SCIENCE OLYMPIAD FOUNDATION

DO NOT OPEN THIS BOOKLET UNTIL ASKED TO DO SO

CLASS 10

SET-B

SOF INTERNATIONAL MATHEMATICS OLYMPIAD 2024-25

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: Navya purchased a hand bag for ₹ 345.50, a pair of shoes for ₹ 480.25 and a cap for ₹ 75.50. How much money did she spend in all?

   A. ₹ 901.25 B. ₹ 785.50 C. ₹ 895.75 D. ₹ 920.25

   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.:.....

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.

369 : 329 :: 237 : ?

A. 169
B. 196
C. 149
D. 100

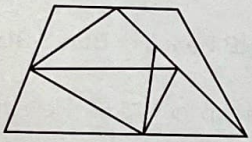
2. Study the given information carefully and answer the following question.

'X ÷ Y' means 'X is the brother of Y'.
'X + Y' means 'X is the mother of Y'.
'X × Y' means 'X is the sister of Y'.
'X – Y' means 'X is the wife of Y'.

Which of the following is definitely true for the expression G + J – E ÷ H?

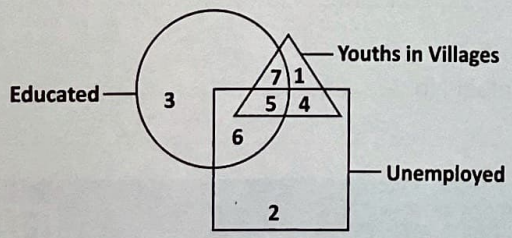
A. G is the mother-in-law of H
B. H is the sister of E
C. J is the sister-in-law of H
D. E is the son of G

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



A. 11
B. 13
C. 14
D. More than 14

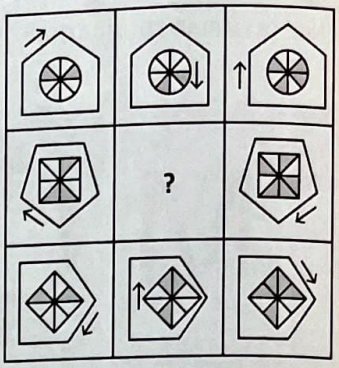
4. Study the given Venn diagram and answer the following question.

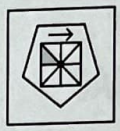
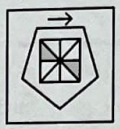


Which number represents educated and employed youths in villages?

A. 1
B. 4
C. 7
D. 3

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



A. 
B. 
C. 
D. 

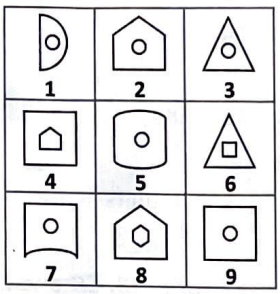
6. Ashok walks 15 m towards West and reaches point P, then he took a left turn and walks 35 m, then he walks 6 m after turning to his right and reaches point R. From point R, he moves 27 m towards North and reaches point Q. How far and in which direction is he now from point P?

A. 15 m, North-West
B. 12 m, South-West
C. 10 m, South-West
D. 15 m, North-East

7. Seven persons S, T, U, V, W, X and Y are sitting in a straight line facing South, but not necessarily in the same order. There are only two persons to the right of T, who is third to the right of X. Neither S nor Y is immediate neighbour of T. V is sitting at the left end. The number of persons to the right of V is same as to the left of Y. U is to the immediate right of T. What is the position of W with respect to Y?

