



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) : Sets, Relations and functions, Mathematical induction, Logarithms, Complex numbers & quadratic equations, Linear inequations, Differentiation, Sequences and series (A.P. & G.P. Misc.), Trigonometry, Cartesian system of rectangular coordinates, Straight lines and family of straight lines, Circles, Conic section, Trigonometry, Permutations and combinations, Binomial theorem, Statistics, Mathematical logic, Limits, Probability, Introduction to 3-D geometry, Verbal and Non Verbal Reasoning.

OR

Section – I (Biology) : Diversity in the Living world, Structural Organisation in Plants and Animals, Cell : Structure and Functions, Plant Physiology, Human Physiology.

Section – II (Physics & Chemistry) : *Physics*: Units & measurements, Mechanics, Properties of matter, Heat & thermodynamics, Oscillations, Waves.

Chemistry: Some Basic Concepts of Chemistry, Structure of Atom, Classification of Elements and Periodicity in Properties, Chemical Bonding and Molecular structure, States of Matter, Thermodynamics, Equilibrium, Redox reactions, Hydrogen, The *s*-Block Elements, The *p*-Block Elements (Groups 13 and 14), Organic Chemistry - Some Basic Principles and Techniques, Hydrocarbons, Environmental Chemistry, Verbal and Non-Verbal Reasoning.



National Science Olympiad

MATHEMATICS

1. A man moving on a parabolic path finds the angle of elevation of a pole, standing on the focus of path, to be 75° . If the directrix of path is at a distance of 7 metres from him then height of pole is
(A) $(14 + 7\sqrt{3})$ m (B) $\frac{(2 + \sqrt{3})}{7}$ m (C) $(14 - 7\sqrt{3})$ m (D) $\frac{(2 - \sqrt{3})}{7}$ m
2. Three ladies have each brought a child for admission to a school. The head of the school wishes to interview the six people one by one, taking care that no child is interviewed before its mother. The number of ways of doing this is
(A) 6 (B) 36 (C) 72 (D) 90
3. A refrigerator is offered for sale at Rs. 250.00 with successive discounts of 20% and 15%. The sale price of the refrigerator is
(A) 35% less than Rs. 250.00 (B) 65% of Rs. 250.00
(C) 77% of Rs. 250.00 (D) 68% of Rs. 250.00
4. The number of revolutions of a wheel, with fixed centre and with an outside diameter of 6 m, required to cause a point on the rim to go one km is
(A) 880 (B) $440/\pi$ (C) $500/3\pi$ (D) 440π

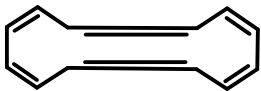
OR

BIOLOGY

1. Which of the following statements are true for photosynthetic bacteria (PB) and chemosynthetic bacteria (CB)?
(a) obtain energy from the oxidation of inorganic molecule such as ammonium salt
(b) obtain energy from sunlight (c) contain photosynthetic pigments
(d) are autotrophs.
(A) PB - b, c, d ; CB - a, d (B) PB - a, c ; CB - b, d
(C) PB - b, d ; CB - a, b (D) PB - a, b, c ; CB - b, c, d
2. Anaerobic respiration releases less energy than aerobic respiration because
(A) Energy from oxygen is not made available (B) Ethyl alcohol is a source of energy
(C) Carbon dioxide is released
(D) Less energy is required by fermenting organisms
3. Three bean seedlings were grown in three culture solutions. After six weeks, X had yellow leaves and short internodes, Y has red patches on the stem and Z had green leaves and stem. It can be deduced that
(A) X lacked magnesium, Y lacked calcium and Z lacked molybdenum
(B) X lacked calcium, Y lacked nitrogen and Z lacks chlorine
(C) X lacked calcium, Y lacked nitrogen and Z had all nutrients
(D) X lacked magnesium, Y lacked nitrogen and Z had all nutrients
4. In the life cycle of a fern the meiosis occurs during the
(A) Formation of spores (B) Formation of gametes
(C) Germination of a spore (D) Development of a zygote

PHYSICS & CHEMISTRY

5. Hydrogen sulphide (H_2S) contains 94.11% sulphur, water (H_2O) contains 11.11% hydrogen and sulphur dioxide (SO_2) contains 50% oxygen. Find the ratio of all given elements. After your calculations which law has been verified?
(A) Law of multiple proportion (B) Law of reciprocal proportion
(C) Law of constant components (D) Law of combining volumes
6. An astronaut in the space shuttle orbiting the earth performs a trick for a television audience. She inflates a helium filled balloon within the shuttle's controlled atmosphere and lets go of it. To the astonishment of all watching, the balloon
(A) Hovers in place where it was released.
(B) Rises noticeably away from the earth.
(C) Falls noticeably towards the earth.
(D) Drifts backwards opposite to the direction of the shuttle's velocity.

