# TANJONG KATONG GIRLS' SCHOOL
# PRELIMINARY EXAMINATION
# SECONDARY FOUR EXPRESS

| | |
|---|---|
| CANDIDATE NAME | |
| CLASS | INDEX NUMBER |

## MATHEMATICS 4052/01

Paper 1

**16 August 2024**

**2 hours 15 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.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE ON ANY BARCODES.

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 $\pi$, use either your calculator value or 3.142.

| For Examiner's use |
|---|
| |



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## *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*

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

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

*Statistics*

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

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



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Answer **all** the questions.

**1** **(a)** Calculate $\dfrac{165^2+\sqrt[4]{75.125-11.2\times(-3)}}{3.142}$ .

Write your answer correct to 2 significant figures.

*Answer* ……..……. [1]

**(b)** The number of people in a shopping mall is 1100, correct to the nearest hundred.

Write down the minimum number of people there are in the mall.

*Answer* ……..……. [1]

**2** Simplify

**(a)** $5-2(6x-1)$,

*Answer* ……..……. [1]

**(b)** $\left(\dfrac{27b^9}{a^6}\right)^{-\frac{1}{3}}$.

*Answer* ……..……. [2]



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**3** Albert and Chris have some savings in the ratio 5 : 3.
They spent $30 each from their savings and the new ratio of their savings is 2 : 1.
Find the amount of savings Chris has at the start.

*Answer* $ …….……. [2]

**4** **(a)** Express 1400 as a product of its prime factors.

*Answer* …….……. [1]

**(b)** $q$ is a number between 70 and 90.
The highest common factor of $q$ and 1400 is 28.
Find the smallest possible value of $q$.

*Answer* $q =$ …….……. [2]



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**5** Given that $\frac{1}{2^{a-1}} = 2^3 + 2^3 + 2^3 + 2^3$ , find the value of $a$.

*Answer* $a =$ …… [2]

**6** **(a)** Expand and simplify $2(5m+3n)^2$ .

*Answer* …… [2]

**(b)** Factorise completely $24(mn)^2 - 21mn^3$ .

*Answer* …… [1]



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**7** The area of triangle $XYZ$ is 12.6 $cm^2$.
$XY = 4.5$ cm and $YZ = 7.1$ cm.

Find two possible values for angle $XYZ$. Give your answers in radians.

*Answer* …...……rad or ……..… rad [3]

**8** $P$ is inversely proportional to $Q^3$ .
Find the percentage change in $P$ when $Q$ is reduced by 20%.

*Answer* ……..……% [2]



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**9** It is given that $p = \dfrac{q + r^2}{q - 5}$.

**(a)** Find $p$ when $q = \dfrac{1}{5}$ and $r = -6$.

*Answer* $p =$ …… [1]

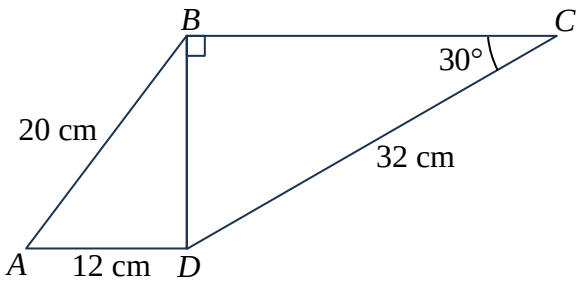
**(b)** Express $q$ in terms of $p$ and $r$.

*Answer* …… [2]



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**10** The diagram shows a quadrilateral $ABCD$ made up of two triangles.
$AB = 20$ cm, $AD = 12$ cm, $CD = 32$ cm.
Angle $CBD = 90°$ and angle $BCD = 30°$.




**(a)** Find $BD$.

*Answer* …… cm [2]

**(b)** **Hence or otherwise**, show that it is possible to form a circle with diameter $AB$ such that point $D$ lies on the circumference of the circle.

