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IMO

SOF INTERNATIONAL MATHEMATICS OLYMPIAD 2023-24

CLASS 10

QUESTION PAPER SET B

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 four sections:
   Logical Reasoning (15 Questions), **Mathematical Reasoning** (20 Questions), **Everyday Mathematics** (10 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: Rahul bought 4 kg 90 g of apples, 2 kg 60 g of grapes and 5 kg 300 g of mangoes. The total weight of all the fruits he bought is_____.
   A. 11.450 kg B. 11.000 kg C. 11.350 kg D. 11.250 kg
   As the correct answer is option A, you must darken the circle corresponding to option A on the OMR Sheet.

   16. ● Ⓑ Ⓒ Ⓓ
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.

Name:.....

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

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SCIENCE OLYMPIAD FOUNDATION
Inspiring Young Minds Through Knowledge Olympiads

1. There is a certain relationship between the pair of numbers on the either side of : :. Identify the relationship of the given pair and find the missing number.

12 : 159 : : 16 : ?

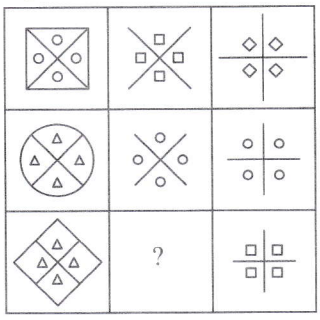
A. 339
B. 256
C. 240
D. 271

2. Arrange the following words in the order in which they occur in a dictionary and choose the correct sequence.

1. Remote
2. Remedies
3. Remainder
4. Reminder
5. Remove

A. 2, 3, 4, 1, 5
B. 3, 2, 4, 1, 5
C. 3, 2, 4, 5, 1
D. 2, 4, 3, 1, 5

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



A. 
B. 
C. 
D. 

4. Two rows of numbers are given. The resultant number in each row is to be worked out separately based on the following rules and the question below the rows of numbers is to be answered. The operations on numbers progress from left to right.

Rules :

(i) If a prime number is followed by an odd number, then the second number is to be subtracted from the first number.

(ii) If a number is followed by a perfect square number, then they are to be added.

(iii) If an even number is followed by another even number which is not a perfect square, then the second number is to be divided by the first number.

(iv) If an even number is followed by an odd number, then they are to be multiplied.

6	36	4
17	7	3

Find the number obtained by adding the resultants of both the rows.

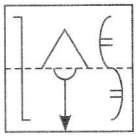
A. 76
B. 20
C. 54
D. 10

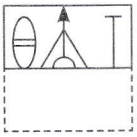
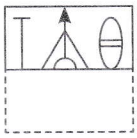
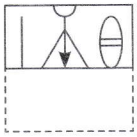
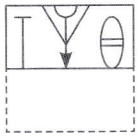
5. Select the correct water image of the given combination of letters and symbols.

RE@D#F@$T

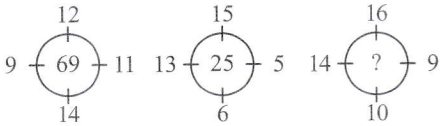
A. RƎ@ᗡ#ꟻ@$T
B. ꓤE@D#F@$T
C. ꓤE◎D#L◎ƧL
D. TƧ◎ꟻ#ᗡ◎ƎꓤЯ

6. A square transparent sheet with a pattern and a dotted line on it is shown here. Select a figure from the options as to how the pattern would appear when the transparent sheet is folded along the dotted line.



A. 
B. 
C. 
D. 

7. Find the missing number, if same rule is followed in all the three figures.

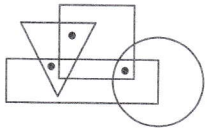


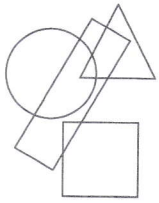
A. 34
B. 52
C. 43
D. 61

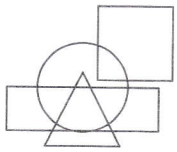
8. Seven children J, K, L, M, N, O and P are sitting around a circular table facing the centre, while playing a game. M is sitting second to the left of K. L is sitting between J and P. P is third to the right of M. O is not an immediate neighbour of K. Which of the following are immediate neighbours of M?

