3}{4}} (x^8)^{\frac{3}{4}} \\ &= 2^3 x^6 = \underline{8x^6} \end{aligned}$$

Answer $8x^6$ [2]

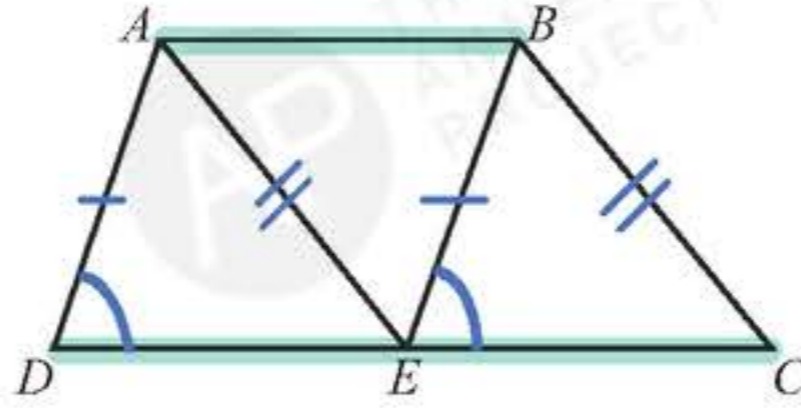
$$(b) \quad \frac{81^p}{3^q} = 27^r$$

Find an expression for q in terms of p and r .

$$\begin{aligned} \frac{3^{4p}}{3^q} &= 3^{3r} \\ 3^{4p-q} &= 3^{3r} \\ \therefore 4p - q &= 3r \\ \underline{q} &= \underline{4p - 3r} \end{aligned}$$

Answer $q =$ $4p - 3r$ [2]

16



$ABCD$ is a trapezium with E on DC such that AE is parallel to BC and BE is parallel to AD .

Show that triangle ADE and triangle BEC are congruent.
Give a reason for each statement you make.

Answer

- $ABCD$ is a trapezium $\rightarrow AB \parallel DE$.
Given $AD \parallel BE$, $ABED$ is a parallelogram.
Hence, $AD = BE$.
 - $ABCD$ is a trapezium $\rightarrow AB \parallel EC$.
Given $AE \parallel BC$, $ABCE$ is a parallelogram.
Hence, $AE = BC$.
 - Since $AD \parallel BE$, DEC is a straight line,
 $\angle ADE = \angle BEC$ (corr. \angle s).
- By SAS test, $\triangle ADE \equiv \triangle BEC$.

[3]

17 Factorise completely.

(a) $9wx + y - 3x - 3wy$

$$\begin{aligned} &= 9wx - 3wy + y - 3x \\ &= 3w(3x - y) + (y - 3x) \\ &= 3w(3x - y) - (3x - y) \\ &= \underline{(3w - 1)(3x - y)} \end{aligned}$$

Answer $(3w - 1)(3x - y)$ [2]

(b) $5x^4 - 80y^4$

$$\begin{aligned} &= 5(x^4 - 16y^4) \\ &= 5(x^2 - 4y^2)(x^2 + 4y^2) \\ &= \underline{5(x - 2y)(x + 2y)(x^2 + 4y^2)} \end{aligned}$$

Answer $5(x - 2y)(x + 2y)(x^2 + 4y^2)$ [3]

18 An aircraft has three sections, Business Class (B), Premium (P) and Economy (E).

On an outward flight there are 15 Business Class passengers, 80 Premium passengers and 152 Economy passengers.

On the return flight there are 13 Business Class passengers, 75 Premium passengers and x Economy passengers.

(a) Represent this information in a 2×3 matrix, S .

$$\text{Answer } S = \begin{matrix} & \begin{matrix} B & P & E \end{matrix} \\ \begin{matrix} \text{Outward} \\ \text{Return} \end{matrix} & \begin{pmatrix} 15 & 80 & 152 \\ 13 & 75 & x \end{pmatrix} \end{matrix} \quad [1]$$

(b) The cost of tickets are:

Business Class	\$280
Premium	\$120
Economy	\$90.

