SOF
SCIENCE OLYMPIAD FOUNDATION

N S O
SOF NATIONAL SCIENCE OLYMPIAD

Total Questions : 50   Time : 1 hr.

PATTERN & MARKING SCHEME			
Section	(1) Physics & Chemistry	(2) Achievers Section	(3) Mathematics or Biology
No. of Questions	25	5	20
Marks per Ques.	1	3	1

SYLLABUS

Section – 1 : *Physics* : Units and Measurements, Mechanics, Properties of Matter, Heat and 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.
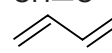**Section – 2 :** Higher Order Thinking Questions - Syllabus as per Section – 1.
Section – 3 : Sets, Relations and Functions, Principle of Mathematical Induction, Logarithms, Complex Numbers & Quadratic Equations, Linear Inequations, Sequences and Series, Trigonometry, Straight Lines, Conic Sections, Permutations and Combinations, Binomial Theorem, Statistics, Mathematical Reasoning, Limits and Derivatives, Probability, Introduction to 3-D Geometry.

OR

Section – 3 : Diversity in the Living World, Structural Organisation in Plants and Animals, Cell : Structure and Functions, Plant Physiology, Human Physiology.

PHYSICS AND CHEMISTRY

1. Read the given statements and select the correct option.
   Statement 1 : The formula connecting u, v and f for a spherical mirror is valid only for mirrors whose sizes are very small compared to their radii of curvature.
   Statement 2 : Laws of reflection are strictly valid for plane surfaces, but not for large spherical surfaces.
   (A) Both statements 1 and 2 are true and statement 2 is the correct explanation of statement 1.
   (B) Both statements 1 and 2 are true but statement 2 is not the correct explanation of statement 1.
   (C) Statement 1 is true but statement 2 is false.
   (D) Statement 1 is false but statement 2 is true.

2. 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

3. A weight is attached to the free end of a sonometer wire. It gives resonance at a length 40 cm when it is resonanced 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

4. 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 proportions
   (B) Law of reciprocal proportions
   (C) Law of constant composition
   (D) Law of combining volumes

5. Which of the following represents the given mode of hybridisation, $sp^2–sp^2–sp–sp$ from left to right?
   (A) $CH_2{=}CH{-}C{\equiv}N$ (B) $CH{\equiv}C{-}C{\equiv}CH$
   (C) $CH_2{=}C{=}C{=}CH_2$ (D) ⟋⟍⟋

6. In the reaction,
   $$4NH_{3(g)} + 5O_{2(g)} \rightarrow 4NO_{(g)} + 6H_2O_{(l)}$$
   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 moles of NO will be produced
   (C) All the oxygen will be consumed
   (D) All the ammonia will be consumed.

7. A bob is attached to one end of a string and other end of which is fixed at peg *A*. The bob is taken to a position where string makes an angle of 30° with the horizontal. On the circular path of the bob in vertical plane there is peg *B* at a symmetrical position with respect to the position of bob as shown in the figure. If v_c and v_a be the minimum speeds in clockwise and anticlockwise directions respectively, given to bob in order to hit the peg *B,* then ratio v_c :
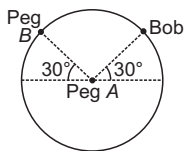
v_a is equal to

(A) $1:1$ (B) $1:\sqrt{2}$ (C) $1:2$ (D) $1:4$

8. A natural gas was containing mixture of methane and ethane only. On complete combustion of 10 litres of gas at STP, the heat evolved was 474.6 kJ. Assuming $\Delta H_{comb} CH_{4(g)}$ = –894 kJ/mol and $\Delta H_{comb} C_2H_{6(g)}$ = –1500 kJ/mol, the percentage of CH_4 and C_2H_6 will be respectively

(A) 30%, 70%   (B) 22%, 78%

(C) 72%, 28%   (D) 70%, 30%.

MATHEMATICS

9. In the diagram, *RS* is common tangent to the two circles with centres *C* and *D*. The circles with centre *C* has a radius of 4 cm and the circle with centre *D* has a radius of 7 cm. Given that *CD* = 15 cm, calculate the approximate length of *RS*.
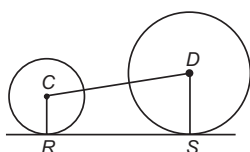
(A) 14.85 cm   (B) 13.70 cm
(C) 14.70 cm   (D) 15.30 cm

10. The value of

$\cos\dfrac{\pi}{15} \cos\dfrac{2\pi}{15} \cos\dfrac{3\pi}{15} \cos\dfrac{4\pi}{15} \cos\dfrac{5\pi}{15} \cos\dfrac{6\pi}{15} \cos\dfrac{7\pi}{15}$ is

(A) $\dfrac{1}{164}$ (B) $\dfrac{1}{138}$

(C) $\dfrac{1}{60}$ (D) $\dfrac{1}{128}$

BIOLOGY

9. Five disaccharides were each hydrolysed with dilute acid, and the purified products were separated by one-dimensional chromatography. The final chromatogram is shown in the given diagram. If spot 1 represents the products obtained from the hydrolysis of sucrose, which one of the following indicates the results obtained from the hydrolysis of lactose (L) and maltose (M)?

	L	M		L	M
(A)	2	3	(B)	2	4
(C)	5	2	(D)	5	3

10. Refer to the given graph and select the correct option for the question that follows.
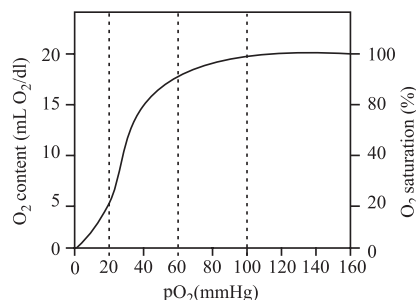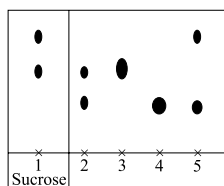
How much oxygen will be released to the tissues by blood on passing from lungs to tissues?

(A) 15 mL of O_2/100 mL of blood

(B) 10 mL of O_2/100 mL of blood

(C) 5 mL of O_2/ 100 mL of blood

(D) 20 mL of O_2/ 100 mL of blood

SPACE FOR ROUGH WORK

ANSWERS

(PHYSICS AND CHEMISTRY)   1. (C)   2. (B)   3. (B)   4. (B)   5. (A)   6. (C)   7. (C)   8. (C)

(MATHEMATICS)   9. (C)   10.(D)

(BIOLOGY)   9. (A)   10.(C)