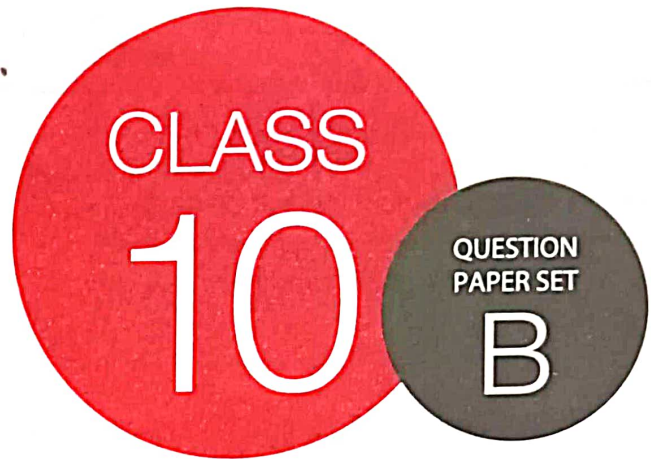


**SOF NATIONAL SCIENCE
OLYMPIAD 2022-23**



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, 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.
6. 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.
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 on this page before attempting the paper.



Name:.....

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

10. Some letters are coded as follows:

Letters	F	T	R	I	S	N	P	E	Z	D
Codes	★	•	@	\$	+	©	?	÷	β	×

While coding the word, following conditions are also to be observed.

Conditions:

- (i) If two vowels come together, then both are to be coded as #.

- (ii) If both the first and last letters are consonants, then both are to be coded as the code for the first letter.
- (iii) If both the first and last letters are vowels, then both are to be coded as the code for the last letter.

Find the code of FRIENDS.

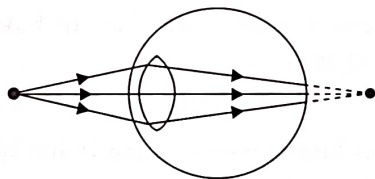
- A. ★##©@★+ B. ★@\$÷©×+
- C. ★@\$÷©×★ D. ★@##©×★

SCIENCE

11. A body weighs 500 gf in air and 300 gf when completely immersed in water. Then the apparent loss in the weight of the body, the upthrust on the body and the volume of the body respectively are

- A. 200 gf, 200 gf, 200 cm³
- B. 200 gf, 200 gf, 100 cm³
- C. 100 gf, 100 gf, 100 cm³
- D. 200 gf, 400 gf, 200 cm³

12. Observe the given diagram carefully, for the formation of image in the eye. What could be the causes of this eye defect?



- (i) The focal length of the eye lens is too long.
- (ii) The eyeball becomes too small.
- (iii) The focal length of the eye lens is too small.
- (iv) The eyeball becomes too long.

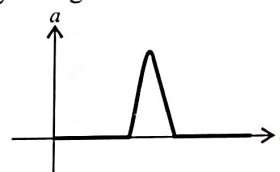
- A. (i) and (ii) only B. (i) and (iv) only
- C. (ii) and (iii) only D. (iii) and (iv) only

13. Consider the following statements and select the option which correctly identifies true (T) and false (F) ones.

- (i) Magnetic field lines do not intersect because they always travel parallel to each other in North to South direction.
- (ii) When a current flows through a straight copper conductor, it gets permanently magnetised.
- (iii) The strength of magnetic field at the centre of a circular coil is inversely proportional to the radius of coil.

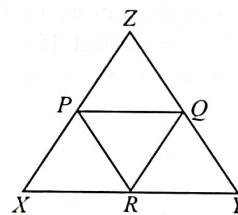
- | | | | |
|----|-----|------|-------|
| | (i) | (ii) | (iii) |
| A. | T | T | F |
| B. | T | F | T |
| C. | F | F | T |
| D. | F | T | F |

14. Which of the following physical situations can be represented by the given acceleration-time graph?



- A. A cricket ball moving with a uniform speed is hit with a bat for a very short time interval.
- B. A ball is falling freely from the top of a tower.
- C. A car is moving with a constant velocity on a straight road.
- D. A football is kicked into the air vertically upwards.

