SINGAPORE CHINESE GIRLS' SCHOOL
PRELIMINARY EXAMINATION 2022
SECONDARY FOUR
O-LEVEL PROGRAMME

CANDIDATE NAME

CLASS	4				REGISTER NUMBER			

CENTRE NUMBER	S					INDEX NUMBER				

MATHEMATICS   **4048/02**
PAPER 2

Monday   **29 August 2022**   **2 hours 30 minutes**

Candidates answer on the Question Paper.

READ THESE INSTRUCTIONS FIRST

Write your name, class, register number, centre number and index number 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/tape.

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 number of marks for this paper is 100.

For Examiner's Use

This document consists of **21** printed pages and **1** blank page.   **[Turn over**

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

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

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

1 **(a)** **(i)** Solve the inequalities $\dfrac{3x+1}{2} < 1 - \dfrac{2x}{5} \leq 5$.

Answer ……………………………….. [3]

(ii) Hence, state the largest integer that satisfies $\dfrac{3x+1}{2} < 1 - \dfrac{2x}{5} \leq 5$.

Answer ……………………………… [1]

(b) Simplify $\dfrac{(4x-10)^2}{10+21x-10x^2}$.

Answer ……………………………… [3]

[Turn over

(c) Solve the equation $\dfrac{6}{x+2} - \dfrac{x-5}{3x^2-12} = 1$.

Answer $x =$ …………………………. [4]

2 The stem-and-leaf diagram shows the scores of a group of students in an English test.

```
0 | a
1 | 8  9
2 | 1  6  8  8
3 | 0  2  3  6  6  6  7
4 | 4  4  5  7
5 | 0  b
```

Key: 1 | 8   represents 18 marks

(a) Students who scored more than n marks were awarded a distinction.
Given that 35% of the students were awarded a distinction, find the value of n.

Answer $n =$ …………………………. [2]

(b) The range of scores for the English test is 44 marks.
The mean score for the English test is 33.3 marks.
By forming two equations, find the value of *a* and of *b*.

Answer   *a* = …….…..... , *b* = …….….....   [3]

(c) The same group of students also took a Science test.
Their results for the Science test are summarised in the table.

Mean	38 marks
Standard Deviation	6 marks

Make two comments comparing the performance of the students in both tests.

Answer ……………………………………………………………………………...

……………………………………………………………………………………………

……………………………………………………………………………………………

……………………………………………………………………………………………

……………………………………………………………………………………………

……………………………………………………………………………………………

……………………………………………………………………………………………

……………………………………………………………………………………………

……………………………………………………………………………………………… [2]

3 Jon and Lim are regular customers of the same fruit supplier.
   As regular customers, they are given a 10% discount off all their purchases.
   The matrix, **T**, shows the number of cartons of fruits they purchased from the supplier.

$$\mathbf{T} = \begin{matrix} & \text{Jon} & \text{Lim} \\ & \begin{pmatrix} 15 & 18 \\ 20 & 15 \\ 12 & 16 \end{pmatrix} & \begin{matrix} \text{Apples} \\ \text{Oranges} \\ \text{Pears} \end{matrix} \end{matrix}$$

(a) Each carton of apples costs \$45.
     Each carton of oranges costs \$35.
     Each carton of pears costs \$40.
     Represent these amounts in a 1×3 row matrix **N**.

Answer   **N** = $\begin{pmatrix} & & \end{pmatrix}$ [1]

(b) Evaluate the matrix **C** = 0.9**NT**.

Answer   **C** =   [2]

(c) State what each element of matrix **C** represents.

Answer …………………………………………………………………………...

………………………………………………………………………………………

………………………………………………………………………………………

……………………………………………………………………………………… [1]

(d) The elements of the matrix **R**, where **R** = **QT**, represent the total number of each
     type of fruit that Jon and Lim purchased respectively.

   (i) Given that there are 32 apples in each carton of apples, 72 oranges in each
        carton of oranges and 45 pears in each carton of pears, write down a 3×3
        matrix **Q** to represent these information.

Answer   **Q** = $\begin{pmatrix} & & \\ & & \\ & & \end{pmatrix}$ [1]

(ii) Evaluate the matrix **R**.

