

The actual test paper has 50 questions. Time allowed : 60 minutes. There are 3 sections: 15 questions in section I, 15 in section II and 20 in section III.

SYLLABUS

Section – I (Mental Ability) : Sets, Relations and Functions, Mathematical Induction, Logarithms, Complex Numbers, Linear Inequations, Quadratic Equations, Sequences and Series, Trigonometry, Cartesian System of Rectangular Coordinates, Straight Lines and Family of Straight Lines, Circles, Conic Section, Permutations and Combinations, Binomial Theorem, Exponential and Logarithmic Series, Mathematical Logic, Statistics & Probability, Three Dimensional Geometry, Vectors, Stocks, Shares and Debentures, Average and Partition Values, Index Numbers, Matrices and Determinants, Limits, Differential Calculus, Integral Calculus.

Section – II (Logical and Analytical Reasoning) : Verbal and nonverbal reasoning.

Section – III (Computers and IT) : Programming in C++, Database Concepts, SQL, Boolean Algebra, Networking & Topologies, Network Security Concepts, Cyber ethics, Viruses and Antiviruses, Open Source Terminologies.



National Cyber Olympiad

The actual test paper has 50 questions. Time allowed : 60 minutes. There are 2 sections: 20 questions in section I and 30 in section II.

SYLLABUS

Section – I (Mathematics) : Sets, Relations and Functions, Mathematical Induction, Logarithms, Complex Numbers, Linear Inequations, Quadratic Equations, Sequences and Series, Trigonometry, Cartesian System of Rectangular Coordinates, Straight Lines and Family of Straight Lines, Circles, Conic Section, Permutations and Combinations, Binomial Theorem, Exponential and Logarithmic Series, Mathematical Logic, Statistics & Probability, Three Dimensional Geometry, Vectors, Stocks, Shares and Debentures, Average and Partition Values, Index Numbers, Matrices and Determinants, Limits, Differential Calculus, Integral Calculus, Verbal and Nonverbal Reasoning.

OR

Section – I (Biology) : Reproduction, Genetics and Evolution, Biology in Human Welfare, Biotechnology, Ecology.

Section – II (Physics & Chemistry) : *Physics:* Electricity and Magnetism, Electromagnetic Induction, AC, E.M. Waves, Optics, Modern Physics, Solids & Semiconductor Devices, Communication Systems. *Chemistry:* Solid State, Solutions, Electrochemistry, Chemical Kinetics, Surface Chemistry, General Principles and Processes of Isolation of Elements, *p*-Block Elements (Group 15 to 18), *d*- & *f*-Block Elements, Coordination Compounds, Haloalkanes and Haloarenes, Alcohols, Phenols and Ethers, Aldehydes, Ketones and Carboxylic Acids, Amines, Biomolecules, Polymers, Chemistry in Everyday Life.



National Science Olympiad

The actual test paper has 50 questions. Time allowed : 60 minutes. There are 3 sections, 20 questions in section I, 20 in section II and 10 in section III.

Section I : Logical Reasoning, **Section II :** Mathematical Reasoning & **Section III :** Everyday Mathematics

SYLLABUS

Sets, Relations and Functions, Mathematical Induction, Logarithms, Complex Numbers, Linear Inequations, Quadratic Equations, Sequences and Series, Trigonometry, Cartesian System of Rectangular Coordinates, Straight Lines and Family of Straight Lines, Circles, Conic Section, Permutations and Combinations, Binomial Theorem, Exponential and Logarithmic Series, Mathematical Logic, Statistics & Probability, Three Dimensional Geometry, Vectors, Stocks, Shares and Debentures, Average and Partition Values, Index Numbers, Matrices and Determinants, Limits, Differential Calculus, Integral Calculus, Verbal and Non-Verbal Reasoning.



**International
Mathematics Olympiad**



National Cyber Olympiad

MENTAL ABILITY

- The equation $x^{\frac{3}{4}(\log_2 x)^2 + \log_2(x) - \frac{5}{4}} = \sqrt{2}$ has

(A) At least one real solution (B) Exactly four real solutions
(C) Exactly two irrational solutions (D) Complex roots
- The roots of the equation $x^3 + ax^2 + bx + c = 0$ are p, q and r . The equation with roots are $\frac{1}{\sqrt{p}}, \frac{1}{\sqrt{q}}, \frac{1}{\sqrt{r}}$ is

(A) $x^4 + ax^2 + b = 0$ (B) $bx^4 + ax^2 + 1 = 0$
(C) $(x^2 + ax + b)^2 = 0$ (D) None of these
- Find $\lim_{x \rightarrow 0} \left\{ \tan\left(\frac{\pi}{4} + x\right) \right\}^{\frac{1}{x}}$

