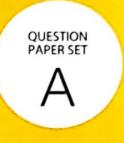




SOF NATIONAL SCIENCE OLYMPIAD 2023-24



CLASS 10



DO NOT OPEN THIS BOOKLET UNTIL ASKED TO DO SO

Total Questions: 50 | Time: 1 hr.

Guidelines for the Candidate

- 1. You will get additional ten minutes to fill up information about yourself on the OMR Sheet, before the start of the exam.
- 2. Write your **Name, School Code, Class, Section, Roll No.** and **Mobile Number** clearly on the **OMR Sheet** and do not forget to sign it. We will share your marks / result and other information related to SOF exams on your mobile number.
- 3. The Question Paper comprises three sections:

Logical Reasoning (10 Questions), **Science** (35 Questions) and **Achievers Section** (5 Questions) Each question in Achievers Section carries 3 marks, whereas all other questions carry one mark each.

- 4. All questions are compulsory. There is no negative marking. Use of calculator is not permitted.
- 5. There is only ONE correct answer. Choose only ONE option for an answer.
- To mark your choice of answers by darkening the circles on the OMR Sheet, use HB Pencil or Blue / Black ball point pen only. E.g. Q.16: In the water cycle, condensation is the process of
 - A. Water vapour cooling down and turning into a liquid
- B. Ice warming up and turning into a liquid
- C. Liquid cooling down and turning into ice
- D. Liquid warming up and turning into water vapour

As the correct answer is option A, you must darken the circle corresponding to option A on the OMR Sheet.

16. ● B © D

- 7. Rough work should be done in the blank space provided in the booklet.
- 8. Return the OMR Sheet to the invigilator at the end of the exam.
- 9. Please fill in your personal details in the space provided before attempting the paper.
- 10. For classes 8, 9 & 10, "Innovation Challenge" is being conducted by Techfest IIT Bombay in association with SOF. For details and to participate, please turn to last page.

Name:	
SOF Olympiad Roll No.:	Contact No.:





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LOGICAL REASONING

- A truck carries goods from city M and travels 28 km North. It then turns right and travels 36 km and then turns right again and travels 10 km. It again turns right and travels 6 km. Finally, it turns left and travels 8 km to reach city N. How far and in which direction is the truck now from city M?
 - A. $3\sqrt{10}$ km, South-West
 - B. 10√10 km, North-East
 - C. $10\sqrt{10}$ km, East
 - D. $3\sqrt{10}$ km, South-East
- Select a figure from the options which is exactly embedded in the given figure as one of its parts.



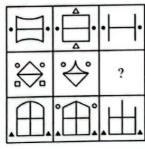








 Select a figure from the options which will complete the given figure matrix.













- 4. How many such pairs of letters are there in the word GUIDELINES each of which has as many letters between them in the word as in the English alphabets?
 - A. Three
- B. Four
- C. Five
- D. More than five
- 5. Three different positions of a cube are shown below. Which alphabet will be on the face opposite to the face having alphabet E?







- A F
- B. H
- C. G
- D. K
- 6. Seven friends P, Q, R, S, T, U and V are standing facing towards East but not in the same order. P is second to the left of V. S and T are at the extreme ends and V is fourth to the right of S. P is sitting between Q and R. R is immediate neighbour of V and U is the immediate neighbour of T. What is the position of U with respect to P?
 - A. Third to the left
- B. Second to the right
- C. Third to the right
- D. Second to the left
- 7. Select the correct water image of the given figure.





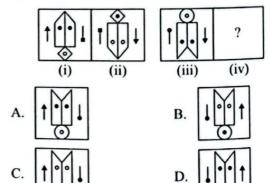








- 8. Introducing Rekha, Neha said, "I am the mother of the son-in-law of her mother." If Rekha is the only married child of her parents, then how is Neha's daughter related to Rekha?
 - A. Sister
- B. Mother-in-law
- C. Sister-in-law
- D. Can't be determined
- There is a certain relationship between figures (i) and (ii). Establish the similar relationship between figures (iii) and (iv) by selecting a suitable figure from the options that would replace the (?) in figure (iv).