*Answer*

[2]



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**11** Write as a single fraction in its simplest form $\frac{3}{(1-2h)^2}+\frac{8}{2h-1}$ .

*Answer* ……..……. [3]



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**12** $k$ is a positive integer.
An odd number is formed when 5 is subtracted from twice of $k$.

**(a)** Write down an expression for the odd number in terms of $k$.

*Answer* …… [1]

**(b)** The sum between the odd number and the next consecutive odd number is greater than 16.

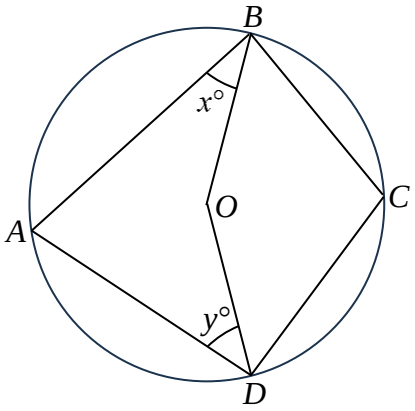
Form an inequality in terms of $k$ and solve it to find the smallest possible value of the larger odd number.

*Answer* …… [3]



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**13** In the diagram, $A$, $B$, $C$ and $D$ are four points on a circle, centre $O$.
Angle $ABO = x°$ and angle $ADO = y°$.




Find angle $BCD$ in terms of $x$ and $y$.
Give reasons for each step of your working.

*Answer* ……...……...….° [3]



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**14** **(a)** Factorise $3x^2 - 14x - 5$ .

*Answer* …… [2]

**(b)** **Hence**, factorise completely $3(y+1)^2 - 14y - 19$.

*Answer* …… [2]



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**15** The points $P(2, 3)$ and $Q(-1, -3)$ lie on the curve $y = ax^2 + bx + 2$ .
Form and solve two simultaneous equations to find the values of $a$ and $b$.

*Answer* $a =$ ……

$b =$ …… [4]



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**16** A bag contains 15 red marbles, some blue marbles and some yellow marbles.
A marble is chosen at random from the bag.

The probability of choosing a blue marble is $\frac{1}{6}$ and the probability of choosing a yellow marble is $\frac{7}{12}$ .

**(a)** Show that there are 60 marbles in total in the bag.

*Answer*

[2]

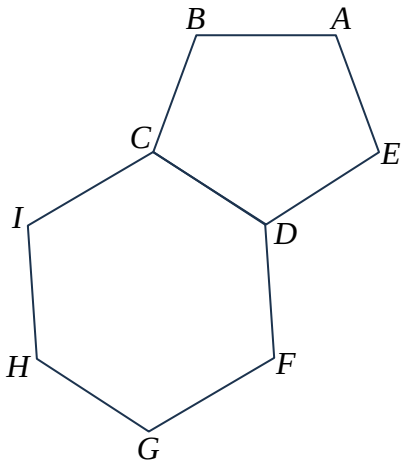
**(b)** Two marbles are chosen at random from the bag.
Find the probability that both marbles are blue.

*Answer* …… [2]



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**17** The figure is made up of a regular pentagon *ABCDE* and a regular hexagon *CDFGHI*.




**(a)** Find angle *BCI*.

*Answer* ……...……...….° [2]

**(b)** Determine whether *BC* and *CI* are two sides of another regular polygon.
Justify your answers with mathematical working.

