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**Anglo-Chinese School
(Parker Road)**

**END-OF-YEAR EXAMINATION 2023
SECONDARY THREE EXPRESS**

**MATHEMATICS 4052
PAPER 1**

1 HOUR 45 MINUTES

Candidates answer on the Question Paper.

READ THESE INSTRUCTIONS FIRST

Write your index number and name on all the work you hand in.
Write in dark blue or black pen.

Answer **all** questions.

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 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, unless the question requires the answer in terms of π .

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

The total of the marks for this paper is 70.

For Examiner's Use

This question paper consists of **16** printed pages.

Mathematical Formulae*Compound interest*

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

Mensuration

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

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

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

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

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

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

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

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

Answer _____ [2]

- 2 The first 4 terms in a sequence are 6, 10, 14, 18, ...

(a) Write down an expression, in terms of n , for the n th term, T_n , of this sequence.

Answer _____ [1]

(b) Evaluate T_{11} .

Answer _____ [1]

(c) Explain why T_n is always an even number, for all values of n .

Answer _____

_____ [1]

- 3 The population of Zimbabwe was 15.99 million with a land area of 390 745 km² in 2021.

(a) Write 15.99 million in standard form.

Answer _____ [1]

(b) Calculate the number of people per square kilometre, correct your answer to the nearest whole number.

Answer _____ [2]

- 4 (a) Express 540 as the product of its prime factors.

Answer _____ [1]

(b) The number $\frac{540p}{q}$ is a perfect cube.

p and q are prime numbers.

Find the value of p and the value of q .

Answer $p =$ _____
 $q =$ _____ [2]

- 5 (a) The time taken to put together a wooden crate is inversely proportional to the number of workers.
Four workers take 12.5 hours.
Find the time it would have taken 5 workers to put together a wooden crate.

Answer _____ hours [1]

- (b) A quantity y is directly proportional to x^3 . If x is increased by 200%, calculate the percentage change in y .

Answer _____ % [2]

- 6 If $2^x \div 8^{x-2} \times 4^{2x+3} = \frac{1}{16}$, find the value of x .

Answer _____ [3]

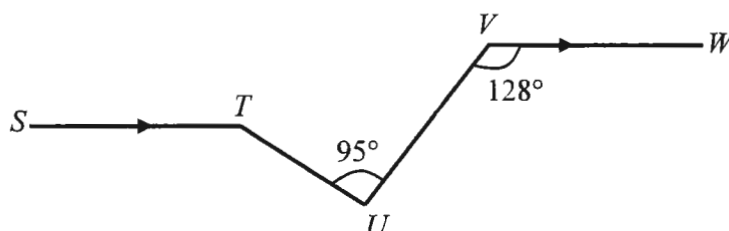
- 7 (a) Express $x^2 - 6x + 4$ in the form $(x - p)^2 + q$.

Answer _____ [2]

- (b) Write down the coordinates of the minimum point of the graph of $y = x^2 - 6x + 4$.

Answer (_____ , _____) [1]

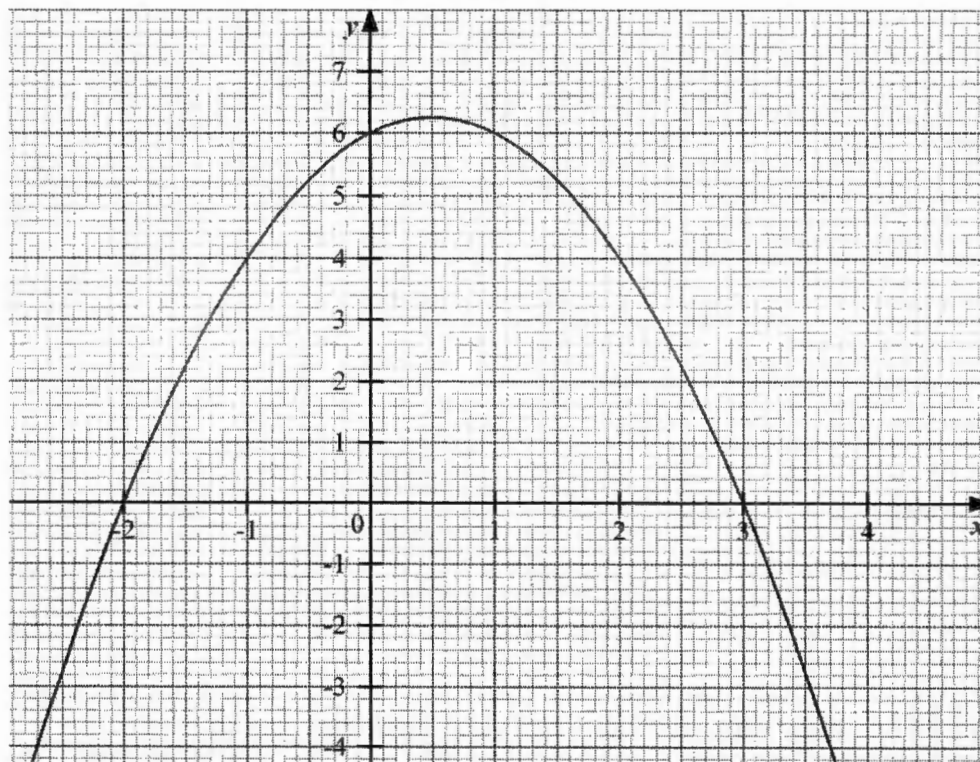
8



In the diagram, $ST \parallel VW$, angle $TUV = 95^\circ$ and angle $UVW = 128^\circ$.
Calculate angle STU .
Give a reason for each step of your working.

