



中正中学 义顺

CHUNG CHENG HIGH SCHOOL (YISHUN)



2025 Preliminary Examination Secondary Four Express / Five Normal Academic

CANDIDATE
NAME

FORM CLASS /
SUBJECT GROUP

 /

INDEX
NUMBER

MATHEMATICS

4052/01

Paper 1

18 August 2025

2 hours 15 minutes

Candidates answer on the Question Paper.

READ THESE INSTRUCTIONS FIRST

Write your name, class and index number on 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 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 with the answer.

Omission of essential working will result in loss of marks.

You are reminded of the need for clear presentation in your answers. Up to 2 marks may be deducted for improper presentation.

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.

Q1		Q2		Q3		Q4		Q5		Q6		Q7		Q8	
1		3		2		3		3		2		3		4	
Q9		Q10		Q11		Q12		Q13		Q14		Q15		Q16	
3		2		2		3		6		6		3		3	
Q17		Q18		Q19		Q20		Q21		Q22		Q23		Q24	
4		3		3		3		3		3		4		5	
Q25		Q26						Presentation Deduction	-1 / -2		Total 90				
8		5													

This document consists of 20 printed pages.

Mathematical Formulae*Compound Interest*

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

Measurement

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

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

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

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

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

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

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

Trigonometry

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

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

Statistics

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

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

- 1 Calculate $\frac{9.26}{\sqrt{51.76} - 2.02^3}$, giving your answer correct to 5 significant figures.

-8.8362	
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Answer [1]

- 2 (a) Express 252 as a product of its prime factors.

$2^2 \times 3^2 \times 7$	
---------------------------	--

Answer [1]

- (b) The highest common factor (HCF) of two numbers is 21.
 The lowest common multiple (LCM) of the two numbers is 252.
 Both numbers are less than 100.
 Find the two numbers.

$A = 3^2 \times 7$ $B = 2^2 \times 3 \times 7$ $\text{LCM} = 252 = 2^2 \times 3^2 \times 7$ $\text{HCF} = 21 = 3 \times 7$ The two numbers are 63 and 84.	
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Answer [2]

- 3 Given that $27^n = 8\sqrt{9^{6n}}$, find the value of 3^n .

$(3^3)^n = 8 \times (3^{12n})^{\frac{1}{2}}$ $3^{3n} = 8 \times 3^{6n}$ $\frac{1}{8} = 3^{6n-3n}$ $3^{3n} = \frac{1}{8}$ $3^n = \sqrt[3]{\frac{1}{8}}$ $= \frac{1}{2}$	
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Answer [2]

- 4 (a) Simplify $(4n)^2 - (4n + a)(4n - a)$.

$= 16n^2 - [(4n)^2 - a^2]$ $= a^2$	
------------------------------------	--

Answer [1]

- (b) Hence, without the use of a calculator, evaluate $75^2 - (78)(72)$.

$= (75)^2 - [(75 + 3)(75 - 3)] \quad \text{M1}$ $= 3^2$ $= 9$	
---	--

Answer [2]

- 5 Cindy invested \$4200 in ABN Bank for 3 years. ABN Bank pays 1.8% per year compound interest. She would have earned the same amount of interest if she had invested the same amount of money for 3 years and 6 months in HKSB Bank which pays $r\%$ per year simple interest.

Calculate the value of r .

$\text{Interest} = 4200 \left(1 + \frac{1.8}{100} \right)^3 - 4200$ $= 230.9068944$ $\frac{4200 \times r \times 3.5}{100} = 230.9068944$ $r = 1.5707952$ $= 1.57$	
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Answer [3]

- 6 Simplify $(4x - 5)(5x^2 + 4x - 7)$.

$=$ $20x^3 + 16x^2 - 28x - 25x^2 - 20x + 35$ $= 20x^3 - 9x^2 - 48x + 35$	
--	--

- 7 Rearrange the formula $\frac{x}{3} = \left(\frac{y}{7z-6w}\right)^{\frac{1}{3}}$ to make z the subject.

