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IMO

SOF INTERNATIONAL MATHEMATICS OLYMPIAD 2023-24

CLASS 10

QUESTION PAPER SET A

DO NOT OPEN THIS BOOKLET UNTIL ASKED TO DO SO

Total Questions: 50 | Time: 1 hr.

Guidelines for the Candidate

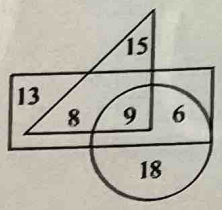
1. You will get additional ten minutes to fill up information about yourself on the OMR Sheet, before the start of the exam.
2. Write your **Name, School Code, Class, Section, Roll No.** and **Mobile Number** clearly on the **OMR Sheet** and do not forget to sign it. We will share your marks / result 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.:.....

SOF
SCIENCE OLYMPIAD FOUNDATION
Inspiring Young Minds Through Knowledge Olympiads

1. In the given Venn diagram, circle represents students living in Delhi, triangle represents students who use metro for transportation, rectangle represents students who like Mathematics. Which number represents students who live in Delhi and use metro for transportation and like Mathematics?



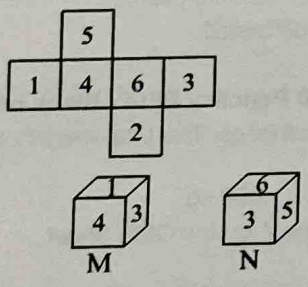
A. 18
B. 8
C. 9
D. 13

2. Select the number which will complete the given series.

2, 7, 22, 67, ?, 607

A. 192
B. 202
C. 127
D. 232

3. Select the box(es) that is/are similar to the box formed, when the given sheet is folded.



A. L only
B. Both L and M
C. N only
D. Both L and N

4. The following digits are coded as follows:

Digits	4	7	9	2	5	3	8	1	6
Codes	#	@	T	$	%	*	P	+	v

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

Conditions:

(i) If the first as well as the last digit is even number, then both are to be coded as ©.

(ii) If the first digit is an odd number and the last digit is an even number, then their codes are to be interchanged.

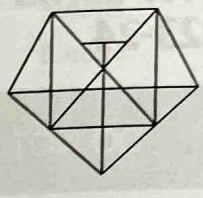
(iii) If the first as well as the last digit is odd number, then both are to be coded as α.

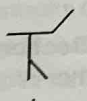
(iv) If the exact middle digit is an odd number, then it is to be coded as *w*.

Find the code for 7259648.

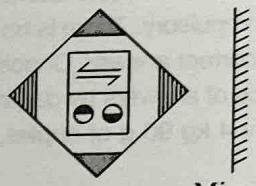
A. @ $ % *w* v # P
B. P $ % *w* v # @
C. P $ % T v # @
D. @ $ % T v # P

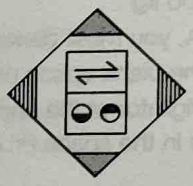
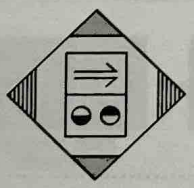
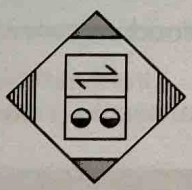
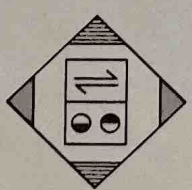
5. Which of the following options is exactly embedded in the given figure as one of its parts?



A. 
B. 
C. 
D. 

6. Select the correct mirror image of the given figure.



A. 
B. 
C. 
D. 

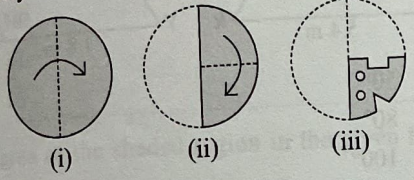
7. How many such pair of letters are there in the word RESPONSIBLE each of which has the same number of letters between them in the word as in the English alphabets?