Answer _____ $^\circ$ [3]

- 9 The graph of $y = -x^2 + x + 6$ is drawn on the grid.



- (a) Write down the equation of the line of symmetry of the curve.

Answer _____ [1]

- (b) The equation $\frac{-x^2}{2} + x + 2 = 0$ can be solved by drawing a suitable straight line on the grid.

- (i) Find the equation of the straight line.

Answer _____ [1]

- (ii) By drawing this straight line, solve the equation $\frac{-x^2}{2} + x + 2 = 0$.

Answer $x =$ _____ or _____ [3]

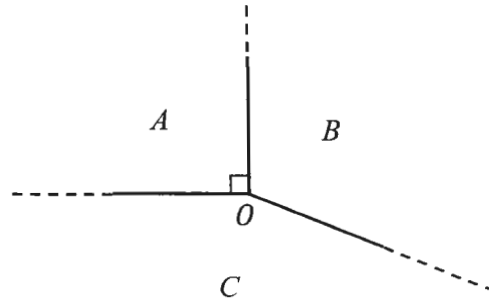
- 10 (a) Given that $p = \frac{\sqrt{h^2 - 4k^2}}{n}$, express k in terms of h , n and p .

Answer _____ [3]

- (b) Hence, find the values of k when $p = -1$, $h = 9$ and $n = 2$.

Answer $k =$ _____ or _____ [2]

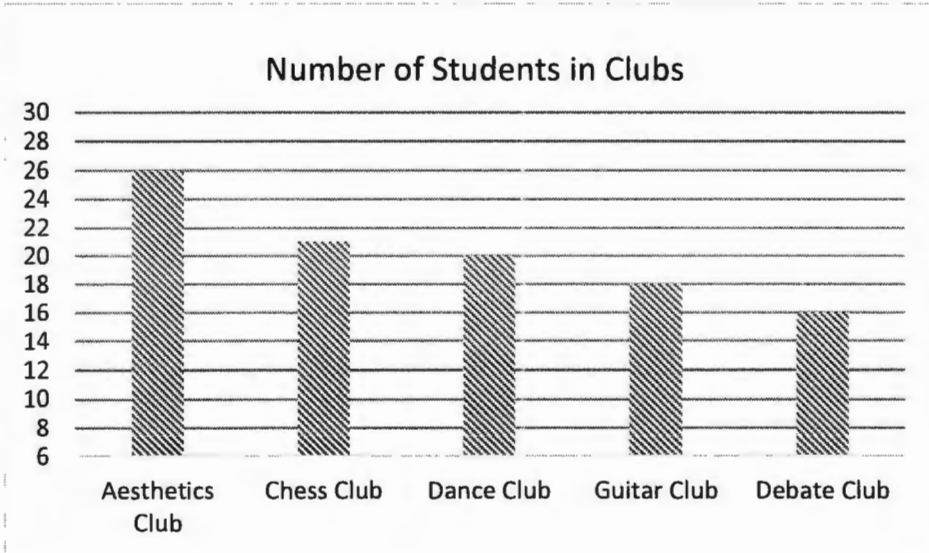
11



The diagram shows the interior angles of each of three regular polygons, A , B and C .
 A is a square, B is a regular pentagon and C is a regular n -sided polygon.
 The polygons fit together at O .
 Find the value of n .

Answer $n =$ _____ [4]

- 12 (a) The diagram shows a bar graph of the number of students in Clubs in a school.



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

Answer _____

 _____ [2]

- (b) The table shows the number of private buses in Singapore from 2020 to 2022.

Year	2020	2021	2022
Number of private buses	2835	2717	2634

Suggest one advantage of using a line graph compared to using a pictogram to represent the above data.

Answer _____

 _____ [1]

13 (a) Simplify $\frac{5(3n-4.5)}{3} + \frac{(2n+9)}{2}$.

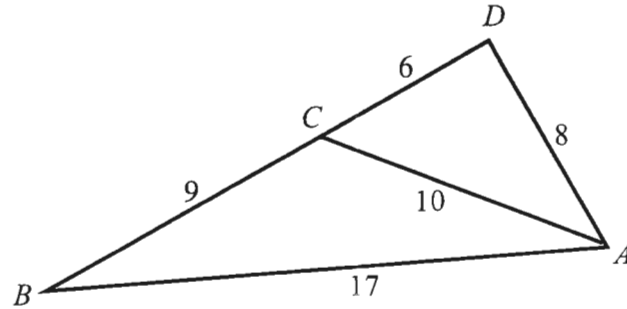
Answer _____ [3]

(b) Hence show that $\frac{5(3n-4.5)}{3} + \frac{(2n+9)}{2}$ is a multiple of 3 for all positive integers n .

Answer

[2]

- 14 ABC is a triangle in which $AC = 10$ cm, $BC = 9$ cm and $AB = 17$ cm. D is a point on BC produced, where $CD = 6$ cm and $AD = 8$ cm.



- (a) Explain why angle ADB is a right angle.

Answer _____

 _____ [2]

- (b) Find $\cos \angle ACB$, expressing your answer as a fraction.

