ZHONGHUA SECONDARY SCHOOL

PRELIMINARY EXAMINATION 2023

SECONDARY 4 EXPRESS / 4 NORMAL (ACADEMIC) SBB

Candidate's Name	Class	Register Number

MATHEMATICS 4052/01

PAPER 1

25 August 2023

2 hours 15 minutes

Candidates answer on the Question Paper.

READ THESE INSTRUCTIONS FIRST

Write your name, class and register number on all the work you hand in.
Write in dark blue or black pen on both sides of the paper.
You may use an HB pencil for any diagrams or graphs.
Do not use paper clips, glue or correction fluid.

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 **90**.

90

Setter: Mr GOH CP
Vetter: Mr Francis Tan

Mathematical Formulae

Compound interest

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

Mensuration

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

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

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

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

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

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

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

Trigonometry

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

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

Statistics

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

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

Answer **all** the questions

1 Calculate $\sqrt[7]{\frac{6.5^3}{12.3-8.8}-7.7^4}$, give your answer correct to 5 significant figures.

Answer ..... [1]

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2 Simplify

(a) $\frac{a^5}{6}\times\frac{4a^3}{3}$.

Answer ..... [1]

(b) $4-2(1-5x)$.

Answer ..... [1]

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3 28 27.5 27.9 32.1 51.1 20.6 31.6 18.7

(a) Find the median of the set of numbers.

Answer ..... [1]

(b) Find the range for the set of numbers.

Answer ..... [1]

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4 The first four diagrams in a sequence are shown below.

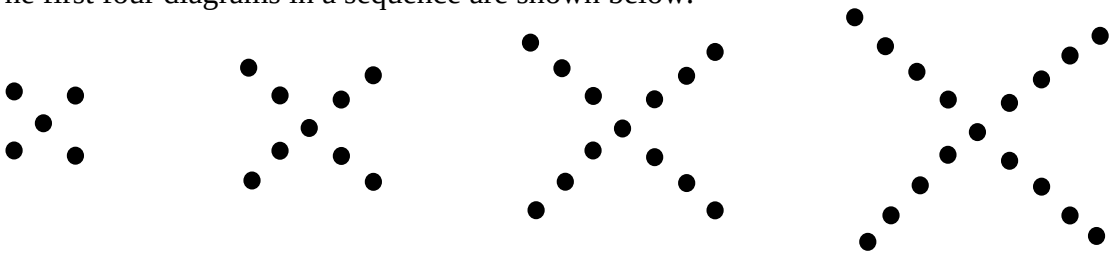


Diagram 1	Diagram 2	Diagram 3	Diagram 4
5 dots	9 dots	13 dots	17 dots

(a) Find the number of dots in Diagram 9.

Answer …… [1]

(b) Find an expression, in terms of n, for the number of dots in Diagram n.

Answer …… [1]

(c) Explain whether it is possible to have a diagram with 533 dots.

.....

..... [1]

5(a) A spinner is divided into red, green and yellow regions.

The probability that the spinner is in the red region is $\frac{1}{3}$.

The probability that the spinner is in the green region is $\frac{5}{12}$.

Find the probability that the spinner is in the yellow region.

Answer …… [1]

(b) A box contains 12 red balls, 14 blue balls and some yellow balls initially.
10 more yellow balls are added to the box.

The probability of picking a yellow ball from the box at random is now $\frac{1}{3}$.

Find the number of yellow balls in the box initially.