Find, in terms of x , the matrix $T = S \begin{pmatrix} 280 \\ 120 \\ 90 \end{pmatrix}$.

$$T = \begin{matrix} & \begin{matrix} 2 \times 3 & & 3 \times 1 \end{matrix} \\ \begin{pmatrix} 15 & 80 & 152 \\ 13 & 75 & x \end{pmatrix} & \begin{pmatrix} 280 \\ 120 \\ 90 \end{pmatrix} \end{matrix}$$

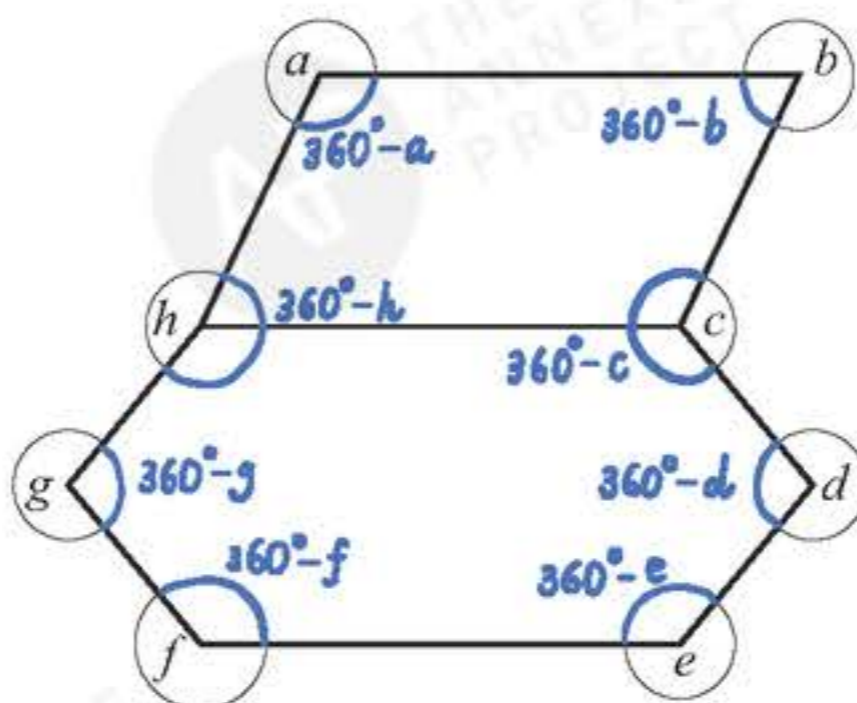
$$\text{Answer } T = \begin{pmatrix} 27480 \\ 12640 + 90x \end{pmatrix} \quad [2]$$

(c) The ticket sales of the return flight was \$1360 more than the ticket sales of the outward flight.

Find x .

$$\begin{aligned} 12640 + 90x &= 27480 + 1360 \\ 90x &= 16200 \\ x &= \underline{180} \end{aligned}$$

$$\text{Answer } x = \dots\dots\dots 180 \dots\dots\dots [1]$$



The diagram shows a shape made from a parallelogram and a hexagon.

Find the sum of the angles a, b, c, d, e, f, g and h .

Step 1: Total interior \angle s in parallelogram $= (4 - 2) \times 180^\circ$
 $= 360^\circ$

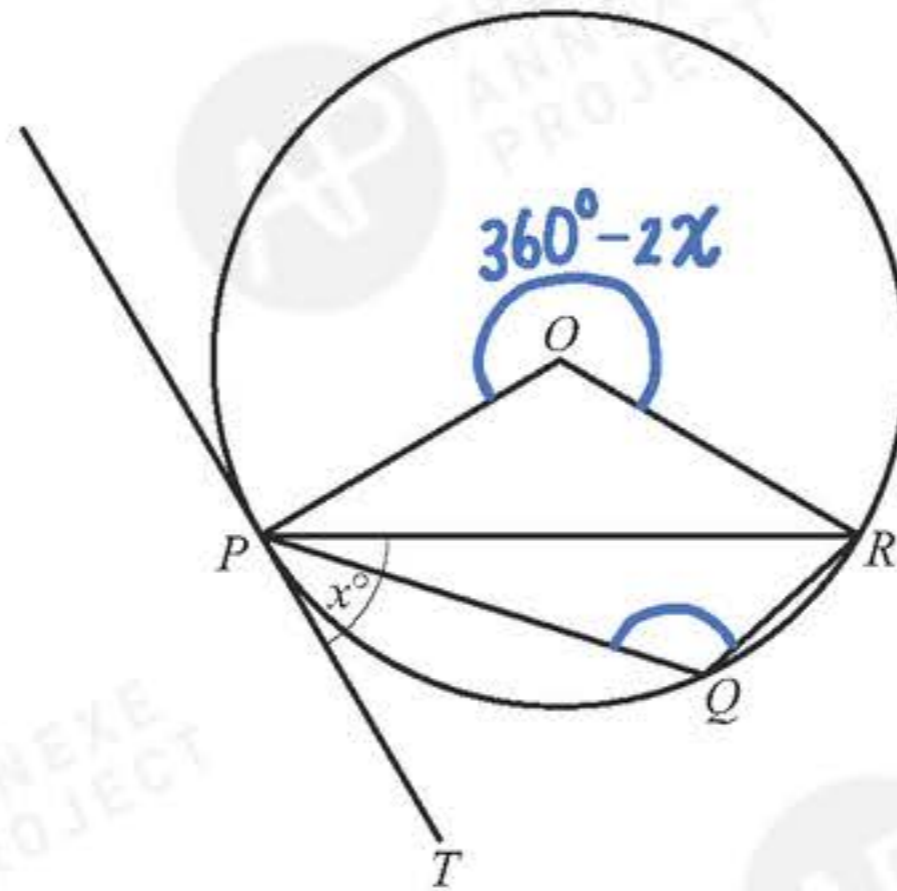
Total interior \angle s in a hexagon $= (6 - 2) \times 180^\circ$
 $= 720^\circ$