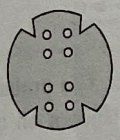
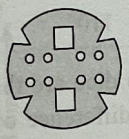
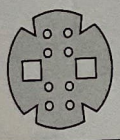
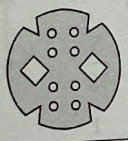
A. Two
B. Three
C. Four
D. More than four

8. If 'P' stands for '÷', 'Q' stands for '+', 'R' stands for '×' and 'S' stands for '–', then which of the following options is correct?

A. 5 R 6 Q 8 P 2 S 9 = 25
B. 4 R 6 Q 8 P 4 S 9 = 15
C. 5 R 3 Q 8 P 2 S 7 = 10
D. 4 R 3 Q 8 P 2 S 7 = 12

9. There is a set of three figures (i), (ii) and (iii) showing a sequence of folding of a piece of paper. Fig. (iii) shows the manner in which the folded paper has been cut. Select a figure from the options which would most closely resembles the unfolded form of fig. (iii).



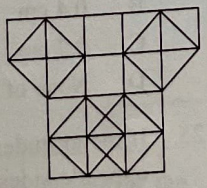
A. 
B. 
C. 
D. 

10. If the first and the last digit of each of the following numbers are interchanged and one is added to the middle digit and then numbers are arranged in descending order, then what is the sum of the digits of the middle number in the new arrangement formed?

246 525 432 726 283

A. 14
B. 12
C. 13
D. 16

11. Find the number of squares formed in the given figure.

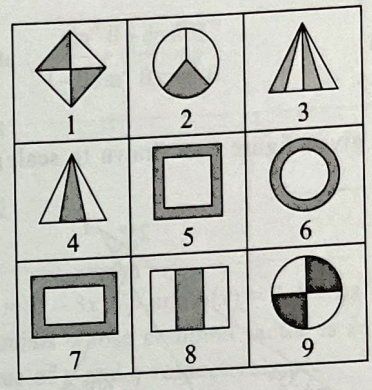


A. 18
B. 19
C. 20
D. More than 20

12. Nikita left her home to play in a garden. She walked 4 m towards North and then turned right and walked 8 m. She then turned right again and walked 10 m. Finally, she turned left and walked 10 m to reach the garden. How far and in which direction is her home from the garden?

A. $6\sqrt{10}$ m , South-East
B. $4\sqrt{10}$ m , North-West
C. $6\sqrt{10}$ m , North-West
D. $4\sqrt{10}$ m , East

13. Group the given figures into three classes on the basis of their identical properties using each figure only once.



A. 1, 3, 9; 2, 4, 8; 5, 6, 7
B. 1, 3, 9; 2, 6, 7; 4, 5, 8
C. 1, 4, 9; 2, 3, 7; 5, 6, 8
D. 1, 4, 7; 2, 4, 8; 3, 5, 9

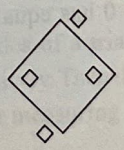
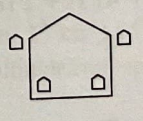
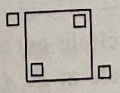
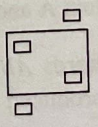
14. Study the given information carefully and answer the following question.

(i) 'A + B' means 'A is the mother of B'.
(ii) 'A × B' means 'A is the father of B'.
(iii) 'A ÷ B' means 'A is the son of B'.
(iv) 'A – B' means 'A is the daughter of B'.

How is G related to L in the expression G × H + K – L?

A. Grandfather
B. Father-in-law
C. Father
D. Son-in-law

15. Select the odd one out.

A. 
B. 
C. 
D. 

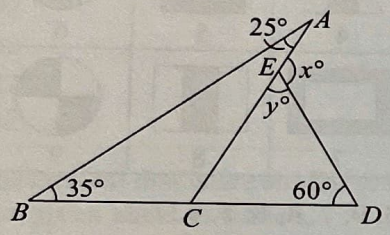
16. If the solution of pair of linear equations $2x - 3y = 13$ and $7x - 2y = 20$ satisfies the equation $y = mx + 7$, then the value of m is _____.

A. 5
B. –5
C. –10
D. 14

17. a_1, a_2, a_3, a_4, a_5 are the first five terms of an A.P. such that $a_1 + a_3 + a_5 = -12$ and $a_1 \cdot a_2 \cdot a_3 = 8$. Find the common difference.

