Please check the examination details below before entering your candidate information

Candidate Name	Class	Section

BLOOM Mathematics Olympiad (BMO)

Question Paper 2023-24

Class 10

Total Questions: **50 + 5** (Tie-Breaking Section)

Total Time Allotted : 60 minutes	**Total Marks** 60

Instructions

1. There are **50 Multiple Choice Questions** in this booklet having 4 options out of which **ONLY ONE** is correct.
2. There are two sections in the Question Paper; Section 1 having 40 Questions carrying 1 Mark each & Section 2 having 10 Higher Difficulty Order Questions carrying 2 Marks each.
3. All questions are compulsory. There is **NO negative** marking for incorrect answers.
4. Total time allotted to complete the paper is 60 minutes.
5. Please fill in your details in the space provided on this page before attempting the paper.

OMR Sheet Instructions

1. Before starting the paper, fill in all the details in the OMR Sheet.
2. Additional 10 minutes will be provided to fill up the OMR sheet, before the start of the exam.
3. Use HB Pencil to darken the circle of the correct Option in OMR sheet. The correct way to darken the circle in OMR sheet is shown below.

   ● ○ ○ ○
4. Use black or blue ball point pen/HB pencil to fill the information in the OMR sheet. Partially filled OMR sheet will not be checked.
5. Return the OMR sheet to the invigilator after the exam.

CODE#1

M10

BLOOM CAP

Founded by | arihant

Bloom Mathematics Olympiad Class 10

Section 1 (1 Mark)

1. A capsule is in the shape of a cylinder of diameter 0.5 cm with two hemispheres stuck to each of its ends. If the length of entire capsule is 2 cm, then the capacity of the capsule is

(a) 0.36 cm^3 (b) 0.35 cm^3
(c) 0.34 cm^3 (d) 0.33 cm^3

2. If S_m denotes the sum of the first m terms in an arithmetic progression and $S_1 : S_4 = 1:10$, then the ratio of first term to the fifth term is

(a) 1: 4 (b) 5 : 1 (c) 1: 5 (d) 1: 3

3. If the ratio of the roots of the equation $x^2 - 2ax + b = 0$ is equal to that of the roots $x_1^2 - 2cx_1 + d = 0$, then

(a) $a^2b = c^2d$ (b) $d^2b = c^2a$
(c) $a^2c = b^2d$ (d) $a^2d = c^2b$

4. There are two poles one on each bank of river, opposite to each other. From the top of one pole 60 m high, the angles of depression of the top and the foot of the other pole are 30° and 60°, respectively. What is the height of the other pole?

(a) 30 m (b) 20 m (c) 10 m (d) 40 m

5. Two circles of radius 1 cm touch at point P. A third circle is drawn through the points A, B and C such that PA is the diameter of the first circle and BC perpendicular to AP is the diameter of the second circle. Then, the radius of the third circle is

(a) $\frac{5}{3}$ cm (b) $\frac{9}{5}$ cm
(c) $\frac{10}{3}$ cm (d) $\frac{\sqrt{10}}{2}$ cm

6. A mason constructs a wall of dimensions 270 cm × 300 cm × 350 cm with the bricks each of size 22.5 cm × 11.25 cm × 8.75 cm and it is assumed that $\frac{1}{8}$ of the wall is covered by the mortar. Then, the number of bricks used to construct the wall is

(a) 11100 (b) 11200 (c) 11000 (d) 11300

7. A factory kept increasing its output by the same percentage every year. Then, the percentage, if it is known that the output is doubled in the last 2 yr, will be

(a) 44.1% (b) 14.4%
(c) 44.4% (d) 41.4%

8. The sum of the series $45^2 - 43^2 + 44^2 - 42^2 + 43^2 - 41^2 + 42^2 - 40^2$.... upto 15 terms is

(a) 1110 (b) 2220
(c) 3330 (d) 4440

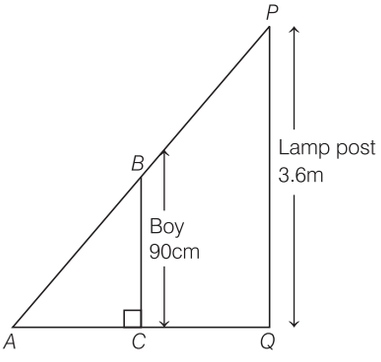
9. Sum of the distances of a point from (ae, 0) and ($-ae$, 0) is $2a$. If $b^2 = a^2(1 - e^2)$, then $\frac{x^2}{a^2} + \frac{y^2}{b^2}$ is equal to