Answer …… [2]

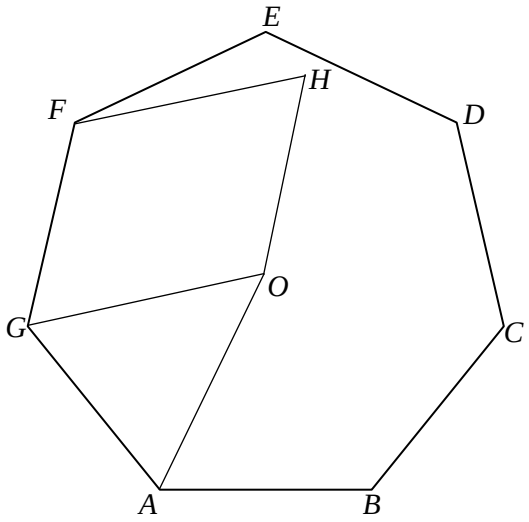
6 A pen costs \$2.10 and a pencil costs \$1.35.
Fyn buys a total of 11 pens and pencils.
She spends \$18.60 for x pens and y pencils.
Find the number of pens and pencils Fyn bought.

Answer Number of pens = ……

Number of pencils = …… [3]

7 The figure is made up of a 7 sided regular polygon with centre O, a triangle and a quadrilateral.

(a) Find angle OGF.



Answer …… [2]

The exact value of angle EFH is $12\frac{6}{7}$ degrees.

GF is parallel to OH.

(b) Show that quadrilateral $FGOH$ is a parallelogram.

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……

……

…… [2]

(c) Find reflex angle AOH.

Answer …… [2]

8 A school sent 60 students from Class A and 105 students from Class B to a museum.

The school divided these students into groups using the following rules.

- Each group must have the same number of students.
- All students in any group must be from the same Class.
- There should be as few groups as possible.

Find the number of students in each group and the total number of groups.

Answer Number of students in each group = ...

Total number of groups = ... [3]

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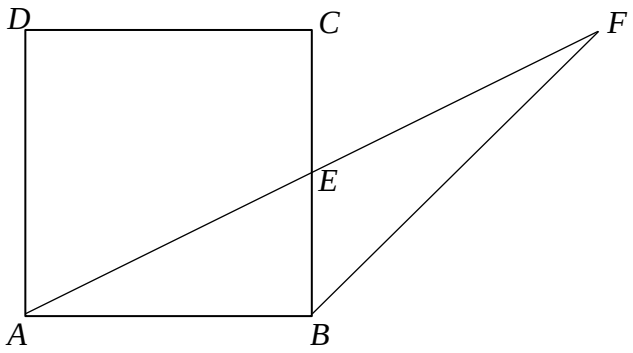
9 The diagram shows a square *ABCD*.

The line *AF* meets the side *BC* at point *E*.

E is the midpoint of *BC* and *AF*.

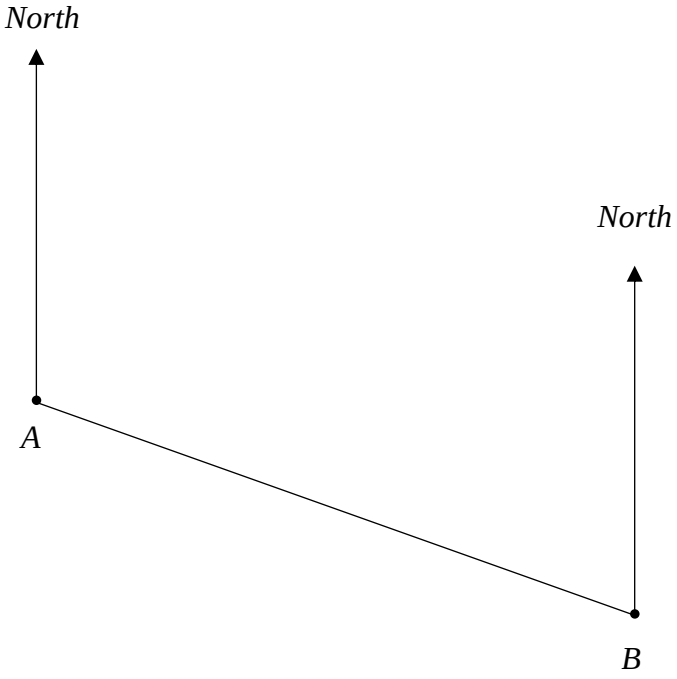
The area of triangle *BEF* is 9 cm^2.