$\frac{x^3}{27} = \frac{y}{7z-6w}$ $7x^3z - 6x^3w = 27y$ $7x^3z = 27y + 6x^3w$ $z = \frac{27y + 6x^3w}{7x^3}$	
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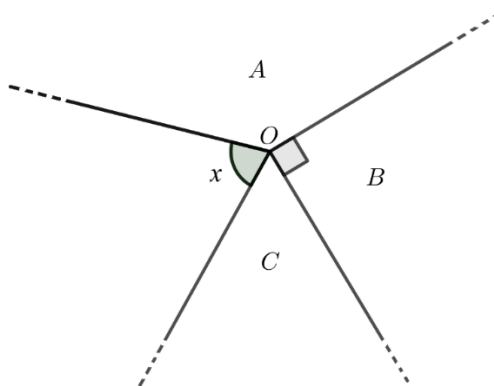
Answer $z = \dots\dots\dots$ [3]

- 8 (a) A polygon has n sides. Two of its exterior angles are 50° and 70° , and the remaining exterior angles are each 16° . Find the value of n .

$50 + 70 + 16(n-2) = 360$ $16n = 272$ $n = 17$	
--	--

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

(b)



The diagram shows one interior angle of each of three regular polygons, A , B and C . The polygons fit together at point O , leaving a space marked by angle x . A is a regular nonagon, B is a square and C is an equilateral triangle. Find angle x .

$x = 360 - \left(\frac{(9-2) \times 180}{9} + 90 + 60 \right)$ $= 70^\circ$	
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Answer $\dots\dots\dots$ [2]

9 An area of 1 km^2 is represented by 4 cm^2 on a map.

- (a) Calculate, in km^2 , the actual area of a volcanic crater which is represented by a circle of area 0.3 cm^2 on the map.

$1 \text{ cm}^2 : 0.25 \text{ km}^2$ Actual area = $0.25 \times 0.3 = 0.075 \text{ km}^2$	
--	--

Answer km^2 [1]

- (b) Find the scale of the map in the form $1:n$.

$1 \text{ cm}^2 : 0.25 \text{ km}^2$ $1 \text{ cm} : 0.5 \text{ km}$ $1 : 50\,000$	
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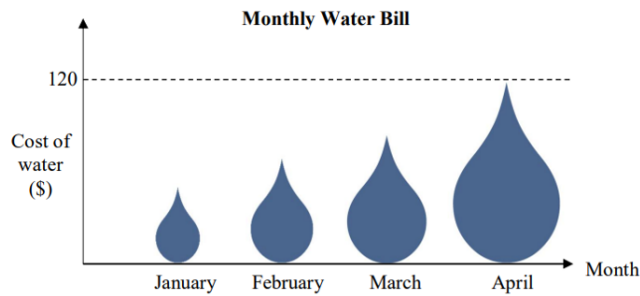
Answer [2]

- 10 The base and the height of a triangle are each reduced by 40% followed by an increase by 50%. Find the percentage reduction in the area of the triangle.

$\text{Original area} = \frac{1}{2} \times b \times h = \frac{bh}{2}$ $\text{New area} = \frac{1}{2} \times (0.6)(1.5)b \times (0.6)(1.5)h$ $= \frac{0.81bh}{2}$ $\text{Percentage reduction} = \frac{1-0.81}{1} \times 100\%$ $= 19\%$	
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Answer% [2]

- 11 Mrs Lim draws this graph to show her monthly water bill for the first four months of the year 2024.



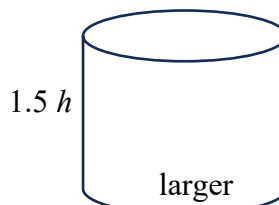
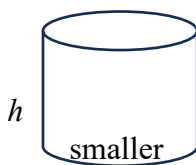
State one aspect of the graph that may be misleading and explain how this may lead to a misinterpretation of the graph.

No equal intervals indicated on the vertical axis and if the values start from 0. Unable to read the cost of water in the months before April.

OR

Not clear if the size of the water droplets, is referring to the area of the droplets or the height of the droplets. Unable to determine the annual water bill.

- 12 Starlight Café sells latte drinks in two geometrically similar mugs. The height of the larger mug is 1.5 times the height of the smaller mug, h . Latte in a smaller mug and in a larger mug are sold at \$3.30 and \$13.20 respectively. Mandy thinks that it is more value for money to buy latte in 4 smaller mugs than one larger mug. Is Mandy correct? Justify your decision with calculations.



$$\frac{V_1}{V_2} = \left(\frac{h}{1.5h} \right)^3 = \frac{h^3}{3.375h^3}$$

Volume of 4 small mugs > Volume of 1 large mug

$$4 > 3.375$$

Cost of 4 small mugs = \$3.30 × 4 = \$13.20

Cost of 1 large mug = \$ 13.20

Mandy is correct. For the same amount paid for the latte, more latte is obtained from 4 small mugs of latte than from 1 large latte.

