

CLASS

12

SAMPLE PAPER



National Cyber Olympiad

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 inequation, Quadratic equation, Sequences and series, Trigonometry, Cartesian system of rectangular coordinates, Straight line and family of straight lines, Circles, Conic section, Permutations and combinations, Binomial theorem, Exponential and logarithmic series, Mathematical logic, Statistics, Introduction to three dimensional geometry, Vectors, Stocks, Shares and debentures, Average and partition values, Index numbers, Matrices and determinants, Limits, Differential calculus.

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

Section – III (Computers and IT) : Computer fundamentals, Programming methodology, Introduction to programming in C++, Computer system organization.



National Science 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) : Relations and functions, Inverse trigonometric functions, Matrices, Determinants, Continuity and Differentiability, Application of derivatives, Integrals (Definite and indefinite), Application of integrals, Differential equations, Vector algebra, Three Dimensional geometry, Linear programming, Probability, Differentiation.

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 system.

Chemistry: Solid state, Solutions, Electrochemistry, Chemical kinetics, Surface chemistry, General principles and processes of isolation of elements, *p, 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.



International Mathematics 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

Relations and functions, Inverse trigonometric functions, Matrices, Determinants, Continuity and Differentiability, Application of derivatives, Integrals (Definite and indefinite), Application of integrals, Differential equations, Vector algebra, Three Dimensional geometry, Linear programming, Probability, Differentiation.



National Cyber Olympiad

MENTAL ABILITY

- The equation $x^4 \log_2 x^2 + \log_2(x) - \frac{5}{4} = \sqrt{2}$ 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
- The value of $f(x)$, so that the function $f(x) = \frac{\sqrt{a^2 - ax + x^2} - \sqrt{a^2 + ax + x^2}}{\sqrt{a+x} - \sqrt{a-x}}$ becomes continuous for all x , is given by
(A) $a^{3/2}$ (B) $a^{1/2}$ (C) $-a^{1/2}$ (D) $-a^{3/2}$
- The function $f(x) = \begin{cases} |x-3|, & x \geq 1 \\ \left(\frac{x^2}{4}\right) - \left(\frac{3x}{2}\right) + \left(\frac{13}{4}\right), & x < 1 \end{cases}$ is :
(A) Continuous at $x = 1$ (B) Not differentiable at $x = 1$
(C) Not continuous at $x = 3$ (D) Differentiable in $(-1, 1)$
- The functions defined by $f(x) = \max\{x^2, (x-1)^2, 2x(1-x)\}$, $0 \leq x \leq 1$
(A) Is differentiable for all x (B) Is differentiable for all x except at one point
(C) Is differentiable for all x except at two points
(D) Is not differentiable at more than two points

LOGICAL & ANALYTICAL REASONING

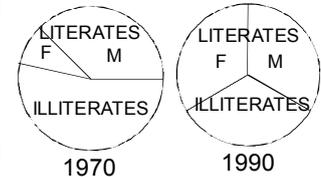
- In a group of persons working in a software company, 6 persons can operate on DOS, 15 can operate on windows operating system and 6 can operate on Linux. In that group none can operate on any other operating system. If 2 persons in the group can work on two operating systems and one person can work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

12. 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

13. Which one of the following four logical diagrams represents correctly the relationship between musicians, instrumentalists and violinists?



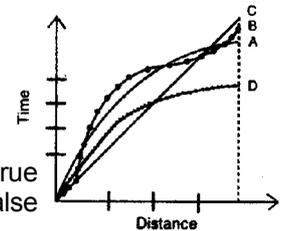
14. The given pie charts show the proportion of literates and illiterates in a country, in the years 1970 and 1990, and also the proportion of males (M) and females (F) among the literates. Which one of the following statements can be said to be beyond any doubt?



- (A) In 1970 half of the illiterates were women (females)
 (B) The proportion of literate males to the total population of males remained the same over the years
 (C) The ratio of male literates to female literates did not improve significantly over this period
 (D) Male literacy did not improve over this period
15. 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

16. 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

17. Distance-time graph in respect of a race among four persons is shown in the given figure. Consider the following statements in this regard:



1. 'A' stood first in the race. 2. 'C' led all the way.
 3. 'D' ran faster than others in the later part of the race.