*Answer*

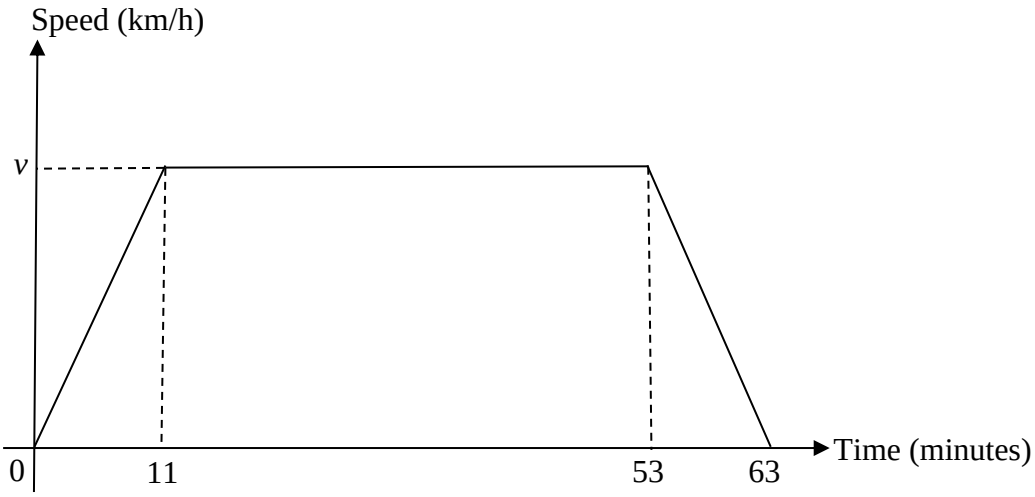
…….

……. [2]



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**18** The diagram shows the speed-time graph of a cyclist from Town *A* to Town *B*.




**(a)** The total distance travelled by the cyclist is 14 km.
Show that $v = 16$.

*Answer*

[2]

**(b)** Find the speed of the cyclist 5 minutes from the start of the journey.

*Answer* ……. km/h [1]

**(c)** Calculate the acceleration of the car in the last 10 minutes.

*Answer* ……. km/h$^2$ [1]



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**19** The times taken, in minutes, by 14 students to complete a Mathematics assignment are recorded.

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

| | | | | | | |
|---|---|---|---|---|---|---|
| 1 | 1 | 5 | 9 | | | |
| 2 | 0 | 3 | 3 | 3 | 6 | 9 |
| 3 | 4 | 8 | 8 | 9 | | |
| 4 | 0 | | | | | |

Key:
4 | 0 represents 40 minutes

**(a)** Find the modal time.

*Answer* …….……. mins [1]

**(b)** Find the percentage of students who took at most 20 minutes to complete the assignment.

*Answer* …….…… % [1]

**(c)** The time taken for the 15th student to complete the assignment is recorded.
The range increases to 31 minutes.
Find two possible times this student spent completing the assignment.

*Answer* ……. mins or ……. mins [2]



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**20** The first four terms in a sequence of numbers are given below.

$$T_1 = \frac{2}{1} - \frac{3}{5} = \frac{7}{5}$$
$$T_2 = \frac{3}{5} - \frac{4}{5^2} = \frac{11}{25}$$
$$T_3 = \frac{4}{5^2} - \frac{5}{5^3} = \frac{3}{25}$$
$$T_4 = \frac{5}{5^3} - \frac{6}{5^4} = \frac{19}{625}$$

**(a)** Find $T_5$ .

*Answer* …… [1]

**(b)** Find an expression, in terms of *n*, for $T_n$ .

*Answer* $T_n =$ …… [2]

**(c)** Evaluate the sum of the first ten terms, $T_1 + T_2 + T_3 + \ldots + T_{10}$ .

*Answer* …… [2]



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**21** Benedict left his house to go to the library.
He took the first bus, which travelled 5 km in $t$ minutes.

He then alighted at a bus stop and waited for 12 minutes to switch to the next bus.

The second bus took 2 minutes less than the first bus to reach his destination after travelling a further 3.75 km.