A. Third to the right
B. Second to the right
C. Third to the left
D. Can't be determined

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



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

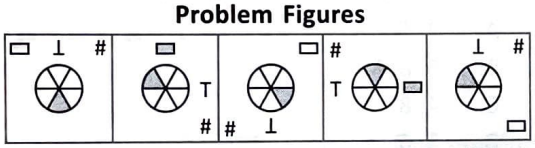
9. **If the first and last digits of the given numbers are replaced by their respective square numbers, then the sum of digits of how many new number(s) thus formed will be even?**

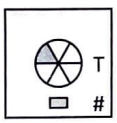
842 264 887 392 773

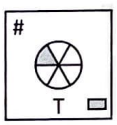
A. One
B. Two
C. Three
D. More than three

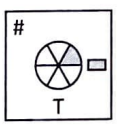
10. **Select a figure from the options which will continue the same series as established by the Problem Figures.**

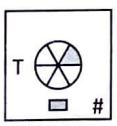
Problem Figures



A. 

B. 

C. 

D. 

11. **Select the correct mirror image of the given combination of letters, symbols and numbers.**

MYN@7i0/41

Mirror

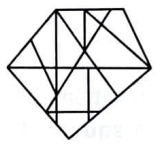
A. MYN@7i0/41
B. 14\0i7@NYM
C. MYN@7i0\41
D. 14\0i7@NYM

12. **Select a figure from the options in which the given figure is not exactly embedded as one of its parts.**

A. 

B. 

C. 

D. 

13. **Three different positions of a cube are given below. Which letter will be at the top when letter M is at the bottom?**

A. N
B. P
C. R
D. Q

14. **How many such pairs of letters are there in the word TECHNIQUE each of which has as many letters between them in the word as in the English alphabets?**

A. None
B. One
C. Two
D. Three

15. **In a certain code language, 'plant is green' is written as 'ku st mn', 'green and cool' is written as 'no nn st' and 'cool is green' is written as 'st no mn'. What is the code for 'plant'?**

A. no
B. st
C. ku
D. mn

16. For what value of k, will the equation $\frac{x^2-bx}{ax-c}=\frac{k-1}{k+1}$ have roots reciprocal to each other?

A. $\frac{c-1}{c+1}$

B. $\frac{c+1}{c-1}$

C. $\frac{1}{c-1}$

D. $\frac{1}{c+1}$

17. A person observes the angle of elevation of the top of a building as 30°. He proceeds towards the building with a speed of $25(\sqrt{3}-1)$ m/hr. After two hours, he observes the angle of elevation as 45°. What is the height of the building (in metres)?

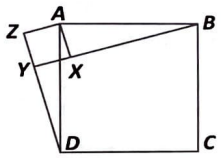
A. 50

B. 45

C. 35

D. 47

18. In the given figure, X is a point in the interior of square $ABCD$. $AXYZ$ is also a square. If $DY = 3$ cm and $AZ = 2$ cm, then BY =



A. 5 cm

B. 6 cm

C. 7 cm

D. 8 cm

19. Find the value of x and state which of the given statements is/are required for it.

I. The L.C.M. of x and 18 is 36.

II. The H.C.F. of x and 18 is 2.

A. 1, only Statement-I is required

B. 2, only Statement-II is required

C. 4, Statement-I and II both are required

D. None of these

20. If a chord of a circle of radius $\frac{r}{2}$ subtends a right angle at the centre of the circle, then the area of the major sector of the circle is

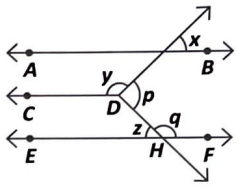
A. $\left(\frac{\pi}{2}-1\right)r^2$ sq. units

B. $\frac{3\pi r^2}{4}$ sq. units

C. $\frac{3\pi r^2}{16}$ sq. units

D. $\left(\frac{\pi}{4}-\frac{1}{2}\right)r^2$ sq. units

21. In the given figure, AB, CD and EF are three parallel lines, if $4y = 5x$ and $z = y - 30°$, then find $\angle q$.



A. 110°

B. 90°

C. 160°

D. 120°

22. If the system of equations
$2x + 3y = 7$;
$2ax + (a + b)y = 28$
has infinitely many solutions, then the values of a and b respectively are _____.

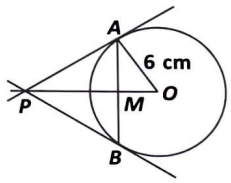
A. 2, 5

B. 5, 8

C. 4, 8

D. 3, 6

23. In the given figure, AB is a chord of length 9.6 cm of a circle with centre O and radius 6 cm. The tangents at A and B intersect at P. Find the length of PA.



