## TEMASEK JUNIOR COLLEGE

## 2023 IP1 END-OF-YEAR EXAMINATION



CANDIDATE NAME			
CG	SUBJECT TUTOR'S NAME		

### FUNDAMENTAL MATHEMATICS

5 October 2023 2 hours

#### READ THESE INSTRUCTIONS FIRST

Write your name, CG and tutor's name on all the work you hand in. Write in dark blue or black pen.

You may use a soft pencil for any diagrams or graphs.

Do not use paper clips, highlighters, glue or correction fluid.

Answer all questions.

Write your answers in the spaces provided in the question paper.

You may request for additional writing materials if there is insufficient space. These should be attached to the back of the booklet.

Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place in the case of angles in degrees, unless a different level of accuracy is specified in the question. The calculator value for  $\pi$  should be used unless the question requires the answer in terms of  $\pi$ .

The use of an approved scientific and/or graphing calculator is expected where appropriate.

You are reminded of the need for clear presentation in your answers. Marks will be deducted for poor or unclear presentation. The number of marks is given in brackets [] at the end of each question or part question.

For Examiner's Use	
Q1	/ 6
Q2	/7
Q3	/6
Q4	/ 6
Q5	/ 6
Q6	/7
Q7	/ 6
Q8	/ 5
Q9	/ 6
Q10	/7
Q11	/7
Q12	/ 5
Q13	/ 6
Presentation Deduction	-1 / -2
Total	/ 80

This document consists of **10** printed pages and **0** blank pages.

#### Answer all questions in the spaces provided. Show all working clearly.

1 (a) Express the following numbers on a number line. [1]

$$\sqrt{12}, -\frac{3\pi}{4}, 1.654, -2$$

(b) Without the use of a calculator, estimate the value of the expression

$$\frac{2.054 + \left(-0.98\right)^2}{\frac{\sqrt{102}}{4}}$$

leaving your answer correct to the nearest integer. [5]

- 2 (a) A prime number, x, is greater than 75 but less than 81.
  - (i) State the value of x. [1]

It is given that x can be expressed as a product of h-22 and h+56, where h is a positive integer.

- (ii) Find the value of h, showing your working clearly. [2]
- (b) (i) Express 127 008 as a product of its prime factors. [1]
  - (ii) Hence find the largest possible value of  $\sqrt[3]{\frac{127\ 008}{2k}}$  and the corresponding value of k, where k is a positive integer. [3]

[4]

- 3 A rectangular tank measures 48 cm by 72 cm by 252 cm.
  If it is to be filled completely with small identical cubes, find
  (i) the greatest possible volume of each cube,
  - (ii) the least possible number of cubes required. [2]

- 4 (a) Convert 20 m/s to km/h.
  - (b) It is given that the value of a limited-edition pair of sneakers increases by 5% every year. In 2020, the value of the pair of sneakers is \$3000. Find the value of the pair of sneakers in 2023, leaving your answer correct to the nearest cent. [2]
  - (c) The diagram below (not drawn to scale) shows a circle with radius r cm inscribed in a square, where the circle touches all four sides of the square.



Find the ratio of the area of the circle to the area of the shaded region, leaving your answers in terms of  $\pi$ . [2]

5 (a) Expand and simplify 
$$-\frac{1}{2}\left[2h\left(\frac{1}{h}+4k\right)-6k\left(2h-\frac{2}{3k}\right)\right]$$
. [3]

**(b)** Factorise 
$$2q - p - (5pr - 10qr)$$
 completely. [3]

6 (i) Solve the equation 
$$-2 + \frac{5+6x}{3x-1} = -\frac{4}{x+5}$$
. [5]

(ii) Hence explain why the equation  $-2 + \frac{5+6y^2}{3y^2-1} = -\frac{4}{y^2+5}$  has no real solutions. [2]

7 In a biathlon race, Penelope ran a total of 15 km at an average speed of *x* km/h and cycled
40 km at an average speed of 15 km/h faster than her average running speed.

It is given that Penelope took  $\frac{1}{x}$  hours longer to cycle than to run.

- (i) Form an equation in terms of x and solve it. [4]
- (ii) Hence find the total time taken, in hours, for Penelope to complete the race. [2]

[2]

Pattern no.	Pattern
1	$1^2 - 1^2 = (0)(2)$
2	$2^2 - 1^2 = (1)(3)$
3	$3^2 - 1^2 = (2)(4)$
4	$4^2 - 1^2 = (3)(5)$

8 The first four lines of a number pattern are shown in the table below.

(i) Complete the table below.

# [Answers for Question 8(i)]

Pattern no.	Pattern
1	$1^2 - 1^2 = (0)(2)$
2	$2^2 - 1^2 = (1)(3)$
3	$3^2 - 1^2 = (2)(4)$
4	$4^2 - 1^2 = (3)(5)$
5	
6	
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[2]

Pattern no.	Pattern
1	$1^2 - 2^2 = (-1)(3)$
2	$2^2 - 2^2 = (0)(4)$
3	$3^2 - 2^2 = (1)(5)$
4	$4^2 - 2^2 = (2)(6)$

The first four lines of another number pattern are shown in the table below.