(A) e (B) e^2 (C) e^3 (D) e^{-1}
- The domain of definition of the function $f(x) = \frac{1}{\sqrt{[x] - 1} - 5}$, where $[.]$ stands for greatest integer function, is

(A) $[6, \infty)$ (B) $(-\infty, 7) \cup (7, \infty)$ (C) $(-\infty, 7] \cup [7, \infty)$ (D) None of these
- If the function $f(x)$ increases in the interval (a, b) then the function $\phi(x) = [f(x)]^2$

(A) Increases in (a, b) (B) Decreases in (a, b)
(C) We cannot say that $\phi(x)$ increases or decreases in (a, b)
(D) All of these
- $\lim_{x \rightarrow 1} \frac{\int_a^x \log t \, dt}{\int_a^x \cos \frac{\pi}{2t} \, dt}$ is equal to

(A) $\pi/2$ (B) 0 (C) $2/\pi$ (D) Does not exist





LOGICAL & ANALYTICAL REASONING

- In a group of persons working in a software company, 6 persons can operate on DOS, 15 can operate on windows operating system and 6 can operate on Linux. In that group none can operate on any other operating system. If 2 persons in the group can work on two operating systems and one person can work on all the three, then how many persons are there in the group?

(A) 21 (B) 22 (C) 23 (D) 24
- Four persons Alok, Bhupesh, Chandu and Dinesh have a total of Rs. 100 among themselves. Alok and Bhupesh between them have as much money as Chandu and Dinesh between them but Alok has more money than Bhupesh, and Chandu has only half the money that Dinesh has. Alok has in fact Rs. 5 more than Dinesh. Who has the most money?

(A) Alok (B) Bhupesh (C) Chandu (D) Dinesh
- The letters L, M, N, O, P, Q, R, S and T in their order are substituted by nine integers 1 to 9 but not in that order. 4 is assigned to P . The difference between P and T is 5. The difference between N and T is 3. What is the integer assigned to N ?

(A) 7 (B) 5 (C) 4 (D) 6
- Which one of the following four logical diagrams represents correctly the relationship between musicians, instrumentalists and violinists?

(A)  (B)  (C)  (D) 
- Six roads lead to a country. They may be indicated by letters X, Y, Z and digits 1, 2, 3. When there is storm, Y is blocked. When there are floods $X, 1$ and 2 will be affected. When road 1 is blocked, Z also is blocked. At a time when there are floods and a storm also blows, which road(s) can be used?

(A) Z and 2 (B) Only Z (C) Only 3 (D) Only Y

12. Two important characteristics of a hypothesis are that it should be testable and that it should be stated in a manner that it can be refuted. Which one of the following hypothesis, fulfills these characteristics?
 (A) Intelligent persons have good memory (B) Some birds are animals
 (C) Some businessmen are dishonest (D) All men are mortal

COMPUTERS & INFORMATION TECHNOLOGY

13. Which of the following statements about C++ are true

Statement 1 : C++ was developed by Bjarne Stroustrup in early 1980s

Statement 2 : C++ provides following tokens (smallest individual unit in program) : keywords, identifiers, literals, punctuator, operators

Statement 3 : C++ allows following literals: integer-constant (Decimal, Octal, Hexadecimal), character-constant, floating-constant, string-literal

Statement 4 : C++ provides two types of data types: fundamental and derived data types.

Which of the above statements are true ?

- (A) 1 and 2 only (B) 1 only (C) 1, 3 and 4 only (D) All of these

14. Match the following

Properties

- (1) A total data rate of at least several Mbps
 (2) Span entire countries
 (3) Very low error rates
 (4) Owned by multiple organization

Network

- (A) LAN
 (B) WAN

(A) 1A, 2B, 3A, 4B

(B) 1A, 2B, 3B, 4A

(C) 1B, 2B, 3A, 4A

(D) 1A, 2A, 3B, 4B

15. **Assertion (A) :** Antivirus programs protect a computer from computer virus.

Reason (R) : These programs work by examining all the files on a disk, looking for the tell-tale 'signatures' of virus code

(A) A is true but R is false

(B) Both A and R are true but R is not the correct reason of A

(C) A and R are true and R is the correct explanation of A

(D) A is false but R is true



National Science Olympiad

MATHEMATICS

1. A large watermelon weighs 20 kg with 98% of its weight being water. It is left to stand in the sun and some of the water evaporates so that now only 95% of its weight is water. What is its reduced weight?
 (A) 17 kg (B) 19.4 kg (C) 10 kg (D) 8 kg
-
2. Four bags were to be weighed but the scale could weigh only weights in excess of 100 kg. If the bags were weighed in pairs and the weights were found to be 103, 105, 106, 107 and 109, then the weight of the lightest bag is
 (A) 50 kg (B) 51 kg (C) 49 kg (D) 52 kg
-
3. A plane flies from A to B and back again with a constant engine speed. Turn-around time may be neglected. Will the travel time be more with a wind of constant speed blowing in the direction from A to B than in still air?
 (A) Yes (B) No
 (C) Depends on the engine (D) Insufficient data
-
4. Given four points in space which are not in a plane, the number of planes which are equidistant from all the four points is
 (A) 7 (B) 3 (C) 5 (D) 6