A. 4 cm

B. 8 cm

C. 11 cm

D. 6 cm

24. If $x^4+\frac{1}{x^4}=194$, then find the value of $\left(x^3+\frac{1}{x^3}\right)$.

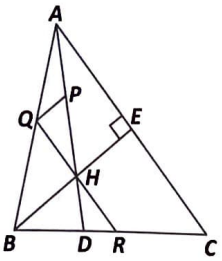
A. 54

B. 52

C. 64

D. 62

25. In the given figure, $BE \perp AC$. AD is any line from A to BC intersecting BE at H. If P, Q and R are respectively the mid-points of AH, AB and BC, then find $\angle PQR$.



A. 90°
B. 85°
C. 80°
D. None of these

26. A number 20 is divided into four parts that are in AP such that the ratio of the product of the first and fourth parts to the product of second and third parts is 2 : 3. The largest part is

A. 12
B. 6
C. 8
D. 9

27. $\left(\frac{\sqrt{3}+2\cos A}{1-2\sin A}\right)^{-3}+\left(\frac{1+2\sin A}{\sqrt{3}-2\cos A}\right)^{-3}=$ _____.

A. 1
B. $\sqrt{3}$
C. 0
D. −1

28. Each observation in a raw data is first multiplied by 3, then 6 is added. It is then divided by 3 and subsequently reduced by 6. Which of the following statements is true?

A. The new mean is equal to the original mean.
B. The new mean is 4 more than the original mean.
C. The new mean is 4 less than the original mean.
D. The new mean is 2 more than the original mean.

29. Two poles of heights a metres and b metres are p metres apart. Find the height of the point of intersection of the lines joining the top of each pole to the foot of the opposite pole.

A. $\frac{ab}{a+b}$ metres
B. $\frac{a+b}{ab}$ metres
C. $\frac{a-b}{ab}$ metres
D. $\frac{ab}{a-b}$ metres

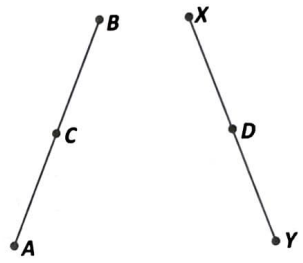
30. Find the value of $x^2 + x + 1$, if $x = \frac{2\left(\sqrt{2}+\sqrt{6}\right)}{3\left(\sqrt{2+\sqrt{3}}\right)}$.

A. $\frac{37}{9}$
B. 1
C. $\frac{43}{16}$
D. None of these

31. If A and B are the points (−3, 4) and (2, 1) respectively, then the coordinates of the point C on AB produced such that $AC = 2BC$ are

A. (2, 4)
B. (3, 7)
C. (7, −2)
D. None of these

32. In the given figure, $AC = XD$, C is mid-point of AB and D is mid-point of XY. Using an Euclid's axiom, we have



A. $AB = XY$
B. $AX = BC$
C. $BY = AC$
D. None of these

33. A solid in the form of a cone is mounted on a hemisphere in such a way that the centre of base of cone just coincide with centre of the base of the hemisphere. Slant height of the cone is l and radius of the base of the cone is $\frac{1}{2}r$, where r is the radius of the hemisphere. The surface area of the solid is

A. $\frac{\pi}{4}lr^2$ sq. units
B. πrl sq. units
C. $\frac{\pi}{4}(11r+2l)r$ sq. units
D. None of these

34. If $(3x-1)^4 = a_4x^4 + a_3x^3 + a_2x^2 + a_1x + a_0$, then find the value of $a_4 + 3a_3 + 9a_2 + 27a_1 + 81a_0$.

A. 0
B. 1
C. −1
D. 2

35. One ticket is selected at random from 100 tickets numbered 00, 01, 02, ..., 99. Suppose x is the sum of the digits and y is the product of the digits. Then, probability of getting $x = 8$ and $y = 0$ is

A. $\frac{2}{17}$

B. $\frac{3}{27}$

C. $\frac{1}{50}$

D. $\frac{1}{25}$

EVERYDAY MATHEMATICS

36. Four men can do a work by working 2 hours daily, the same work can be done by 3 girls working 6 hours daily and 4 boys can do the same work by working 2 hours daily. Find the number of days in which 1 man, 1 girl and 1 boy together can do the work.