**(a)** Find the time taken for the whole journey, in minutes, in terms of $t$.

*Answer* ……..……. minutes [1]

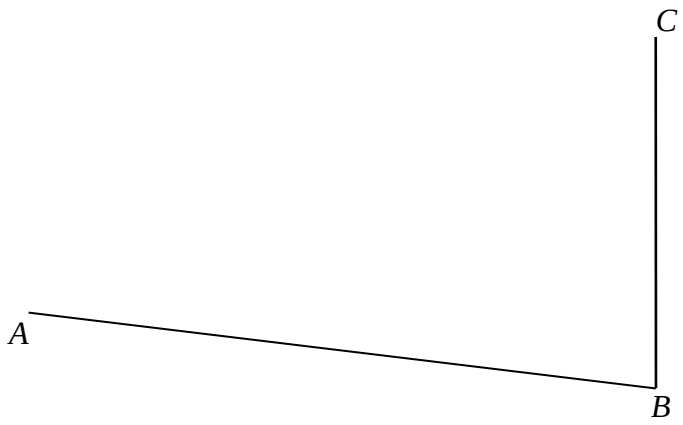
**(b)** Given that the average speed for the whole journey is 10.5 km/h, form an equation in terms of $t$ to calculate the total time taken for the journey.

*Answer* ……..……. minutes [3]



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**22** In this scale drawing, *A*, *B* and *C* are three corners of a park *ABCD* with *C* due north of *B*.




**(a)** Construct the perpendicular bisector of *BC*. [1]

**(b)** *D* is on a bearing of 065° from *A* and equidistant from *B* and *C*.
Mark and label point *D* on the drawing. [1]

**(c)** Construct the bisector of angle *ABC*. [1]

**(d)** Eleanor is standing inside the park *ABCD* such that she is closer to *BC* than *AB* and closer to *B* than *C*.
Shade the region where Eleanor could be standing.
[1]



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**23** The table below shows the number of books read by 50 students in Class *A* in semester 1.

| Number of books read, $n$ | Frequency |
|---|---|
| $0 < n \leq 2$ | 8 |
| $2 < n \leq 4$ | 21 |
| $4 < n \leq 6$ | 11 |
| $6 < n \leq 8$ | 3 |
| $8 < n \leq 10$ | 7 |

**(a)** Calculate an estimate for

**(i)** the mean number of books read by the students,

*Answer* ……. [1]

**(ii)** the standard deviation of the number of books read by the students.

*Answer* ……. [1]

**(b)** After introducing a reading programme in semester 2, the number of books read by each student in Class *A* increased by 2.
State how the mean and standard deviation will change after the increase.

*Answer*

…….

……. [2]

**(c)** The standard deviation of the number of books read by the students from Class *B* was 3.15.

Use this information to comment on one difference between the two distributions.

*Answer*

…….

…….

…….. [1]



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**24** An enrichment centre offers drama, writing and speech enrichment classes on weekdays during the school holiday.

The matrix **S** shows the number of students who attend the different classes for beginners and advanced levels in a day.

$$\begin{matrix} & \text{drama} & \text{writing} & \text{speech} \\ \mathbf{S} = & \begin{pmatrix} 25 & 32 & 40 \\ 21 & 19 & 32 \end{pmatrix} & \begin{matrix} \text{beginners} \\ \text{advanced} \end{matrix} \end{matrix}$$

**(a)** Evaluate the matrix $\mathbf{W} = 5\mathbf{S}$.

*Answer* **W =** [1]

The school fee for drama cost $40 per session, $25 per session for writing and $30 per session for speech. The fees for beginner and advanced learners are the same for each type of class.

**(b)** Represent these amounts in a column matrix **C**.

*Answer* **C =** [1]

**(c)** Evaluate the matrix $\mathbf{T} = \mathbf{WC}$.

*Answer* **T =** [2]

**(d)** Explain what the elements in **T** represent.

*Answer*

…….

…….