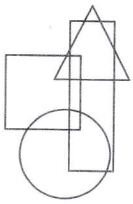
A. J and N
B. K and L
C. O and J
D. O and N

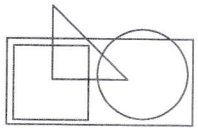
9. Select a figure from the options which satisfies the same conditions of placement of dots as in the given figure.



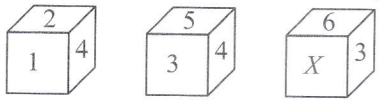
A. 

B. 

C. 

D. 

10. Three positions of a dice are given below. Which of the following number will come in the place of *X*?



A. 1
B. 2
C. 4
D. 5

11. If in a certain code language, OLYMPIAD is coded as OGZBNJXK, then how will NATIONAL be written in that code language?

A. MYSGNLZJ
B. OCUKPPBN
C. NLZJMYSG
D. NBPPKUCO

12. A word and number arrangement machine when given an input of words and numbers rearranges them following a particular rule in each step. The following is an illustration of input and steps of rearrangement.

Input: winter 57 jacket 81 ice 36 warm 72 cool 64

Step I : cool 36 winter 57 jacket 81 ice warm 72 64

Step II : cool 36 ice 57 winter jacket 81 warm 72 64

Step III : cool 36 ice 57 jacket 64 winter 81 warm 72

Step IV : cool 36 ice 57 jacket 64 warm 72 winter 81

And step IV is the last step of the above input.

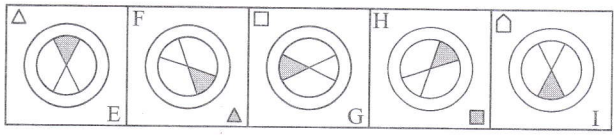
As per the rule followed in the above steps, answer the question.

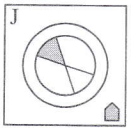
If step II of an input is "happy 28 laugh 49 time 84 63 smile wise 51", then which of the following is definitely the input?

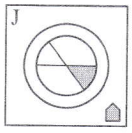
A. laugh 28 time 84 happy 63 smile 49 wise 51
B. laugh 49 time 28 happy 63 wise 51 smile 84
C. laugh 28 happy 49 time 63 wise 84 smile 51
D. Can't be determined

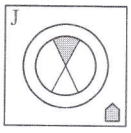
13. Select a figure from the options which will continue the same series as established by the Problem Figures.

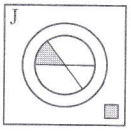
Problem Figures



A. 

B. 

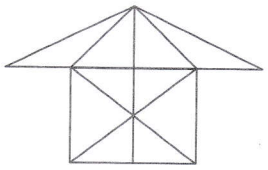
C. 

D. 

14. Maya is the mother of Shruti. Varun and Kartik are brothers. Shruti is the sister of Varun and wife of Nakul. Which of the following statements is incorrect?

A. Maya is the mother-in-law of Nakul.
B. Shruti is the sister of Kartik.
C. Kartik is the son-in-law of Nakul.
D. Maya is the mother of Varun.

15. Find the number of triangles formed in the given figure.



A. 19
B. 20
C. 21
D. More than 21

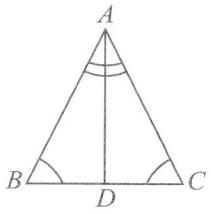
16. A racetrack is in the form of a ring whose inner and outer circumferences are 437 m and 503 m, respectively. Find the area of the track.