(a) 0 (b) 1
(c) – 1 (d) 2

10. If $\cos\theta - 4\sin\theta = 1$, then the positive value of $3(\sin\theta + 4\cos\theta)$ is

(a) 6 (b) 9
(c) 12 (d) 24

11. A boy of height 90 cm is walking away from the base of the lamp-post at a speed of 1.2 m/s. If the lamp is 3.6 m above the ground, then the length of his shadow after 6s is

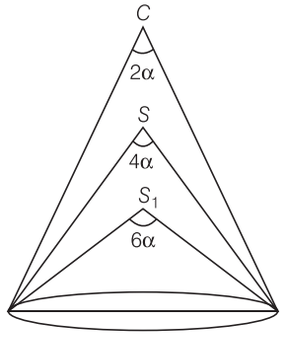


(a) 1.2 m (b) 2.4 m
(c) 3.6 m (d) None of these

12. If $\text{cosec}\,\theta - \sin\theta = x^3$ and $\sec\theta - \cos\theta = y^3$, then the value of $x^2y^2(x^2 + y^2)$ is

(a) 0 (b) 1
(c) 3 (d) 2

13. A cone made of paper has height $3h$ and vertical angle 2α. It contains two other cones of height $2h$ and h, vertical angles 4α and 6α, respectively. Then, the ratio of the volumes of regions S and S_1 will be



(a) $(8\tan^2\alpha - 27\tan^2 2\alpha) : (5\tan^2\alpha - \tan 3\alpha)$

(b) $(27\tan^2\alpha - 8\tan^2 2\alpha) : (8\tan^2 2\alpha - \tan^2 3\alpha)$

(c) $(25\tan^2\alpha - 7\tan^2 2\alpha) : (8\tan^2\alpha - \tan 3\alpha)$

(d) None of the above

14. Simplify $\dfrac{\left(a+\frac{1}{b}\right)^m \times \left(a-\frac{1}{b}\right)^n}{\left(b+\frac{1}{a}\right)^m \times \left(b-\frac{1}{a}\right)^n}$

(a) $\left(\frac{a}{b}\right)^{m-n}$ (b) $\left(\frac{a}{b}\right)^{m+n}$ (c) $\left(\frac{b}{a}\right)^{\frac{m}{n}}$ (d) $\left(\frac{b}{a}\right)^{mn}$

15. If the roots of equation $(c^2 - ab)x^2 - 2(a^2 - bc)x + b^2 - ac = 0$ are equal, then which option is correct?

(a) $a = 0$

(b) $a^3 + b^3 + c^3 = -3abc$

(c) $a^2 + b^2 + c^2 = 2abc$

(d) None of the above

16. If $P_n = \cos^n x + \sin^n x$, then $2P_6 - 3P_4 + 1$ is

(a) 1 (b) 0 (c) 3 (d) 2

17. A student distributed an average of 5 chocolates per student on his birthday. If on the arrival of the teacher and the headmaster to whom the student gives 10 and 15 chocolates respectively, the average chocolate distributed per head increases to 5.5, then what is the number of students in the class?