- 10. In a certain code language, 'flying very high' is written as 'tec pec bec', 'high and low' is written as 'sec din tec' and 'birds flying low' is written as 'pec bin sec'. Which of the following is the code of 'birds'?
 - A. pec

B. din

C. bec

D. bin

■ SØF | NSO | Class-10 | Set-A | Level 1

Read the given statements and select the correct option.
 Statement 1: When three identical bulbs of 80 W,
 V rating are connected in series to a 220 V supply,
 the power drawn by them will be 240 W.

Statement 2: In series combination, the total power loss is always equal to the sum of the power ratings of individual electric appliances.

- 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. Both statements 1 and 2 are false.
- Read the following statements carefully and select the option that correctly identifies them as true (T) and false (F) ones.
 - (i) When a soft iron bar is inserted inside a current carrying solenoid, the magnetic field inside the solenoid increases.
 - (ii) When the current carrying wire is held exactly in vertical position and current is passed in vertically upward direction and if observed from above, magnetic field gets developed in clockwise direction.
 - (iii) When only the direction of current in electromagnet winding is reversed, strength of the magnetic field remains unchanged.
 - (iv) Among steel, soft iron and silver, most suitable material for making the core of electromagnet is steel.

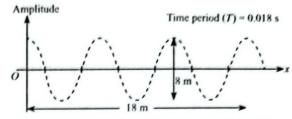
	(i)	(ii)	(iii)	(iv)
A.	T	T	T	F
B.	T	F	T	F
C.	T	F	T	T
D	F	Т	T	T

- 13. The given figure shows a planet in an elliptical orbit around the Sun S. The correct statements for motion of the planet are P_3
 - (i) The velocity of planet is maximum at P₄ and minimum at P₁.



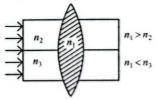
- (ii) For equal interval of time, the area covered by the planet in between points P_1 and P_3 is equal to area in between P_2 and P_4 .
- (iii) The kinetic energy of planet is more at point P_1 than at point P_4 .
- (iv) The planetary motion around Sun in an elliptical orbit is explained by Kepler's laws.
- A. (ii) and (iv) only
- B. (ii), (iii) and (iv) only
- C. (i), (iii) and (iv) only
- D. (i), (ii), (iii) and (iv)

14. The given graph represents a sound wave travelling in positive x direction. On the basis of the graph, match column I with column II and select the correct option from the given codes.



Column I		Column I	
P.	Amplitude of wave	(i)	6 m
Q.	Velocity of wave	(ii)	3 m
R.	Wavelength of wave	(iii)	4 m
S.	Distance between first rarefaction to first compression	(iv)	350 m/s
		(v)	333 m/s

- A. P-(iii), Q-(v), R-(i), S-(ii)
- B. P-(i), Q-(iv), R-(ii), S-(iii)
- C. P-(ii), Q-(iv), R-(iii), S-(i)
- D. P-(iii), Q-(v), R-(ii), S-(i)
- 15. A convex lens, made up of a material of refractive index n_1 is placed inside two transparent immiscible liquids of refractive indices n_2 and n_3 such that $n_2 < n_1 < n_3$. A parallel beam of light is incident on the lens as shown in the given figure. The lens will produce

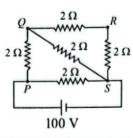


- A. A divergent beam
- B. A divergent and a convergent beam
- C. A convergent beam
- D. Two convergent beams.
- 16. Which of the following statements are correct?
 - We use red light in traffic signals to stop the vehicles because red colour is most scattered colour.
 - (ii) The angle of deviation for a prism of refractive index 3/2 and angle 60°, is 45°.
 - (iii) Blue colour of sky is explained by scattering of light.
 - (iv) An observer can see a rainbow when the Sun is behind the observer.
 - A. (iii) and (iv) only
 - B. (i), (ii) and (iii) only
 - C. (ii), (iii) and (iv) only
 - D. (i), (ii), (iii) and (iv)

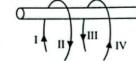
17. The equivalent resistance between the points P and S in the given circuit is



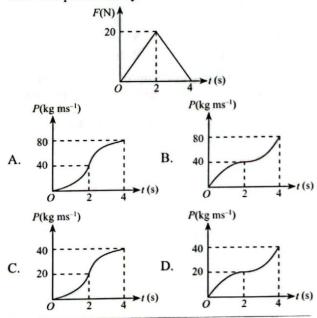
- C. $\frac{5}{4}\Omega$ D. $\frac{4}{3}\Omega$



- Two current carrying conducting wires are hung on a plastic rod. A large current is passed through the two wires in the direction shown in the given figure. Which of the following statements are correct regarding this?
 - (i) I and IV parts of the wire repel each other.