Answer   **R** =   [1]

(e) Jon sold all his apples in bags of 5 and at $6 per bag.
He sold all his pears at $1 each.
He found that 15% of his oranges were rotten and could not be sold.
He sold all the remaining oranges.
Given that Jon made a profit of 20% from the sale of the fruits, calculate the price
at which he sold each orange.
Give your answer correct to the nearest cent.

Answer $ …………………………..   [4]

4
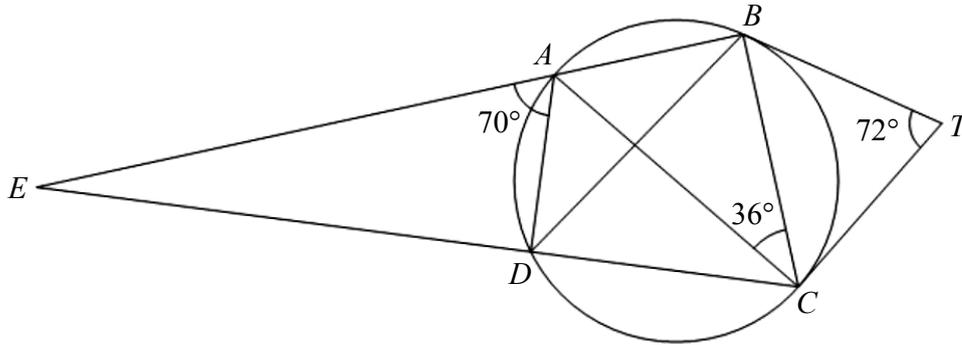
The diagram shows a circle *ABCD*.
BAE and *CDE* are straight lines.
BT and *CT* are tangents to the circle.
Angle *EAD* = 70°, angle *ACB* = 36° and angle *BTC* = 72°.

(a) Find, giving reasons for each answer,

(i) angle *BCD*,

Answer   Angle *BCD* = ……………… [2]

(ii) angle *ABD*,

Answer   Angle *ABD* = ……………… [2]

(iii) angle *ACT*.

Answer   Angle *ACT* = ……………… [2]

(b) Hence, what can you deduce about the line *AC*?
Give a reason for your answer.

Answer ………………………………………………………………………………...

……………………………………………………………………………………………

……………………………………………………………………………………………

……………………………………………………………………………………………

…………………………………………………………………………………………… [2]

(c) *Q* is a point on *AC* such that angle *AQB* = 72°.
Explain clearly whether *Q* is the centre of the circle.

Answer ………………………………………………………………………………...

……………………………………………………………………………………………

……………………………………………………………………………………………

……………………………………………………………………………………………

……………………………………………………………………………………………

……………………………………………………………………………………………

……………………………………………………………………………………………

……………………………………………………………………………………………

…………………………………………………………………………………………… [2]

5 **(a)** Complete the table of values for $y = 2 + x - \dfrac{x^3}{5}$.

x	-3	-2	-1	0	1	2	3
y	4.4	1.6	1.2	2	2.8	2.4	

[1]

