

NAME: _____ ()

CLASS: _____

**FAIRFIELD METHODIST SCHOOL (SECONDARY)****PRELIMINARY EXAMINATION 2025****SECONDARY 4 EXPRESS / 5 NORMAL (ACADEMIC)****MATHEMATICS****4052/01****Paper 1****Date: 25 August 2025****Duration: 2 hours 15 minutes**

Candidates answer on the Question Paper.

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class 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.

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.**For Examiner's Use**

Table of Penalties		Question Number	Parent's/Guardian's Signature	90
Presentation	☐ 1 ☐ 2			
Rounding off	☐ 1			

Setter: Mdm Lee SP

This question paper consists of 21 printed pages

Mathematical Formulae*Compound interest*

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

Mensuration

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

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

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

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

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

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

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

Trigonometry

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

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

Statistics

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

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

NAME: _____ ()

CLASS: _____

Answer **all** the questions.

- 1 Expand and simplify $(3x + 4a)(3a - 4x)$.

Answer [2]

- 2 (a) Express the ratio of 0.55 hours to 5 minutes and 30 seconds in its simplest form.

Answer : [1]

- (b) Given that $p = 3q$ and $2r = q$, write down the ratio of $p : q : r$.

Answer : : [2]

- 3 A shopkeeper marked the price of a laptop so that he could make a profit of 25% on the cost price. During the Great Singapore Sale, he offered a 10% discount on the marked price and sold it at \$1521.

(a) Calculate the cost price of the laptop.

Answer \$ [2]

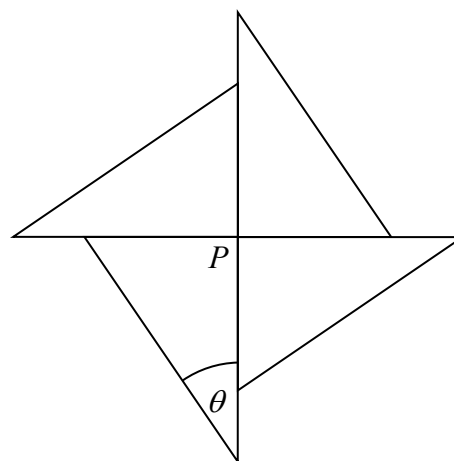
(b) Calculate the profit made during the sale.

Answer \$ [1]

- 4 The figure below is made up of four congruent right-angled triangles, meeting at one common point, P .

It is given that the length of the hypotenuse of the right-angled triangle is 12 cm and $\sin \theta = \frac{3}{5}$.

Without solving for θ , calculate the perimeter of the figure.



Answer cm [2]

NAME: _____ ()

CLASS: _____

5 2 cm on a map of Singapore represents 5 km.

- (a) The scale can be written in the form $1 : n$.
Find the value of n .

Answer $n = \dots\dots\dots$ [1]

- (b) The distance on the map from Sentosa to Buona Vista is 4.72 cm.
Calculate the actual distance, in kilometres, between these two places.

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

- (c) The area of Sentosa is 4.71 km^2 .
Calculate the area, in square centimetres, of Sentosa on the map.

Answer $\dots\dots\dots \text{cm}^2$ [2]

6 The expression $x^2 - 8x + 13$ can be written in the form $(x - 4)^2 + n$.

- (a) Find the value of n .

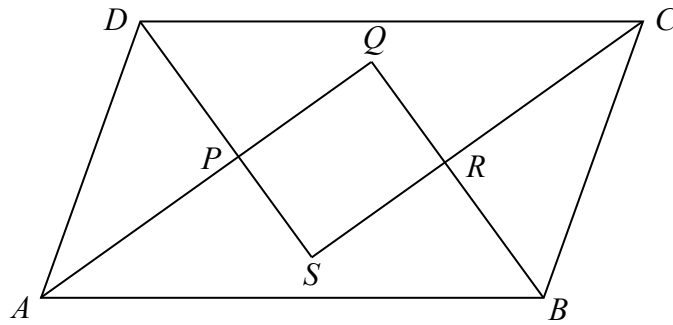
Answer $n = \dots\dots\dots$ [1]

- (b) Explain why when $x = 4$, the expression $x^2 - 8x + 13$ has its minimum value.

