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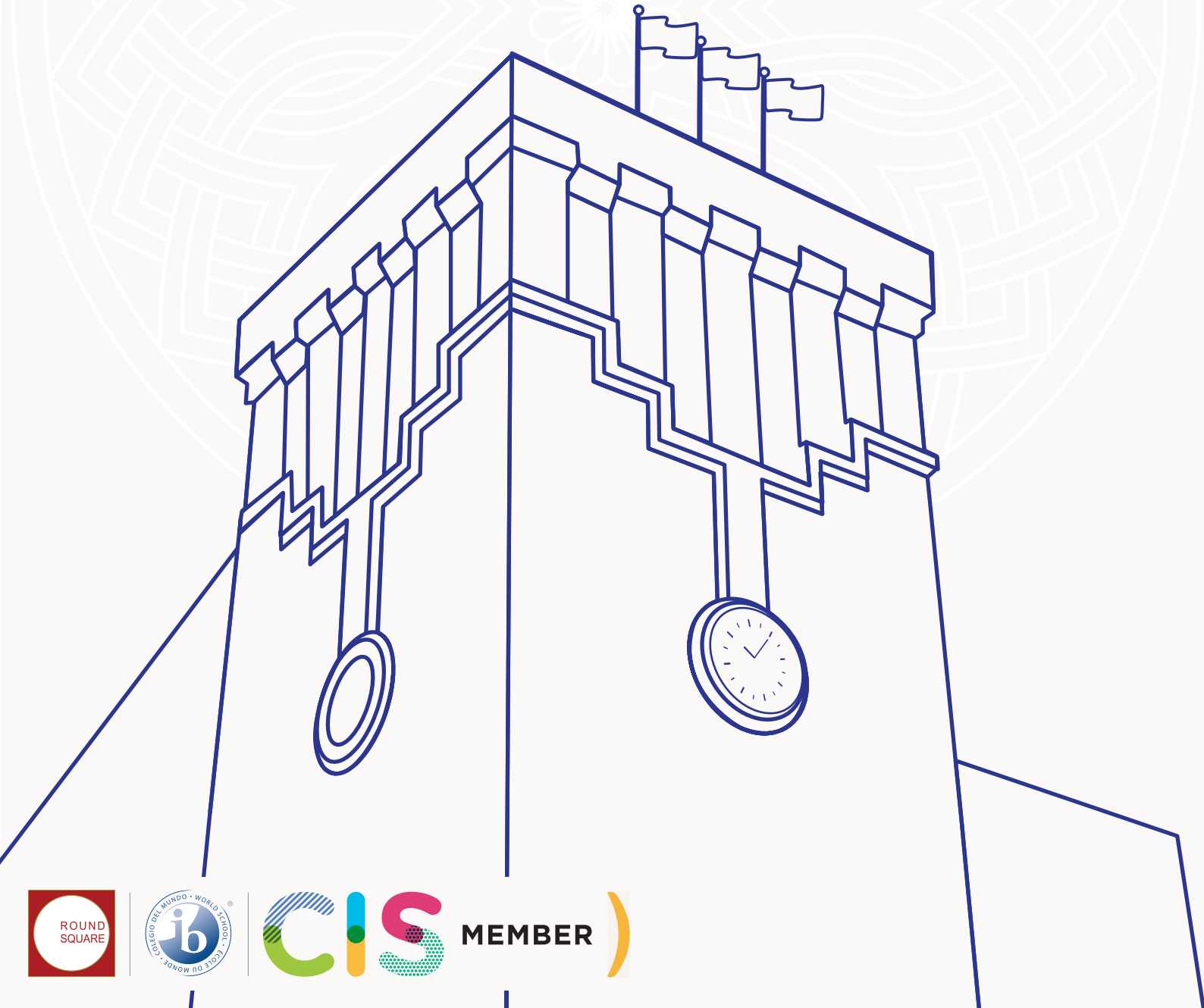
LYCEUM

"Shirakatsy Lyceum" International Scientific-Educational Complex



ROUND SQUARE

CIS MEMBER

"SHIRAKATSY LYCEUM" INTERNATIONAL SCIENTIFIC-EDUCATIONAL COMPLEX
INTERNATIONAL BACCALAUREATE DIPLOMA PROGRAMME ADMISSION 2nd ROUND
MATHEMATICS EXAMINATION TEST

APPLICANT _____

ADDRESS_____

SCHOOL _____

DATE _____

PAPER CODE:

GENERAL INSTRUCTIONS`

1. Duration: 90 minutes.
2. Total number of points: 100.
3. Please keep the academic integrity rules.
4. Please read the questions carefully and follow the instructions.
5. You may use a simple calculator.
6. For each correctly solved task, you will receive the point indicated next to the question number.
7. Please write neatly and legibly, use a ruler and pencil for diagrams.

RESULT (%)`_____

EXAMINER`_____

SIGNATURE`_____

COMMENTS`

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PAPER CODE:

Section 1-Number, numerical sets.

1.1. Set A consists of the multiples of 9 among the first 100 natural numbers. Set B is the subset of set A containing those numbers that leave a remainder of 4 when divided by 5. Set C consists of the composite numbers within the interval $[1; 21]$.