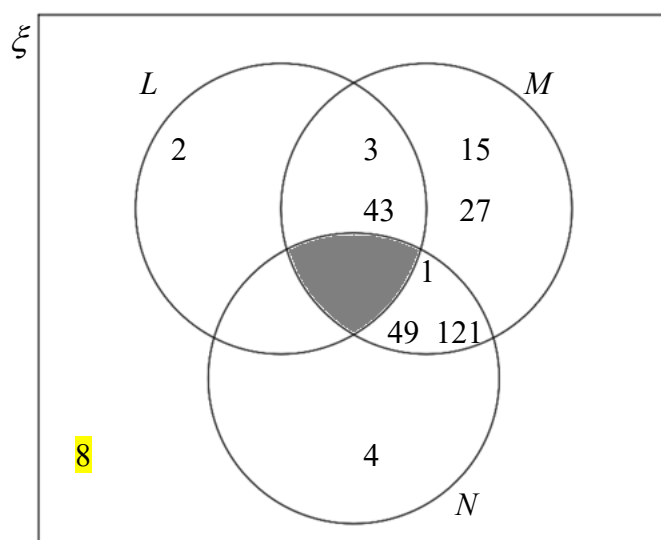
13 $\xi = \{1, 2, 3, 4, 8, 15, 27, 43, 49, 121\}$

$L = \{\text{Prime Numbers}\}$

$M = \{\text{Odd Numbers}\}$

$N = \{\text{Square Numbers}\}$

- (a) Complete the Venn diagram to illustrate this information.
There are no elements in the shaded portion of the diagram.



[2]

- (b) List the elements in $(M \cup L)'$

$\{4, 8\}$	
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- (c) Find the value of $n((L' \cup N) \cap (L \cup N'))$.

$(L' \cup N) = \{1, 4, 8, 15, 27, 49, 121\}$ $(L \cup N') = \{2, 3, 8, 15, 27, 43\}$ $n((L' \cup N) \cap (L \cup N')) = 3$	
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- (d) The numbers in ξ are each printed on one card.

If a card is picked at random from the ten cards, find the probability that the number printed on the card

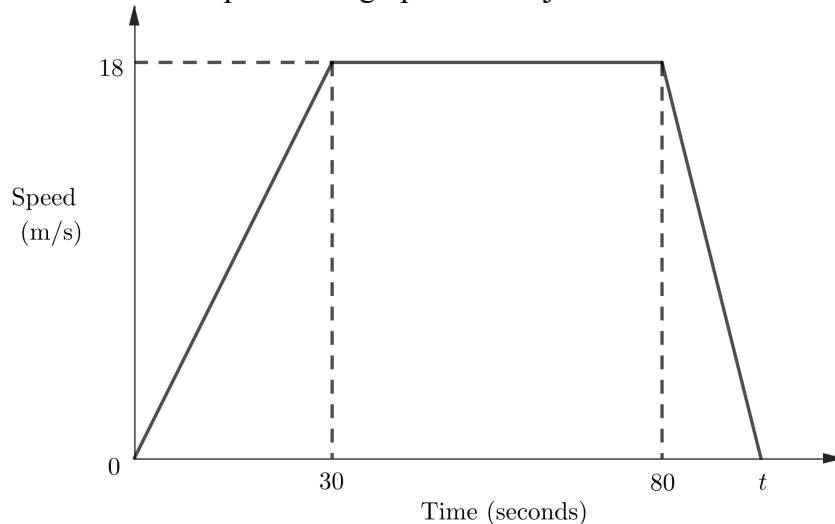
- (i) is a perfect cube,

(1, 8, 27). Thus the probability is $\frac{3}{10}$.	
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- (ii) is a multiple of 3.

(3, 15, 27). Thus the probability is $\frac{3}{10}$.	
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- 14 The diagram below shows the speed-time graph of an object.



- (a) Calculate the speed of the object at 18 seconds. Give your answer in km/h.