15. Two equilateral triangular wires XYZ and PQR have same centroid as shown in the given figure. The ratio of respective side lengths are 2 : 1. The resistance per unit length is constant. The resistance of XY is 10 Ω . Find the equivalent resistance between X and Y .



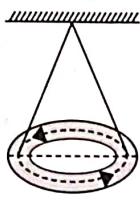
- A. 10 Ω B. $\frac{50}{9} \Omega$
- C. 20 Ω D. $\frac{20}{9} \Omega$

16. A pendulum consists of a wooden bob of mass m and a string of length l . A bullet of mass m_1 is fired towards the pendulum with a speed v_1 . The bullet emerges out of the bob with a speed $v_1/3$, and the bob just completes the vertical circle. The value of v_1 is

- A. $\frac{m}{m_1} \sqrt{5gl}$ B. $\frac{m}{m_1} \sqrt{\frac{g}{l}}$
- C. $\frac{2}{3} \left(\frac{m_1}{m} \right)$ D. $\frac{3}{2} \left(\frac{m}{m_1} \right) \sqrt{5gl}$

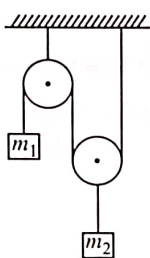
17. A circular loop is suspended in air by insulating threads as shown in the given figure. When the loop is seen from above, current flows in anticlockwise direction and when seen from below, current flows in clockwise direction. This loop behaves as a magnet. The N-pole of this magnet is along

- A. The upper face of the loop
 B. The lower face of the loop
 C. The right side of the loop
 D. The left side of the loop



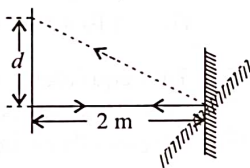
18. In the arrangement, shown in the given figure, pulleys are massless and frictionless, and threads are in-extensible. If the acceleration of block of mass m_2 is a , then the acceleration of block of mass m_1 is

- A. $2a$ B. a
 C. $\frac{a}{2}$ D. $4a$



19. Light incident normally on a plane mirror attached to a galvanometer coil, reflects backward as shown in the given figure. A current in the coil produces a deflection of 15° to the mirror. Find the displacement of the reflected spot of light on a screen placed 2.0 m away.

- A. 127.5 m
 B. 148.9 cm
 C. 115.4 cm
 D. 112.2 m

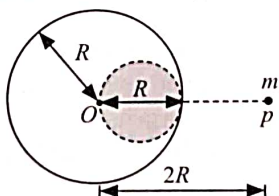


20. An object is placed in front of a pinhole camera. An image is seen at the centre of the translucent screen when viewed from behind. If the object is now moved slightly nearer and to the observer's right, the image becomes

- A. Larger and moves to the observer's right
 B. Larger and moves to the observer's left
 C. Smaller and moves to the observer's right
 D. Smaller and moves to the observer's left.

21. A uniform sphere of mass M and radius R exerts a force X on a small mass m situated at a distance of $2R$ from the centre O of the sphere. A spherical portion of diameter R (shaded portion) is cut from the sphere as shown in the given figure. The force of attraction between the remaining portion of the sphere and the mass m will be

- A. $\frac{X}{3}$ B. $\frac{2X}{3}$
 C. $\frac{4X}{3}$ D. $\frac{7X}{9}$



22. A girl standing in front of a large wall, claps at a regular frequency of 12 Hz. She finds that the echoes coincide with her clapping. The speed of sound in air is 330 m s^{-1} . Which of the following statements is/are correct?

- (i) The time taken between successive clappings is 0.2 s.
 (ii) If she hears one more echo after she stops clapping, then the distance between the girl and the wall is 13.75 m.
 (iii) The distance between the girl and the wall, after she stops clapping, if she hears four more echoes is 55 m.
- A. (i) only B. (ii) and (iii) only
 C. (i) and (ii) only D. (i), (ii) and (iii)

23. pH values of a few solutions are given :

Solution I : 2.2 – 2.4
 Solution II : 6.8
 Solution III : 7.4
 Solution IV : 10

Solutions I, II, III and IV could be respectively

- A. Vinegar, hydrochloric acid, window cleaner and milk
 B. Curd, sodium hydroxide, milk of magnesia and coffee
 C. Lemon juice, milk, human blood and milk of magnesia
 D. None of these.