- Of these statements,
 (A) 1 and 3 are false and 2 is true (B) 1 and 2 are false and 3 is true
 (C) 1 and 3 are true and 2 is false (D) 1 is true and 2 and 3 are false

COMPUTERS & INFORMATION TECHNOLOGY

18. 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

19. 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

20. **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

1. Gametophytic self incompatibility does not differ from sporophytic self incompatibility in that
(A) There is codominance of self incompatibility alleles
(B) Both gives 50% functional pollen in pollinations of some other plants
(C) There is breakdown of incompatibility on induction of polyploidy
(D) There is complete failure of seed set on self pollination
2. XO-chromosomal abnormality in human beings causes
(A) Turner's syndrome (B) Down's syndrome
(C) Klinefelter's syndrome (D) None of these.
3. 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
4. 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

5. 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
6. Mortar is a mixture of
(A) Ca(OH)_2 , Silica and Water (B) CaCO_3 and SiO_2
(C) CaO and Silica (D) CaCO_3 , SiO_2 and Water
7. 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) $2\sin^{-1}(\mu/2)$
8. 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

9. A freshly prepared radioactive source of half-life 2 hr. emits radiation of intensity which is 64 times the permissible safe level. The minimum time after which it would be possible to work safely with this source is
 (A) 128 hr (B) 24 hr (C) 6 hr (D) 12 hr

10. A radio capacitor of variable capacitance is made of n plates each of area A and separated from each other by constant distance d . The alternate plates are connected together, one group of alternate plates is fixed while the other is movable. Find the maximum capacitance.

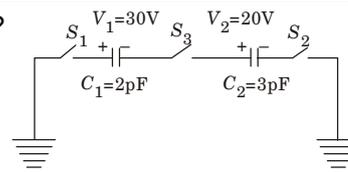
- (A) $\frac{n\epsilon_0 A}{2d}$ (B) $\frac{(n-1)\epsilon_0 A}{d}$ (C) $\frac{2n\epsilon_0 A}{d}$ (D) $\frac{2(n-1)\epsilon_0 A}{d}$

11. 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

12. For the circuit shown in figure, which of the following statements is true?

- (a) With S_1 closed, $V_1 = 15$ V, $V_2 = 20$ V
 (b) With S_3 closed, $V_1 = V_2 = 25$ V
 (c) With S_1 and S_2 closed, $V_1 = V_2 = 0$
 (d) With S_1 and S_3 closed, $V_1 = 30$ V, $V_2 = 20$ V.



13. The solution in which the blood cells retain their normal form are with regard to the blood is

- (A) Isotonic (B) Hypertonic
 (C) Hypotonic (D) Suspension

14. An organic compound X contains Y and Z impurities. Their solubility differs slightly. They may be separated by

- (A) Simple crystallisation (B) Fractional crystallisation
 (C) Sublimation (D) Fractional distillation

15. A binary liquid solution of n -heptane and ethyl alcohol is prepared. Which of the following statements correctly represents the behaviour of this liquid solution?

- (A) The solution formed is an ideal solution
 (B) The solution formed is a non-ideal solution with negative deviation from Raoult's law
 (C) The solution formed is a non-ideal solution with positive deviation from Raoult's law
 (D) Normal heptane exhibits positive deviation whereas ethyl alcohol exhibits negative deviation from Raoult's law.

16. $(\text{NH}_4)_2\text{Cr}_2\text{O}_7$ on heating liberates a gas. The same gas will be obtained by

- (A) Heating NH_4NO_2 (B) Heating NH_4NO_3
 (C) Treating H_2O_2 with NaO_2 (D) Treating Mg_3N_2 with H_2O

17. 2.2 kW power is transmitted through a $10\ \Omega$ line at 22000 V. The power loss in the form of heat is

- (A) 110 W (B) 10 W (C) 1 W (D) 0.1 W

18. The IUPAC name of $\text{CH}_3-\text{CH}(\text{CH}_3)-\text{CH}_2-\overset{\text{O}}{\parallel}{\text{C}}-\text{CH}_2-\text{CH}(\text{CH}_3)_2$ is