.....

..... [1]

7



$ABCD$ is a parallelogram.

APQ , BRQ , CRS and DPS are straight lines which bisect angles A , B , C and D respectively.

Show that triangle ADP and triangle CBR are congruent.

Give a reason for each statement you make.

Answer

[3]

NAME: _____ ()

CLASS: _____

- 8 (a) Write 1.2×10^{-499} in the form $A \times 10^{-500}$.

Answer [1]

- (b) Work out $(1.2 \times 10^{-499}) \times (4 \times 10^{500})$.

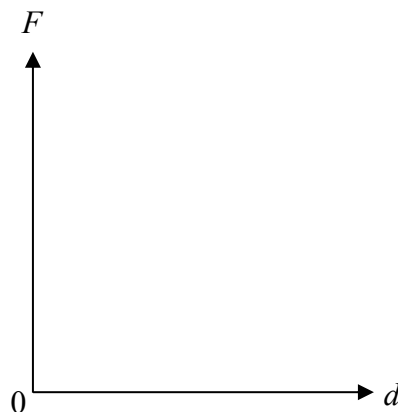
Give your answer in standard form.

Answer [1]

-
- 9 The force of attraction, F newtons, between two magnets is inversely proportional to the square of the distance, d metres, between the magnets.

- (a) Sketch the graph of F against d .

Answer



[1]

- (b) The force of attraction reduced by 75% of its original value. Calculate the percentage increase in the distance between the two magnets.

Answer % [2]

- 10 (a) Convert $\frac{17}{\pi}$ radians into degrees.

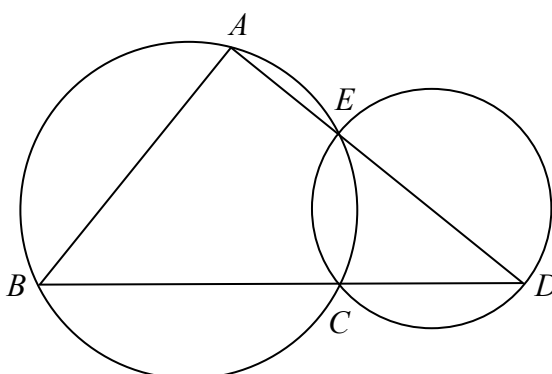
Answer° [1]

- (b) $\sin y^\circ = 7 \cos 85^\circ$

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

Answer $y = \dots\dots\dots$ or $y = \dots\dots\dots$ [2]

11



In the diagram, A, B, C, D and E are points on a circle.

AED and BCD are straight lines.

DE is the diameter of the smaller circle.

Explain why BE is the diameter of the larger circle.

.....

.....

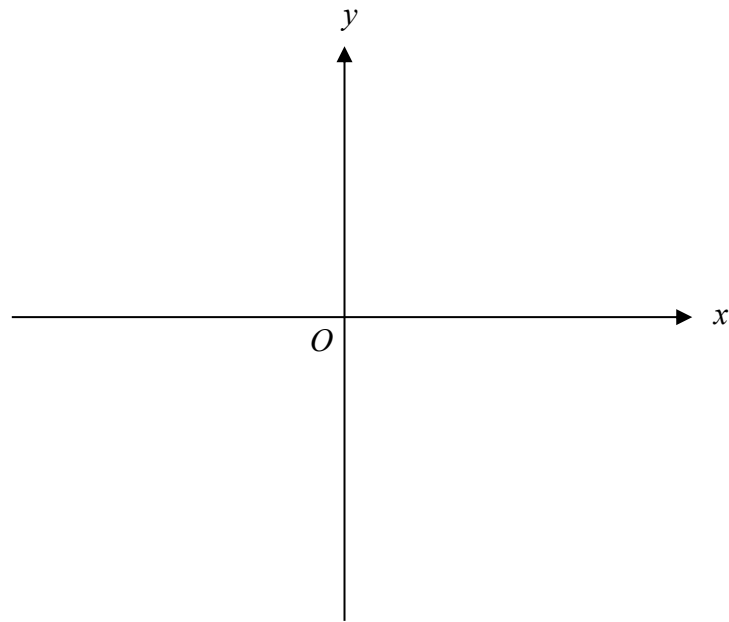
.....

