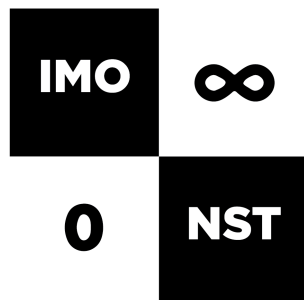




IMO National Selection Test
Ujian Pemilihan Kebangsaan IMO

IMO NATIONAL SELECTION TEST 2 2025
PIONEER CATEGORY
8 NOVEMBER 2025

INSTRUCTIONS:

1. This paper consists of 6 essay questions, each worth 7 points. Answer **ALL** questions.
 2. Each question comes in English Language followed by *Bahasa Melayu*.
 3. The duration of this paper is 4 hours.
 4. Write your answers in the space provided. Show your working to obtain points. You are not required to rewrite the questions.
 5. Only basic utensils and geometric sets are allowed during the exam. Calculators, electronic/internet devices, books, and printed materials are **NOT ALLOWED**.
 6. Discussion, cheating, and guidance are **NOT ALLOWED** during the exam. Any evidence will result in disqualification.
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ENGLISH

- 1** Suppose $a_1, a_2, \dots, a_{10}$ are ten real numbers such that the numbers

$$(a_1 + 0.25)^2, (a_2 + 0.25)^2, \dots, (a_{10} + 0.25)^2$$

can be rearranged back to $a_1, a_2, \dots, a_{10}$.

Prove that $a_1 = a_2 = a_3 = \dots = a_{10} = 0.25$.

- 2** Suppose $ABCD$ is a cyclic quadrilateral such that the lines AB and CD intersect at E , and the lines AD and BC intersect at F . The internal angle bisector of angle $\angle AED$ intersects the lines AD and BC at X and Y respectively.

Prove that $FX = FY$.

- 3** Find all pairs of positive integers (x, y) such that

$$1! + 2! + \dots + x! = 1 + 2 + \dots + y$$

. Note: $n!$ is defined to be the factorial $n! = 1 \times 2 \times \dots \times n$.

- 4** Let A, B be different positive real numbers. Ivan first writes A and B on the whiteboard. Then, in each operation, he can take two numbers x and y ($x \neq y$) on the whiteboard and write either $|x - y|$ or $x \div y$ on the whiteboard.

Can Ivan eventually write:

- i. $A \times B$?
- ii. $A + B$?

- 5** Let n be an even positive integer. Janson has $3n$ coins with heads facing up, arranged into a rectangle with 3 rows and n columns. He wants to flip some coins such that the following is true: if any row is removed, exactly half of the columns will contain exactly one head and one tail.

Determine all n such that this is possible.

- 6** Find all positive real numbers a, b, c such that:

- i. a, b, c are all greater than or equal to 3.
- ii. $ab + bc + ca + 9 = 3a + 4b + 5c$.

BAHASA MELAYU

- 1** Andaikan $a_1, a_2, \dots, a_{10}$ sepuluh nombor nyata sedemikian yang nombor-nombor

$$(a_1 + 0.25)^2, (a_2 + 0.25)^2, \dots, (a_{10} + 0.25)^2$$

boleh disusun semula menjadi $a_1, a_2, \dots, a_{10}$.

Buktikan bahawa $a_1 = a_2 = a_3 = \dots = a_{10} = 0.25$.

- 2** Andaikan $ABCD$ sisiempat kitaran yang garis AB dan CD bersilang pada E , dan garis AD dan BC bersilang pada F . Pembahagi dua sudut dalam bagi sudut $\angle AED$ menyalangi garis AD dan BC masing-masing di X dan Y .

Buktikan bahawa $FX = FY$.

- 3** Cari semua pasangan integer positif (x, y) sehinggakan

$$1! + 2! + \dots + x! = 1 + 2 + \dots + y.$$

Nota: $n!$ ditakrifkan sebagai faktorial $n! = 1 \times 2 \times \dots \times n$.

- 4** Andaikan A, B nilai-nilai nyata positif yang berlainan. Ivan pada mulanya menulis A dan B pada papan putih. Kemudian, dalam setiap operasi, dia boleh mengambil dua nombor x dan y ($x \neq y$) pada papan tersebut dan menulis sama ada $|x - y|$ atau $x \div y$.

Bolehkah Ivan akhirnya menulis:

i. $A \times B$?

ii. $A + B$?

- 5** Andaikan n integer positif genap. Janson mempunyai $3n$ syiling dengan bahagian kepala menghadap ke atas, disusun dalam bentuk segi empat tepat dengan 3 baris dan n lajur. Dia mahu membalikkan beberapa syiling supaya perkara berikut benar: jika mana-mana satu baris dibuang, separuh daripada lajur akan mengandungi satu kepala dan satu ekor.

Tentukan semua n yang membolehkan keadaan ini berlaku.

- 6** Cari semua nilai nyata positif a, b, c sehinggakan:

i. a, b, c semuanya lebih besar atau sama dengan 3.

ii. $ab + bc + ca + 9 = 3a + 4b + 5c$.

END OF QUESTION PAPER — *KERTAS SOALAN TAMAT*