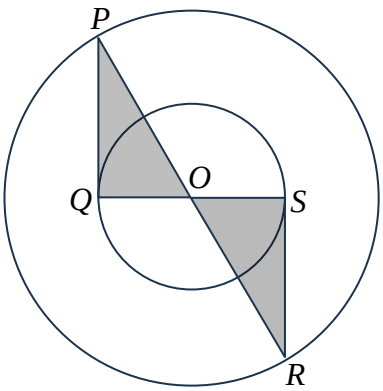
……. [1]



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**25** *PR* is a diameter of the large circle, centre *O*.
*QS* is a diameter of the small circle, centre *O*.

*PQ* and *RS* are tangents to the small circle.




**(a)** Show that triangle *OPQ* is congruent to triangle *ORS*.
Give a reason for each statement you make.

*Answer*

[3]

**(b)** The ratio of *OQ* to *PQ* to *OP* is 5 : 12 : 13.
Express the area of the shaded region as a percentage of the large circle.

*Answer* ……..……. % [3]



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## Answer Key

| | |
|---|---|
| **1(a)** | 8700 |
| **1(b)** | 1050 |
| **2(a)** | $7-12x$ |
| **2(b)** | $\frac{a^2}{3b^3}$ |
| **3** | \$90 |
| **4(a)** | $1400 = 2^3 \times 5^2 \times 7$ |
| **4(b)** | $q = 84$ |
| **5** | $a = -4$ |
| **6(a)** | $50m^2 + 60mn + 18n^2$ |
| **6(b)** | $3mn^2(8m - 7n)$ |
| **7** | $\angle XYZ = 0.909$ radian or 2.23 radian |
| **8** | $95\frac{5}{16}\%$ |
| **9(a)** | $-7\frac{13}{24}$ |
| **9(b)** | $q = \frac{r^2 + 5p}{p - 1}$ |
| **10(a)** | 16 cm |
| **11** | $\frac{16h - 5}{(1-2h)^2}$ |
| **12(a)** | $2k - 5$ |
| **12(b)** | 11 |
| **13** | $180° - x° - y°$ |
| **14(a)** | $(3x+1)(x-5)$ |
| **14(b)** | $(3y+4)(y-4)$ |
| **15** | $a = -1.5$ and $b = 3.5$ |
| **16(a)** | 60 |
| **16(b)** | $\frac{3}{118}$ |
| **17(a)** | 132° |
| **17(b)** | Since the number of sides is not a positive integer greater than 3, *BC* and *CI* cannot be sides of a regular polygon. |
| **18(b)** | $7\frac{3}{11}$ km/h |
| **18(c)** | –96 km/h$^2$ |

| | |
|---|---|
| **19(a)** | 23 |
| **19(b)** | $28\frac{4}{7}\%$ |
| **19(c)** | 42 and 9 |
| **20(a)** | $T_5 = \frac{6}{5^4} - \frac{7}{5^5} = \frac{23}{3125}$ |
| **20(c)** | 2.00 |
| **21(a)** | $(2t+10)$ minutes |
| **21(b)** | 50 minutes |
| **23a(i)** | 4.2 |
| **23a(ii)** | 2.47 |
| **23(b)** | The mean number of books will increase by 2 while the standard deviation value will remain the same. |
| **23(c)** | SD of class $A = 2.47$<br>SD of class $B = 3.15$<br>Since the standard deviation value of class *A* is lesser than class *B* by 0.68, class *A* has a smaller spread in distribution and the books read by class *A* is more homogeneous in general. |
| **24(a)** | $\begin{pmatrix} 125 & 160 & 200 \\ 105 & 95 & 160 \end{pmatrix}$ |
| **24(b)** | $\begin{pmatrix} 40 \\ 25 \\ 30 \end{pmatrix}$ |
| **24(c)** | $\begin{pmatrix} 15000 \\ 11375 \end{pmatrix}$ |
| **24(d)** | The elements in **T** represent the total amount of school fees paid for weekdays in a week for beginner and advanced students respectively. |
| **25(a)** | ASA / RHS / AAS test |
| **25(b)** | 11.3% |



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