A. 4935 m^2
B. 5170 m^2
C. 3254 m^2
D. 5490 m^2

17. If α and β are the zeroes of the quadratic polynomial $p(s) = 3s^2 - 6s + 4$, then find the value of $\frac{\alpha}{\beta}+\frac{\beta}{\alpha}+2\left(\frac{1}{\alpha}+\frac{1}{\beta}\right)+3\alpha\beta$

A. 10
B. -4
C. 8
D. None of these

18. In the given figure, $\angle ABC = \angle ACB$, AD is bisector of $\angle BAC$ and AD meets BC at D. Then select the correct option.



A. $BD = DC$
B. $\Delta ABD \cong \Delta ACD$
C. $\Delta ABD \cong \Delta DCA$
D. Both A and B

19. If 5 cot θ = 3, then $\frac{5\sin\theta-3\cos\theta}{4\sin\theta+3\cos\theta}$ is equal to

A. $\frac{11}{18}$
B. $\frac{16}{29}$
C. $\frac{14}{27}$
D. None of these

20. If one root of $ax^2 + bx + c = 0$ is thrice the other root, then $\frac{b^2}{ac}$ =

A. $\frac{3}{10}$
B. $\frac{16}{3}$
C. $\frac{5}{3}$
D. $\frac{7}{16}$

21. If $x = 7 + 4\sqrt{3}$ and $xy = 1$, then find the value of $\frac{1}{x^2}+\frac{1}{y^2}$.

A. 194
B. 150
C. 134
D. 130

22. If two vertices of a triangle are (6, 3) and (– 1, 7) and its centroid is (1, 5), then find its third vertex.

A. (3, – 5)
B. (3, – 2)
C. (4, 2)
D. (– 2, 5)

23. In a triangle ABC, D and E are the points on sides AB and AC respectively such that $DE||BC$, AB = 27.4 m, DB = 17.2 m and AE = 5.1 m. Find EC.

A. 7.2 m
B. 6.6 m
C. 8.6 m
D. 9.2 m

24. The edges of a triangular board are 6 cm, 8 cm and 10 cm. Find the cost of painting it at the rate of ₹ 15.50 per sq. cm.

A. ₹ 540.50
B. ₹ 372
C. ₹ 410.50
D. None of these

25. A two-digit number is 4 more than 6 times the sum of its digits. If 18 is subtracted from the number, then the digits are reversed. Find the number.

A. 36
B. 64
C. 25
D. 30

26. The angle of elevation of the top of a tower from the bottom of a building is twice that from its top. What is the height of the building, if the height of the tower is 75 m and the angle of elevation of the top of the tower from the bottom of the building is 60°?

A. 25 m
B. 37.5 m
C. 50 m
D. 60 m

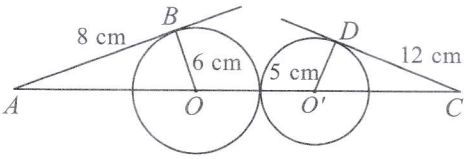
27. Select the incorrect option.

A. In a parallelogram, the sum of any two consecutive angles is 180°.
B. In a triangle ABC, if median AD is produced to X such that $AD = DX$, then $ABXC$ is a parallelogram.
C. Both A and B
D. Neither A nor B

28. The sum of all terms of the arithmetic progression having ten terms except the first term, is 99, and except the sixth term, is 89. Find the 8^{th} term of the progression, if the sum of the first and the fifth term is equal to 10.

A. 15
B. 25
C. 18
D. 10

29. In the given figure (not drawn to scale), find AC, if O and O' are the centres of the two circles.



A. 21 cm
B. 19 cm
C. 24 cm
D. 34 cm

30. If the radius of the base of a cone is halved, keeping the height same, then what is the ratio of the volume of the reduced cone to that of the original cone?

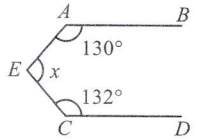
A. 1 : 4
B. 2 : 3
C. 4 : 1
D. 3 : 2

31. If the median of the following distribution is 58 and the sum of all the frequencies is 140, then find the values of x and y.