- (A) 2,4-dimethylhexanone-3 (B) 2,6-dimethylheptanone-4
 (C) 2,6-dimethylhexanone-4 (D) 2,6-dimethylheptanone-5

19. A planoconvex lens is 3 mm thick. When seen through the plane side, thickness appears to be 2.18 mm and when seen through the curved side it appears to be 2 mm. The refractive index of material of lens is

- (A) 1.5 (B) 1.37 (C) $\frac{4}{3}$ (D) 2

20. For a certain indicator HIn , $K_{\text{In}} = 1 \times 10^{-6}$. The undissociated HIn has a red colour; the anion In^- has a yellow colour. The colour of the indicator in a solution of $\text{pH} = 8.0$ will be

- (A) Red (B) Orange
 (C) Yellow (D) Green



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

5. Which of the following sentence is true about the graphs of $y = 3(x - 5)^2 + 1$ and $y = 3(x + 5)^2 + 1$?

- (A) Their vertices are maximum
 (B) The graphs have the same shape with different vertices
 (C) The graphs have different shapes with different vertices
 (D) One graph has a vertex that is a maximum, while the other graph has a vertex that is a minimum

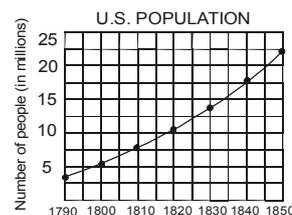
6. If \vec{a} , \vec{b} , \vec{c} are vectors such that $\vec{c} = \vec{a} + \vec{b}$ and $\vec{a} \cdot \vec{b} = 0$ then

- (A) $a^2 + b^2 + c^2 = 0$ (B) $a^2 - b^2 = c^2$ (C) $a^2 + b^2 = c^2$ (D) $\vec{c} = \vec{a} \times \vec{b}$

7. In 1790, the United States had a population of approximately 4,000,000 people, as shown on the graph below.

According to the graph, in what year had the population grown to approximately twice that number?

- (A) 1797 (B) 1808 (C) 1813
 (D) 1822



MATHEMATICAL REASONING

8. Which expression represents $f(g(x))$ if $f(x) = x^2 - 1$ and $g(x) = x + 3$?

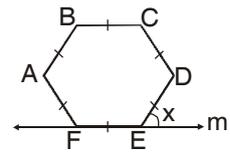
- (A) $x^3 + 3x^2 - x - 3$ (B) $x^2 + 6x + 8$ (C) $x^2 + x + 2$ (D) $x^2 + 8$

9. 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) $\frac{2}{17}$

10. Figure **ABCDEF** below is a regular hexagon with line m passing through side FE . What is the measure of x ?

- (A) 75° (B) 60°
(C) 51° (D) 45°



11. 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 $x = 4$

12. 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

13. Given the equation $y = x^n$ where $x > 0$ and $n < 0$, which statement is valid for real values of y ?

- (A) $y > 0$ (B) $y = 0$ (C) $y < 0$ (D) $y \leq 0$

14. If the equation $y = 2^x$ is graphed, which of the following values of x would produce a point closest to the x -axis?

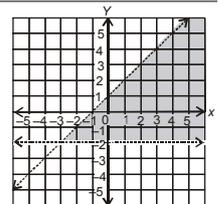
- (A) $1/4$ (B) $3/4$ (C) $5/3$ (D) $8/3$

15. 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) $y = \frac{1}{3}x, y = -\frac{1}{3}x$

16. What system of inequalities best represents the graph shown below?

- (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 $y < x + 1$

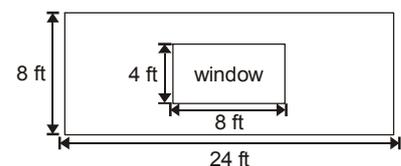


17. If $\int_{\pi/6}^{\pi/3} \frac{\sqrt{\sin x}}{\sqrt{\cos x} + \sqrt{\sin x}} dx = \frac{k}{4}$ then value of k equals

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

EVERYDAY MATHEMATICS

18. Mrs. Ballard decided to apply wallpaper on one wall of her living room. A diagram of the rectangular wall with its window is shown below. 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

19. 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) $1/5$

20. 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