Find the length of the side of the square.



Answer …… cm [4]

10 In this scale drawing, *A* and *B* are two points in a garden.



Amy starts walking towards a lamp post 500 metres away at a bearing of 165° from *A*.

(a) Mark and label on the drawing the position, *L*, of the lamp post. [2]

(b) Sandy walks from point *B* to meet Amy.
When they meet, she had walked the shortest possible distance.
Find the bearing of Sandy's path.

Answer …… [2]

11 **(a)** Factorise completely $105r^2 - 35rs$.

Answer …… [1]

(b) Factorise $12x^2 - 4x - 21$.

Answer …… [2]

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12 A bag of sweets contains chocolates, mints and toffees.

The ratio of chocolates to mints is $4n : 7$.

The ratio of toffees to mints is $6n : 13$.

(a) Work out the ratio of chocolates to toffees.

Give your answer in its simplest form.

Answer …… [2]

(b) Given that there are 273 mints, find the total number of sweets in terms of n.

Answer …… [1]

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13 The average water flow of tap *A* is 18 litres per hour.

The average water flow of tap *B* is 25 litres per hour.

(a) Find the time, in minutes, for tap *A* to fill a tank of *v* litres.

Answer ……minutes [1]

(b) Find the time, in minutes, for tap *B* to fill a tank of $(v + 7)$ litres.

Answer ……minutes [1]

(c) Given that tap *B* takes 4 minutes and 10 seconds less to fill up the $(v + 7)$ litre tank as compared to the time taken by tap *A* to fill a tank of *v* litres, form an equation in *v* to find the value of *v*.

Answer $v =$…… [3]

14 Ace thinks of a prime number, p.

He multiples it by 3 and subtracts 9.

He divides the answer by 3 and adds 2.

His final answer is less than 55.

(a) Without simplifying, write down an inequality in p.

Answer …… [1]

(b) Solve your inequality to find the largest possible value of p.

Answer …… [2]

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15 Expand and simplify $(2x + 3y)(3y – 2x) – (2y – x)^2$.

Answer …… [2]

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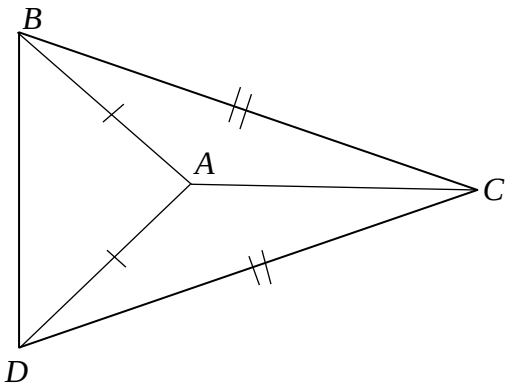
16 In the figure, triangle *BAD* and triangle *BCD* are isosceles triangles.

Show that triangle *BAC* is congruent to triangle *DAC*.

Give a reason for each statement you made.

Answer



[3]

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17 The diagram shows a kite, *ABDC*.

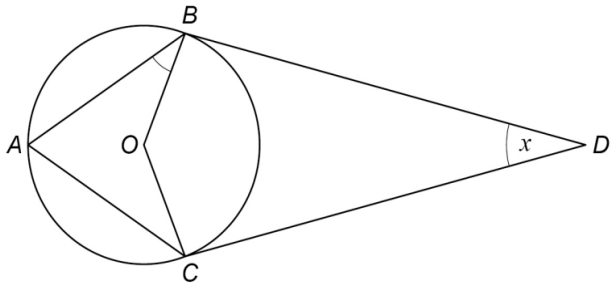
A, *B* and *C* are three points on the circumference of a circle, centre *O*.

BD and *CD* are tangents to the circle.

Angle *BDC* is *x* radians.

Show that angle *ABO* is $\frac{\pi - x}{4}$ radians.