Step 2: $(360 - a) + (360 - b) + (360 - c)$
 $+ (360 - d) + (360 - e) + (360 - f)$
 $+ (360 - g) + (360 - h) = 360^\circ + 720^\circ$

$2880^\circ - (a + b + c + d + e + f + g + h) = 1080^\circ$

$\therefore a + b + c + d + e + f + g + h = 2880^\circ - 1080^\circ = \underline{1800^\circ}$

Answer [3]



P , Q and R are points on a circle, centre O .
 TP is a tangent to the circle and angle $TPR = x^\circ$.

Find, in terms of x , angle PQR .
 Give a reason for each step of your answer.

$$\angle OPR = 90^\circ - x \text{ (radius } \perp \text{ tangent)}$$

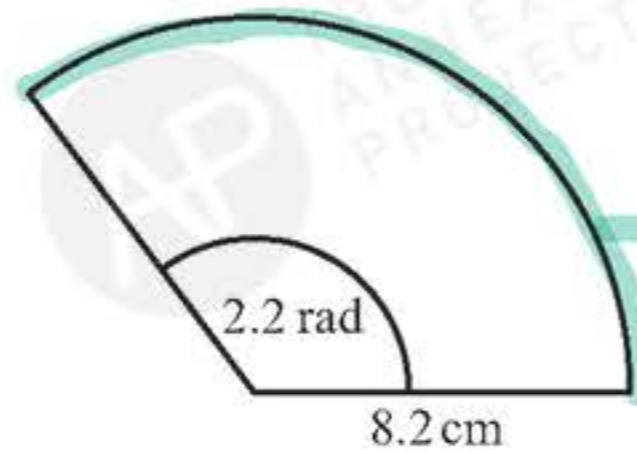
$$\angle ORP = \angle OPR = 90^\circ - x \text{ (OP = OR, base } \angle \text{s of isos. } \triangle)$$

$$\angle POR = 180^\circ - 2(90^\circ - x) = 2x \text{ (sum of } \angle \text{s in } \triangle)$$

$$\text{Reflex } \angle POR = 360^\circ - 2x$$

$$\therefore \angle PQR = (180 - x)^\circ \text{ (} \angle \text{ at } \odot = 2 \angle \text{ at circumference)}$$

Answer $(180 - x)^\circ$ [3]



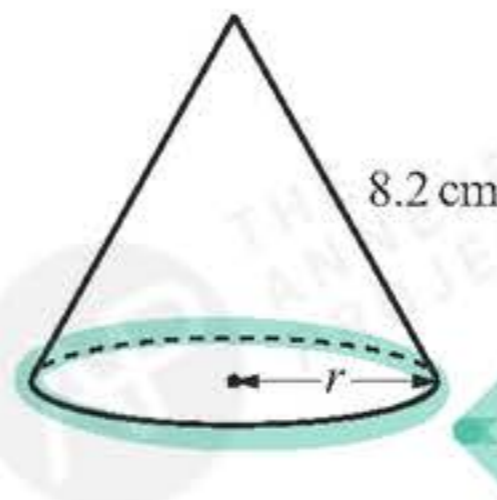
The diagram shows a sector of a circle with a sector angle of 2.2 radians and radius 8.2 cm.

- (a) Calculate the perimeter of the sector.

$$\begin{aligned} P &= r\theta + 8.2 + 8.2 \\ &= (8.2 \times 2.2) + 16.4 \\ &= 34.44 \end{aligned}$$

Answer **34.4** cm [2]

- (b) The sector is used to make a cone.