A. 2
B. –3
C. 4
D. –5

18. In the given figure (not drawn to scale), the value of x is _____.



A. 60
B. 75
C. 90
D. 120

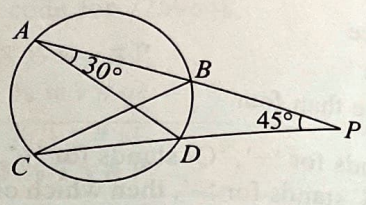
19. The angles of elevation of an artificial satellite measured from two earth stations are 30° and 60° respectively. If the distance between the earth stations, which are in straight line with the point directly below the satellite, is 4000 km, then the height of the satellite is _____. (Use $\sqrt{3} = 1.732$)

A. 2000 km
B. 6000 km
C. 3464 km
D. 2828 km

20. Find the value of α for which the quadratic equation $(\alpha - 4)\,x^2 + 2\,(\alpha - 4)\,x + 4 = 0$ has equal roots.

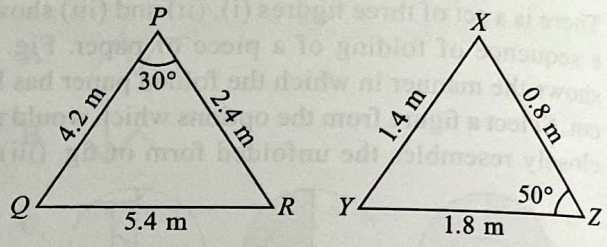
A. 8
B. 4
C. 6
D. Both A and B

21. Two chords AB and CD of a circle cut each other when produced outside the circle at P. AD and BC are joined. If $\angle PAD = 30°$ and $\angle CPA = 45°$, then find $\angle CBP$.



A. 105°
B. 115°
C. 135°
D. None of these

22. Find the value of $\angle Q$ in the given figure.



A. 50°
B. 80°
C. 100°
D. 110°

23. Two dice are thrown at a time. The probability that the difference of the numbers shown on the dice is 1, is

A. $\frac{5}{18}$
B. $\frac{1}{36}$
C. $\frac{1}{6}$
D. None of these

24. A cylindrical vessel of diameter 4 cm is partly filled with water. 300 lead balls are dropped in it. The raise in water level is 0.8 cm. The diameter of each ball is _____

A. 0.8 cm
B. 0.4 cm
C. 0.2 cm
D. None of these

25. If the altitudes from two vertices of a triangle to the opposite sides are equal, then the triangle is

A. Equilateral

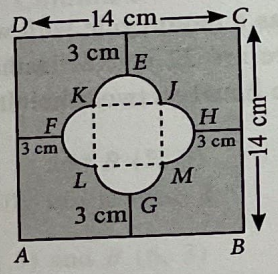
B. Isosceles
C. Scalene
D. Right-angled

26. Which of the following is a rational number?
A. Sum of $2 + \sqrt{3}$ and its inverse
B. Square root of 18
C. Square root of $7 + 4\sqrt{3}$
D. None of these

27. The points (1, 2), (3, 5) and (4, –3) are the vertices of a/an _____ triangle.
A. Right-angled
B. Isosceles
C. Scalene
D. Equilateral

28. If $p(x) = x^3 + 3x^2 - 2x + 4$, then find the value of $p(2) + p(-2) - p(0)$.
A. 28
B. 14
C. 12
D. 16

29. The area of the shaded region in the given figure is



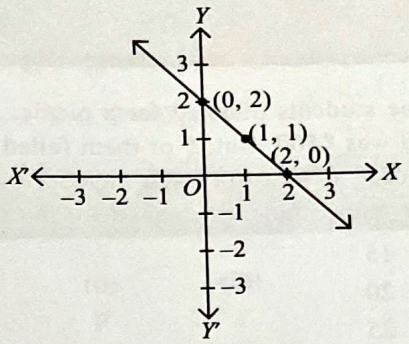
A. 8π cm^2
B. $(180 - \pi)$ cm^2
C. $(180 - 8\pi)$ cm^2
D. 180 cm^2

30. Calculate the missing frequency f_1 in the given distribution, it is given that the median of the distribution is 24.