24. Match column I with column II and select the correct option from the given codes.

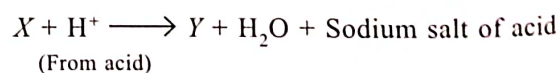
Column I

Column II

- (i) Components of ink P. Separating funnel
 (ii) Petrol and water Q. Sublimation
 (iii) Salt and ammonium chloride R. Fractional distillation
 (iv) Separation of components of air S. Chromatography

- A. (i) - (S), (ii) - (P), (iii) - (Q), (iv) - (R)
 B. (i) - (P), (ii) - (R), (iii) - (S), (iv) - (Q)
 C. (i) - (Q), (ii) - (P), (iii) - (R), (iv) - (S)
 D. (i) - (R), (ii) - (Q), (iii) - (P), (iv) - (S)

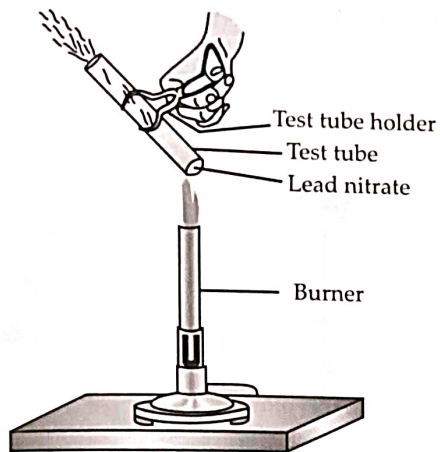
25. Observe the following reaction carefully.



Now, select the correct statement.

- A. X is a mild corrosive acidic salt and can be used to neutralise a base.
 B. On heating X during cooking, H_2 gas is produced.
 C. X is used as an ingredient in antacids and is also used in soda-acid fire extinguishers.
 D. Y is carbon monoxide gas that makes bread and cakes soft and spongy.

26. Observe the following figure carefully.



Now, select the option that correctly identifies the given statements as true (T) and false (F) ones.

- I. The given experimental set-up depicts a combination reaction.
- II. Heating of lead nitrate results in the formation of lead oxide, nitrous oxide and hydrogen.
- III. Brown fumes are evolved during the given reaction.

	I	II	III
A.	T	F	T
B.	T	T	F
C.	F	T	F
D.	F	F	T

27. Which of the following pairs of elements represents a mole ratio of 1 : 3?

- A. 12 g of carbon and 11 g of sodium
- B. 18 g of sulphur and 46 g of calcium
- C. 24 g of carbon and 12 g of magnesium
- D. 10 g of calcium and 18 g of magnesium

28. Which of the following represents the incorrect IUPAC name of the given compound?

- A. $\text{CH}_3\text{CH}_2 - \text{CO} - \text{CH}_3$: Butanone
- B. $\text{CH}_3\text{CH}_2 - \text{CHO}$: Propanal
- C. $\text{CH}_3\text{CH}_2 - \text{COOCH}_3$: Ethanoic acid
- D. $\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \text{CH}_2 - \text{OH}$: Butanol

29. Select the incorrect matches.

- (i) Burning of natural gas – Exothermic reaction
- (ii) Decomposition of vegetable matter into compost – Endothermic reaction
- (iii) Reaction of zinc with copper sulphate – Decomposition reaction
- (iv) Reaction of barium chloride with sodium sulphate – Single displacement reaction

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

30. An organic compound X has the molecular formula, $\text{C}_2\text{H}_4\text{O}_2$. X reacts with $\text{C}_2\text{H}_5\text{OH}$ to produce Y . The reaction of X with sodium carbonate results in the formation of its corresponding salt, water and a gas Z that produces a brisk effervescence. X , Y and Z are respectively