$\text{Speed} = \frac{18}{30} \times 18 = 10.8 \text{ m/s}$ $= 38.88 \text{ km/h}$	
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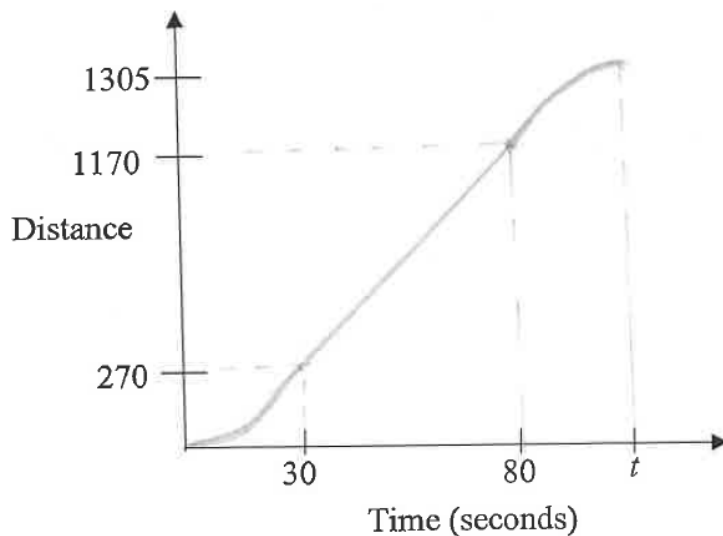
Answerkm/h [2]

- (b) At 80 seconds, the object starts decelerating at a rate that was twice its acceleration from 0 to 30 seconds, before coming to a stop at t seconds.
Calculate the total distance travelled on the journey.

$\text{Distance} = \frac{1}{2} \times 30 \times 18 + 50 \times 18 + \frac{1}{2} \times 15 \times 18$ $= 1305 \text{ m}$	
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- (c) Draw the distance-time graph of the object on the grid given below.
You must label the values on the distance-axis clearly.

[2]



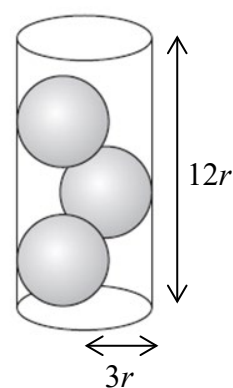
- 15 Tom has 46 blue and 29 red balls. He wants to use all the balls to fill a ball pit. He wants at least 70% of the balls to be blue. Find the smallest number of extra blue balls he needs to add to his ball collection.

$\frac{46+x}{46+29+x} \geq \frac{7}{10}$ $460+10x \geq 525+7x$ $3x \geq 65$ $x \geq 21.666$ Smallest $x = 22$	
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Answer [3]

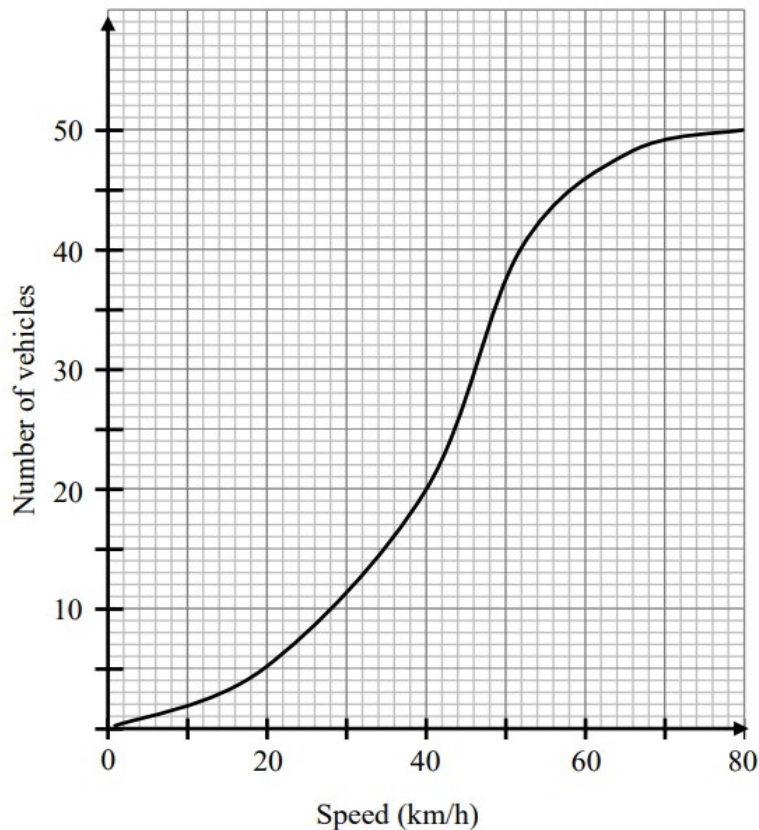
- 16 Three spheres, each of radius $2r$ cm, are placed inside a cylinder. The cylinder has radius $3r$ cm and height $12r$ cm. Water is poured into the cylinder to fill it completely. The volume of water poured into the cylinder is $k\pi r^3 \text{ cm}^3$. Find the value of k .