Answer _____ [2]

- (c) Hence calculate the largest angle in the triangle ABC .

Answer _____[°] [1]

- 15 The screen times, to the nearest hours, 20 students spent on handphone games in a week are represented in a stem-and-leaf diagram.

Screen times of 20 students									
Stem	Leaf								
0	4	5	6	7	9				
1	0	3	4	5	6	6	6	7	9
2	0	0	1	1	2	2			

Key: 0 | 6 means 6 hours

- (a) A value is chosen.
Find the probability that the value chosen is the same value as the median.

Answer _____ [1]

- (b) The value, x , of another student is recorded and added to the diagram.
(i) If the mean of the new set of data is 15, find the value of x .

Answer $x =$ _____ [2]

- (ii) If the mode of the new set of data is affected, write down an inequality in x .

Answer _____ [1]

- 16 (a) Factorise completely $4ax - 3ay - 8bx + 6by$.

13

Answer _____ [2]

(b) Simplify $\frac{16x^2 - 9}{4x^2 - 9x - 9}$.

Answer _____ [3]

17 A store owner purchased x number of small boxes and y number of big boxes.

A small box cost \$0.10 and a big box cost \$0.18. If the total number of boxes he purchased was 343 and he spent \$42.70 altogether, by forming a pair of simultaneous equations, find the number of each type of box he purchased.

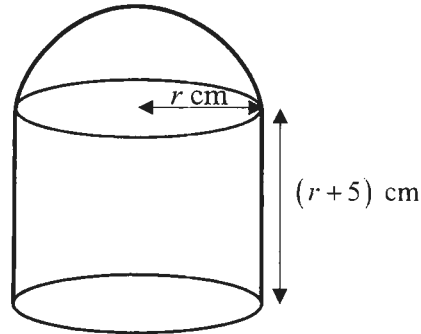
Answer 1st equation: _____

2nd equation: _____

Number of small boxes = _____

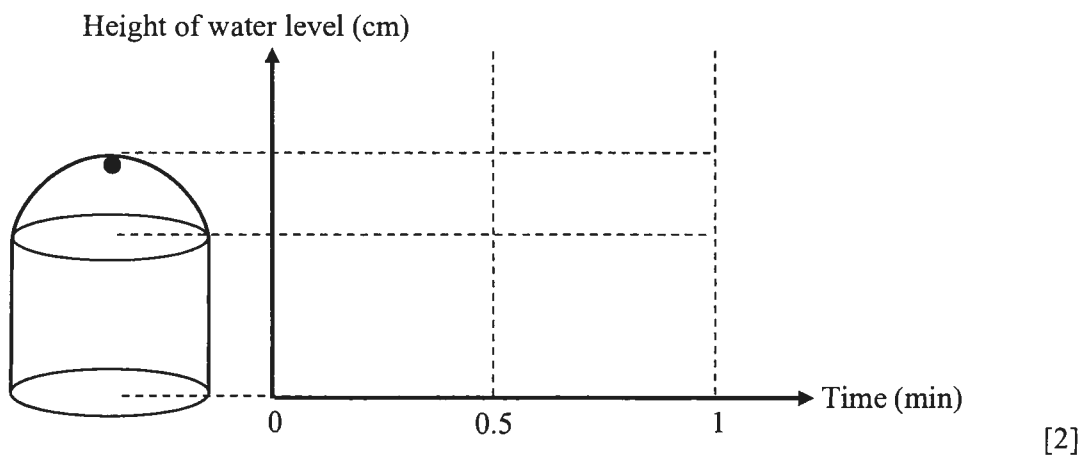
Number of big boxes = _____ [5]

- 18 (a) A container is made up of a cylinder and a hemisphere. The height of the cylinder is $(r + 5)$ cm and the radius of the hemisphere is r cm.
Find an expression, in terms of π and r , for the total surface area of the container.



Answer _____ cm^2 [4]

- (b) Water is poured at a constant rate into the container through a hole as shown below.
Use the grid below to sketch the change in the water level of the container if it takes 1 minute to fill the container with water.



Marking Scheme
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1	(a)	$(2x-3y)^2 = (2x)^2 - 2(2x)(3y) + (3y)^2$ $= 4x^2 - 12xy + 9y^2$
2	(a)	$6 + (n-1)(4)$ or $4n + 2$
	(b)	$T_{11} = 4(11) + 2 = 46$
	©	The n th term is $2(2n+1)$, hence the value should always be an even number.
3	(a)	$15.99 \text{ million} = 15.99 \times 10^6 = 1.599 \times 10^7$
	(b)	$\frac{15.99 \times 10^6}{390745} = 40.921 \approx 41$
4	(a)	$540 = 2^2 \times 3^3 \times 5$
	(b)	$\frac{2^2 \times 3^3 \times 5 \times p}{q} \quad \therefore p = 2, q = 5$
5	(a)	$t = \frac{k}{w} \quad \therefore \text{time} = 10 \text{ hours}$
	(b)	$y = kx^3$ $y = k(3x)^3 = k(27x^3)$ $\frac{27y - y}{y} \times 100\% = 2600\%$
6		$2^x \div 8^{x-2} \times 4^{2x+3} = \frac{1}{16}$ $2^x \div 2^{3(x-2)} \times 2^{2(2x+3)} = 2^{-4}$ $2^{x-3x+6+4x+6} = 2^{-4}$ $2x = -16$ $x = -8$
7	(a)	$(x-3)^2 - 5$
	(b)	Minimum point: $(3, -5)$
8		$128^\circ - 95^\circ = 33^\circ$ (alternate $\angle$ s, $VW \parallel UX$)