1.1.1. Write set A and determine how many elements it contains. (2 points)

1.1.2. Write the ratio of the largest number in set A to its median, and express the result as a mixed number. (2 points)

1.1.3. Write down the set B and find the arithmetic mean of that set.(2 points)

1.1.4. Write down the set $\boldsymbol{C}$. Find the intersection of sets $\boldsymbol{A}$ and $\boldsymbol{C}$. (2 points)

1.1.5. Find the least common multiple (LCM) of the largest number in set $\boldsymbol{C}$ and the smallest number in set $\boldsymbol{B}$. (2 points)

1.1.6. How many elements are there in the union of sets $\boldsymbol{A}$, $\boldsymbol{B}$, and $\boldsymbol{C}$? (2 points)

1.1.7. All the numbers from sets A, B, and C were written in a single sequence, forming a new numerical set. Find the mode of this set. (1 point)

1.1.8. What number must be added to set B so that its arithmetic mean doubles? (3 points)

1.2. A number was increased by 50%, and then $\frac{1}{5}$ of the result was calculated. By what percentage did the number change? (2 points)

1.3. Calculate: $\frac{(4-\sqrt{15})(\sqrt{45}+\sqrt{27})}{\sqrt{20}-\sqrt{12}}$ (3 points)

Section 2-Algebra.

2.1. If the quadratic equation $kx^2 + 6x + 4 = 0$ has exactly one solution, what is the value(s) of k. (3 points)

2.2. Simplify the expression: $\left(\frac{1+\sqrt[4]{a}}{1-\sqrt[4]{a}} + \frac{1-\sqrt[4]{a}}{1+\sqrt[4]{a}}\right) \cdot \frac{1-\sqrt{a}}{1+\sqrt{a}}$ (5 points)

2.3. Solve the equation $\left|1 - 5\sqrt{x}\right| = 14$. (3 points)

2.4. Solve the equation: $\frac{x^2-4x+3}{\sqrt{x-2}} = 0$: (3 points)

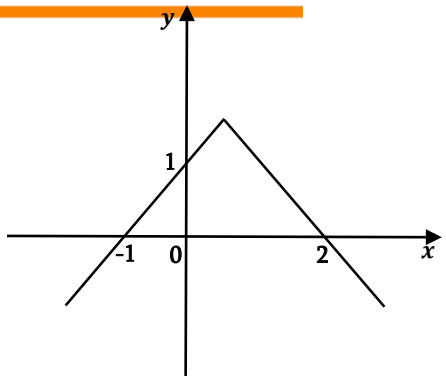
2.5. Solve the inequality: $\frac{|x+3|}{x(x-4)^2} \leq 0$: (3 points)

2.6. If ± 1 are two real roots of the polynomial function $f(x) = ax^3 + bx^2 + cx + d$ and $(0;\ 3)$ is the y intercept of graph of $f(x)$, what is the value of b. (4 points)

2.7. The table above gives values of $f(x)$ and $g(x)$ at selected values of x. What is the value of $f\big(g(-2)\big) + g\big(f(3)\big)$ (3 points)

x	$f(x)$	$g(x)$
-2	-5	0
0	6	4
3	0	-5

2.8. The following diagram shows part of the modulus function $f(x)$ with two x intercepts and one y intercept.



2.8.1. Write the domain of the function. Write the solution set of the inequality $f(x) \geq 0$. (1 point)

2.8.2. Find the abscissa of the vertex of the modulus function $f(x)$. (1 point)

2.8.3. What are the positive root of the equation $f(x) = 1$? (1 point)

2.8.4. Find the equation of the modulus function $f(x)$. (3 points)

2.8.5. Find the maximum value of the modulus function $f(x)$. (1 point)

2.8.6. How many roots does the equation $f(x) = -x + 5$ have? Justify your answer. (2 points)

2.9. First Car Rental company charges a flat fee of $40.00 per day plus $0.75 per mile to rent a car. Second Car Rental company charges a flat fee of $64.00 per day plus $0.60 per mile to rent a car. If a car is rented for three days, at how many miles would the rental charges of the two companies be the same? (4 point)

Section 3-Sequences.

3.1. In an $a_1;\ a_2;\ a_3;$ ... arithmetic sequence, $a_3 + a_7 = 19$. Find the sum of $a_1 + a_4 + a_6 + a_9$. (2 points)

3.2. The sequence (b_n) is a geometric sequence. Find n given that $b_n = 6,\ S_n = 726, q = \frac{1}{3}$. (4 points)

3.3. Find the common ratio (q) of the geometric sequence (b_n), given that $b_8 \cdot b_{11} = 3(b_9)^2$. (2 points)

3.4. Calculate the sum: $S = \left(2 - \sqrt{3}\right) + \left(3\sqrt{3} - 5\right) + \left(14 - 8\sqrt{3}\right) + \cdots$ (5 points)

3.5. Find the sum of the arithmetic sequence (a_n) from the 11^{th} to the 20^{th} term, given that $a_3 = 9$ and $a_5 = 17$. (4 points)

Section 4 - Probability and Statistics.

4. **There are 5 novels, 3 scientific books, and 1 encyclopedia on a bookshelf. Three books are selected at random from the shelf.**

4.1. What is the probability that the selected books are all scientific? (3 points)

4.2. What is the probability that one of the selected books is the encyclopedia? (4 points)

Section 5-Trigonometry.

5.1. Find the value of the expression: $1 - 2sin^2\frac{\pi}{12} + 6sin\frac{\pi}{3}tg\frac{\pi}{4}$. (2,5 points)

5.2. Find the solutions that satisfy the equation $\sqrt{3}\cos x + sinx = 0$ and belong to the interval $0 \leq x \leq 2\pi$. (3,5 points)

Section 6-Geometry.

6. The right trapezoid $ABCD$ has a short diagonal AC equal to $6\sqrt{2}$, and $AB = BC$, $\angle C = 120^0$.

6.1. Find the length of the trapezoid's short base. (2 points)

6.2. Find the length of the trapezoid's long leg. (2 points)

6.3. Find the perimeter of the trapezoid. (3 points)

6.4. Find the area of the trapezoid. (1 points)

6.5. Find the radius of the inscribed circle in triangle ABC. (1 point)

6.6. Find the area of the part of the circumscribed circle around triangle ABD that lies outside the triangle. (3 points)

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