Vol of 3 spheres + Vol of water = Vol of cylinder $3 \times \left(\frac{4}{3} \pi (2r)^3 \right) + k\pi r^3 = \pi (3r)^3 (12r)$ $32\pi r^3 + k\pi r^3 = 108\pi r^3$ $k\pi r^3 = 76\pi r^3$ $\Rightarrow k = 76$	
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Answer [3]

- 17 The cumulative frequency graph shows the speed of 50 vehicles passing by a narrow road within 5 minutes.



- (a) If 8% of the 50 vehicles received a speeding ticket, find the speed limit on this road.

60 km/h

Answerkm/h [1]

- (b) Find the interquartile range of the speed of the vehicles.

50 – 32 or 50 – 31
=18 =19

Answerkm/h [2]

- (c) It was said that more than 50% of the vehicles are travelling at 45 km/h when passing through the narrow road. Explain, with reason, whether you agree with the statement.

Disagree. 50% of the vehicles are travelling at a speed less than 44km/h.

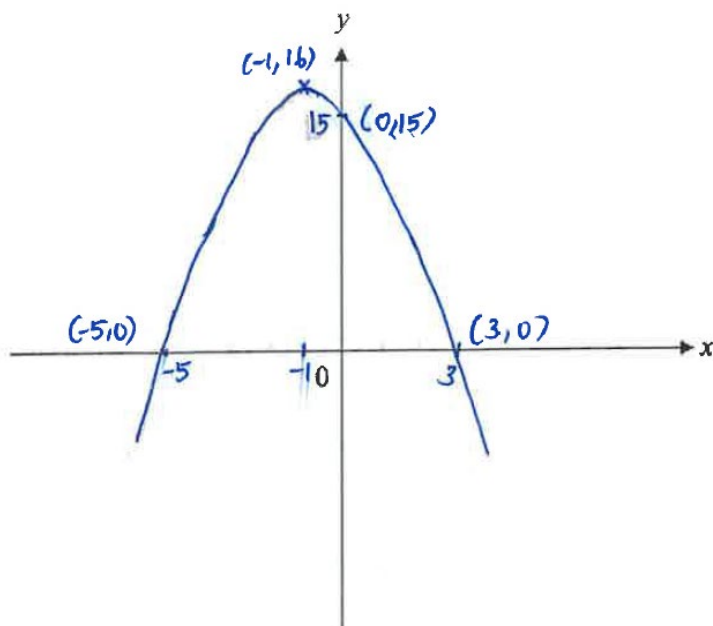
Answer

.....

..... [1]

- 18 Sketch the graph of $y = (x+5)(3-x)$ on the axes below.
Indicate clearly the coordinates of the points where the graph crosses the axes and the turning point of the curve.

[3]

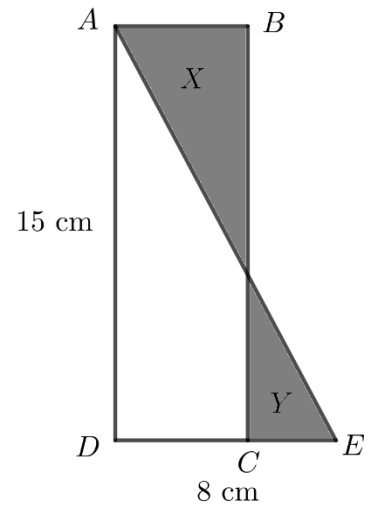


- 19 Given that n is an integer and $n > 1$, decide whether each statement in the table is **true** or **false**.
For each statement write **true** or **false** in the table
If you write **false**, give an example to justify your decision.