Marking Scheme
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		$180^\circ - 33^\circ = 147^\circ$ (interior $\angle$ s, $ST \parallel UX$)
9	(a)	$x = 0.5$
	(bi)	$-x^2 + 2x + 4 = 0$ $-x^2 + x + 6 = -x + 2$ $\therefore$ Equation of straight line: $y = -x + 2$
	(bii)	
		Line drawn $x = 3.2$ or -1.2 (allow for ± 0.1 for both answers)
10	(a)	$np = \sqrt{h^2 - 4k^2}$ $n^2 p^2 = h^2 - 4k^2$ $k^2 = \frac{h^2 - n^2 p^2}{4}$ $k = \pm \sqrt{\frac{h^2 - n^2 p^2}{4}}$ or $\pm \frac{1}{2} \sqrt{h^2 - n^2 p^2}$
	(b)	$k = \pm \frac{1}{2} \sqrt{9^2 - 2^2 (-1)^2} = 4.39$ or -4.39
11		$\frac{(5-2) \times 180}{5} = 108^\circ$ Interior angle of $B =$ $360 = 108 + 90 + \frac{(n-2) \times 180}{n}$ $162 = \frac{(n-2) \times 180}{n}$ $162n = 180n - 360$ $n = 20$
12	(a)	The bars do not start from zero, making the proportion of number of students in Aesthetics Club seems double of those in Debate Club.
	(b)	It will be easier to show the exact numbers of private buses using a line graph than a pictogram.

Marking Scheme
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Mathematics 4052
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13	(a)	$\frac{5(3n-4.5)}{3} + \frac{(2n+9)}{2} = \frac{10(3n-4.5)+3(2n+9)}{6}$ $= \frac{30n-45+6n+27}{6}$ $= \frac{36n-18}{6} = 6n-3$
	(b)	$\frac{5(3n-4.5)}{3} + \frac{(2n+9)}{2} = 6n-3 = 3(2n-1)$ Since , it will always be a multiple of 3.
14	(a)	$AD^2 + BD^2 = 8^2 + 15^2 = 289 = 17^2$ $AB^2 = 17^2$ Since $AD^2 + BD^2 = AB^2$, by the Converse of Pythagora's Theorem, angle ADB is a right angle.
	(b)	$AC = 10 \text{ cm}$ $\cos \angle ACB = -\cos \angle ACD = -\frac{3}{5}$
	(c)	Largest angle = angle $ACB = 126.9^\circ$

Marking Scheme
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15	(a)	$P(\text{value chosen is median}=16) = \frac{3}{20}$
	(bi)	$21(15) = 4 + 5 + 6 + 7 + 9 + 10 + 13 + 14 + 15$ $+ 3(16) + 17 + 19 + 2(20) + 2(21) + 2(22) + x$ $x = 22$
	(bii)	$20 \leq x \leq 22$
16	(a)	$4ax - 3ay - 8bx + 6by$ $= a(4x - 3y) - 2b(4x - 3y) = (4x - 3y)(a - 2b)$
	(b)	$\frac{16x^2 - 9}{4x^2 - 9x - 9} = \frac{(4x - 3)(4x + 3)}{(4x + 3)(x - 3)}$ $= \frac{4x - 3}{x - 3}$
17		1 st equation: $x + y = 343$
		2 nd equation: $(0.10)x + (0.18)y = 42.7$
		Show elimination or substitution method.
		Number of small boxes = 238 Number of big boxes = 105
18	(a)	Total S.A = $2\pi r^2 + \pi(2r)(r + 5) + \pi r^2$ $= 3\pi r^2 + 2\pi r^2 + 10\pi r$ $= 5\pi r^2 + 10\pi r$
	(b)	Height of water level (cm) Time (min)

Full Name	Class Index No	Class



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PAPER 2**

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

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

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

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

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

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

- 1 (a) The price of a game console in Singapore is \$620.
The price of the same game console in Japan is 42 980 yen.
The exchange rate between Singapore dollar (\$) and Japanese yen (¥) is
 $\$1 = ¥104.2$.
Calculate how much more expensive the game console is in Singapore than in Japan.

Answer \$ _____ [2]

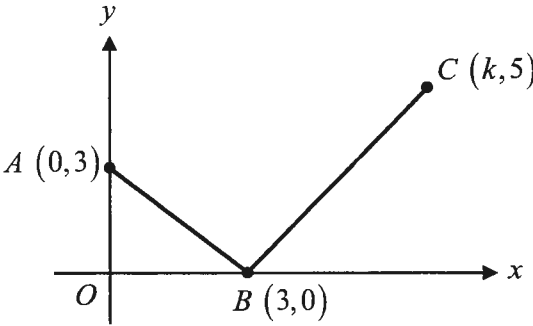
- (b) Mr Ong invests \$10 000 at a rate of $r\%$ per year compound interest.
At the end of 3 years the value of his investment is \$11 313.
Calculate the value of r .

Answer $r =$ _____ [2]

- (c) The cash price of a television set is \$2480.
 The hire-purchase price of the television set is \$2772.
 The hire-purchase price is a deposit of 15% of the cash price plus 12 equal monthly payments.
 Calculate one monthly payment.