(b) On the grid, draw the graph of $y = 2 + x - \dfrac{x^3}{5}$ for $-3 \le x \le 3$. [3]
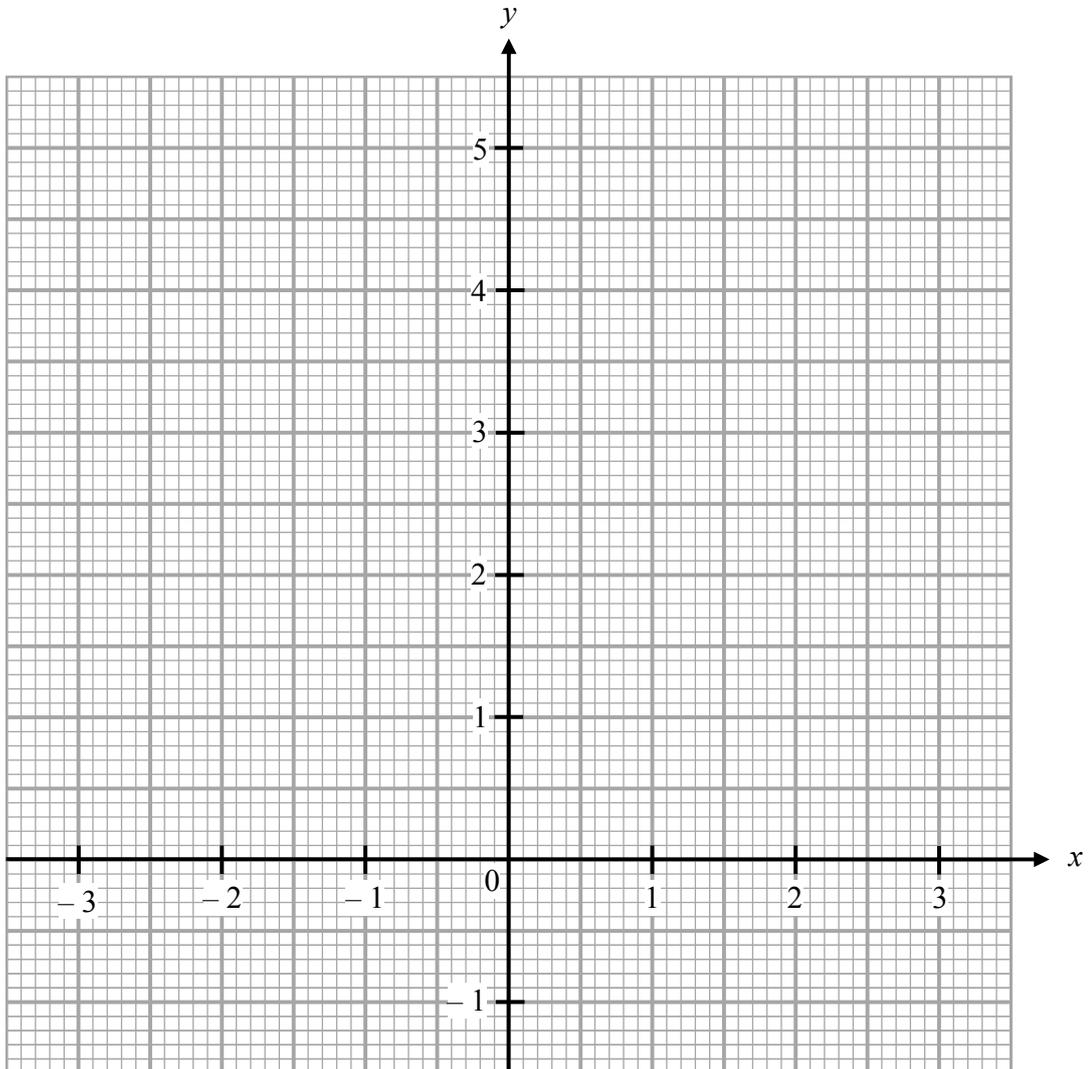
(c) The equation $2 + x - \dfrac{x^3}{5} = k$ has exactly two solutions.

Use your graph to write down a possible value of k.

Answer $k = $ ………………………….. [1]

(d) By drawing a tangent, find the gradient of the curve at (2, 2.4).

Answer ………………………………….. [2]

(e) The points of intersection of the line $x + 4y = 5$ and the curve give the solutions of the equation $Ax^3 - Bx - 15 = 0$.

(i) Find the value of A and of B.

Answer $A = $ ………….. , $B = $ …………… [2]

(ii) By drawing the line $x + 4y = 5$ on the grid for $-3 \le x \le 3$, solve the equation $Ax^3 - Bx - 15 = 0$.

Answer $x = $ ……………………………… [3]

[Turn over

6
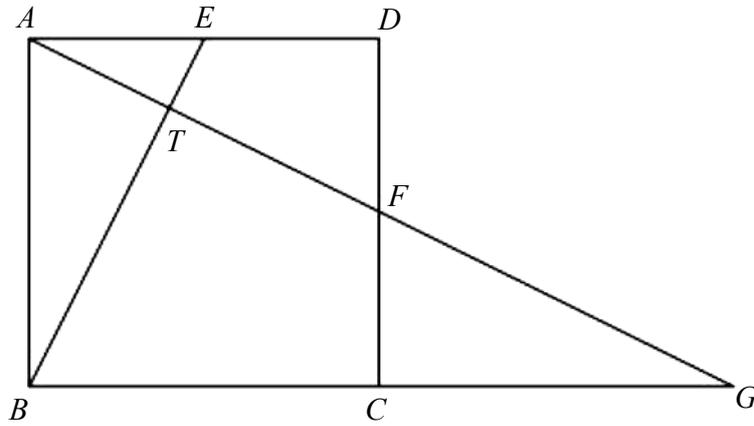
In the diagram, *ABCD* is a square.
E and *F* are the midpoints of *AD* and *DC* respectively.
T is the point of intersection of *AF* and *BE*.
When produced, the lines *ATF* and *BC* meet at *G*.