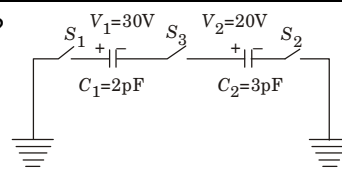
OR

BIOLOGY

- Gametophytic self incompatibility differs from sporophytic self incompatibility in that
(A) It allows germination of pollens
(B) It occurs due to incompatibility of stigma
(C) It occurs due to incompatibility of sporophytic tissues
(D) It occurs due to incompatibility of pollens.
- XO-chromosomal abnormality in human beings causes
(A) Turner's syndrome (B) Down's syndrome
(C) Klinefelter's syndrome (D) None of these.
- The best definition of an ecosystem is
(A) The inter-relationship between producers, consumers and decomposers of an environment
(B) A stable co-existence of dominant species in an environment
(C) A natural unit including plants, animals and non-living constituent of the environment
(D) A number of population of organisms of different species
- The main reason why antibiotics could not solve all the problems of bacteria mediated diseases is
(A) Insensitivity of the individual following prolonged exposure to antibiotics
(B) Inactivation of antibiotics by bacterial enzymes
(C) Decreased efficiency of the immune system
(D) The development of mutant strains resistant to antibiotics.

PHYSICS & CHEMISTRY

- A metal x is prepared by the electrolysis of fused chlorides. It reacts with hydrogen to form a colourless solid from which hydrogen is released on treatment with water. The metal is
(A) Al (B) Ca (C) Cu (D) Zn
- Mortar is a mixture of
(A) Ca(OH)₂, Silica and Water (B) CaCO₃ and SiO₂
(C) CaO and Silica (D) CaCO₃, SiO₂ and Water
- A ray of light passes from vacuum into a medium of refractive index μ , the angle of incidence is found to be twice the angle of refraction. Then the angle of incidence is
(A) $\cos^{-1}(\mu/2)$ (B) $2\cos^{-1}(\mu/2)$ (C) $2\sin^{-1}\mu$ (D) $2\sin^{-1}(\mu/2)$
- What causes the tail of the comet?
(A) Centrifugal force pushes away the gases (B) Lighter gases are left behind during the orbital motion
(C) Tail of comet always exists but becomes visible near the sun.
(D) The radiation pressure from the sun causes the tail
- A ray of light in a liquid of refractive index 1.4, approaches the boundary surface between the liquid and air at an angle of incidence whose sine is 0.8. Which of the following statements is correct about the behavior of the light ?
(A) It is impossible to predict the behavior of the light ray on the basis of the information supplied
(B) The sine of the angle of refraction of the emergent ray will be less than 0.8
(C) The ray will be internally reflected
(D) The sine of the angle of refraction of the emergent ray will be greater than 0.8
- For the circuit shown in figure, which of the following statements is true?
(A) With S₁ closed, V₁ = 15 V, V₂ = 20 V
(B) With S₃ closed, V₁ = V₂ = 25 V
(C) With S₁ and S₂ closed, V₁ = V₂ = 0
(D) With S₁ and S₃ closed, V₁ = 30 V, V₂ = 20 V.



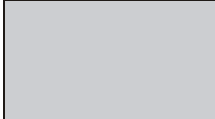
- The IUPAC name of $\text{CH}_3\text{CH}(\text{CH}_3)\text{CH}_2\text{C}(=\text{O})\text{CH}_2\text{CH}(\text{CH}_3)_2$ is
(A) 2,4-dimethylhexanone-3 (B) 2,6-dimethylheptanone-4
(C) 2,6-dimethylhexanone-4 (D) 2,6-dimethylheptanone-5



International Mathematics Olympiad

LOGICAL REASONING

1. The "Golden Rectangle" of the ancient Greeks was considered to have the most pleasing proportion of any rectangle. The ratio of width (w) to height (h) of the rectangle is expressed in the following proportion and is shown in the drawing below.

$$\frac{w}{h} = \frac{2}{\sqrt{5} - 1}$$


Jason is planning to paint a rectangular mural using the proportions of the "Golden Rectangle." If the mural is 15 meters wide, how high should it be?

- (A) 1.6 meters (B) 9.3 meters (C) 16.5 meters (D) 24.2 meters
2. The given table shows the boiling points in degrees Celsius for some different elements. Which of the following elements have boiling points that are lower than -190°C ?