Answer \$ _____ [3]

2



In the diagram, A is the point $(0, 3)$, B is the point $(3, 0)$ and C is the point $(k, 5)$.

- (a) Calculate the length of the line AB .

Answer _____ units [1]

4

- (b) Show that the value of k is 7 if the gradient of BC is $\frac{5}{4}$.

Answer

[2]

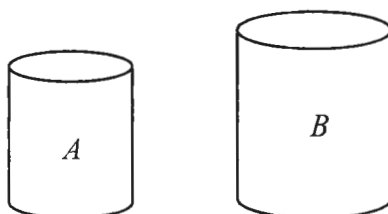
- (c) Hence find the equation of the line BC .

Answer _____ [2]

- (d) A point D lies on the y -axis such that $AC = CD$. Find the coordinates of D .

Answer (_____ , _____) [1]

- 3 (a) In the diagram, A and B are two geometrically similar cylindrical cans. The ratio of the base area of A to that of B is $9 : 16$.



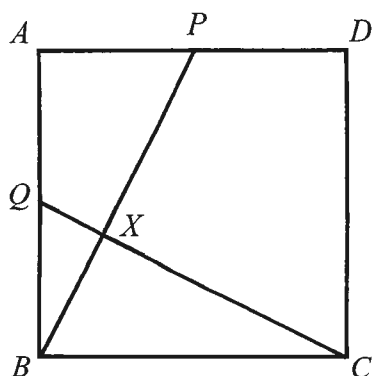
- (i) Find the ratio of the capacities of A and B .

Answer _____ : _____ [1]

- (ii) If the capacity of can B is $768\pi \text{ cm}^3$ and the height of can A is 9 cm , find the base radius of can A .

Answer _____ cm [2]

(b)



In the diagram, $ABCD$ is a square. P and Q are the mid points of AD and AB respectively.

(i) Show that triangle APB and triangle BQC are congruent.

Answer

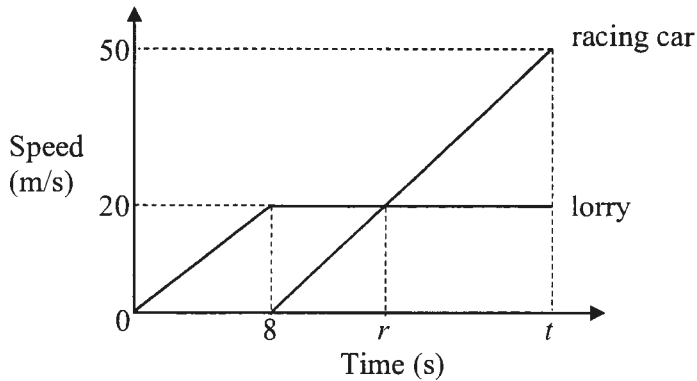
[2]

(ii) QC and PB intersect at X . Show that angle $BXC = 90^\circ$.

Answer

[2]

- 4 The diagram shows the speed-time graph of a lorry and a racing car that travelled along the same road during an interval of t seconds. Both vehicles started from the same place but the racing car started 8 seconds later than the lorry.



- (a) At the t^{th} second, the distance covered by both vehicles is the same.
 (i) Form an equation in t and solve the equation.

Answer $t =$ _____ [3]

- (ii) Hence calculate the average speed by the lorry for the whole journey.

Answer _____ m/s [2]

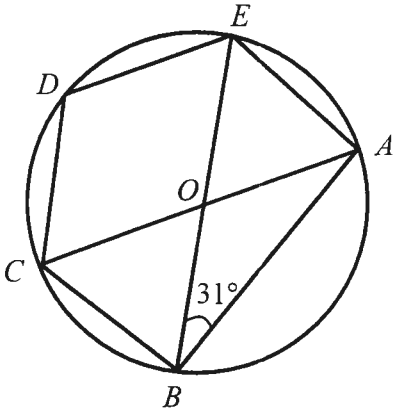
- (b) Calculate the acceleration of the racing car at 10 seconds.

Answer _____ m/s² [1]

- (c) Find the value of r when the two vehicles are at the same speed.

Answer $r =$ _____ [2]

- 5 (a) The diagram shows a circle, $ABCDE$, centre O .
 BE and AC are the diameters of the circle and F lies on CA produced.
 Angle $ABE = 31^\circ$.



Find, giving reasons for each answer,

(i) angle BCA ,

Answer _____ $^\circ$ [1]

(ii) angle CDE ,

Answer _____ $^\circ$ [1]

(iii) angle COE .

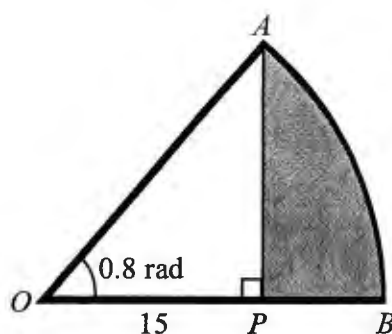
Answer _____ $^\circ$ [2]

- (iv) Show, with reasons, whether BC is parallel to AE .

Answer

[2]

(b)



The diagram shows a sector OAB with centre O and angle $AOB = 0.8$ rad.
 P is a point on OB such that $OP = 15$ cm and AP is perpendicular to OB .