- (ii) II and IV parts of wire repel each other.
- (iii) I and III parts of wire repel each other.
- (iv) II and III parts of wire repel each other. A. (i) and (ii) only
 - B. (ii) and (iii) only
- C. (iii) and (iv) only
- D. (i) and (iv) only
- The given graph represents the variation of the force (F) acting on a body with time (t). If the body starts from rest, the variation of momentum (P) with time is represented by

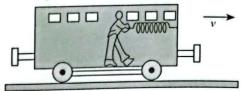


Read the given statements and select the correct option. Statement 1: The image of an object, placed in between infinity and the pole of convex mirror forms behind the mirror in between focus and the pole.

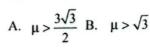
Statement 2: Air bubble inside a glass of water behaves as a convex lens.

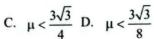
- A. Both statements 1 and 2 are true and statement 2 is the correct explanation of statement 1.
- B. Both statements 1 and 2 are true but statement 2 is not the correct explanation of statement 1.
- Statement 1 is true but statement 2 is false.
- Both statements 1 and 2 are false.
- A bus moving with a uniform speed has a spring of constant k fixed to its front wall as shown in the given

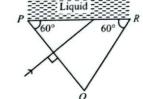
figure. A person stretches the spring by a distance x and in the mean time the bus moves by a distance s. Work done by the person is



- A. $\frac{1}{2}kx(s-x)$
- C. $\frac{1}{2} kxs$
- $\frac{1}{2}kx(s+x+s)$
- Light is incident normally on the face PQ of a prism as shown in the given figure. A liquid of refractive index µ is placed on the face PR of the prism. The prism is made of glass of refractive index 3/2. The limits of μ for which total internal reflection takes place on the face PR is







- Select the correct statement.
 - A. Metals such as Ca and Mg can be obtained from their compounds by heating with carbon.
 - Solder, an alloy of Cu and Sn, has a high melting point and is used for welding electrical wires together.
 - C. Copper reacts with moist nitrogen in the air and attains a green coat.
 - D. Hydrogen gas is not evolved when a metal reacts with nitric acid.
- Four substances were thoroughly mixed with water separately to obtain mixtures P, Q, R and S. Some of their properties are given below:
 - The solute particles are visible to naked eyes in R but invisible in P, Q and S.
 - II. On leaving undisturbed, the particles of the substances settle down in R but not in P, Q and S.
 - III. Path of a beam of light passing through the mixtures is visible in Q, R and S but invisible in P.

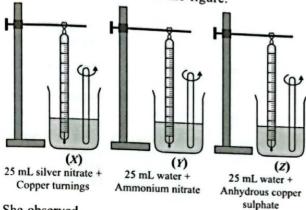
From the above properties it can be concluded that

- A. P and Q are colloids, S is a true solution
- B. R is a suspension and P, S are true solutions
- C. P is a true solution and Q, S are colloids
- D. Q is a colloid and R, S are true solutions.
- Read the given statements and select the correct option. Statement 1: Both methanol and ethanol react with sodium metal to evolve CO₂ gas.

Statement 2: Methanol and ethanol do not have the same functional group.

- A. Both statements 1 and 2 are true and statement 2 is the correct explanation of statement 1.
- Both statements 1 and 2 are true but statement 2 is not the correct explanation of statement 1.

- Statement 1 is true but statement 2 is false.
- Both statements 1 and 2 are false.
- 26. Rohini took three beakers X, Y and Z. She put 25 mL of silver nitrate solution in beaker X and 25 mL of water in beakers Y and Z. She recorded the temperature of each liquid in the three beakers. Then she added 5 g of copper turnings, ammonium nitrate and anhydrous copper sulphate to beakers X, Y and Z respectively as shown in the figure.