[3]

Statement	True or False	Example (if false)
$n^3 > 1$	True	
$\frac{1}{n} > \frac{1}{n^2}$	True	
$(n-1)(n+3)$ is always odd	False	When $n = 3$, $(3-1)(3+3) = 12$, which is even

- 20** The figure shows a rectangle $ABCD$ with $AD = 15$ cm .
 E is on DC produced such that $DE = 8$ cm .
 The area of the shaded part X is 12 cm^2 more than the area of the shaded part Y .
 Find the length of AB .



Let the unshaded region be Z .
 Area of $X = 12 + \text{Area of } Y$
 Area of $X + \text{Area of } Z = 12 + \text{Area of } Y + \text{Area of } Z$
 Area of $ABCD = \text{Area of } \triangle ADE + 12$
 $AB \times 15 = \frac{1}{2} \times 15 \times 8 + 12$
 $AB = \frac{72}{15} = 4.8 \text{ cm}$

Answercm [3]

- 21 The table shows the quiz scores for a group of 30 students.

Quiz score, m	Frequency
$0 < m \leq 5$	2
$5 < m \leq 10$	5
$10 < m \leq 15$	15
$15 < m \leq 20$	8

- (a) Calculate an estimate for
(i) the mean scores of the students.

$$\begin{aligned}\text{mean} &= \frac{2.5 \times 2 + 7.5 \times 5 + 12.5 \times 15 + 17.5 \times 8}{30} \\ &= 12\frac{1}{3}\end{aligned}$$

Answer [1]

- (ii) The standard deviation of the quiz scores.

$$\begin{aligned}\text{s.d.} &= \sqrt{\frac{2.5^2 \times 2 + 7.5^2 \times 5 + 12.5^2 \times 15 + 17.5^2 \times 8}{30} - \left(12\frac{1}{3}\right)^2} \\ &= 4.18\end{aligned}$$

Answer [1]

- (b) A student who was sick did a make-up for the quiz.
The new mean mark was 13.

Given that the original median was 12, what can be deduced about the new median?

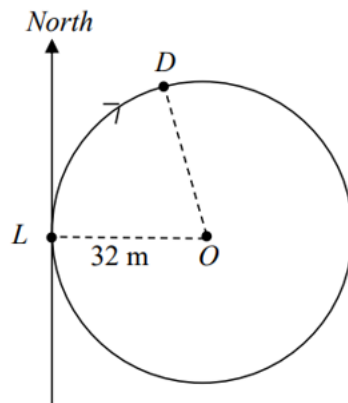
Answer The new median can be either 12 or larger than 12.

OR the new median cannot be lower than 12.

.....

..... [1]

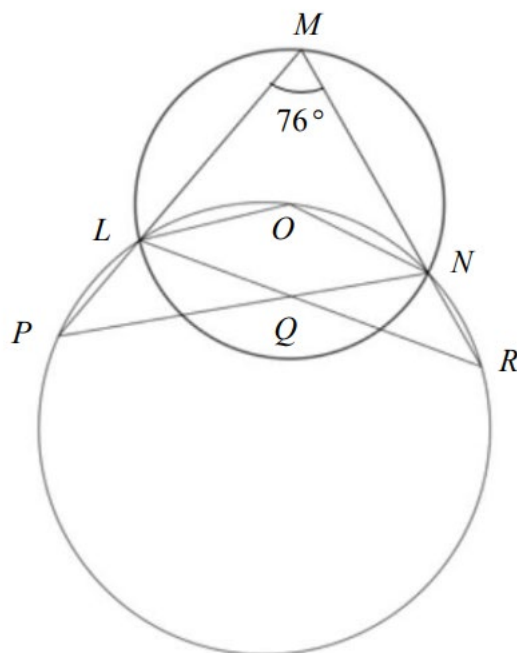
- 22 Alex flew an aerial drone from a landing site L . It flew in a circle of radius 32 metres in a clockwise direction shown in the diagram below. The centre of the circle is due east of L .