.....

..... [2]

- 12 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 on the curve.



[3]

-
- 13 (a) The square root of x is equal to the cube root of $10^3 \times 3^{6n}$.
Write x as the product of its prime factors.

Answer $x = \dots\dots\dots$ [1]

- (b) Simplify $1 \div \left(\frac{-27}{x^3}\right)^{-\frac{2}{3}}$. Give your answer in positive index form.

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

NAME: _____ ()

CLASS: _____

14 Written as a product of its prime factors, $M = 2^{10} \times 5^3 \times 11$.

(a) The quotient of M and K is a perfect cube.

Find the smallest possible integer value of K .

Answer $K = \dots\dots\dots$ [1]

(b) The highest common factor of M and N is $2^5 \times 5^3 \times 11$.

The lowest common multiple of M and N is $2^{10} \times 5^7 \times 11^3$.

Find the value of N .

Give your answer as a product of its prime factors.

Answer $N = \dots\dots\dots$ [1]

15 A is the point $(-5, 3)$ and B is the point $(3, -2)$.

(a) Find the length of AB .

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

(b) $C(p, q)$ is a point such triangle ABC is isosceles with base angles $\angle ABC$ and $\angle ACB$.

Given that p and q are integers, state one possible pair of values for p and q .

Answer $p = \dots\dots\dots$ $q = \dots\dots\dots$ [1]

NAME: _____ ()

CLASS: _____

- 16 Sam wishes to earn **at least \$800 in interest** over 3 years by depositing money in a bank that offers 2.8% per annum compound interest.

Find, to the nearest dollar, the minimum amount of money Sam needs to deposit.

Answer \$ [3]

- 17 Factorise completely.

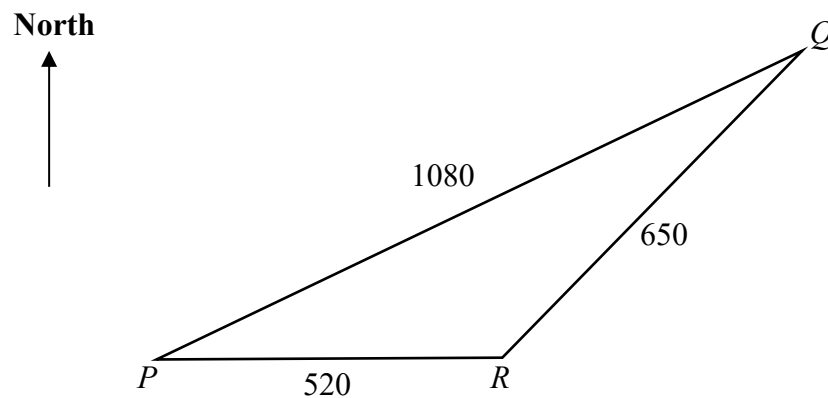
(a) $28 + 43x + 10x^2$

Answer [1]

(b) $4 - 9y^2 - 6xy + 4x$

Answer [2]

18



P , Q and R are three points on level ground.

R is 520 km east of P .

PQ is 1080 km and RQ is 650 km.

Find the bearing of Q from R .