Find

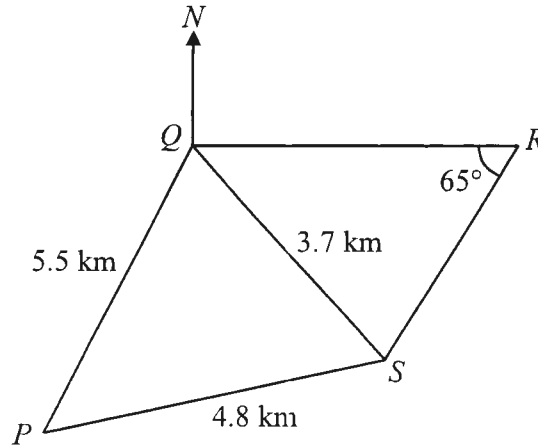
- (i) the length of OA ,

Answer $OA =$ _____ cm [2]

- (ii) the area of the shaded region.

Answer _____ cm^2 [3]

6



The diagram shows the positions of four points P , Q , R and S on a horizontal ground. It is given that R is due east of Q , P is on a bearing of 200° from Q and S is on a bearing of 130.5° from Q . Angle $QRS = 65^\circ$, $PS = 4.8$ km, $QS = 3.7$ km and $PQ = 5.5$ km.

(a) Calculate

(i) angle QPS ,

Answer _____ $^\circ$ [3]

(ii) the bearing of S from P ,

Answer _____ $^\circ$ [2]

(iii) the distance of SR ,

Answer _____ km [2]

(b) A man walks from Q to R . Calculate the maximum angle of elevation from the man to the top of a building of height 0.58 km at S .

Answer _____ ° [3]

- 7 In a certain town, the amount of rainwater collected over a period of time, x h, in an open tank is denoted by y m³. The volume, y , and the time, x , are connected by the equation $y = \frac{6}{2x+1} + x$.

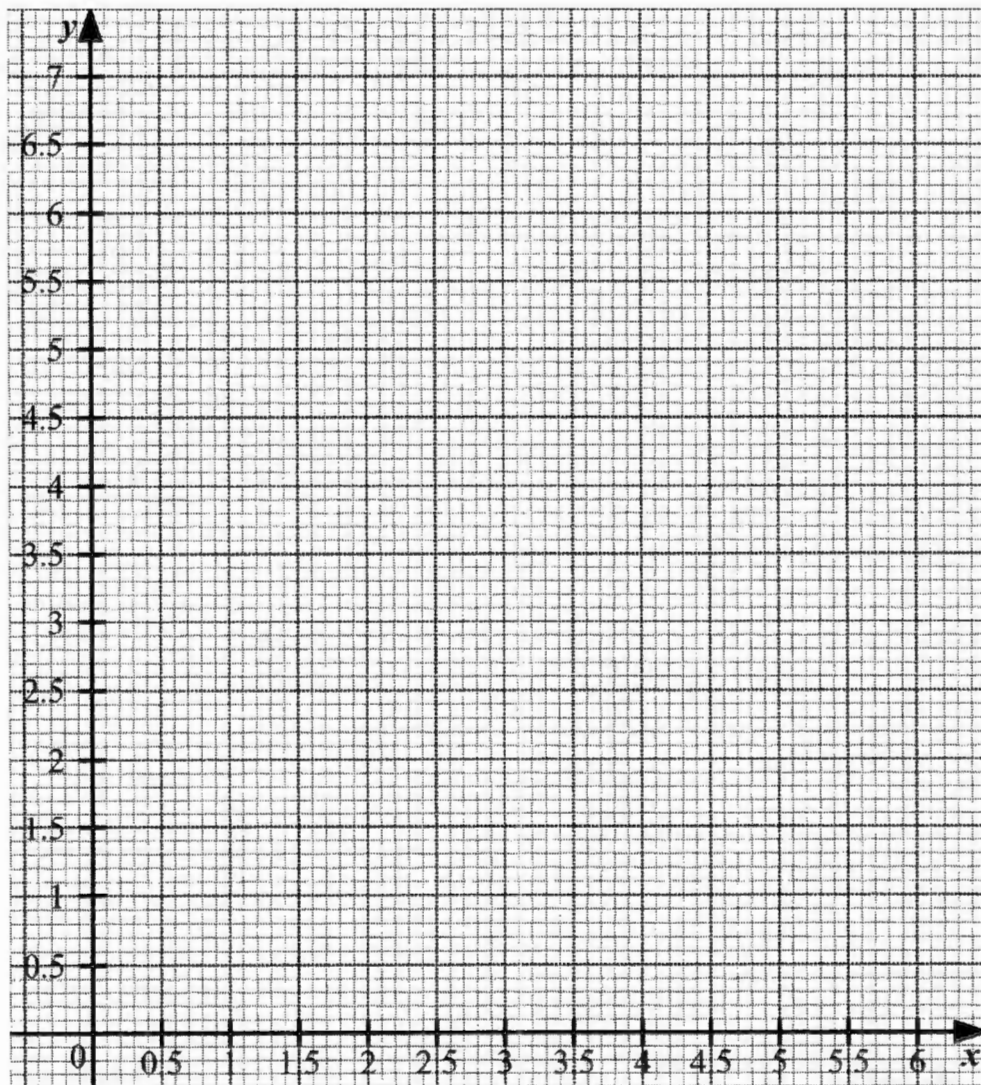
Some corresponding values of x and y are given in the table below.

x	0	0.5	1	1.5	2	3	4	5	6
y	6.0	3.5	3.0	3.0	3.2	3.9	4.7	5.6	6.5

- (a) What is the amount of rainwater in the open tank at the start?