Find the bearing of the drone D from L after it travelled 43 metres along the circumference of the circle.

$$\begin{aligned} \frac{\theta}{360^\circ} \times 2\pi(32) &= 43 \\ \theta &= \frac{43 \times 360^\circ}{2\pi(32)} \\ &= 76.991^\circ \\ \angle OLD &= \frac{180^\circ - 76.991^\circ}{2} \\ &= 51.5045^\circ \\ \text{Bearing} &= 090^\circ - 51.5045^\circ \\ &= 038.5^\circ \end{aligned}$$

Answer [3]



The diagram shows two circles with the bigger circle passing through the centre, O , of the smaller circle. The circles intersect at L and N . PLM and MNR are straight lines. PN and LR intersect at Q . Angle $LMN = 76^\circ$.

Find, giving reason for each answer,

(a) angle QPL ,

$\angle LON = 76^\circ \times 2 = 152^\circ$ (angle at center = 2 x angles at circumference) $\angle QPL = 180^\circ - 152^\circ$ (angles in opposite segment) = 28°	
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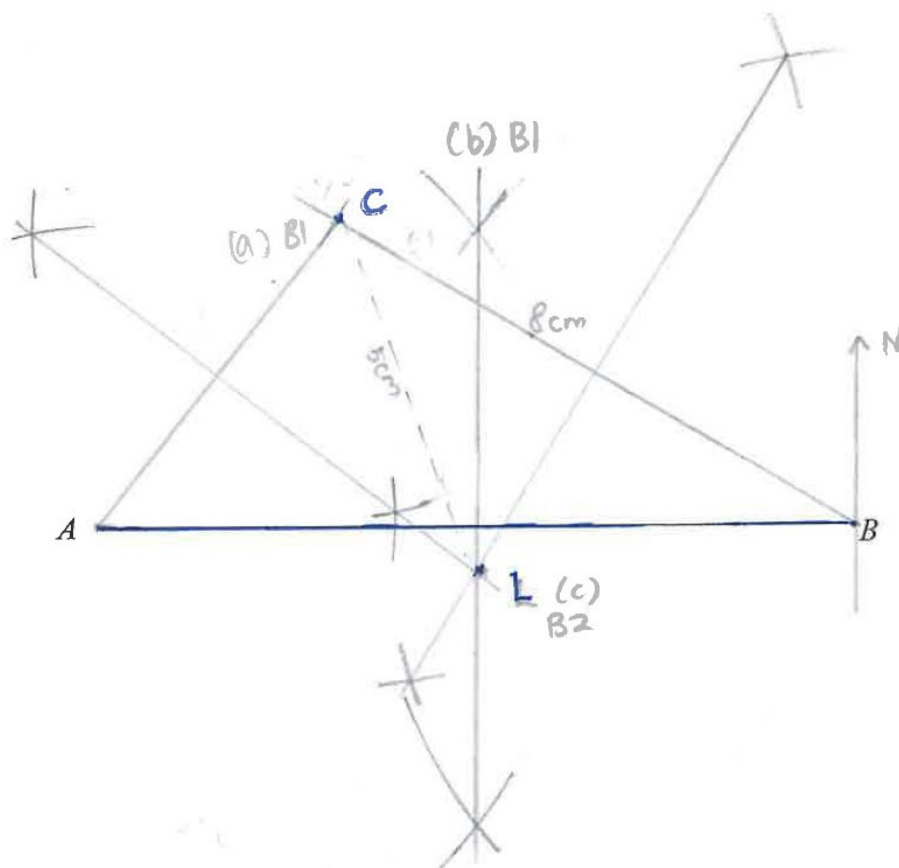
Answer [2]

(b) angle NQR .

$\angle PNR = 76^\circ + 28^\circ$ (exterior angle of triangle) = 104° $\angle NRL = 28^\circ$ (angles in same segment) $\angle NQR = 180^\circ - 104^\circ - 28^\circ$ ($\angle$ sum of Δ) = 48°	
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Answer [2]

- 24 The diagram shown below is part of a model drawing of the neighborhood. Block B is due east of Block A . Block C has a bearing of 300° from B . The distance between Block B and Block C is 8 cm.