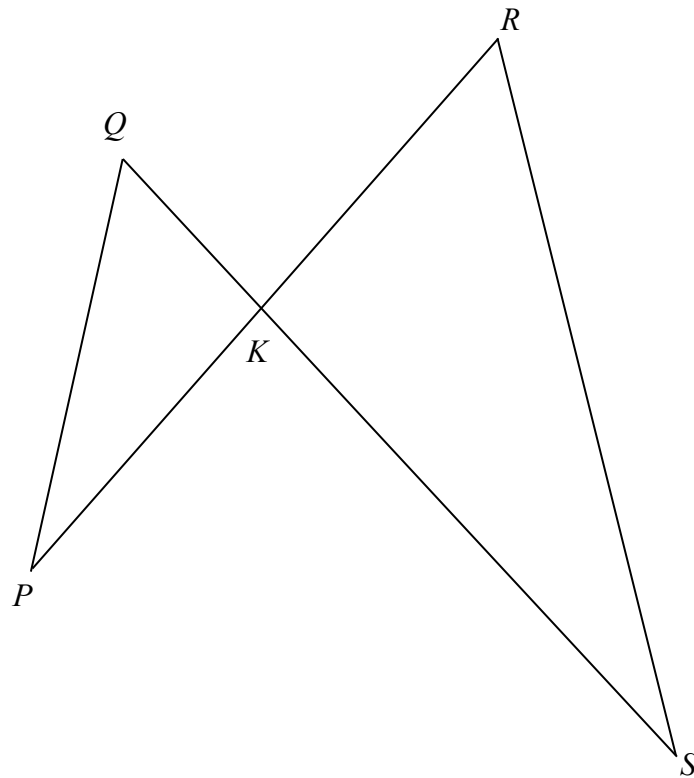
Answer [4]

19 In the diagram, PR and QS intersect at K .

A circle can be drawn such that points P , Q , R and S lie on its circumference.

- (a)** By constructing the appropriate bisector(s), locate and label the centre of the circle as point C .

Answer



[2]

- (b)** Show that triangle PQK is similar to triangle SRK .

Answer

[2]

- 20** A class of 20 students took a Mathematics quiz.

The scores are shown in the stem-and-leaf diagram.

1		6							
2		2	3	4	5	6	8		
3		0	2	2	6	7	7	8	8
4		1	3	6	8				

Key: 4 | 3 means a score of 43

- (a)** Find the median score.

Answer [1]

- (b)** Find the standard deviation of the scores.

Answer [1]

- (c)** When the score for the 21st student is added to the diagram, the median score remains unchanged. State the score of this student.

Answer [1]

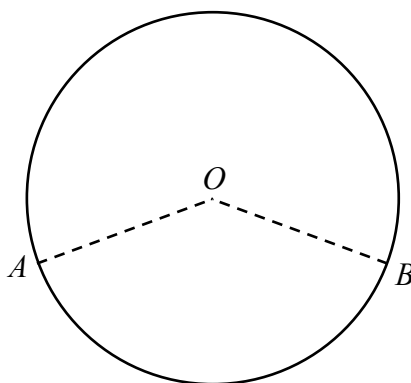
21 Simplify $\frac{2x^2 + 3x - 9}{6x^2y^2 - 9xy^2}$.

Answer [2]

- 22 The Isoperimetric Quotient (IQ) is a measure used to compare how close a shape is to a perfect circle. It is defined by the formula:

$$\text{Isoperimetric Quotient (IQ)} = \frac{4\pi \times \text{Area of a shape}}{(\text{Perimeter of a shape})^2}$$

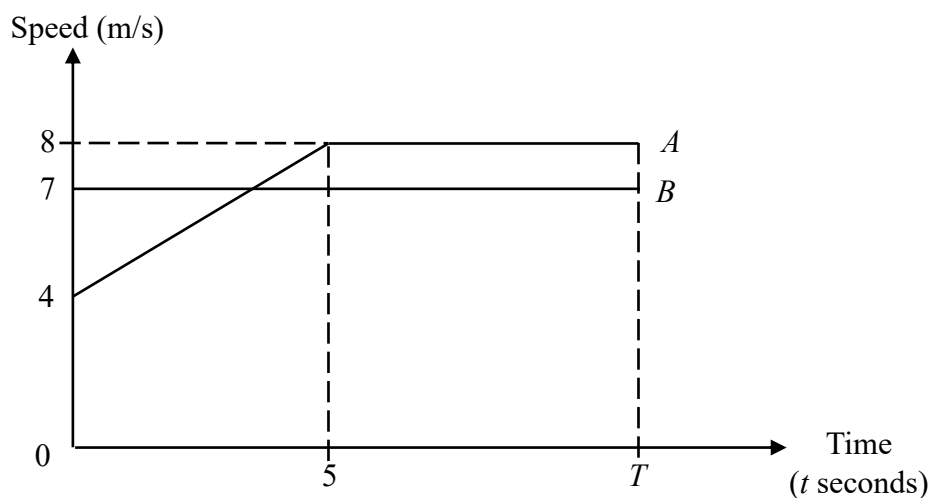
The diagram shows a circle, centre O , radius 5 cm. Angle $AOB = 2.4$ radians.