(ii) Complete the table below.

[1]

(iii) By considering your answers in parts (i) and (ii), find the value of  $55^2 - 45^2$  without the use of a calculator. [2]

### [Answers for Question 8(ii) and (iii)]

Pattern no.	Pattern
1	$1^2 - 2^2 = (-1)(3)$
2	$2^2 - 2^2 = (0)(4)$
3	$3^2 - 2^2 = (1)(5)$
4	$4^2 - 2^2 = (2)(6)$
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n	

9 The graphs below show the cost, \$C, of purchasing poplin cloth of length x metres from Shops A and B respectively. It is given that the delivery fees for Shop A and Shop B are \$30 and \$15 respectively.



- (i) Calculate the gradient of the line representing the cost of purchasing poplin cloth from Shop A.
   [2]
- (ii) Explain the significance of the value of the gradient calculated in part (i) based on the context of the question. [1]
- (iii) Hence state the equation of the line representing the cost of purchasing poplin cloth from Shop A. [1]
- (iv) Using the graphs provided, estimate the additional cost incurred if a customer purchases 44 metres of poplin cloth from Shop B instead of Shop A. [1]

Jesse claims that it is always cheaper to purchase poplin cloth from Shop B than from Shop A.

(v) Justify if Jesse's claim is accurate by using information from the graphs. [1]

#### Solutions to this question using accurate drawing will not be accepted.

- **10** (i) State the gradient and the *y*-intercept of the line 2y = 10 2x. [2]
  - (ii) Show that the point (1,3) does not lie on the line 2y = 10 2x. [2]
  - (iii) The line 2y = 10 2x intersects the y-axis at A. It is given that the coordinates of B is (h, k), where h and k are positive real numbers. The area of isosceles triangle *OAB*, where OB = AB, is 10 units<sup>2</sup>. Find the value of h and of k. [3]
- 11 The diagram below (not drawn to scale) shows a solid isosceles trapezoidal prism with a cylindrical hole of diameter 2 cm.



Given that the perpendicular height of the trapezium is 6 cm, find

(i)	the volume of the prism,	[3]

(ii) the total surface area of the prism. [4]

12 In the diagram below (not drawn to scale), *BA* is parallel to *FE*, *AB* is perpendicular to *BC*, reflex angle  $BCD = 245^{\circ}$  and angle  $DEF = 27^{\circ}$ . Find the reflex angle *CDE*. [5]



13 The figure below (not drawn to scale) shows part of a regular *n*-sided polygon where points *A*, *B*, *C*, *D* and *E* are five vertices of the polygon. *AB* is produced to *G* such that BC = CG and *CDFG* is a rhombus.



Given that the interior angle of a regular *n*-sided polygon is 14 times as large as its exterior angle, find

- (i) angle CBG, [2]
- (ii) angle DFG. [4]

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Answers 1 (i)  $-\frac{3\pi}{4} - 2 \quad 1.654 \quad \sqrt{12}$ (ii) 1 2 (a) (i) 79 (ii) 23 **(b) (i)**  $127\ 008 = 2^5 \times 3^4 \times 7^2$ (ii) k = 294; largest value = 6 (i)  $1728 \text{ cm}^3$ 3 (**ii**) 504 **(b)** \$3472.88 **(c)**  $\pi:(4-\pi)$ 4 (a) 72 km/h **(b)** -(p-2q)(1+5r)(a) 2hk-35 (i)  $-\frac{31}{19}$ 6 (ii) no solution (i)  $\frac{40}{x+15} - \frac{15}{x} = \frac{1}{x}$ ; 10 7 (ii) 3.1 h 8 (i) Pattern no. Pattern  $1^2 - 1^2 = (0)(2)$ 1  $2^2 - 1^2 = (1)(3)$ 2  $3^2 - 1^2 = (2)(4)$ 3  $4^2 - 1^2 = (3)(5)$ 4  $5^2 - 1^2 = (4)(6)$ 5  $6^2 - 1^2 = (5)(7)$ 

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 $n^2 - 1^2 = (n-1)(n+1)$ 

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(ii)

Pattern no.	Pattern
1	$1^2 - 2^2 = (-1)(3)$
2	$2^2 - 2^2 = (0)(4)$
3	$3^2 - 2^2 = (1)(5)$
4	$4^2 - 2^2 = (2)(6)$
:	:
n	$n^2 - 2^2 = (n-2)(n+2)$

(iii) 1000

3.2

9 (i)

- (ii) The cost of each metre of poplin cloth costs \$3.20.
- (iii) C = 3.2x + 30 (iv) \$30
- (v) not accurate

**10** (i) gradient = 
$$-1$$
, y-intercept = 5

(iii) 
$$h = 4, k = \frac{5}{2}$$
 or 2.5

- **11** (i)  $271 \text{ cm}^3$  (ii)  $409 \text{ cm}^2$
- **12** 308°
- **13** (i) 12° (ii) 36°