Class Interval	15-25	25-35	35-45	45-55	55-65	65-75	75-85	85-95
Frequency	8	10	x	25	40	y	15	7

A. $x = 15, y = 20$
B. $x = 15, y = 30$
C. $x = 5, y = 10$
D. $x = 10, y = 15$

32. In the adjoining figure, if $AB \parallel CD$, then the value of x is

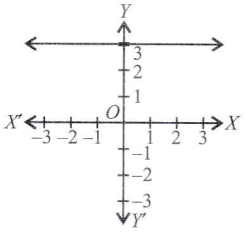


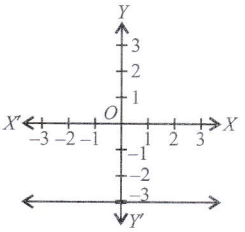
A. 80°
B. 88°
C. 90°
D. 98°

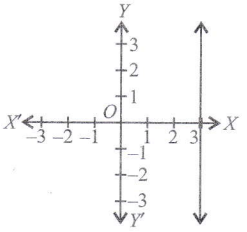
33. A box contains 54 balls each of which is red, green or black. The probability of selecting a red ball at random from the box is $\frac{1}{3}$, and the probability of selecting a green ball at random is $\frac{4}{9}$. How many black balls does the box contain?

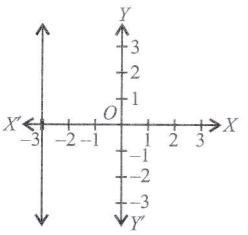
A. 10
B. 8
C. 15
D. 12

34. Geometric representation of $x = -3$ as an equation in two variables is

A.


B.


C.


D.


35. A circus tent is in the form of a right circular cylinder and right circular cone above it. The radius and height of conical part is 8 m and 6 m respectively. If the height of cylindrical part is 10 m, then the total area of the canvas required is (Use $\pi = 3.14$)

A. 502.4 m^2
B. 624.3 m^2
C. 753.6 m^2
D. 704.7 m^2

EVERYDAY MATHEMATICS

36. A 100 m long train takes 9 seconds to cross a man walking at 5 km/hr in the direction opposite to that of the train. Find the speed of the train.

A. 30 km/hr
B. 45 km/hr
C. 35 km/hr
D. 50 km/hr

37. A man starts his job with a certain monthly salary and earns a fixed increment every year. If his salary was ₹ 15000 after 4 years of service and ₹ 18000 after 10 years of service, then find his starting salary and annual increment respectively.

A. ₹ 11000, ₹ 700
B. ₹ 13000, ₹ 500
C. ₹ 13000, ₹ 700
D. ₹ 11000, ₹ 500

38. ₹ 9,000 were divided equally among a certain number of persons. If there had been 20 more persons, each would have got ₹ 160 less. Find the original number of persons.

A. 25
B. 24
C. 26
D. 27

39. A and B solved a quadratic equation. In solving it, A made a mistake in the constant term and obtained the roots as 5, – 3, while B made a mistake in the coefficient of x and obtained the roots as 1, – 3. The correct roots of the equation are

A. 1, 3
B. – 1, 3
C. – 1, – 3
D. 1, – 1

40. Two vessels A and B contain milk and water mixed in the ratio 5 : 2 and 8 : 5 respectively. Find the ratio in which these mixtures are to be mixed to get a new mixture containing milk and water in the ratio 9 : 4.

A. 7 : 2
B. 5 : 7
C. 3 : 5
D. 4 : 9

41. There were 35 students in a hostel. Due to the admission of 7 new students, the expenses of the mess were increased by ₹ 42 per day while the average expenditure per head diminished by ₹ 1. What was the original expenditure of the mess?

A. ₹ 421
B. ₹ 422
C. ₹ 420
D. ₹ 430

42. 16 men can complete a work in 12 days and 24 children can complete the same work in 18 days. 12 men and 8 children started the work and after 8 days 3 more children join them. In how many days will they now complete the remaining work?

A. 4
B. 6
C. 8
D. 7

43. The internal and external diameters of a hollow hemispherical vessel are 24 cm and 25 cm respectively. The cost to paint 1 cm^2 of the surface is ₹ 0.05. Find the total cost of painting the vessel all over.