(a) 28 (b) 32 (c) 30 (d) 36

18. Cards numbered from 11 to 60 are kept in a box. If a card is drawn at random from the box, then the probability that the number on the drawn card is

(i) an odd number

(ii) a perfect square number

(iii) a prime number less than 20

(iv) divisible by 5

	(i)	(ii)	(iii)	(iv)
(a)	$\frac{1}{2}$	$\frac{1}{5}$	$\frac{4}{25}$	$\frac{2}{25}$
(b)	$\frac{2}{25}$	$\frac{1}{2}$	$\frac{2}{25}$	$\frac{1}{5}$
(c)	$\frac{1}{2}$	$\frac{1}{5}$	$\frac{2}{25}$	$\frac{2}{25}$
(d)	$\frac{1}{2}$	$\frac{2}{25}$	$\frac{2}{25}$	$\frac{1}{5}$

19. The first and last term of an AP is $2a$ and $4b$, respectively. If S is the sum of all terms of the AP and common difference is given by $\dfrac{16b^2 - ka^2}{2S - (2a + 4b)}$, then the value of k is equal to

(a) 2 (b) 4 (c) 6 (d) 8

20. The remainder when $1^{1997} + 2^{1997} + \ldots + 1996^{1997}$ is divided by 1997, is

(a) 0 (b) 1 (c) 2 (d) 3

21. If $\tan\theta = -1$, then the value of $\dfrac{\sec\theta + \operatorname{cosec}\theta}{\cos\theta - \sin\theta}$ is equal to

(a) 0 (b) 1

(c) $\sin^2\theta - \cos^2\theta$ (d) $\sin\theta - \cos\theta$

22. If $m = \operatorname{cosec}\theta - \sin\theta$ and $n = \sec\theta - \cos\theta$, then $(m^2 n)^{\frac{2}{3}} + (mn^2)^{\frac{2}{3}}$ is equal to

(a) 0 (b) 1

(c) 2 (d) None of these

23. The value of P for which the system of equations $3x + y = 2$ and $2Px + (P-1)y = 2P + 1$ has no solution, is

(a) 2 (b) 3 (c) 4 (d) 5

24. If $\sin^4 x + \sin^2 x = 1$, then the value of $\cos^4 x + \cos^2 x$ is

(a) $2 - \sqrt{5}$ (b) $\sqrt{5} - 3$ (c) $5 - 2\sqrt{5}$ (d) $3 - 2\sqrt{5}$

25. *ABCD* is a parallelogram. A circle through *A* and *B* is drawn such that it intersects *AD* at *P* and *BC* at *Q*. Then, *PQCD* is

(a) Parallelogram (b) Quadrilateral
(c) Cyclic Quadrilateral (d) None of these

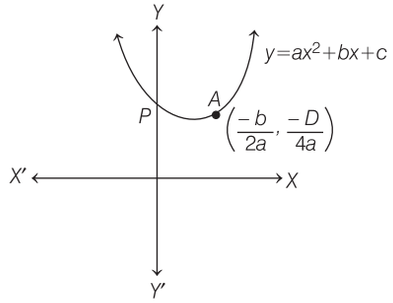
26. If $a679b$ is a five-digit number in base 10 and is divisible by 72, then the value of $a + b$ is

(a) 2 (b) 3 (c) 5 (d) 8

27. One side of a parallelogram is 12 cm and its area is 60 cm^2. If the angle between the adjacent sides is 30°, then its other side is

(a) 15 cm (b) 20 cm
(c) 10 cm (d) None of these

28. The graph of $y = ax^2 + bx + c$ is given. Identify the signs of *a*, *b* and *c*.



(a) $a > 0, b < 0$ and $c < 0$ (b) $a > 0, b > 0$ and $c < 0$
(c) $a < 0, b < 0$ and $c > 0$ (d) $a > 0, b < 0$ and $c > 0$

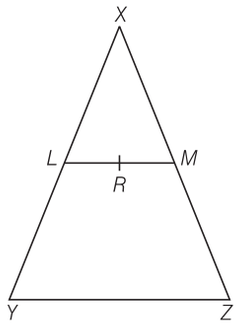
29. The digit at tens place of a two-digit number is three times the digit at the unit place. If the sum of this number and the number formed by reversing the digits is 44, then the number is