Calculate the base radius r .

$$\begin{aligned} 2\pi r &= 8.2 \times 2.2 \\ r &= \frac{8.2 \times 2.2}{2\pi} \\ &= 2.8712 \end{aligned}$$

Answer **2.87** cm [2]

- 22 (a) $\xi = \{\text{integers } x: 15 < x \leq 25\}$
 $A = \{\text{prime numbers}\}$
 $B = \{\text{multiples of } 5\}$

List the elements in

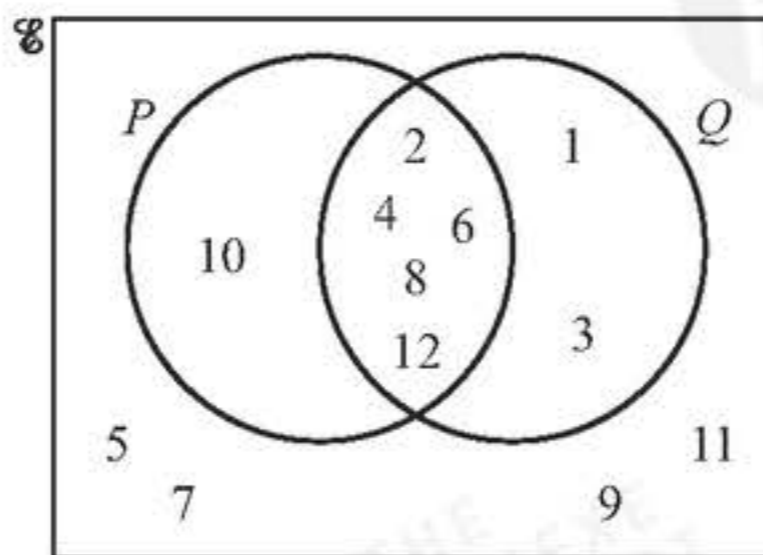
- (i) A ,

Answer **{17, 19, 23}** [1]

- (ii) $(A \cup B)'$.

Answer **{16, 18, 21, 22, 24}** [1]

- (b) The Venn diagram shows the elements of $\xi = \{\text{integers } x: 1 \leq x \leq 12\}$.



- (i) Underline the correct statement from the list below.

$$n(P) = 10 \quad P \cup Q = \{2, 4, 6, 8, 12\} \quad P' \subset Q$$

$$\underline{11 \notin P \cap Q} \quad P' \cap Q = \{5, 7, 9, 11\}$$

[1]