7. A boy throws a table tennis ball of mass 20 g upwards with a velocity of $u_0 = 10$ m/s at an angle θ_0 with the vertical. The wind imparts a horizontal force of 0.08 N, so that the ball returns to the starting point. Then, the angle θ_0 must be such that, $\tan \theta_0$ is
(A) 0.2 (B) 0.4 (C) 2.5 (D) 1.2
8. A weight is attached to the free end of a sonometer wire. It gives resonance at a length 40 cm when it is resonated with a tuning fork of frequency 51 Hz. The weight is then immersed wholly in water, the resonant length is reduced to 30 cm. The relative density in which weight suspended is
(A) 16/9 (B) 16/7 (C) 16/5 (D) 16/3
9. A tank of water has a pinhole leak in the side, 1 m below the water line. If the tank is open to the atmosphere (air pressure = 1.013×10^5 pa), how fast is the water leaving the pinhole?
(A) $\sqrt{g/4}$ (B) $\sqrt{g/0.1}$ (C) $\sqrt{2g}$ (D) \sqrt{g}
10. Find the correct statement from the following.
(A) In planetary motion, total energy remains constant but total angular momentum may vary
(B) Both total energy and total angular momentum are constant in planetary motion and the total energy is negative
(C) Motion of a planet about the Sun and motion of an electron about an attracting nuclear centre are governed by identical relations and the total energy is always positive in both cases
(D) Both total energy and total angular momentum are constant in planetary motion and the total energy is positive
11. One mole of an ideal monatomic gas expands till its temperature doubles under the process $V^2 T = \text{constant}$. If the initial temperature is 400 K, the work done by the gas is
(A) 400 R (B) 200 R (C) -200 R (D) Indeterminate
12. A projectile is thrown such that its range should be 1000 metres, but at highest point it breaks into two equal masses, one of whom falls vertically downwards. The other mass will fall at a distance
(A) 1500 metres from launching point (B) 2000 metres from launching point
(C) 3000 metres from launching point (D) 2500 metres from launching point
13. A spirit level containing a bubble in a liquid is jerked forward. Relative to the level and liquid the bubble moves
(A) Backwards, due to its inertia; (B) Backwards, due to a pressure gradient in the liquid;
(C) Forwards, due to its inertia; (D) Forwards, due to a pressure gradient in the liquid;
14. The fourth state of matter is
(A) Super fluid (B) Plasma
(C) Liquid crystals (D) Small particles suspended in the gas
15. In the reaction,
$$4\text{NH}_{3(g)} + 5\text{O}_{2(g)} \rightarrow 4\text{NO}_{(g)} + 6\text{H}_2\text{O}_{(l)}$$
when 1 mole of ammonia and 1 mole of O_2 are made to react to completion :
(A) 1.0 mole of H_2O is produced (B) 2.0 mole of NO will be produced
(C) All the oxygen will be consumed (D) All the ammonia will be consumed
16. Electric cookers have a coating that protects them against fire. The coating is made of
(A) Magnesium oxide (B) Heavy lead (C) Chromium oxide (D) Nickel
17.  is
(A) Aromatic compound (B) Annulene
(C) Heterocyclic compound (D) Polycyclic compound
18. Atom may be regarded as comprising of protons, neutrons and electrons. If the mass attributed to a neutron were halved and that attributed to the electron were doubled, the atomic mass of ${}^6_6\text{C}^{12}$ would
(A) Remain approximately the same (B) Be approximately doubled
(C) Be approximately halved (D) Be reduced approximately by 25%
19. The chemistry of lithium is very much similar to that of magnesium even though they are placed in different groups. The reason is
(A) Both have nearly the same size (B) The ratio of their charge to size is nearly the same
(C) Both have similar electronic configuration (D) Both are found together in nature
20. A bottle of dry ammonia and a bottle of dry hydrogen chloride connected through a long tube are opened simultaneously at both ends, the white ammonium chloride ring first formed will be
(A) At the centre of the tube (B) Near the hydrogen chloride bottle
(C) Near the ammonium bottle (D) Throughout the length of the tube