Answer



Not drawn to scale

[4]

18 Sam and Dean are each landscaping their own gardens.

Sam needs x packs of gravels, $(x + 6)$ packs of tiles, 10 potted plants and 5 trees.
Dean needs 10 packs of gravels, 8 packs of tiles, 15 potted plants and 8 trees.

This information is represented by the matrix $\mathbf{R} = \begin{pmatrix} x & x+6 & 10 & 5 \\ 10 & 8 & 15 & 8 \end{pmatrix}$.

In a shop, a pack of gravels costs \$130, a pack of tiles \$200, a potted plant \$25 and a tree \$45.
In an online store, a pack of gravels costs \$100, a pack of tiles \$210, a potted plant \$20 and a tree \$50.

This information is represented by the matrix $\mathbf{S} = \begin{pmatrix} 130 & 100 \\ 200 & 210 \\ 25 & 20 \\ 45 & 50 \end{pmatrix}$.

(a) Find, in terms of x, the matrix $\mathbf{Q} = \mathbf{RS}$.

Answer $\mathbf{Q} = \begin{pmatrix} & \end{pmatrix}$ [2]

(b) Explain what the elements of the second row of the matrix **Q** represent.

……

…… [1]

(c) Sam will be able to save \$25 if he buys his items from the shop compared to the online store. Find x.

Answer …… [2]

(d) Dean will be able to save some money if he buys all his items from the online store. Calculate how much will he save.

Answer \$…… [2]

19 Given that 10 sin x = 3, find the two possible values for angle x, where $0^\circ \leq x \leq 180^\circ$.

Answer …… [2]

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20 $\sqrt[3]{6p - 5q^3} = \frac{2q}{3}$

Rearrange the formula and make q the subject.

Answer …… [2]

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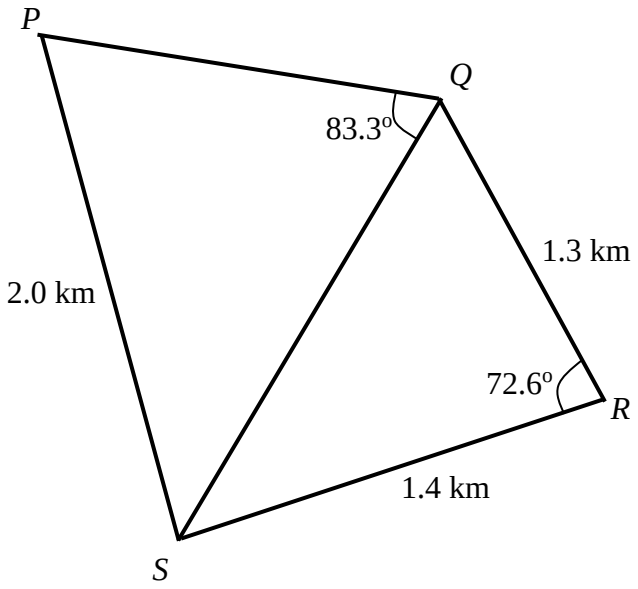
21 The diagram shows a quadrilateral *PQRS*.

Given that *QR* = 1.3 km, *SR* = 1.4 km, *SP* = 2.0 km,

angle *PQS* = 83.3° and angle QRS = 72.6°,



calculate the

(a) length of *QS*.

Answer ……km [2]

(b) angle *PSQ*.

Answer Angle *PSQ* = …… [2]

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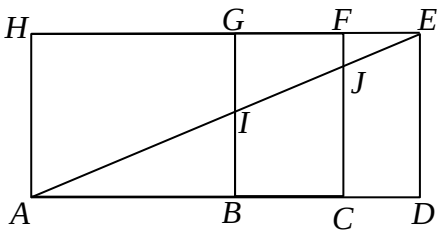
22 The diagram shows a rectangle *ADEH*.



It is is divided into three smaller rectangles by the lines *BG* and *CF*. *AD* is 20 cm, *FJ* is 1 cm. and the ratio of *AB* : *BC* : *CD* is 6 : 3 : 1.