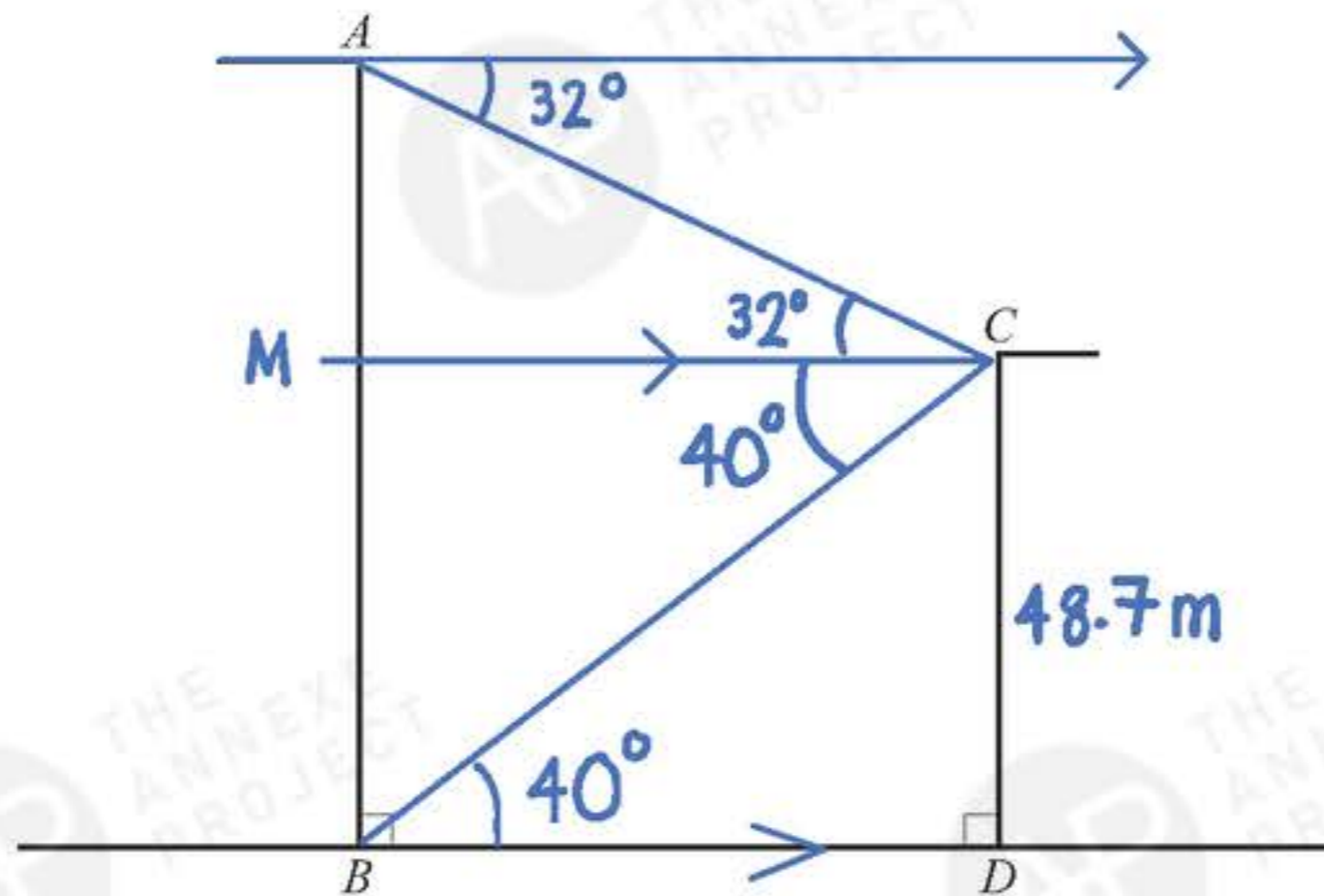
- (ii) Find the value of

(a) $n[(P \cap Q) \cup Q']$,

Answer **10** [1]

(b) $n[(P \cup Q) \cap (P \cap Q)']$.

Answer **3** [1]



In the diagram, AB and CD represent the sides of two buildings.
 The angle of elevation of C from B is 40° .
 The angle of depression of C from A is 32° .
 The height, $CD = 48.7$ m.

Calculate the height AB .

Refer to the above diagram:

$$\tan 40^\circ = \frac{48.7}{MC}$$

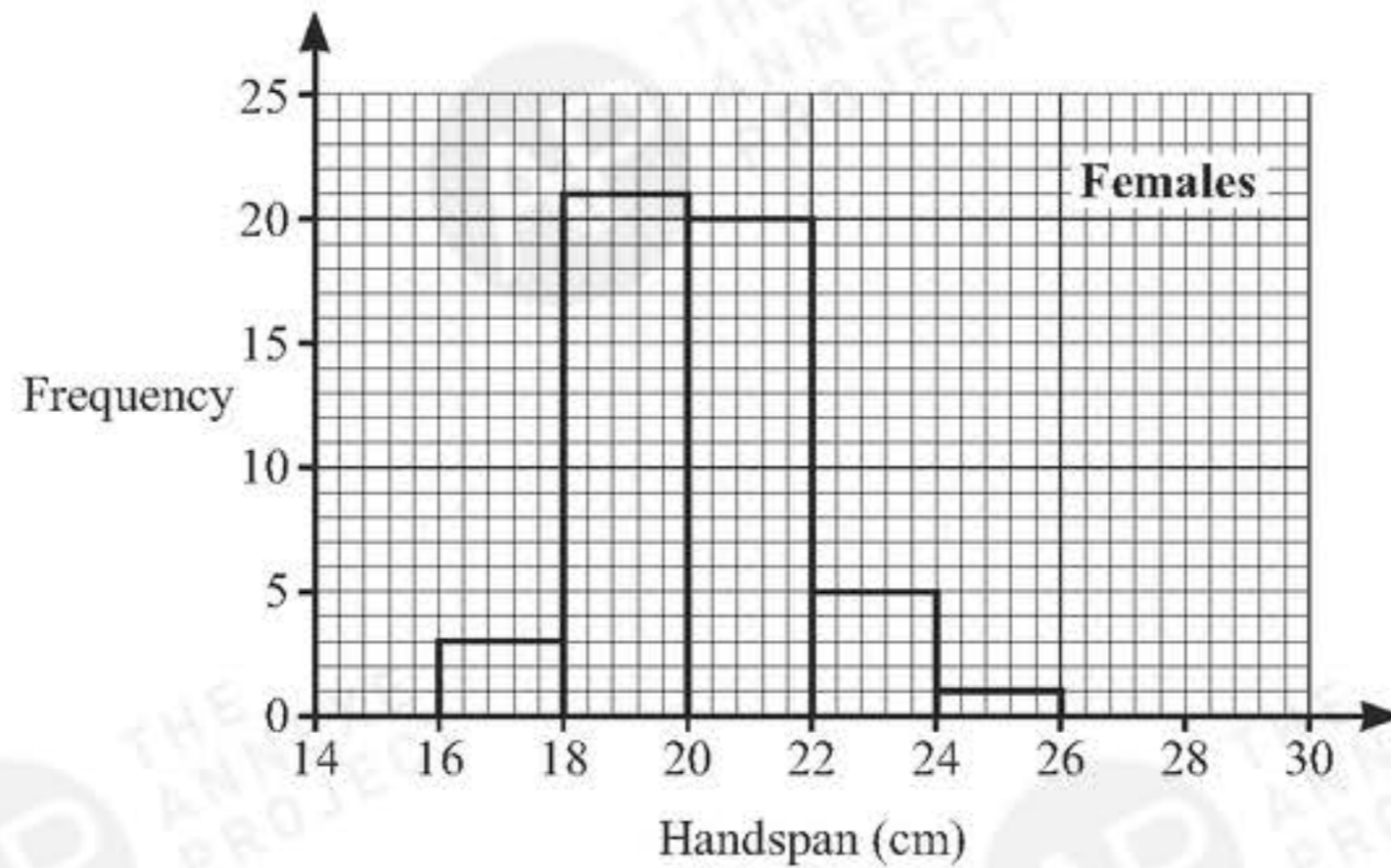
$$\therefore MC = 58.038 \text{ m}$$

$$\tan 32^\circ = \frac{AM}{58.038}$$

$$\therefore AM = 36.266 \text{ m}$$

$$\begin{aligned} AB &= AM + MB \\ &= 36.266 + 48.7 \\ &= 84.966 \\ &= 85.0 \end{aligned}$$

Answer m [5]



(a) The histogram shows the distribution of the handspans of 50 females.

