Full Name	Class Index No	Class		



# Anglo-Chinese School (Parker Road)

END-OF-YEAR EXAMINATION 2023 SECONDARY THREE EXPRESS

### MATHEMATICS 4052 PAPER 2

# **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  $\pi$  , use either your calculator value or 3.142, unless the question requires the answer in terms of  $\pi$  .

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 18 printed pages.

## Mathematical Formulae

Compound interest

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

Mensuration

Curved surface area of a cone 
$$= \pi r l$$
  
Surface area of a sphere  $= 4\pi r^2$   
Volume of a cone  $= \frac{1}{3}\pi r^2 h$   
Volume of a sphere  $= \frac{4}{3}\pi r^3$   
Area of triangle  $ABC = \frac{1}{2}ab\sin C$   
Arc length  $= r\theta$ , where  $\theta$  is in radians  
Sector area  $= \frac{1}{2}r^2\theta$ , where  $\theta$  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** 

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

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

 (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.



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]

(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  $768\pi$  cm<sup>3</sup> and the height of can A is 9 cm, find the base radius of can A.

*Answer* \_\_\_\_\_ cm [2]



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

**(b)** 



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/s<sup>2</sup> [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*,

(ii) angle *CDE*,

*Answer* \_\_\_\_\_\_° [1]

*Answer* \_\_\_\_\_\_° [1]

(iii) angle *COE*.

0

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

Answer

**(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<sup>2</sup> [3]



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* \_\_\_\_\_\_° [3]

(ii) the bearing of S from P,

(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]

[1]

Answer \_\_\_\_\_ m<sup>3</sup>

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 m<sup>3</sup>. 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
у	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?

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

**(b)** 

(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]
(i	i)	What does this gradient represent?		
Ans	wer			
				[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