Find the IQ of the major sector of the circle above.

Answer [3]

- 23 The diagram shows the speed-time graph of two objects, A and B , along the same path in the same direction.



- (a) Find the speed of object A at $t = 2$.

Answer m/s [2]

- (b) The area under each speed-time graph represents the distance travelled by each object.

- (i) Find an expression, in terms of T , for the distance travelled by B in the T seconds.

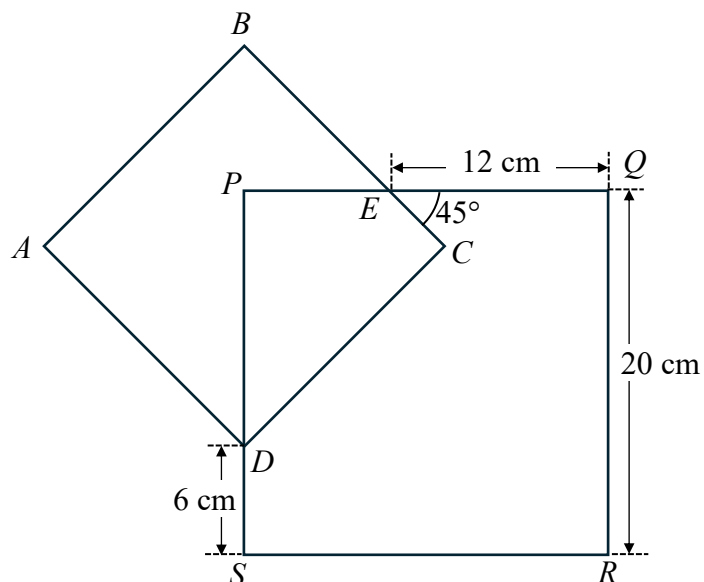
Answer [1]

- (ii) When $t = 0$, B is 20 m ahead of A . When $t = T$, A passes B .
Find the value of T .

Answer $T =$ [3]

- 24 Square $PQRS$ of side 20 cm overlaps a smaller square $ABCD$ as shown below.
 BC intersects PQ at E with $EQ = 12$ cm. $DS = 6$ cm. Angle $QEC = 45^\circ$.

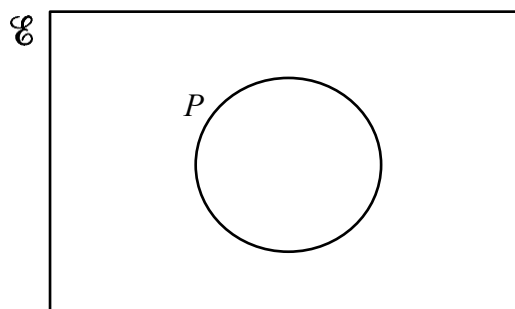
Find the area of square $ABCD$.



Answer cm^2 [3]

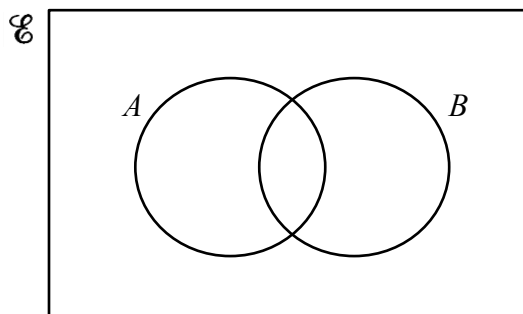
- 25 (a) The diagram shows the universal set and set P .

Draw set Q such that $P \cap Q \neq \emptyset$ and $P \cup Q = Q$.



[1]

- (b) On the Venn diagram, shade the region which represents $(A \cap B') \cap (A' \cup B')$.



[1]

- (c) $\mathcal{U} = \{\text{whole numbers } x : x < 10\}$
 $A = \{\text{factors of } 10\}$
 $B = \{\text{prime numbers}\}$

- (i) Find $A \cup B'$.