(i) Find the probability that a female, chosen at random, has a handspan of at least 20 cm.

$$\frac{20+5+1}{50} = \frac{26}{50} = \frac{13}{25} \quad \text{Answer } \dots\dots\dots \frac{13}{25} \dots\dots\dots [2]$$

(ii) Which interval contains the median handspan?

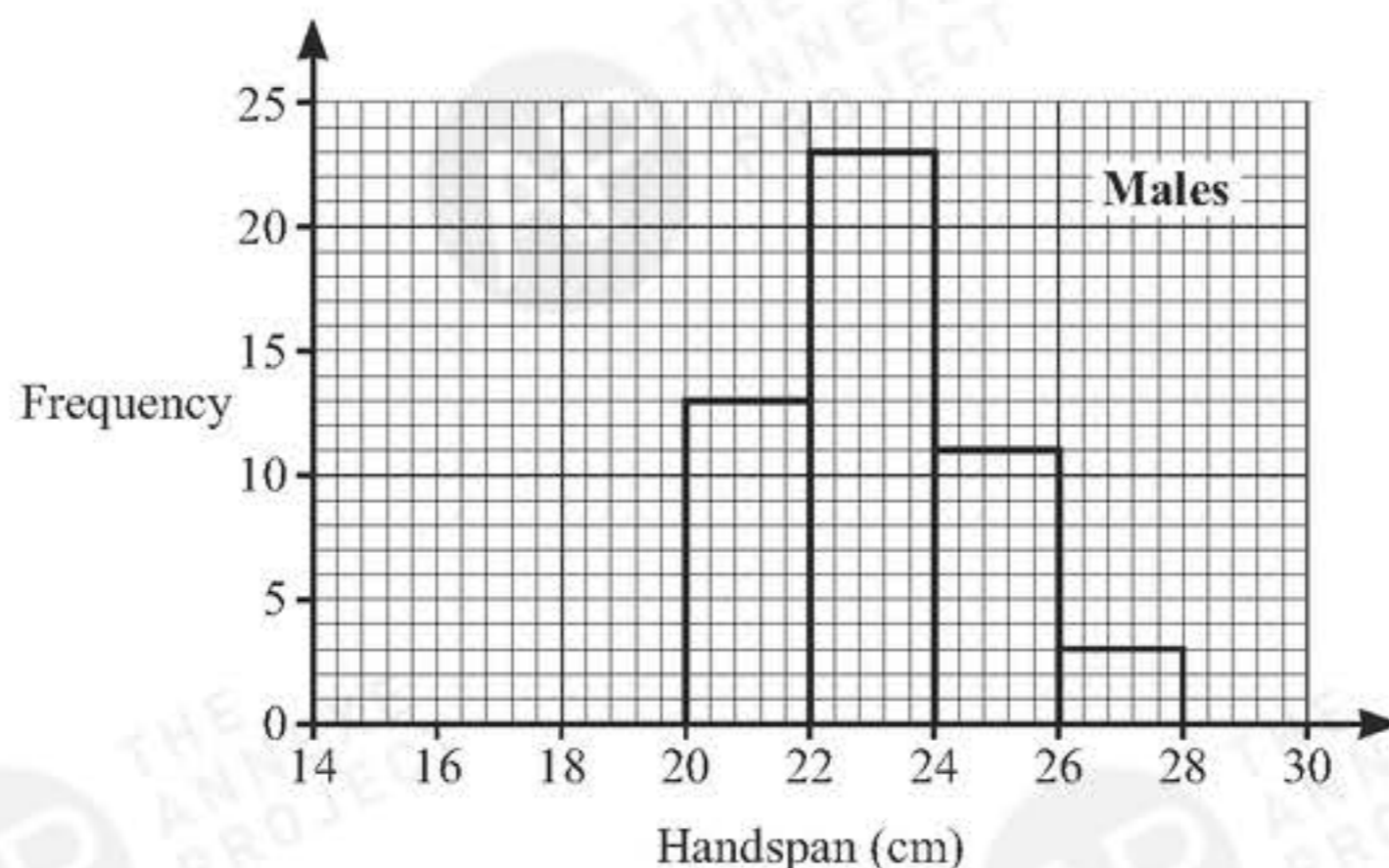
$$\text{Answer } \dots\dots\dots 20-22 \text{ cm} \dots\dots\dots [1]$$