She observed

- A. Temperature rise in beakers X and Y
- B. Temperature fall in beaker Y and colour change in beaker X
- C. Temperature fall in beaker X and colour change in beaker Z
- D. Temperature rise in beaker Y and colour change in beaker Z.
- Study the following table carefully.

Element	Number of protons	Number of neutrons
X	4	5
Y	18	22
Z	20	20

From the given table, it can be concluded that

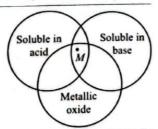
- Mass number of X is 9 and atomic number of Z is 20.
- II. Valency of Y is 2.
- III. Y and Z are isotopes.
- IV. The formula of chloride of X is XCl_2 .

The incorrect conclusion(s) is/are

- A. II only
- B. I and IV only
- C. II and III only
- D. I, II and IV only
- 28. Study the following Venn diagram and identify the compound M.



D. CO₂



29. What is the ratio of the coefficients of the substance getting reduced to the substance getting oxidised if the following reaction is correctly balanced?

$$\begin{array}{ccc}
\text{MnO}_2 + \text{Al} & \longrightarrow & \text{Mn} + \text{Al}_2\text{O}_3 \\
\text{B. } 4:3 & \text{C. } 3:2 & \text{D. } 2:3
\end{array}$$

- 30. The boiling points of four liquids P, Q, R and S are 373 K, 129 K, 351.3 K and 337.7 K respectively. Identify the incorrect statement(s).
 - The increasing order of their interparticle forces of attraction is Q < S < R < P.
 - II. Among the four liquids, Q is most volatile and P is least volatile liquid.
 - III. At 25°C, the liquid S will be in the gaseous state while liquid Q remains in liquid state.
 - A. II and III only
- B. I and II only
- C. III only
- D. None of these
- The pH values of different solutions are listed as follows:

Solution	pН
P	12.6 - 13.2
Q	8.5 - 8.8
R	5.6 - 6.1
S	2.5 - 2.9

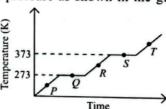
Arrange the given solutions in decreasing order of OH ion concentration.

$$A. \quad S > R > Q > P$$

B.
$$S > Q > P > R$$

D. $Q > R > S > P$

- C. P > Q > R > S
- Examine the heating curve of a pure substance at one atmospheric pressure as shown in the given figure:



According to the graph,

- A. At point P, the substance is in solid state and at point Q, the substance is in liquid state
- B. During the phase change, the temperature increases
- C. At point R, the substance exists as a liquid and at point T, the substance exists as a gas
- D. At point S, the substance exists both as a liquid as well as a gas, and the boiling point of the substance is 273 K.
- A white powder (X) is used by the doctors to support the fractured bones in the right position. (X) is obtained by heating (Y) at temperature (Z) K. On mixing with water, (X) changes to (Y). (X) is also called (M). (X), (Y), (Z) and (M) are respectively
 - A. $CaSO_4.2H_2O$, $CaSO_4.\frac{1}{2}H_2O$, 373 K, Calcium
 - B. CaSO₄. ¹/₂H₂O, CaSO₄. 2H₂O, 373 K, Anhydrous calcium sulphate
 - C. $CaSO_4 \cdot \frac{1}{2}H_2O$, $CaSO_4 \cdot 2H_2O$, 373 K, Calcium sulphate hemihydrate
 - 2CaSO₄.H₂O, CaSO₄.2H₂O, 273 K, Calcium sulphate hemihydrate.

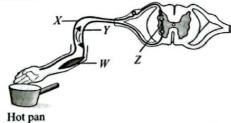
 15.3 g potassium chlorate was heated in a dry test tube till no further loss of mass takes place. The residue left behind weighs 9.3 g.

(Given atomic mass of K = 39 u, Cl = 35.5 u, O = 16 u) Which of the following is the correct statement?