Answer [1]

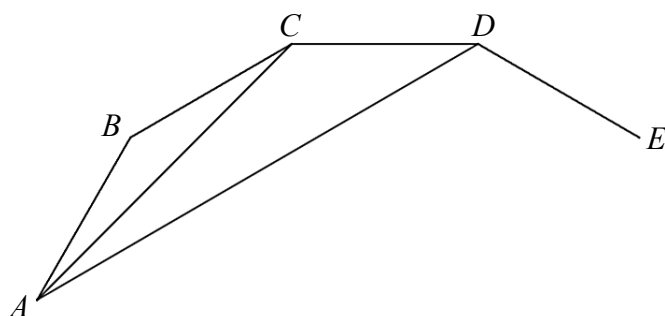
- (ii) Find the number of elements in $(A \cap B') \cup (A \cup B)'$.

Answer [1]

- (iii) A number, p , is chosen at random from the set of $A \cup B$.
 Find the probability that $p \notin B$.

Answer [1]

26



In the figure, $ABCDE$ is part of an n -sided regular polygon.

The ratio of an interior angle to an exterior angle of this polygon is 5 : 1.

- (a) Find the value of n .

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

- (b) Explain why the quadrilateral $ABCD$ is a trapezium.

.....

 [2]

- (c) Find angle ADE .

Answer Angle $ADE = \dots\dots\dots^\circ$ [2]

27 The table shows some number sequences.

n	U_n	T_n	S_n
1	1	3	2
2	4	12	11
3	9	27	26
4	16	48	47
$\vdots$	$\vdots$	$\vdots$	$\vdots$

(a) Write down the value of T_5 .

Answer $T_5 = \dots\dots\dots$ [1]

(b) Write down, in terms of n , the expression for S_n .

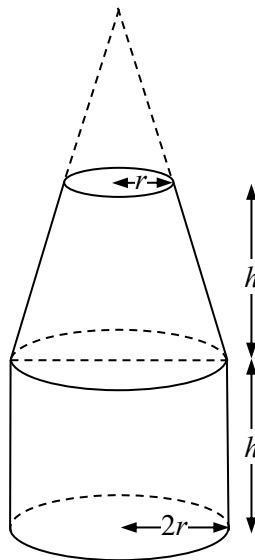
Answer $S_n = \dots\dots\dots$ [1]

(c) It is given that $S_p - S_q = 63$ and $p + q = 21$.
Find the value of p and of q .

Answer $p = \dots\dots\dots$ $q = \dots\dots\dots$ [3]

- 28 The diagram shows a toy which is made up of a frustum and a cylinder.
The frustum and the cylinder have the same height h cm.
The cylinder has radius twice the radius of the top circular surface of the frustum, r cm.

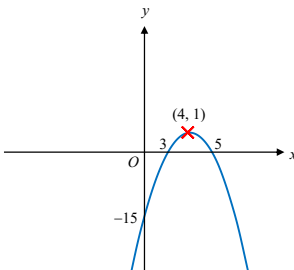
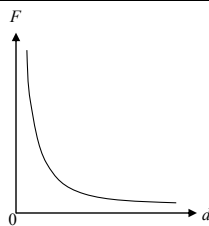
Given that the curved surface area of the frustum and cylinder are equal, show that the square of height of the cylinder, h^2 , can be expressed as $\frac{9r^2}{7}$.

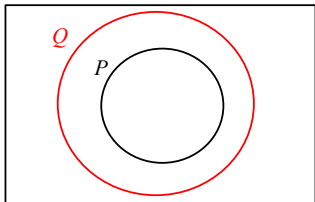
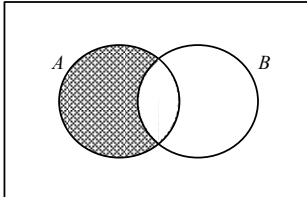
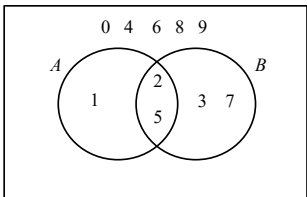


[3]