(a) Show that triangle *ADF* is congruent to triangle *GCF*.

Answer

[3]

(b) Show that triangle *FCG* is similar to triangle *ABG*.

Answer

[2]

(c) Write down another pair of triangles that are similar but not congruent.

Answer Triangle …………………….. is similar to triangle ……………………… [1]

(d) Find the ratio

(i) area of triangle *AET* : area of triangle *GBT*,

Answer ……………... : ……………. [1]

(ii) area of triangle *FCG* : area of quadrilateral *ABCF*,

Answer ……………... : …………… [1]

(iii) area of triangle *AET* : area of quadrilateral *BCFT*.

Answer ……………... : …………… [1]

7
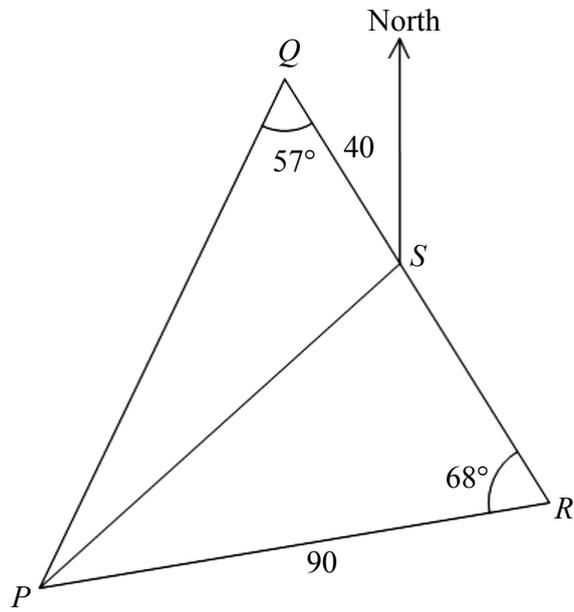
In the diagram, P, Q and R are three points on horizontal ground.
S is a point on QR, such that the bearing of R from S is 145°.
$QS = 40$ m and $PR = 90$ m.
Angle $PQS = 57°$ and angle $PRS = 68°$.

(a) Calculate the bearing of Q from P.

Answer ………………………………… [2]

(b) Show that $SR = 47.9$ m, correct to 3 significant figures.

Answer

[3]

(c) Calculate *PS*.

Answer …………………………... m   [3]

(d) A surveyor at point *S* walks along *QR* such that the distance between him and the point *P* is a minimum.
Showing your working clearly, state whether the surveyor should walk towards point *Q* or point *R* and find the distance he should walk from *S* such that the distance between him and point *P* is a minimum.

The surveyor should walk towards point ………………… for a distance

of ………………… metres such that the distance between him and point *P* is a

minimum.   [3]

8   *ABCD* is a rhombus.
D is to the right of *A* such that *AD* is parallel to the *x*-axis.
$$\overrightarrow{AB} = \begin{pmatrix} 4.5 \\ 6 \end{pmatrix}.$$

(a)   Find $\left|\overrightarrow{AB}\right|$.

Answer ………………………….. units   [1]

(b)   Write down the column vector $\overrightarrow{BC}$.

Answer ……………………………...   [1]

(c)   Find the column vector $\overrightarrow{BD}$.

Answer ……………………………...   [2]

(d)   A line is parallel to *BD* and passes through the point (3, 7).
Find the equation of the line.

Answer ……………………………...   [2]

(e) The diagonals of the rhombus intersect at the point P.

(i) D is the point $(5, -2)$.
Using vector method, find the position vector of P.