A. $3\frac{3}{11}$ days

B. $3\frac{2}{11}$ days

C. $3\frac{1}{11}$ days

D. None of these

37. A cylindrical box is within the cubical box touching all the vertical faces. A cone shaped toy is inside the cylindrical box. If their heights are same with the same base, then find the ratio of volumes of cubical box, cylindrical box and conical toy.

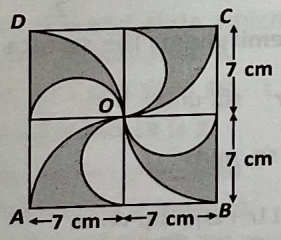
A. 42 : 33 : 11

B. 44 : 33 : 12

C. 49 : 35 : 12

D. 43 : 33 : 11

38. Nandini made a design on a square chart paper *ABCD*, made of squares, semicircular arcs and arcs of quadrant of circles. The total shaded area in given figure is



A. 77 cm^2

B. 37 cm^2

C. 49 cm^2

D. 87 cm^2

39. A trader bought a number of articles for ₹ 900. Five articles were found damaged. He sold each of the remaining articles at ₹ 2 more than what he paid for it. He got a profit of ₹ 80 on the whole transaction. Find the number of articles he bought.

A. 30

B. 52

C. 75

D. 68

40. There are 12,000 notebooks to be donated to a charity. 4000 of them, are to be donated to NGO-1, 3000 of them to be donated to NGO-2 and rest are to be donated to NGO-3. If one notebook is selected at random, then what is the probability that it is neither from NGO-1 nor from NGO-2?

A. $\frac{5}{12}$

B. $\frac{7}{12}$

C. $\frac{1}{3}$

D. $\frac{1}{4}$

41. The average monthly income (in ₹) of certain agricultural workers is S and that of other workers is T. The number of agricultural workers are 11 times that of other workers. Then the average monthly income (in ₹) of all the workers is _____.

A. $\frac{S+T}{2}$

B. $\frac{S+11T}{2}$

C. $\frac{1}{11S}+T$

D. $\frac{11S+T}{12}$

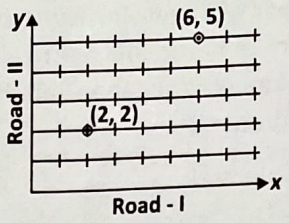
42. The electricity bill of a certain establishment is partly fixed and partly varies as per the number of units of electricity consumed. When in a certain month 540 units were consumed, the bill was ₹ 1800. In another month, 620 units were consumed and the bill was ₹ 2040. In yet another month 500 units are consumed. The bill for that month will be

A. ₹ 1560
B. ₹ 1680
C. ₹ 1840
D. ₹ 1950

43. A bag contains 600 coins of 25 p denomination and 1200 coins of 50 p denomination. If 12% of 25 p coins and 24% of 50 p coins are removed, then the percentage of money removed from the bag is nearly

A. 15.6 %
B. 17.8 %
C. 21.6 %
D. 30 %

44. A well planned locality, has two straight roads perpendicular to each other. There are 5 lanes parallel to Road - I. Each lane has 8 houses as seen in figure. Chaitanya lives in the 6^{th} house of the 5^{th} lane and Hamida lives in the 2^{nd} house of the 2^{nd} lane. What will be the shortest distance between their houses?



A. 10 units
B. 12 units
C. 6 units
D. 5 units

45. If 6 years are subtracted from the present age of Gagan and the remainder is divided by 18, then the present age of his grandson Anup is obtained. If Anup is 2 years younger to Madan whose age is 5 years, then what is Gagan's present age?