- A. The molecular mass of the chemical compound present in the residue is 64.5 u and the loss of mass is due to oxygen.
- B. The weight of gas produced is 3.0 g and the given observation proves the law of constant composition.
- C. The molecular mass of the chemical compound present in the residue is 74.5 u and the weight of gas produced is 2.5 g
- D. The loss of mass is due to evolution of 6 g of oxygen, the given observation proves the law of conservation of mass.
- Read the given statements and select the option that correctly identifies them as true (T) and false (F) ones.
 - (i) During inhalation, the ribs move upward and outward.
 - (ii) Food is manufactured in the mesophyll cells of the leaves.
 - (iii) The length of the day during which sunlight is available to plants is called phototropism.
 - (iv) Pulmonary artery supplies oxygenated blood from lungs to the left atria.

	(i)	(ii)	(iii)	(iv
A.	T	T	F	F
B.	T	F	T	F
C.	T	F	T	T
D.	T	F	F	T

36. The given figure shows the pathway of a nerve impulse in a reflex action. Which part serves as a link between neurons?



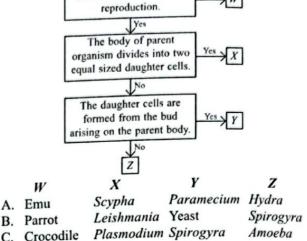
A. W B. X C. Y D. Z

37. Read the given statements and select the correct option.

Statement 1: Oral contraceptives are hormone containing medications.

Statement 2: Oral contraceptives are used in the form of tablets.

- 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. Both statements 1 and 2 are false.
- Refer to the given flow chart. Identify the modes of reproduction (W-Z) and select the option that correctly identifies the organisms in which they occur.



It is an asexual mode of

39. A pea plant that is heterozygous for yellow seeds and green pods was crossed with a pea plant having green seeds and yellow pods. What will be the phenotypic ratio of new combinations in the F₂ generation?

A. 9:1

Salmon

D.

B. 3:1

Mucor

C. 3:3

Syllis

D. 9:3

Leishmania

40. Refer to the given food chain.

Oak tree → Birds → Lice and bugs → Bacteria and fungi
What will be the shape of pyramid of number of the given food chain?



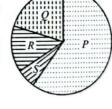
41. Refer to the given pie chart showing the percentage of different greenhouse gases in the atmosphere.

Which among the given gases is

- (i) Produced by flooded paddy fields and marshes?
- (ii) Used as refrigerant and in the manufacturing of aerosol sprays?



B. *Q R* C. *Q P* D. *S R*



- 42. In a composite fish culture system, X lives mostly at the surface zone and feeds on zooplanktons. X could be
 - A. Catla

A

B. Rohu

C. Mrigal

- D. Common carp.
- Identify the cell organelle shown in the given figure and select the correct statement regarding its function.
 - It helps in modification and packaging of secretory products.
 - B. It helps in the breakdown of stored proteins, fats, etc., during starvation.

 It is the site of protein synthesis in a cell.

D. It helps in the synthesis of biochemicals like cytochromes, steroids, etc.



Which of the following epithelial tissues lines the thyroid glands, small salivary ducts and pancreatic ducts?



B.





- Refer to the given list of nutrients required by plants.
 - (ii) Magnesium (iii) Copper (iv) Nitrogen (v) Sulphur

How many of the given nutrients belong to the category of macronutrients?

A. 3

B. 2

C. 4

D. 5

ACHIEVERS SECTION

Refer to the given table of differences between light and dark phase of photosynthesis. Identify the incorrect sets of differences.

S. No.	Light phase	Dark phase
(i)	It occurs in matrix of chloroplasts.	It occurs in the thylakoid membrane.
(ii)	It is dependent on light.	It does not require light.
(iii)	Oxygen is evolved.	Glucose is the end product.
(iv)	It consumes NADPH and ATP.	It produces NADPH and ATP.

- A. (i) and (ii) only
- B. (ii) and (iv) only
- C. (i) and (iv) only
- D. (ii) and (iii) only
- 47. Refer to the given figure of a flower and select the incorrect statement regarding the labelled parts (i) - (iv).