- A. HCOOCH_3 , $\text{CH}_3\text{COOCH}_2\text{CH}_3$ and H_2
- B. $\text{CH}_3\text{CH}_2\text{COOH}$, $\text{CH}_3\text{COOCH}_3$ and H_2
- C. CH_3COOH , $\text{CH}_3\text{COOCH}_2\text{CH}_3$ and CO_2
- D. CH_3COOH , $\text{CH}_3\text{COOCH}_3$ and CO

31. Which of the following statements are incorrect?

- I. Silver and copper are considered to be two of the best conductors of heat.
- II. Alkali metals like lithium and sodium have high densities and high melting points.
- III. Metals form acidic oxides while non-metals form basic oxides.
- IV. Metals such as aluminium, iron and zinc react with cold water to produce corresponding metal hydroxide and evolve hydrogen gas.

- A. I, II and III only
- B. II, III and IV only
- C. I, III and IV only
- D. II and IV only

32. Study the following table carefully and fill in the blanks by selecting an appropriate option.

Dispersed Phase	Dispersion Medium	Example
(i)	Solid	Rubber
Solid	(ii)	Milky glass
Gas	(iii)	Shaving cream
Liquid	(iv)	Mist

- | | (i) | (ii) | (iii) | (iv) |
|----|--------|--------|--------|--------|
| A. | Gas | Solid | Liquid | Gas |
| B. | Solid | Liquid | Gas | Gas |
| C. | Gas | Liquid | Gas | Solid |
| D. | Liquid | Gas | Solid | Liquid |

33. The ratio of atomic numbers of two elements C and D is 1 : 2. The number of electrons present in the valence shell (L -shell) of C is four less than the number of valence electrons present in the L -shell of D . Which of the following statements are correct regarding C and D ?

- I. The atomic numbers of C and D are 12 and 24 respectively.
 - II. The number of valence electrons in C and D are 3 and 7 respectively.
 - III. The difference between the number of neutrons of C and D is 3.
 - IV. The valency of both C and D is 2.
- A. I and IV only
 - B. III and IV only
 - C. II and III only
 - D. I and II only

34. The electronic configuration of element P , Q , R and S are (2, 8, 2), (2, 8, 8, 2), (2, 6) and (2, 8, 6) respectively. Which of them can make an ion with two positive charges?

- A. P and R B. Q and S
 C. P and Q D. Q and R

35. The energy absorbed by chlorophyll is responsible for carrying out which of the following functions?

- A. Formation of ATP
 B. Synthesis of NADPH
 C. Photolysis of water
 D. All of these

36. A tall pea plant with green seeds (TTyy) is crossed with a dwarf pea plant with yellow seeds (ttYY). All the progenies produced in the first generation will be

- A. Tall and yellow seeded
 B. Dwarf and yellow seeded
 C. Tall and green seeded
 D. Dwarf and green seeded.

37. Select the incorrect match.

Gland	Function
A. Thyroid	– Lowers calcium level in blood
B. Pituitary	– Stimulates growth of body by increasing bone growth
C. Pancreas	– Differentiation of T-lymphocytes of immune system
D. Ovaries	– Control growth and functioning of secondary sexual organs in females

38. Jahanvi was asked by her teacher to write names of the plants based on their vegetative reproductive structures. She made few groups but made a mistake in each one of them. Identify the mistakes and select the correct option.

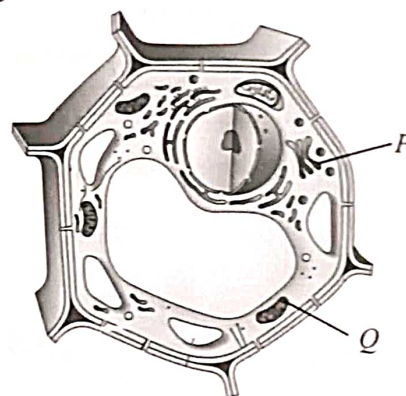
Group I : *Bryophyllum*, *Begonia*, *Colocasia*

Group II : Potato, Onion, *Kalanchoe*

Group III : Ginger, Sweet potato, *Dahlia*

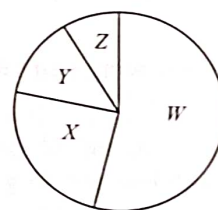
- A. *Colocasia* of group I must be interchanged with sweet potato of group III.
 B. Ginger of group III must be interchanged with onion of group II.
 C. *Colocasia* of group I must be interchanged with *Kalanchoe* of group II.
 D. *Dahlia* of group III must be replaced with *Oxalis*.