(a) 13 (b) 31 (c) 62 (d) 60

30. If α and β are the roots of the quadratic equation $4x^2 - 20x = p^2$, then $\alpha - \beta$ is equal to

(a) $\sqrt{25 + p^2}$ (b) $\sqrt{25 - p^2}$
(c) $5 + p$ (d) $5 - p$

31. In ΔXYZ, *L* and *M* are the mid-points of the sides *XY* and *XZ*, respectively. *R* is a point on the line segment *LM* such that $LR : RM = 1 : 2$. If $LR = 3$ cm, then *YZ* is equal to

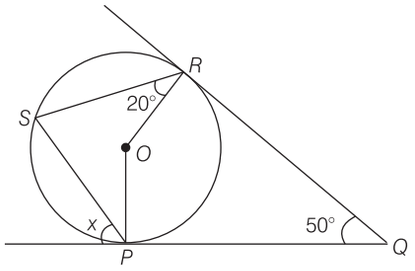


(a) 9 cm (b) 18 cm (c) 20 cm (d) 12 cm

32. The number of real roots of the equation $(x+3)^2 + (x+1)^2 + (x-5)^2 + (x-6)^2 = 0$ is *P*. Then, the value of $\frac{P+3}{3}$ is

(a) 2 (b) $\frac{4}{3}$ (c) $\frac{5}{3}$ (d) 1

33. In the given diagram, *PQ* and *QR* are tangents to the circle with centre *O*, at *P* and *R* respectively, then the value of *x* is equal to

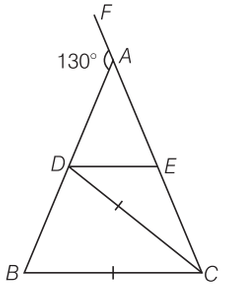


(a) 25° (b) 35° (c) 45° (d) 55°

34. The coordinates of the point which is three-fourth of the way *A*(3, 1) to *B*(– 2, 5), are

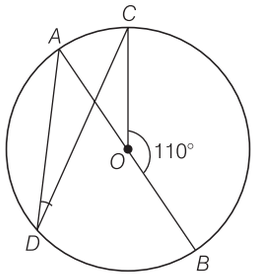
(a) $\left(\frac{3}{4}, 4\right)$ (b) $\left(4, \frac{3}{4}\right)$ (c) $\left(-\frac{3}{4}, 4\right)$ (d) $\left(4, -\frac{3}{4}\right)$

35. In the following figure $AB = AC$, $BC = CD$ and $DE \,||\, BC$. The value of $\angle CDE$ is



(a) 30° (b) 40° (c) 50° (d) 130°

36. In the given figure, AB is a diameter of the circle with centre O. If $\angle BOC = 110°$, then the value of $\angle ADC$ is



(a) 35° (b) 45° (c) 30° (d) 65°

37. The radii of two concentric circles are 16 cm and 10 cm. AB is a diameter of the bigger circle. BD is tangent to the smaller circle touching it at D, then the length of AD is

(a) $3\sqrt{130}$ cm (b) $2\sqrt{139}$ cm
(c) $2\sqrt{130}$ cm (d) $4\sqrt{139}$ cm

38. A and B throw alternatively a pair of dice. A wins, if he throws a sum of 6 before B throws a sum of 7 and B wins, if he throws a sum of 7 before A throws a sum of 6. Find the chances of A's winning, if A begins.

(a) $\frac{30}{61}$ (b) $\frac{35}{61}$ (c) $\frac{5}{36}$ (d) $\frac{5}{61}$

39. For which value of k, the system of equations $(k-1)x - y = 5$ and $(k+1)x + 1(1-k)y = 3k+1$ has infinitely many solutions?

(a) $k = 2$ (b) $k = 7$ (c) $k = 3$ (d) $k = 4$

40. If the roots of $\frac{1}{x+p} + \frac{1}{x+q} = \frac{1}{r}$ are equal in magnitude but opposite in sign and the product of roots is $k(p^2 + q^2)$, then k^2 is

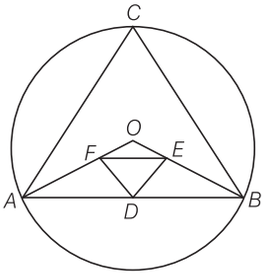
(a) $\frac{1}{4}$ (b) $\frac{1}{2}$
(c) $\frac{1}{8}$ (d) None of these

Section 2 (2 Marks)

41. Consider the following statements.

Statement I In the given figure, O is the centre of the circle with D, E and F as mid-points of AB, BO and OA, respectively.