(iii) Calculate an estimate of the mean handspan of the females.

$$\frac{(3 \times 17) + (21 \times 19) + (20 \times 21) + (5 \times 23) + (1 \times 25)}{50}$$

$$= 20.2 \quad \text{Answer } \dots\dots\dots 20.2 \dots\dots\dots \text{ cm } [1]$$

(b)



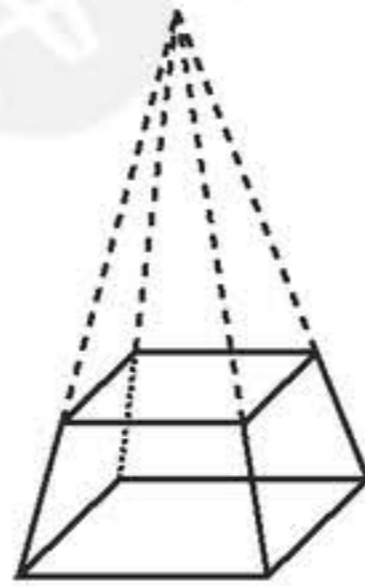
This histogram shows the distribution of the handspans of 50 males.

Make two different comments comparing the averages (1.) and distributions (2.) for the handspans of the females and the males.

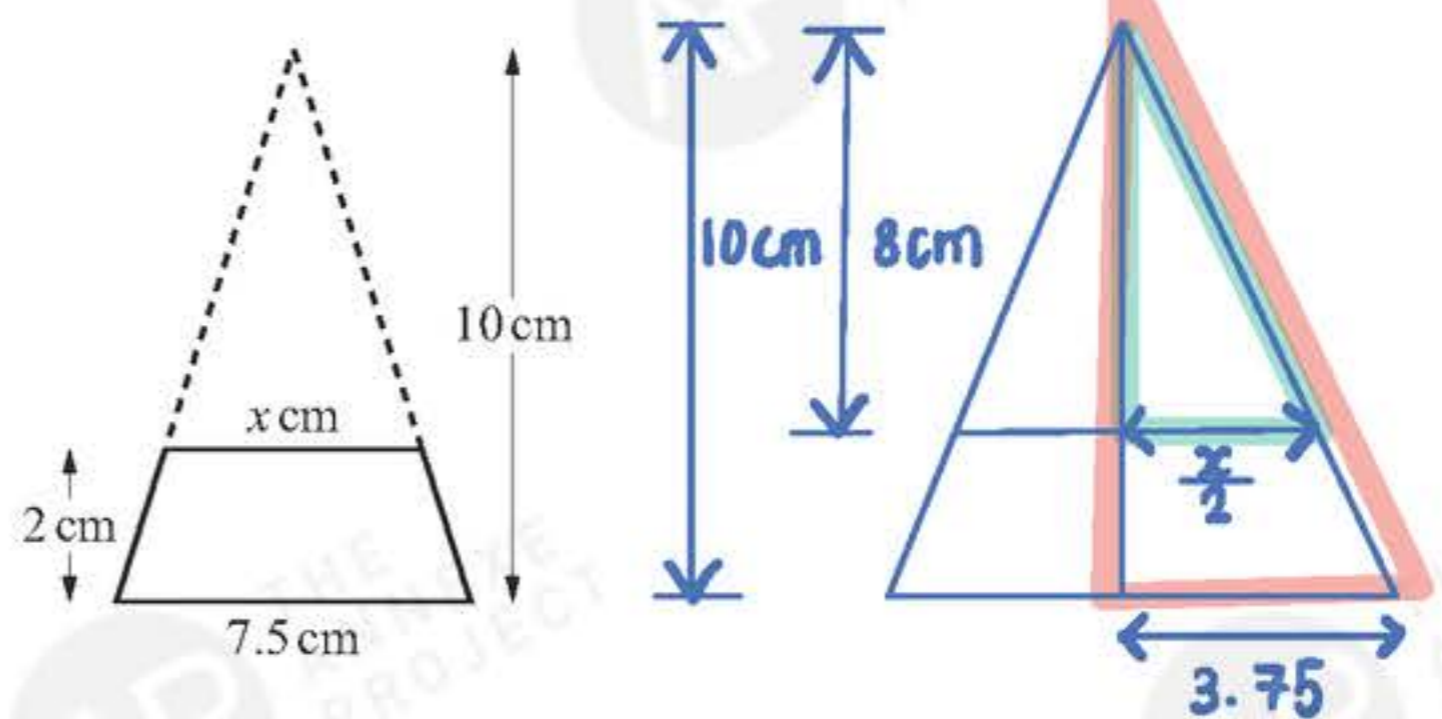
1. The mean handspans of males is larger than the mean handspans of the females.
2. The median handspans of males is 22–24 cm while that of females is 20–22 cm. The mode [2]

headspans of males is 22–24 cm while that of females is 18–20 cm.

- 25 A glass block is in the shape of a frustum of a square-based pyramid. The frustum is made by removing a small square-based pyramid from a larger square-based pyramid as shown in the diagram. The vertical height of the frustum is 2 cm.



This is a side view of the glass block.



- (a) Use similar triangles to find the value of x .

$$\frac{8}{10} = \frac{\frac{1}{2}x}{3.75}$$

$$5x = 30$$

$$x = 6$$

Answer $x = \dots\dots\dots 6 \dots\dots\dots$ [2]

- (b) 1 cm^3 of the glass has a mass of 2.6 grams.

Calculate the mass of the glass block.

Volume of big pyramid – Volume of small pyramid

$$= \frac{1}{3} (7.5)^2 (10) - \frac{1}{3} (6)^2 (8) = 91.5 \text{ cm}^3$$

$$91.5 \times 2.6 = 237.9 \text{ g}$$

Answer $\dots\dots\dots 238 \dots\dots\dots$ g [3]

26 The first five terms of a sequence are 10, 14, 18, 22, 26.

- (a) Write down an expression for the n th term of the sequence.

Answer $4n + 6$ [2]

- (b) Explain why 264 is not a term of this sequence.

$$\text{Let } 4n + 6 = 264, \text{ then } n = 64.5$$

Since n has to be an integer, 264 is not a term of this sequence. [1]

- (c) The sum of the first n terms of this sequence is given by $2n^2 + 8n$.

Using algebra, find the value of n when the sum of the first n terms is 384.

$$\text{Let } 2n^2 + 8n = 384$$

$$n^2 + 4n - 192 = 0$$

$$(n - 12)(n + 16) = 0$$

$$\underline{n = 12} \text{ or } n = -16 \text{ (rej.)}$$

Answer $n =$ 12 [3]

BLANK PAGE

Permission to reproduce items where third-party owned material protected by copyright is included has been sought and cleared where possible. Every reasonable effort has been made by the publisher (UCLES) to trace copyright holders, but if any items requiring clearance have unwittingly been included, the publisher will be pleased to make amends at the earliest possible opportunity.

Cambridge Assessment International Education is part of the Cambridge Assessment Group. Cambridge Assessment is the brand name of the University of Cambridge Local Examinations Syndicate (UCLES), which itself is a department of the University of Cambridge.