Age (in years)	0–10	10–20	20–30	30–40	40–50
No. of persons	5	25	f_1	18	7

A. 25
B. 20
C. 15
D. 30

31. Choose the equation whose graph is shown in the given figure.

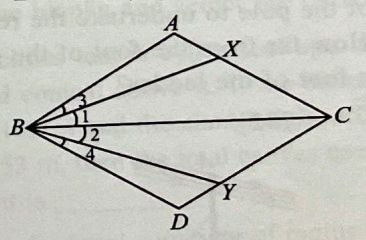


A. $x + y = 2$
B. $x - y = 2$
C. $2x + 3y = 6$
D. None of these

32. Evaluate : $\dfrac{\sin^4\theta + \cos^4\theta}{1 - 2\sin^2\theta\cos^2\theta}$
A. –1
B. 1
C. –2
D. 2

33. If $p(x) = x^2 - 3x + p$ and $q(x) = 2x^2 + qx + 2$ are the polynomials whose common factor is $(x + 2)$, then the value of p and q respectively are
A. 10, 5
B. –10, 5
C. 10, –5
D –10, –5

34. In the given figure (not drawn to scale), $\angle 1 = \angle 2$ and $\angle 3 = \angle 4$. Then, which of the following is true?



A. $\angle ABC = \angle DBC$
B. $\angle ABC \neq \angle DBC$
C. $\angle BAX = \angle BXC$
D. None of these

35. The sides of a triangle are 14 cm, 15 cm and 13 cm respectively. Then the length of its altitude corresponding to side measuring 14 cm, is
A. 12 cm
B. 6 cm
C. 18 cm
D. 24 cm

36. Some students planned for a picnic. The budget for food was ₹500. But, 5 of them failed to go and thus the cost of food for each member increased by ₹5. How many students planned for the picnic?

A. 15
B. 20
C. 25
D. 30

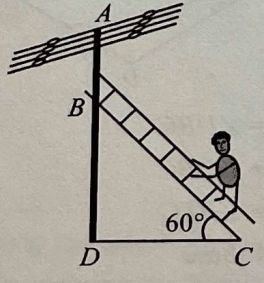
37. A, B, C are three partners in a business. If twice the investment of A is equal to thrice the capital of B and the capital of B is 4 times the capital of C, then out of a total profit of ₹29700, the share of B is

A. ₹ 14000
B. ₹ 18000
C. ₹ 10800
D. ₹ 14800

38. The average monthly salary of the workers in a garage is ₹8500. If the average monthly salary of 7 mechanics is ₹10000 and average monthly salary of the rest is ₹7800, the total number of workers in the garage is

A. 18
B. 20
C. 22
D. 24

39. An electrician has to repair an electric fault on a pole of height 5 m. He has to reach a point 1.3 m below the top of the pole to undertake the repair work (see figure). How far from the foot of the pole should he place the foot of the ladder?
[Take $\sqrt{3} = 1.732$].



A. 3.14 m
B. 2.14 m
C. 2.26 m
D. 3.16 m

40. 3 caps and 4 bats together cost ₹257 whereas 4 caps and 3 bats together cost ₹324. Find the total cost of 1 cap and 10 bats.

A. ₹250
B. ₹255
C. ₹155
D. ₹160

41. A train of length 150 m takes 10 seconds to pass over another train 100 m long coming from the opposite direction. If the speed of the first train is 30 kmph, then the speed of the second train is

A. 54 kmph
B. 60 kmph
C. 72 kmph
D. 36 kmph

42. If the compound interest on a certain sum of money for 3 years at 10% p.a. is ₹993, then what would be the simple interest on the same sum at same rate and for the same time?

A. ₹ 750
B. ₹ 800
C. ₹ 900
D. None of these

43. Priyanshu has a motorcycle with wheels of diameter 91 cm. There are 22 spokes in the wheel. Find the length of arc between two adjoining spokes.