Answer _____ m³ [1]

- (b) On the grid, draw the graph of $y = \frac{6}{2x+1} + x$ for $0 \leq x \leq 6$. [3]



- (c) Use **your graph** to find the time taken for the rainwater collected in the open tank to be the minimum volume.

Answer _____ h [1]

- (d) (i) By drawing a tangent, find the gradient of the curve at (0.5, 3.5).

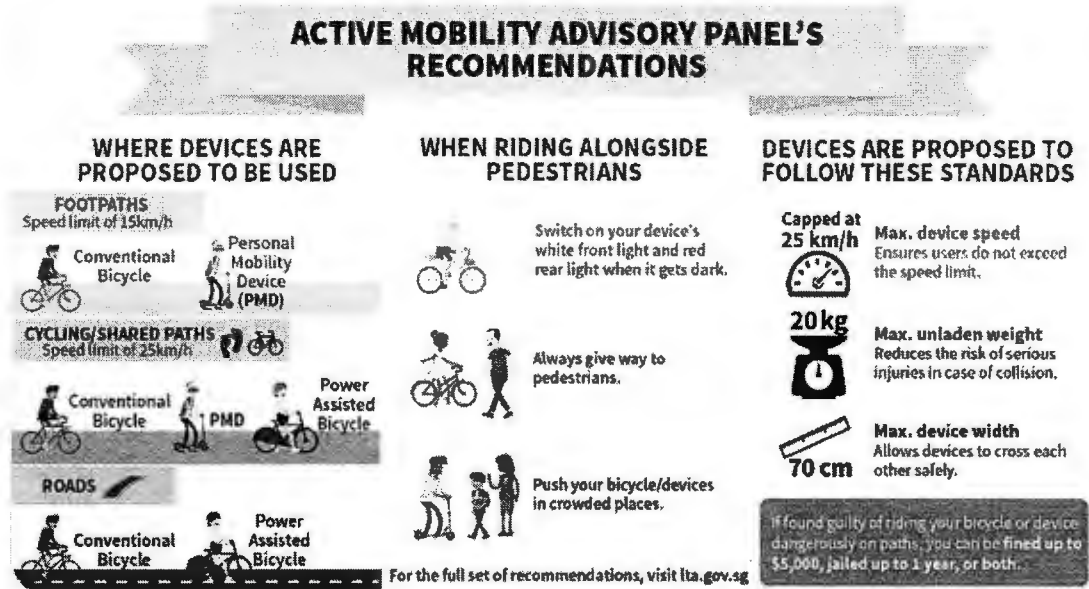
Answer _____ [2]

- (ii) What does this gradient represent?

Answer _____

_____ [1]

- 8 The infographic below describes the Active Mobility Act (AMA) that came into force in May 2018. It provides a set of rules and code of conduct to enable safe use of a Personal Mobility Device (PMD) in public areas.



Source: lta.gov.sg

- (a) From the infographic, deduce, in metres, the minimum width of a public path.

Answer _____ m [1]

- (b) If a cyclist is riding at 5 m/s on the footpath, did he exceed the maximum speed allowed?
 Show your working clearly.

Answer Yes / No (circle one), the cyclist _____
 as _____ . [2]

- (c) An experienced rider is riding on a power assisted bicycle of length 170 cm. He passes through a tunnel of length 2.2 km.
Calculate the minimum possible time for the rider to pass completely through the tunnel, giving your answer in minutes and seconds, correct to the nearest ten seconds.

Answer _____ min _____ sec [2]

Mr Ang wants to get a PMD for his ten-year-old son. He has shortlisted his choices as shown in the table below.

	Design A	Design B
Wheel Size	18-inch	22-inch
Weight	8.5 kg	10 kg
Price	\$299	\$219

* 1 inch = 2.54 cm

Design A can reach a maximum speed of 1.5 m/s faster than design B. The two designs cover 270 m with a time difference of a quarter of a minute.

- (d) By letting x be the maximum speed of design B, **form a quadratic equation** and calculate the maximum speeds of PMD designs A and B.

Answer Design A: _____ m/s
Design B: _____ m/s [5]

- (e) By checking if the bicycles adhere to the maximum speed limit imposed by the Land Transport Authority (LTA), recommend which design Mr Ang should purchase for his son.

State your assumptions and calculations clearly.

Answer

[3]

Marking Scheme and Markers' Report
Secondary 3 Express
Mathematics 4052
End-of-Year Examination Paper 2 2023