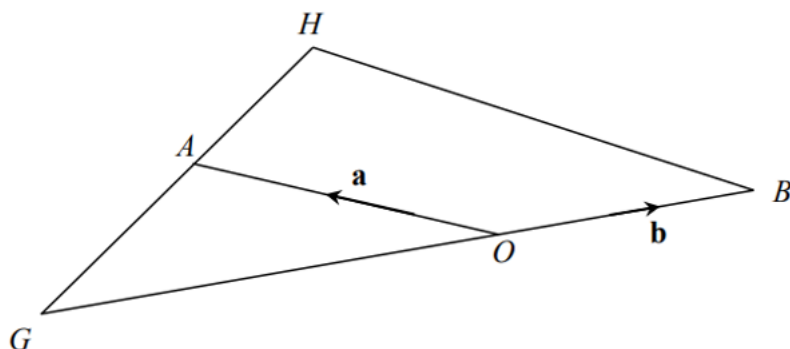
- (a) Mark and label the position of Block C on the model drawing. [1]
 (b) On the same diagram, construct the perpendicular bisector of the line AB . [1]
 (c) A letterbox is to be positioned such that it is equidistant from the three blocks.
 (i) On the same diagram, mark L to represent the position of the letterbox. [2]
 (ii) Given that the actual distance of $AB = 4$ km, calculate the actual distance between Block C and the letterbox, in kilometres.

2 km

Answer [1]

- 25 The position vectors of A and B , relative to O , are $\mathbf{a}$ and $\mathbf{b}$ respectively.

$$GB = 3OB \text{ and } GA = \frac{1}{2}GH.$$



- (a) Express each of the following in terms of $\mathbf{a}$ and $\mathbf{b}$.

(i) $\overrightarrow{GA}$

$= \overrightarrow{GO} + \overrightarrow{OA} = 2\mathbf{b} + \mathbf{a}$	
--	--

Answer [1]

(ii) $\overrightarrow{HB}$

$\begin{aligned} \overrightarrow{GH} &= 2(2\mathbf{b} + \mathbf{a}) \\ \overrightarrow{HB} &= \overrightarrow{HG} + \overrightarrow{GB} \\ &= -4\mathbf{b} - 2\mathbf{a} + 3\mathbf{b} \\ &= -\mathbf{b} - 2\mathbf{a} \end{aligned}$	
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Answer [2]

- (b) Use your answer to (a)(ii) to explain why $OAHB$ is not a trapezium.

Answer $\overrightarrow{OA}$ is not a scalar multiple of $\overrightarrow{HB}$, hence, OA is not parallel to HB and since AH is also not parallel to OB , thus, $OAHB$ is not a trapezium as it has no parallel sides.

..... [1]

(c) Find the ratio of

(i) $\frac{\text{area of triangle } OHB}{\text{area of triangle } GHO},$

$= \frac{\frac{1}{2} \times OB \times h}{\frac{1}{2} \times GO \times h} = \frac{1}{2}$	
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Answer [1]

(ii) $\frac{\text{area of triangle } OHA}{\text{area of } OAHB}.$

$\begin{aligned} \frac{\text{Area of } \triangle OHB}{\text{Area of } \triangle GHO} &= \frac{1}{2} \\ \frac{\text{Area of } \triangle OHA}{\text{Area of } \triangle OHB} &= \frac{1}{1} \\ \frac{\text{Area of } \triangle OHA}{\text{Area of } \triangle GHO} &= \frac{1}{2} \\ \frac{\text{Area of } \triangle OHA}{\text{Area of } \triangle OAHB} &= \frac{1}{2} \end{aligned}$	
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Answer [2]

- 26 In sequence A, the first 3 terms are

$$a \quad ar \quad ar^2,$$

where a and r are constants.

In sequence B, the first term is a and the same non-zero number is added each time to obtain the next term.

The first 3 terms of sequence A are equal to the first, third and sixth term of Sequence B respectively.

- (a) Show that $2r^2 - 5r + 3 = 0$.

Answer

Let the same non-zero number be d . Then we have

$$ar = a + 2d$$

$$ar^2 = a + 5d$$

$$d = \frac{ar - a}{2}$$

$$d = \frac{ar^2 - a}{5}$$

Equating the two equations

$$\frac{ar - a}{2} = \frac{ar^2 - a}{5}$$

$$\frac{r - 1}{2} = \frac{r^2 - 1}{5}$$

$$5r - 5 = 2r^2 - 2$$

$$2r^2 - 5r + 5 - 2 = 0$$

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

[3]

- (b) Find the value of r , justifying your answer.

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

$$(2r - 3)(r - 1) = 0$$

$$r = \frac{3}{2} \quad \text{or} \quad r = 1$$

r cannot be 1 because the difference between consecutive terms in sequence B is non-zero.

Thus, $r = \frac{3}{2}$.

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..... [2]