A. 26 cm
B. 13 cm
C. 15 cm
D. 18 cm

44. A hemispherical bowl of internal diameter 36 cm is full of liquid. The liquid is to be filled into cylindrical shaped bottles each of radius 3 cm and height 9 cm. How many bottles are required to empty the bowl?

A. 45
B. 49
C. 46
D. 48

45. In the Maths Olympiad of 2020 at Animal Planet two representatives from the donkey's side, while solving a quadratic equation, committed the following mistakes.

(i) One of them made a mistake in the constant term and got the roots as 5 and 9.
(ii) Another one committed an error in the coefficient of x and he got the roots as 12 and 4.

But in the meantime, they realised that they are wrong and they managed to get it right jointly. Find the quadratic equation.

A. $x^2 + 4x + 14 = 0$

B. $2x^2 + 7x - 24 = 0$

C. $x^2 - 14x + 48 = 0$

D. $3x^2 - 17x + 52 = 0$

ACHIEVERS SECTION

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

Statement-I : If α and β are the roots of the equation $ax^2+bx+c=0$, then the value of $\frac{\alpha}{a\beta+b}+\frac{\beta}{a\alpha+b}$ is $\frac{-2}{a}$.

Statement-II : The value of $\sqrt{6+\sqrt{6+\sqrt{6+.....}}}$ is 5.

A. Statement-I is true but Statement-II is false.

B. Statement-I is false but Statement-II is true.

C. Both Statement-I and Statement-II are true.

D. Both Statement-I and Statement-II are false.

47. Match the coordinates of the point P given in Column-II that divides the line segment joining the points in the given ratio, given in Column-I and select the correct option.

Column-I	Column-II
(P) A (3, 5) and B (−3, −2) internally in the ratio 2 : 3.	(i) $\left(2,\frac{9}{2}\right)$
(Q) A (−1, 3) and B (5, 6) internally in the ratio 1 : 1.	(ii) (2, 3)
(R) A (−4, 3) and B (6, 3) internally in the ratio 3 : 2	(iii) $\left(\frac{3}{5},\frac{11}{5}\right)$

A. (P) - (i); (Q) - (ii); (R) - (iii)

B. (P) - (ii); (Q) - (iii); (R) - (i)

C. (P) - (iii); (Q) - (i); (R) - (ii)

D. (P) - (iii); (Q) - (ii); (R) - (i)

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

(i) If the 8th term of an A.P. is 31 and the 15th term is 16 more than the 11th term, then the A.P. is 3, 7, 11, 15, ...

(ii) The first negative term of the A.P. 20, $19\frac{1}{4}$, $18\frac{1}{2}, 17\frac{3}{4}, \ldots$ is 28th term.

(iii) If the sum of first n terms of an A.P. is $S_n = 5n^2 + 3n$, then its n^{th} term is $5n + 2$.

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

49. Solve the following and select the correct option.

(i) A vertically straight tree, 15 m high, is broken by the wind in such a way that its top just touches the ground and makes an angle of 60° with the ground. At what height from the ground did the tree break? (Use: $\sqrt{3} = 1.732$)

(ii) A parachutist is descending vertically and makes angles of elevation of 45° and 60° at two observing points 100 m apart from each other on the left side of himself. Find the distance of the point where he falls on the ground from the just observation point. (Use: $\sqrt{3} = 1.732$)

	(i)	(ii)
A.	6.96 m	136.6 m
B.	9.61 m	98.4 m
C.	3.82 m	136.6 m
D.	7.26 m	75.8 m

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

(i) A circus tent is cylindrical upto a height of 3 m and conical above it. If the diameter of the base is 105 m and the slant height of the conical part is 53 m, then the total canvas used in making the tent is _____.

(ii) A cylindrical container of radius 6 cm and height 15 cm is filled with ice cream. The whole ice cream has to be distributed to 10 children in equal cones with hemispherical tops. If the height of the conical portion is four times the radius of its base, then the radius of the ice cream cone is _____.

	(i)	(ii)
A.	6210 m^2	6 cm
B.	9735 m^2	3 cm
C.	4895 m^2	8 cm
D.	9735 m^2	5 cm