Anglo-Chinese School
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Qn	Part	
1	(a)	$\frac{42980}{104.2} = \text{S\$}412.476$
	(b)	$412.476 - 620 = \text{S\$}207.52$ $11313 = 10000\left(1 + \frac{r}{100}\right)^1$ $\sqrt[1]{\frac{11313}{10000}} = 1 + \frac{r}{100}$ $r = 4.20$
	(c)	Deposit = $15\%(2480) = \text{S\$}372$ $\frac{2772 - 372}{12} = \text{S\$}200$
2	(a)	$\sqrt{(3-0)^2 + (0-3)^2} = 4.24264 = 4.24 \text{ units}$
	(b)	$\frac{5-0}{k-3} = \frac{5}{4}$ $20 = 5k - 15$ $5k = 35$ $k = 7 \text{ (shown)}$
	(c)	$c = -3\frac{3}{4}$ $y = \frac{5}{4}x - 3\frac{3}{4}$
	(d)	(0, 7)
3	(ai)	$\frac{V_1}{V_2} = \left(\sqrt{\frac{9}{16}}\right)^3 = \frac{27}{64}$
	(aii)	Capacity of can A = $\frac{768\pi}{64} \times 27 = 324\pi \text{ cm}^3$ $\pi r^2(9) = 324\pi$ $r = 6 \text{ cm}$
	(bi)	$AP = BQ$ (mid points of sides of a square) $\angle BAP = \angle CBQ$ (right angle of a square) $AB = BC$ (sides of a square) $\therefore \triangle APB \equiv \triangle BQC$ (SAS Test)

	(bii)	Since $\therefore \triangle APB \equiv \triangle BQC$, $\angle APB + \angle ABP = \angle BQC + \angle ABP = 90^\circ$ $\therefore \angle BXC = 90^\circ$ (exterior angle of triangle BQC)
4	(ai)	$\frac{1}{2}(50)(t-8) = \frac{1}{2}(t+t-8)(20)$ $25t - 200 = 20t - 80$ $5t = 120$ $t = 24$
	(aii)	$\frac{1}{2}(24+24-8)(20) \div 24 = 16.7 \text{ m/s}$
	(b)	$\frac{50}{24-8} = \frac{25}{8} = 3.125 \text{ m/s}^2$
	(c)	$\frac{20}{r-8} = \frac{25}{8}$ $160 = 25r - 200$ $r = 14.4$
5	(ai)	$\angle BCA = 90^\circ - 31^\circ = 59^\circ$ (angle in a semicircle)
	(aii)	$\angle CDE = 180^\circ - 59^\circ = 121^\circ$ (angles in opp. segments)
	(aiii)	$\text{reflex } \angle COE = 2 \times 121^\circ = 242^\circ$ ($\angle$ at centre = 2 $\angle$ at circumference)
		$\angle COE = 360^\circ - 242^\circ = 118^\circ$ ($\angle$ at a point)
	(aiv)	$\angle OAE = \frac{118^\circ}{2} = 59^\circ$ (angles in same segment)
		Since $\angle OAE = \angle BCA$, BC is parallel to AE since they are alternate angles.
	(bi)	$\cos 0.8 = \frac{15}{OA}$ $OA = 21.5298 = 21.5 \text{ cm}$
	(bii)	$\frac{1}{2}(21.5298^2)(0.8) - \frac{1}{2}(15)(21.5298)(\sin 0.8)$ $= 185.412 - 115.833 = 69.578 = 69.6 \text{ cm}^2$
6	(ai)	$\cos \angle QPS = \frac{5.5^2 + 4.8^2 - 3.7^2}{2(5.5)(4.8)}$ $\angle QPS = 41.4096 = 41.4^\circ$
	(aii)	Bearing of Q from P = 20° Bearing of S from P = $20^\circ + 41.4096^\circ = 061.4^\circ$

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	(a) $\angle RQS = 40.5^\circ$ $\frac{SR}{\sin 40.5} = \frac{3.7}{\sin 65}$ $SR = 2.65137 = 2.65 \text{ km}$ (b) $\sin 40.5 = \frac{d}{3.7}$ $d = 2.402957 = 2.40 \text{ km}$ $\tan \theta = \frac{0.58}{2.402957}$ $\text{max angle of elevation} = 13.569 = 13.6^\circ$	
7	(a) 6.0 m^3 (b) (c) Min volume at 1.2 h (di) Tangent drawn Gradient = -2 (dii) The rate of decrease of the volume of rainwater in the open tank after 0.5 hour.	

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8	(a) $\frac{70 \times 2}{100} = 1.4 \text{ m}$ (b) Conversion of either 5 m/s to km/h or vice versa to compare the speeds. Yes/No, according to the speed limit indicated on either the footpath or cycling/shared path. (<i>follow conversion working</i>). (c) Min time = $\frac{\text{total distance covered}}{\text{max speed}}$ $= \frac{2.2 + 0.0017}{25} = 0.088068 = 5 \text{ min } 20 \text{ sec}$ (d) Let max speed of design B be $x \text{ m/s}$. Hence, max speed of design A be $(x + 1.5) \text{ m/s}$. $\frac{270}{x} - 15 = \frac{270}{x + 1.5}$ $270(x + 1.5) - 15x(x + 1.5) = 270x$ $270x + 405 - 15x^2 - 22.5x = 270x$ $2x^2 + 3x - 54 = 0$ $(2x - 9)(x + 6) = 0$ $x = 4.5 \text{ or } -6 \text{ (rejected)}$ Maximum speed of Design A: 6 m/s Maximum speed of Design B: 4.5 m/s (e) $4.5 \text{ m/s} = \frac{(4.5 \times 3600)}{1000} = 16.2 \text{ km/h}$ $6 \text{ m/s} = \frac{(6 \times 3600)}{1000} = 21.6 \text{ km/h}$ Since both PMD designs adhere to the maximum speed limit imposed by LTA as shown in the infographic, it is recommended for Mr Ang to purchase design A for his ten-year old son as it is lighter and smaller.
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