If $\angle DEF$ is 30°, then $\angle ACB$ is 60°.



Statement II Angle subtended by an arc at the centre is twice the angle subtended by it on the remaining part of the circle.

Which of the following options hold?

(a) Both Statement I and Statement II are true.
(b) Statement I is true but Statement II is false.
(c) Statement I is false but Statement II is true.
(d) Both Statement I and Statement II are false.

42. Match the following columns of List I and List II.

	List I		List II
P.	If $\tan\theta + \sin\theta = m$ and $\tan\theta - \sin\theta = n$, then $m^2 - n^2$ is equal to	(i)	2
Q.	The value of $\frac{\cot\theta + \operatorname{cosec}\theta - 1}{\cot\theta - \operatorname{cosec}\theta + 1}$ is equal to	(ii)	$4\sqrt{mn}$
R.	If $x = \sec\theta - \tan\theta$ and $y = \sec\theta + \tan\theta$, then $xy + 1$ is equal to	(iii)	$\frac{1+\cos\theta}{\sin\theta}$

(a) P-(ii), Q-(i), R-(iii) (b) P-(iii), Q-(ii), R-(i)
(c) P-(ii), Q-(iii), R-(i) (d) P-(i), Q-(iii), R-(ii)

43. Select the correct option.

Assertion (A) From a solid cylinder of height 7 cm and base diameter 12 cm, a conical cavity of same height and same base radius is hollowed out. Then, the total surface area of the remaining solid is 500 cm^2.

Reason (R) For finding the surface area, use the curved surface area of cylinder, curved surface area of cone and area of one circle.

(a) Both A and R are true and R is the correct explanation of A.
(b) Both A and R are true and R is the not correct explanation of A.
(c) A is true but R is false.
(d) A is false but R is true.

44. Which of the following statement is true?

Statement I In square *ABCD*,

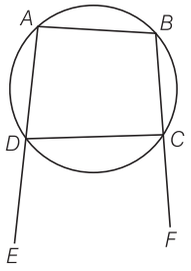
$AB^2 + BC^2 + CD^2 + DA^2 = AC^2 + BD^2$

Statement II In rhombus *ABCD*,

$AC^2 + BD^2 = 2AB^2$

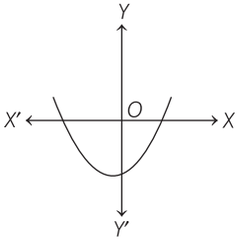
(a) Both Statement I and Statement II are true.
(b) Statement I is true but Statement II is false.
(c) Statement I is false but Statement II is true.
(d) Both Statement I and Statement II are false.

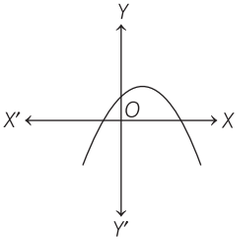
45. In the given figure, chords *AD* and *BC* in the circle are extended to *E* and *F*, respectively. If $\angle CDE = 80°$, $\angle DCF = 95°$, then the value of $\angle ABF + \angle EAB$ is

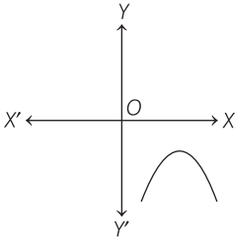


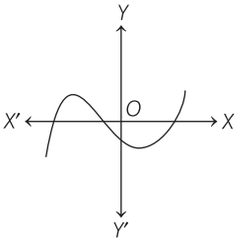
(a) 175° (b) 185°
(c) 205° (d) 180°

46. Which of the following is not the graph of a quadratic polynomial?

(a) 

(b) 

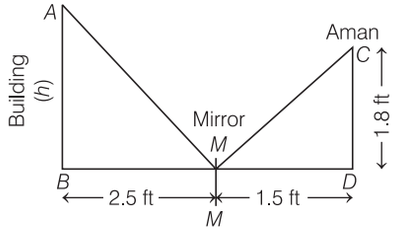
(c) 