A. ₹ 108.32
B. ₹ 296.28
C. ₹ 101.59
D. ₹ 96.29

44. A sum invested for 3 years compounded annually at 5%, 10% and 20% respectively. In these three years, sum amounts to ₹ 16632, find the sum.

A. ₹ 12000
B. ₹ 11000
C. ₹ 15000
D. ₹ 9000

45. A shopkeeper sells a pair of sunglasses at a profit of 25%. If he had bought it at 25% less and sold it for ₹ 10 less, then he would have gained 40%. The cost price of the pair of sunglasses is

A. ₹ 25
B. ₹ 50
C. ₹ 60
D. ₹ 75

46. Read the given statements carefully and select the correct option.

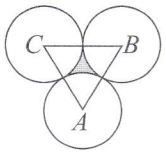
Statement-I : If $\tan^2\theta = 1 - a^2$, then $\sec\theta + \tan^3\theta \operatorname{cosec}\theta = (2 - a^2)^{3/2}$

Statement-II : If $a\cos\theta + b\sin\theta = 4$ and $a\sin\theta - b\cos\theta = 3$, then the value of $a^2 + b^2 = 7$

A. Both Statement-I and Statement-II are true.
B. Both Statement-I and Statement-II are false.
C. Statement-I is true but Statement-II is false.
D. Statement-I is false but Statement-II is true.

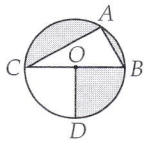
47. Solve the following :

(i) If 3 equal circles (having A, B, C as centres) of radius 3 cm each touch each other, then area of the shaded portion is _____ .



(ii) In the given figure, O is the centre of the circle with $AC = 24$ cm, $AB = 7$ cm and $\angle BOD = 90°$, then the area of the shaded region is _____ .

(Take $\pi = 3.14$)



	(i)	(ii)
A.	$(\sqrt{3} - 2\pi)$ cm^2	315.20 cm^2
B.	$\frac{9}{2}(2\sqrt{3} - \pi)$ cm^2	283.97 cm^2
C.	$2(\sqrt{2} - \pi)$ cm^2	179.83 cm^2
D.	$4(\sqrt{3} - 2\pi)$ cm^2	225.85 cm^2

48. Fill in the blanks and select the correct option.

(i) If the mid point of the line joining the points (3, 4) and (k, 7) is (x, y) and satisfies $2x + 2y + 1 = 0$, then the value of k is _____.

(ii) The x-coordinate of a point P is twice its y-coordinate. If P is equidistant from Q (2, –5) and R (–3, 6), then the coordinates of P is _____.

	(i)	(ii)
A.	10	(8, 16)
B.	12	(8, 4)
C.	– 15	(16, 8)
D.	– 15	(4, 8)

49. Read the given statements carefully and state T for true and F for false.

(i) A basket contains 6 dozen apples. If the probability of getting a rotten apple from the basket is $\frac{1}{4}$, then the number of good apples in the basket is 54.

(ii) A card is drawn at random from a pack of 52 playing cards. The probability that the card drawn is black queen is $\frac{1}{13}$.

(iii) A number is selected at random from the numbers 2, 4, 6, ..., 20. The probability that it is a prime number is $\frac{1}{19}$.

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

50. Which of the following options is correct?

A. P and Q are the points on the sides AB and AC respectively of a ΔABC. If $AP = 3$ cm, $PB = 6$ cm, $AQ = 5$ cm and $QC = 10$ cm, then $BC = 3\ PQ$.
B. The line segments joining the mid points of the sides of a triangle form four triangles, each of which is similar to the original triangle.
C. Both A and B
D. Neither A nor B

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SOF SCIENCE OLYMPIAD FOUNDATION
National Office: Plot 99, Sector 44 Institutional area, Gurugram -122 003 (HR) India
Email: info@sofworld.org | Website: www.sofworld.org