~ End of Paper ~

Answer Key

1	$-7ax-12x^2+12a^2$			12			
2a	6 : 1	2b	6 : 2: 1				
3a	\$1352	3b	\$169				
4	57.6 cm						
5a	$n = 250\,000$	5b	11.8 km				
5c	0.7536 cm^2						
6a	$n = -3$			13a	$x = 2^2 \times 5^2 \times 3^{4n}$		
6b	When $x = 4$, <u>$(x - 4)^2$ has value of 0</u> or <u>$(x - 4)^2$ has its minimum value.</u>			13b	$\frac{9}{x^2}$		
7	$\angle DAB = \angle DCB$ (<u>opposite angles</u> of parallelogram $ABCD$ are equal) $\angle PAD = \angle RCB$ (APQ and CRS bisect angles A and C respectively) $\angle ADC = \angle ABC$ (<u>opposite angles</u> of parallelogram $ABCD$ are equal) $\angle ADP = \angle CBR$ (DPS and BRQ bisect angles D and B respectively) $AD = CB$ (<u>opposite sides</u> of parallelogram $ABCD$ are equal) $\therefore \triangle ADP \equiv \triangle CBR$ (ASA)			14a	$K = 22$		
				14b	$N = 2^5 \times 5^7 \times 11^3$		
				15a	9.43 units (3 sig. fig.)		
				15b	Possible points for C : (3, 8) (0, -5) (-10, -5) (-13, -2) (-10, 11) (0, 11)		
				16	Minimum amount = \$9263		
				17a	$(5x+4)(2x+7)$		
				17b	$(2-3y)(2+3y+2x)$		
				18	044.5° (1 dec. pl.)		
8a	12×10^{-500}	8b	4.8×10	19a	Construct <u>at least two</u> perpendicular bisectors of any chords: PQ , QR , QS , RP , RS or SP . Circle property: $\perp$ bisector of chord passes through centre of circle		
9a		9b	100%				
10a	310.0° (1 dec. pl.)			19b	$\angle QPK = \angle RSK$ ($\angle$ s in the same segment) $\angle PQK = \angle SRK$ ($\angle$ s in the same segment) $\angle PKQ = \angle SKR$ (vert. opp. $\angle$ s) $\therefore \triangle PQK$ is similar to $\triangle SRK$ (AA Similarity Test)		
10b	$y^\circ = 37.6^\circ$ (1 dec. pl.) or 142.4° (1 dec. pl.)						
11	$\angle ECD = 90^\circ$ (right $\angle$ in semicircle) $\angle BCE = 90^\circ$ (adj. $\angle$ s on a str line) Since $\angle BCE = 90^\circ$, by converse of right angle in a semicircle, BE is the diameter of the larger circle.			20a	Median = 34	20b	SD = 8.44 (3 sig. fig.)
				20c	21 st student: 34		
				21	$\frac{x+3}{3xy^2}$	22	0.705 (3 sig. fig.)

23a	5.6 m/s	23bi	$7T$	26a	$n = 12$
23bii	$T = 10$				26b $\angle ABC = \angle BCD$ as both angles are interior angles of a regular polygon. $\underline{AB} = \underline{CD}$ as both sides are sides of a regular polygon. Thus, quadrilateral $ABCD$ is an isosceles trapezium with a pair of parallel sides, BC and AD.
24	242 cm^2				
25a	$\mathcal{C}$				26c $\angle ADE = 120^\circ$
25b	$\mathcal{C}$				27a $T_7 = 75$
					27b $S_n = 3n^2 - 1$
					27c $p = 11, q = 10$
25ci	$\mathcal{C}$	 $A \cup B' = \{0, 1, 2, 4, 5, 6, 8, 9\}$			28 Curved SA of frustum = Curved SA of cylinder $3\pi r\sqrt{h^2 + r^2} = 2\pi(2r)h$ $3\sqrt{h^2 + r^2} = 4h$ $9(h^2 + r^2) = 16h^2$ $9h^2 + 9r^2 = 16h^2$ $9r^2 = 7h^2$ $h^2 = \frac{9r^2}{7}$ (shown)
25cii	Number of elements in $(A \cap B') \cup (A \cup B)' = 6$				
25ciii	$P(p \notin B) = \frac{1}{5}$				

End