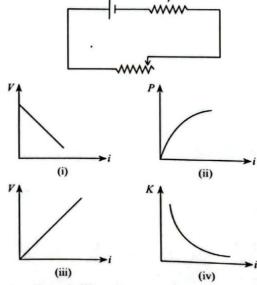


- A. (iv) is usually a bilobed structure that contains
 - microsporangia whereas, (iii) of watermelon has several ovules.
- B. (iv) produces diploid pollen grains formed after mitosis in microspore mother cell whereas, (ii) is a hollow part that contains female gamete.
- C. (i) receives pollen grains during pollination whereas, (ii) provides passage for the entry of pollen tube.
- D. (iii) contains ovules which bear egg cell towards the micropylar end.

Direction (Q. No. 48 and 49): An organic compound 'X' having molecular formula, C2H4O2 has melting point 290 K in its purest form and it often freezes during winter in cold climates.

- Compound (X) contains
 - A. Two C-H single bonds and one O-H single bond

- B. Two C-O single bonds and one C=O double bond
- C. One C=O double bond and three C-H single bonds
- D. One C-C single bond two C-O single bonds.
- Compound (X)
 - A. Turns red litmus blue
 - B. Reacts with ethanol to give a sweet smelling compound
 - Reacts with metallic sodium to produce a gas which turns lime water milky
 - D. Reacts with sodium carbonate to produce a salt and a gas which is supporter of combustion.
- 50. A cell of emf E has internal resistance r and a variable resistor. At an instant, current flowing through the circuit is i, potential difference between the terminals of the cell is V, thermal power developed in the external circuit is P and ratio of power generated in the circuit to the thermal power developed in the cell is K. Then, which of the following graphs are correct?



- A. (ii) and (iii) only
- B. (i) and (ii) only
- C. (i), (ii) and (iv) only

D. (ii), (iii) and (iv) only

SPACE FOR ROUGH WORK



SOF-TECHFEST IIT BOMBAY INNOVATION CHALLENGE

About the Challenge:

Techfest is Asia's Largest Science and Technology Festival and the Annual Science and Technology Festival of IIT Bombay. Techfest IIT Bombay is conducting Innovation Challenge in association with Science Olympiad Foundation for school students across the globe.

Guidelines:

- Appearing in the Innovation Challenge is not compulsory. No registration fee is to be paid.
- To participate, read the following problem statement and email the answer at ic.iitbombay@sofworld.org.
- Answers should be submitted as per the following schedule:

NSO Set-A	NSO Set-B	NSO Set-C
17 th October	21st November	5 th December
By 22 nd October	By 26 th November	By 10 th December

PROBLEM STATEMENT

Green Innovation: Technological Breakthroughs for a Sustainable Tomorrow

In a rapidly evolving world, where the demand for resources and energy continues to rise, green innovation offers a pathway to mitigate environmental impact while promoting economic growth and societal well-being. Some of how innovative technologies are reshaping industries, practices, and lifestyles to align with sustainable principles are:

- Sustainable Plastic Waste Management Without affecting the usage of plastic
- Sustainable Habitat Zero or low energy consumption, low embodied energy and low construction waste
- Sustainable Agriculture Focus on soil degradation, excessive water usage, detrimental effects of pesticides, insecticides, and fertilisers

Choose ANY ONE of the above topics and answer in the following format:

Title - Write the title of the chosen topic.

Problems - Describe the social, industrial, and environmental challenges corresponding to the topic and need for sustainable solutions (in about 100-150 words).

Solutions - Innovate and explain the sustainable solutions to the problems stated above (in about 150-200 words).

Conclusion - Justify your solutions concerning their implementation and impact (in about 50-100 words).

Rewards:

- Each participant will be awarded a Certificate of Participation from SOF-Techfest, IIT Bombay.
- Top 20 students will be invited to Techfest 2023-24 with an accompanying adult from 27th to 29th December 2023 with travel and accommodation provided by Techfest, IIT Bombay.
- Winners will be awarded trophies, gifts, merit certificates, and a visit to ISRO's Vikram Sarabhai Space Centre, Thiruvananthapuram with expenses reimbursed.



SOF INTERNATIONAL GENERAL KNOWLEDGE OLYMPIAD

SOF INTERNATIONAL ENGLISH





Techfest **IIT Bombay**









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