



National Science Olympiad™

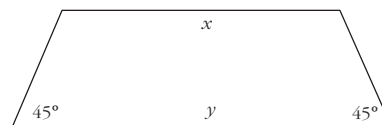
Syllabus **Section – I (Mathematics)** : Sets, relations and functions, mathematical induction, logarithms, complex numbers, linear in equation, quadratic equation, sequences and series, trigonometry, Cartesian system of rectangular coordinates, straight line and family of straight lines, circles, conic 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, Integral calculus.

Section – II (Physics-Chemistry) : *Chemistry*: Solid state, Solutions, Thermodynamics, Electrochemistry & Redox reactions, Chemical kinetics, Surface chemistry, p,d & f block elements, Coordination compound, Nuclear chemistry, Stereo chemistry, Organic compounds containing functional groups, Polymers, Biomolecules. *Physics*: Electricity and Magnetism, Electromagnetic induction, AC, E.M. waves, Optics, Modern physics, Solids & semiconductor devices.

Comprehensively covers syllabus from CBSE Board, ICSE, Maharashtra Board, Andhra Pradesh Board, Tamilnadu Board & Other state boards

MATHEMATICS

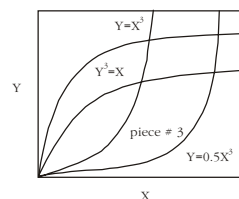
- A large watermelon weighs 20 kg with 98% of its weight being water. It is left to stand in the sun and some of the water evaporates so that now only 95% of its weight is water. What is its reduced weight?
 (A) 17 kg (B) 19.4 kg (C) 10 kg (D) 8 kg.
- Four bags were to be weighed but the scale could 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.
- 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.
- 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
- A carpenter had 4 pieces of wood cut in the shape of isosceles trapezoid as indicated in figure. The x and y in each case are a whole number of cms. Although the x and y are different in each piece, the area is the same for all four pieces and is indeed a whole number of square cms, less than 40. What are the dimensions of the four pieces.
 (A) (31, 24), (17, 13), (13, 7), (11, 1)
 (B) (29, 31), (13, 17), (11, 1), (13, 7)
 (C) (30, 29), (71, 13), (7, 7), (11, 4)
 (D) (33, 29), (25, 13), (15, 7), (11, 1)



PHYSICS – CHEMISTRY

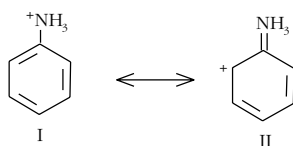
- A metal x is prepared by the electrolysis of fused chlorides. It reacts with hydrogen to form a colourless solid from which hydrogen is released on treatment with water. The metal is
 (A) Al (B) Ca (C) Cu (D) Zn

7. Stained glass construction is a fun hobby. If the patterns are generated by mathematical relationships it is straightforward to generate patterns and to purchase just enough of each of the type of glass required. If the dimensions for X and Y are in feet, what is the area of piece #3?
- (A) 0.21 ft² (B) 0.27 ft²
 (C) 0.187 ft² (D) none of the above



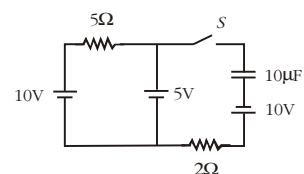
8. A ray of light passes from vacuum into a medium of refractive index μ , the angle of incidence is found to be twice the angle of refraction. Then the angle of incidence is
- (A) $\cos^{-1}(\mu/2)$
 (B) $2\cos^{-1}(\mu/2)$
 (C) $2\sin^{-1}\mu$
 (D) $2\sin^{-1}(\mu/2)$
9. What causes the tail of the 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
10. 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.
11. 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) $\frac{2(n-1)\epsilon_0 A}{d}$
12. An X-ray tube passes 10 mA current at a potential difference of 150 kV. The target material of the tube has a mass of 0.3 kg and specific heat $148.5 \text{ J kg}^{-1}\text{K}^{-1}$. One percent of the supplied electric power is converted into X-rays and the entire remaining energy goes into heating the target. Then,
- (A) the average rate of rise of temperature of target would be 33 K s^{-1}
 (B) the minimum wavelength of the X-ray emitted is about 0.08 \AA
 (C) the rate of heating of the target is 1485 W
 (D) all the above
13. 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.
14. The motion of a vibrating particle is defined by $x = 8 \sin \pi t$ and $y = -2 \cos 2\pi t$
- (A) the path of the particle is parabola
 (B) the path of the particle is symmetric about the axis $x = 0$
 (C) the acceleration of the particle is directed towards the origin
 (D) both A and B are correct.

15. 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) none of these.
16. 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.
17. 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.
18. "Mercury tree" can be prepared by
 (A) litting up mercuric thycyanate and gum
 (B) adding Nessler's reagent to a ammonium salt solution
 (C) pouring little mercury into AgNO₃ solution
 (D) by heating mercuric chloride.
19. Examine the following two structures for the anilinium ion and choose the correct statement from the one given below:



- (A) II is not acceptable canonical structure because carbonium ions are less stable than ammonium ions
 (B) II is not an acceptable canonical structure because it is nonaromatic
 (C) II is not an acceptable canonical structure because nitrogen has 10 valence electrons
 (D) II is an acceptable canonical structure.
20. When the tungsten filament of an electric lamp is heated from room temperature to its operating temperature, its resistance increases 16 fold. The resistance of a 240 V, 100 W lamp at room temperature will be
 (A) 9216 Ω (B) 1500 Ω (C) 576 Ω (D) 36 Ω
21. A big lake which is about 65 km (40 miles) long and about 10 km (6 miles) wide, covering an area of exactly 538.5 square km. Now exactly 1 gram (about 1 spoonful) of ordinary sugar is poured into the lake. After a period of time the sugar needs to distribute uniformly over the whole lake, you take a glass of water (0.2 litre = 200 ml) out of the lake. How many saccharose molecules of the spoonful of sugar do you find in this glass of water? (Lake has an average depth of 50 m)
 (A) about 10 million molecules (B) about 13 million molecules
 (C) exact 1 million molecules (D) data is not sufficient.
22. 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.

23. In the circuit shown in the fig, switch S has been closed for a long time
- charge on the capacitor is $150\ \mu\text{C}$
 - charge on the capacitor is $100\ \mu\text{C}$
 - charge on the capacitor increases if the gap of the capacitor's plate is filled with a dielectric
 - A and C are correct



24. $k_a = 1 \times 10^{-6}$ for a certain indicator HIn. The undissociated HIn has a red colour; the anion, In^- , a yellow colour. The colour of the indicator in a solution of $\text{pH} = 8.0$ will be
- red
 - orange
 - yellow
 - green.
25. 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?
- the solution formed is an ideal solution
 - the solution formed is a non-ideal solution with negative deviation from Raoult's law
 - the solution formed is a non-ideal solution with positive deviation from Raoult's law
 - normal heptane exhibits positive deviation whereas ethyl alcohol exhibits negative deviation from Raoult's law.



ANSWERS

Mathematics :	1. (D)	2. (B)	3. (A)	4. (A)	5. (A)					
Physics – Chemistry :	6. (B)	7. (A)	8. (A)	9. (D)	10. (D)	11. (A)	12. (D)	13. (C)		
	14. (D)	15. (A)	16. (B)	17. (C)	18. (C)	19. (C)	20. (D)	21. (B)		
	22. (B)	23. (D)	24. (C)	25. (C)						