(d) 

47. If α, β and γ are the zeroes of the polynomial $f(x) = ax^3 + bx^2 + cx + d$, then $\frac{1}{\alpha} + \frac{1}{\beta} + \frac{1}{\gamma}$ is equal to

(a) $-\frac{b}{d}$ (b) $\frac{c}{d}$
(c) $-\frac{c}{d}$ (d) $-\frac{c}{a}$

Directions (Q.Nos. 48-50) Aman's father is a mathematician. One day he gave Aman an activity to measure the height of building. Aman accepted the challenge and placed a mirror on ground level to determine the height of the building. He is standing at a certain distance. So that he can see the top of the building reflected from mirror. Aman eye level is at 1.8 ft above ground. The distance of Aman from mirror and that of building from mirror are 1.5 ft and 2.5 ft, respectively.



Based on the above information, answer the following questions.

48. Two similar triangles formed in the given figure are

(a) ΔABM and ΔCMD
(b) ΔAMB and ΔCDM
(c) ΔABM and ΔCDM
(d) None of the above

49. Which criteria of similarity is applied here?

(a) AA similarity (b) SSS similarity
(c) ASA similarity (d) SAS similarity

50. Height of the building is

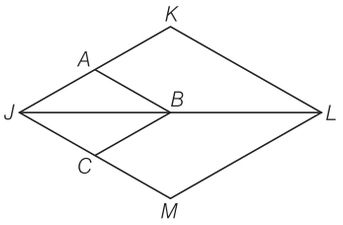
(a) 1 ft (b) 2 ft
(c) 3 ft (d) 4 ft

Tie-Breaking Section

Instructions

1. This section consists of 5 Questions.
2. The score achieved in this section will not be included in the total marks.
3. If overall marks of two or more students are same, winner will be decided based on the score in this section.
4. Participation in this section is optional, and students may choose to attempt it or not.

1. In the given figure, if $AB \parallel KL$ and $BC \parallel LM$, then the value of $\frac{JA}{JK}$ is



(a) $\frac{JC}{CM}$ (b) $\frac{JC}{JM}$ (c) $\frac{JC}{JL}$ (d) $\frac{JC}{JB}$

2. If the angle of elevation of a cloud from a point h m above a lake is α and the angle of depression of its reflection in the lake is β, then the distance of the cloud from the point of observation is

(a) $\frac{2h \sec \alpha}{\tan \beta + \tan \alpha}$ (b) $\frac{2 \sec \alpha}{\tan \beta + \tan \alpha}$

(c) $\frac{2h \sec \alpha}{\tan \beta - \tan \alpha}$ (d) None of these

3. A boy is standing on the ground and flying a kite with 75 m of string at an elevation of 45°. Another boy is standing on the roof of a 25 m high building and is flying his kite at an elevation of 30°. Both the boys are on opposite sides of the two kites. Then, the length of the string that the second boy must have so that the two kites meet is

(a) 55.75 m (b) 56 m

(c) 55.05 m (d) None of these

4. If the mean of x_1 and x_2 is M_1 and that of x_1, x_2, x_3 and x_4 is M_2, then the mean of ax_1, ax_2, $\frac{x_3}{a}$, $\frac{x_4}{a}$ is

(a) $\frac{M_1 + M_2}{2}$

(b) $\frac{aM_1 + \left(\frac{M_2}{2}\right)}{2}$

(c) $\frac{1}{2a}[(a^2 - 1)M_1 + 2M_2]$

(d) $\frac{1}{2a}[2(a^2 - 1)M_1 + M_2]$

5. If a point $P\left(\frac{23}{5}, \frac{33}{5}\right)$ divides the line AB joining two points $A(3, 5)$ and $B(x, y)$ internally in the ratio $2 : 3$, then the value of x and y will be

(a) $x = 4, y = 7$

(b) $x = 5, y = 9$

(c) $x = 7, y = 9$

(d) $x = 7, y = 8$