Answer ………………………………… [2]

(ii) Stating your reasons clearly, determine whether a circle passing through points C, D and P can be drawn.

Answer …………………………………………………………………………..

………………………………………………………………………………………...

………………………………………………………………………………………...

………………………………………………………………………………………...

………………………………………………………………………………………...

………………………………………………………………………………………... [2]

9
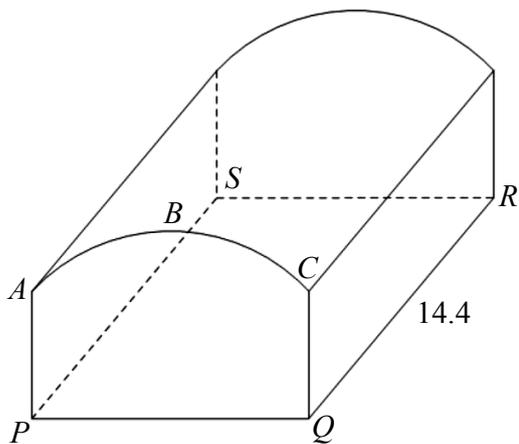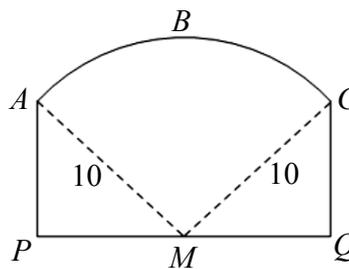

**Diagram I**   **Diagram II**

Diagram 1 shows a barn constructed with a rectangular base *PQRS*.
The barn is positioned on horizontal ground with both its ends open.
QR = 14.4 m.
Diagram II shows the cross-section of one end of the barn where *APQC* is a rectangle.
The roof is represented by *ABC*, the arc of a circle of radius 10 m, centre *M*.
M is a point on *PQ* such that it is vertically below *B*.

$\cos \angle CMQ = \dfrac{3}{5}$.

(a) Without calculating the value of angle *CMQ*, show that the exact length of *PQ* is 12 m.

Answer

[1]

(b) Hence, calculate the angle of elevation of *B* from *R*.

Answer ……………………………… [2]

(c) Calculate the total surface area, including the base, of the barn.

Answer …………………………... m^2 [4]

(d) The volume of a geometrically similar barn is $\frac{1}{3}$ of the volume of the barn in **Diagram I**.

Given that the cost of painting the roof of the barn in **Diagram I** is $1000, calculate the cost of painting the roof of the smaller barn.

Answer $ …………………………. [3]

10 (a) Paul is in Singapore for a holiday.
As a tourist, he is eligible for a 7% goods and services tax (GST) rebate at participating shops.

Paul sees the following laptop sold at a local shop.

He buys the laptop on hire purchase using his credit card.
He pays a deposit of S$1000.
He then makes 18 monthly payments of S$230.
Calculate the additional amount that Paul will pay for the laptop when he purchases it on hire purchase.

Answer S$ ………………………….. [3]

(b) Smith is a foreigner working in Singapore.
He has a sum of money, in euros, which he intends to invest for 3 years.
He visits an investment company and is given the following information.

Average Exchange Rate

				USD (US$)
			Euro (€)	1.0500
		JPY (¥)	0.0071	0.0074
	GBP (£)	164.95	1.1641	1.2225
SGD (S$)	0.5884	97.1506	0.6854	0.7193

Key: £1 = €1.1641

	Plan A	**Plan B**	**Plan C**
Minimum Amount	€10 000	S$10 000	S$1000
Simple interest rate per annum	First €5000 : 0% Subsequent : 2.5%	1.8%	2.02%
Minimum Period	3	2	3
Currency Used	€	S$	S$
Eligibility	All	All	Singaporeans

Smith has a choice of investing the sum of money in euros or changing the sum of money to Singapore dollars before investing it.

If he changes all the euros that he has to Singapore dollars, he will get S$8 less than when he changes it to US dollars first, then Singapore dollars.

Smith thinks that Plan A will be the best investment plan for him as the simple interest rate per annum is the highest.
Do you agree with him?
Justify the decision you make and show your calculations clearly.

…………………………………………………………………………………………………

………………………………………………………………………………………………… [7]

BLANK PAGE