39. Refer to the given figure of a plant cell. Identify the labelled parts P and Q and select the correct option regarding their function.



- (i) P gives rise to acrosome in animal sperm.
 (ii) Q uses molecular oxygen and brings step wise oxidation of food stuff.
 (iii) P is the site of protein synthesis.
 (iv) Q stores food in the form of starch, fats and protein.
 A. (i) and (iii) only B. (ii) and (iii) only
 C. (i) and (ii) only D. (iii) and (iv) only

40. Refer to the given figure showing contribution of different gases W , X , Y and Z to greenhouse effect and select the incorrect statement regarding them.



- A. Green plants synthesise food from W and water.
 B. Main sources of X are refrigerators, air conditioners, aerosol sprays, etc.
 C. Y is responsible for ozone depletion in ozonosphere.
 D. Breakdown of nitrogen fertilisers in soil produces Z .

41. Read the given statement and select the option that correctly fills the blanks.

Growth of cartilage is (i) and it is present in (ii).

- | (i) | (ii) |
|-------------------|-----------------------------|
| A. Unidirectional | Middle part of long bone |
| B. Bidirectional | Blood vessels |
| C. Unidirectional | Pinna of ears |
| D. Bidirectional | Endoskeleton of vertebrates |

42. The main purpose of water harvesting is not only to hold rainwater on the surface of the earth but also to make rainwater percolate under the ground so as to recharge groundwater. Which of the following statements are true for water stored in the ground?

- (i) It spreads out to recharge wells.
 (ii) It does not promote breeding of mosquitoes.
 (iii) It is utilised for benefit of the local population.
- A. (i), (ii) and (iii)
 B. (i) and (iii) only
 C. (iii) only
 D. (i) and (ii) only

43. Select the incorrect match.

- A. *Rhizobium* - Converts atmospheric nitrogen gas into utilisable nitrogen compounds
 B. *Azotobacter* - Converts ammonia into nitrites
 C. *Nitrobacter* - Converts nitrites into nitrates
 D. Putrefying bacteria - Convert nitrogen containing proteins of dead plants and animals into ammonia

44. Given below is a list of few diseases.

(i) Typhoid (ii) Dysentery (iii) Cholera (iv) Tuberculosis

Which of these are spread by houseflies?

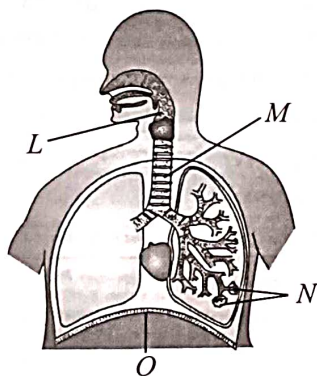
- A. (i) and (iii) only
 B. (ii), (iii) and (iv) only
 C. (i) and (iv) only
 D. (i), (ii), (iii) and (iv)

45. Which of the following comparisons of the two birth control methods used by women are correct?

	Contraceptive pills	Tubal ligation
A.	No implantation of embryo	Implantation of embryo occurs
B.	Menstruation occurs	No menstruation occurs
C.	Reversible	Reversibility is very poor
D.	Ovulation occurs	No ovulation

ACHIEVERS SECTION

46. Refer to the given figure and read the given statements regarding it.



- I. *L* provides a passage into trachea through a slit-like aperture called glottis.
 II. *M* has cartilaginous rings to prevent it from collapsing in between breaths.
 III. Wall of *N* is composed of moist, non-ciliated squamous epithelium and it is the main site of gaseous exchange.
 IV. During inhalation *O* becomes dome shaped whereas during exhalation it becomes flat.