Find angle *AEH*.

Answer angle *AEH* = …… [3]

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23 Solve for the value of x

$$2^{4x} \times 3^{8x} = 18$$

Answer …… [2]

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24 Jen sold her watch to a dealer at a loss of 15%.

The dealer then sold the watch to Gin at a profit of 15%.

Gin paid $2130.95 for the watch inclusive of an 8% Goods and Service Tax.

Calculate

(a) the Goods and Services Tax,

Answer $…… [2]

(b) the amount which Jen sold her watch to the dealer.

Answer $…… [3]

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25 6 men can complete tarring 10 km of road in 5 days.
Dave claims that he will need to hire 9 more men to complete tarring 30 km of road in 5 days.

(a) By showing your calculations clearly, do you agree with Dave?

Answer

……

……

……

……

…… [3]

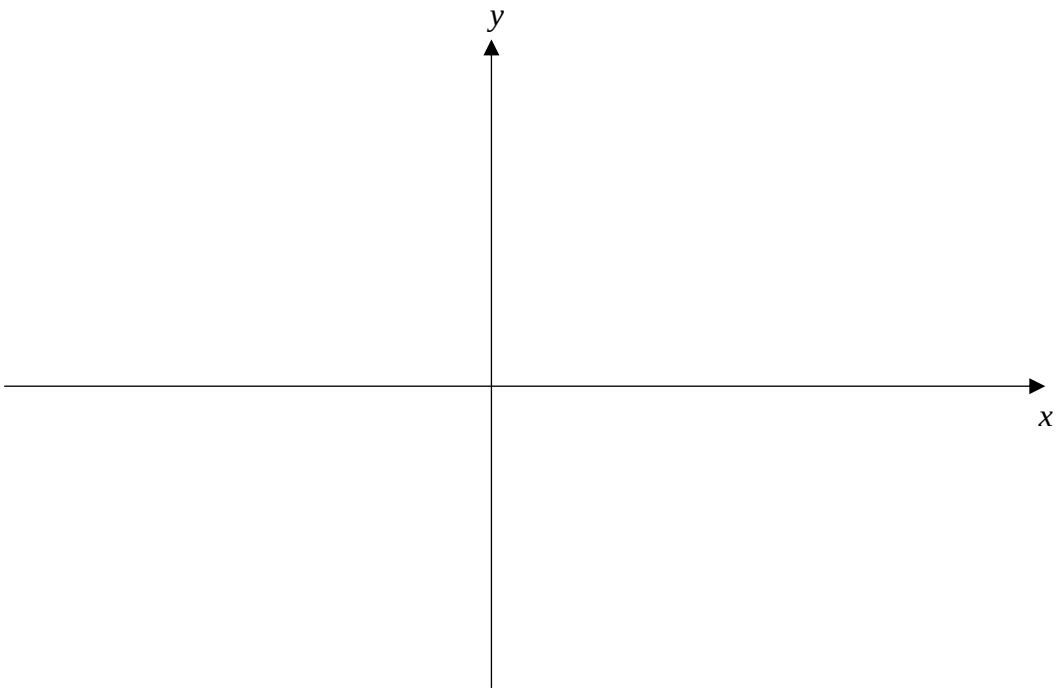
(b) Give one assumption Dave had made.

……

…… [1]

26(a) On the axes, sketch the graph of $y = -(5 + 2x)(2x + 1)$.

State clearly the coordinates of the x-intercepts and the y-intercept. [3]



(b) *A, B* and C are vertices of a triangle on a cartesian plane.

Given that *A* is (2, 5) and *B* is (2, –6) and the area of triangle *ABC* is 121 square units.

(ii) Find the x-coordinate of *C*.

Answer …… [2]

(ii) Given that point *D* is (–26, –16),

Calculate the length of *BD*.

Answer …… [2]

~ End of Paper ~

[Turn over]