BOILING POINTS OF SOME ELEMENTS

Element	Boiling Point (in $^{\circ}\text{C}$)
Chlorine	-34.6
Helium	-269.0
Hydrogen	-252.9
Nitrogen	-195.8
Oxygen	-183.0

- (A) Chlorine and Oxygen
 (B) Oxygen and nitrogen
 (C) Chlorine, helium, and hydrogen
 (D) Helium, hydrogen, and nitrogen
3. A certain radioactive element decays over time according to the equation $y = A \left(\frac{1}{2}\right)^{\frac{t}{300}}$, where A = the number of grams present initially and t = time in years. If 1000 grams were present initially, how many grams will remain after 900 years?
- (A) 500 grams (B) 250 grams (C) 125 grams (D) 62.5 grams
4. Which is the first incorrect step in simplifying $\log_4 \frac{4}{64}$?
- Step 1: $\log_4 \frac{4}{64} = \log_4 4 - \log_4 64$ Step 2: $= 1 - 16$ Step 3: $= -15$
 (A) Step 1 (B) Step 2 (C) Step 3 (D) Each step is correct

MATHEMATICAL REASONING

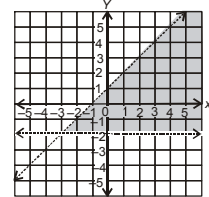
5. Which expression represents $f(g(x))$ if $f(x) = x^2 - 1$ and $g(x) = x + 3$?
 (A) $x^3 + 3x^2 - x - 3$ (B) $x^2 + 6x + 8$ (C) $x^2 + x + 2$ (D) $x^2 + 8$
6. From a deck of card two are drawn. The probability that both are of same suit is
 (A) $\frac{1}{2}$ (B) $\frac{1}{13}$ (C) $\frac{4}{17}$ (D) $\frac{2}{17}$
7. On a recent test, Jyoti wrote the equation $\frac{x^2 - 16}{x - 4} = x + 4$. Which of the following statements is correct about the equation she wrote?
 (A) The equation is always true (B) The equation is always true, except when $x = 4$
 (C) The equation is never true (D) The equation is sometimes true when $x = 4$
8. If x is a real number, which best describes the values of x for which the inequality $\sqrt{x} > 0$ is true?
 (A) All $x > 0$ (B) All $x \geq 0$ (C) All values of x (D) No values of x
9. If the equation $y = 2^x$ is graphed, which of the following values of x would produce a point closest to the x -axis?
 (A) $1/4$ (B) $3/4$ (C) $5/3$ (D) $8/3$

10. The graph of $\left(\frac{x}{2}\right)^2 - \left(\frac{y}{3}\right)^2 = 1$ is a hyperbola. Which set of equations represents the asymptotes of the hyperbola's graph?

- (A) $y = \frac{3}{2}x, y = -\frac{3}{2}x$ (B) $y = \frac{3}{2}x, y = -\frac{2}{3}x$
 (C) $y = \frac{1}{2}x, y = -\frac{1}{2}x$ (D) $y = \frac{1}{3}x, y = -\frac{1}{3}x$

11. What system of inequalities best represents the graph shown?

- (A) $y > -2$ and $y > x + 1$ (B) $y > -2$ and $y < x + 1$
 (C) $y < -2$ and $y > x + 1$ (D) $y < -2$ and $y < x + 1$

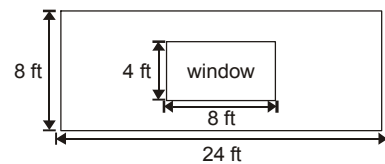


12. If $\int_{\pi/6}^{\pi/3} \frac{\sqrt{\sin x}}{\sqrt{\cos x} + \sqrt{\sin x}} dx = \frac{k}{4}$ then value of k equals

- (A) $\pi/12$ (B) $\pi/3$ (C) $\pi/2$ (D) $\pi/7$

EVERYDAY MATHEMATICS

13. Mrs. Ballard decided to apply wallpaper on one wall of her living room. A diagram of the rectangular wall with its window is shown. A roll of wallpaper covers approximately 30 square feet. What is the minimum number of rolls she will have to buy in order to cover the entire wall excluding the window?



- (A) 2 rolls (B) 5 rolls (C) 6 rolls (D) 7 rolls

14. A box contains 7 large red marbles, 5 large yellow marbles, 3 small red marbles, and 5 small yellow marbles. If a marble is drawn at random, what is the probability that it is yellow, given that it is one of the large marbles?

- (A) $5/12$ (B) $7/20$ (C) $5/8$ (D) $1/5$

15. A restaurant manager bought 20 packages of bagels. Some packages contained 6 bagels each, and the rest contained 12 bagels each. There were 168 bagels in all. How many packages of 12 bagels did the manager buy?

- (A) 6 (B) 8 (C) 9 (D) 12