Which of the given statements is/are incorrect?

- A. I and II only B. II and III only
 C. I and III only D. IV only

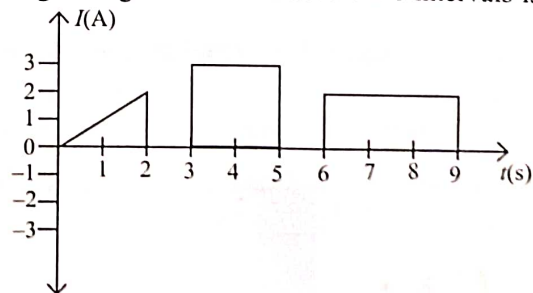
47. Read the given statements and select the option that correctly fills the blanks.

- (i) _____ stimulates transformation of primary follicle of ovary into Graafian follicle.

- (ii) Luteinising hormone stimulates corpus luteum to secrete _____ hormone.
 (iii) Ovulation is controlled by increased level of _____ in blood.

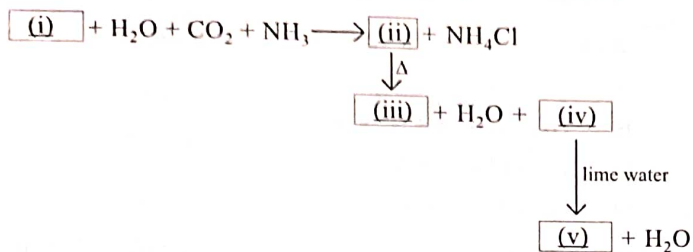
	(i)	(ii)	(iii)
A.	Follicle stimulating hormone	Progesterone	Luteinising hormone
B.	Luteinising hormone	Progesterone	Follicle stimulating hormone
C.	Follicle stimulating hormone	Estrogen	Progesterone
D.	Luteinising hormone	Estrogen	Follicle stimulating hormone

48. The given graph represents the flow of current through a wire at three different time intervals. The ratio of charges flowing through the wire at these time intervals is



- A. 1 : 2 : 3 B. 3 : 2 : 1
 C. 1 : 1 : 1 D. 1 : 3 : 3

49. Study the following flow chart carefully and fill in the blanks by selecting an appropriate option.



- | | (i) | (ii) | (iii) | (iv) | (v) |
|----|------|---------------------------------|---------------------------------|-----------------|---------------------|
| A. | NaCl | Na ₂ CO ₃ | Na ₂ O | CO | CaO |
| B. | NaOH | NaHCO ₃ | Na ₂ CO ₃ | CO ₂ | CaCO ₃ |
| C. | NaOH | Na ₂ CO ₃ | Na ₂ O | CO | Ca(OH) ₂ |
| D. | NaCl | NaHCO ₃ | Na ₂ CO ₃ | CO ₂ | CaCO ₃ |

50. Read the given passage carefully and fill in the blanks by selecting an appropriate option.


In electrolytic refining process, the impure metal is made the (i) and a thin strip of pure metal is

made the (ii). A solution of metal salt is used as an electrolyte. On passing the current through the electrolyte, the pure metal from the (iii) dissolves into the electrolyte. An equivalent amount of pure metal from the electrolyte is deposited on the (iv). The insoluble impurities that settle down at the bottom of the anode are known as (v).


- | | (i) | (ii) | (iii) | (iv) | (v) |
|----|---------|---------|---------|---------|------------------|
| A. | Anode | Cathode | Anode | Cathode | Anode mud |
| B. | Cathode | Anode | Cathode | Anode | Cathode mud |
| C. | Anode | Cathode | Cathode | Anode | Gangue particles |
| D. | Cathode | Anode | Anode | Cathode | Anode mud |

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SOF NATIONAL SCIENCE OLYMPIAD




SOF INTERNATIONAL MATHEMATICS OLYMPIAD




SOF NATIONAL CYBER OLYMPIAD




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