A. 48 years
B. 60 years
C. 84 years
D. 96 years

ACHIEVERS SECTION

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

Statement-I : Two towers stand on a horizontal plane. *P* and *Q*, where *PQ* = 30 m are two points on the line joining their feet. As seen from *P*, the angle of elevation of the tops of the towers are 30° and 60° but as seen from *Q* are 60° and 45°. The distance between the towers is equal to $15(4 + \sqrt{3})$ m.

Statement-II : A man is watching from the top of a tower a boat speeding away from the tower. The boat makes an angle of depression of 45° with the man's eye when at a distance of 60 m from the bottom of the tower. After 5 s, the angle of depression becomes 30°. The approximate speed of the boat assuming that it is running in still water is 31.6 km/hr.
(Use : $\sqrt{3}$ = 1.732)

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. The median of the following frequency distribution is 46.

Variable	10-20	20-30	30-40	40-50	50-60	60-70	70-80	Total
Frequency	12	30	*x*	65	*y*	25	18	229

Find

(i) Missing frequencies

(ii) Mode (approx.)

(iii) Mean (approx.)

	(i)	(ii)	(iii)
A.	40 and 40	63.54	40.42
B.	33.5 and 45.5	46.18	45.87
C.	45 and 40	60.07	48.34
D	33.5 and 45.5	59.32	34.88

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

(i) If S_1, S_2, S_3 denote respectively the sum of first n_1, n_2 and n_3 terms of an A.P., then the value of $\frac{S_1}{n_1}(n_2 - n_3) + \frac{S_2}{n_2}(n_3 - n_1) + \frac{S_3}{n_3}(n_1 - n_2)$ is _____.

(ii) The sum of the series $1^2 - 2^2 + 3^2 - 4^2 + ... + 99^2 - 100^2$ is _____.

(iii) If the sum of the first *n* terms of the arithmetic progression 3, $5\frac{1}{2}$, 8, ... is equal to the $(2n)^{th}$ term of the A.P. $16\frac{1}{2}, 28\frac{1}{2}, 40\frac{1}{2}$, ... then the value of *n* is _____.

	(i)	(ii)	(iii)
A.	1	–4950	20
B.	0	–4950	20
C.	1	–5050	18
D.	0	–5050	18

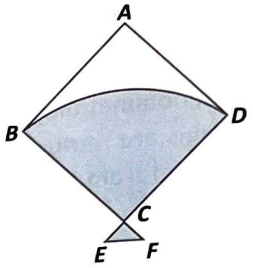
49. From a pack of 52 playing cards, if all the kings and queens are removed and a card is drawn at random from remaining cards, then find the probability that the card drawn is

Column-I	Column-II
(p) A black face card	(i) $\frac{1}{2}$
(q) A red card	(ii) $\frac{1}{4}$
(r) A heart	(iii) $\frac{1}{22}$
(s) An ace	(iv) $\frac{1}{11}$

A. (p) → (iii), (q) → (i), (r) → (ii), (s) → (iv)
B. (p) → (iii), (q) → (ii), (r) → (i), (s) → (iv)
C. (p) → (iv), (q) → (iii), (r) → (ii), (s) → (i)
D. (p) → (i), (q) → (ii), (r) → (iii), (s) → (iv)

50. Solve the following.

(i) A kite in which *BCD* is the shape of a quadrant of a circle of radius 42 cm. *ABCD* is a square and ΔCEF is an isosceles right angled triangle, right angled at *C* whose equal sides are 6 cm long. Find the area of the shaded region.



(ii) Two identical circles intersect so that their centres, and the points at which they intersect, form a square of side 1 cm. Find the area (in sq. cm) of the portion that is common to the two circles.

	(i)	(ii)
A.	1028 cm^2	$\frac{\pi}{2}+1$
B.	1309 cm^2	$\pi + 1$
C.	1404 cm^2	$\frac{\pi}{2}-1$
D.	1298 cm^2	$\pi - 1$

SPACE FOR ROUGH WORK