Mathematical Association of Nepal
Reg. No. 2797/076/077
IMO2024 65th International Mathematical Olympiad

District Level Mathematical Olympiad[DMO]-2023/024

1. If the price of petrol is increased by 10% and then decreased by 10%, what is the equivalent change in percentage?
   a) 0% b) 1% increased c) 1% decreased d) None of them
2. The price of an article was sold with x% loss. Had it been sold with Rs y more, there would have been gain of z%. Which of the following was the cost price of the article?
   a) $\frac{y}{z+x} \times 100$ b) $\frac{z}{x-y} \times 100$ c) $\frac{z}{y+x} \times 100$ d) $\frac{y}{x-z} \times 100$
3. If $x^2 - 4x + 3 < 0$, which of the following satisfies this inequality?
   a) $x > 3$ b) $1 < x < 3$ c) $x < 1$ d) $x > 1$
4. The sum of $cos^2 1^0 + cos^2 2^0 + \cdots + cos^2 89^0 + cos^2 90^0$ is ?
   a) 44 b) $\frac{89}{2}$ c) 45 d) $\frac{91}{2}$
5. If $k < 1$, which of the following must be negative?
   a) $k^2 - 6k + 8$ b) $k^2 - 2k + 1$ c) $|k| - k^2$ d) $2^k - 3$
6. The ratio of the marbles with Jack and Dave was 13:9. Now, they each have 10 more marbles with them. Which of the following cannot be the ratio of their marbles now?
   a) 7:4 b) 7:5 c) 15:11 d) 31:23
7. If $\frac{1}{2} f(x) = f\left(\frac{1}{2}x\right)$, which of the following is true for all values of $f(x)$?
   a) $f(x) = 2x + 2$ b) $f(x) = x^2$ c) $f(x) = \sqrt{x}$ d) $f(x) = 13x$
8. A total of $450 was donated to charity by 25 employees. If 15 employees donated at least $12 but less than $19 and 9 employees donated at least $19, what is the maximum amount, in dollars, that the last employees could have donated?
   a) $51 b) $99 c) $109 d) $89
9. The price of a phone call consists of a standard connection fee, which is constant, plus a per-minute charge. A ten minute call costs Rs 2.90 and a sixteen minute call costs Rs 4.40. How much does a thirteen minute call cost?
   a) Rs 3.55 b) Rs 3.57 c) Rs 3.58 d) Rs 3.65
10. The $\frac{4}{5}$ of the women and $\frac{3}{4}$ of the men in a group speak Spanish. If there are 40% as many men as women in the group, what fraction of the group speaks Spanish?
    a) $\frac{14}{11}$ b) $\frac{11}{14}$ c) $\frac{3}{5}$ d) $\frac{7}{11}$
11. How many factors greater than 1 do 120, 210 and 270 have in common?
    a) 1 b) 3 c) 6 d) 7
12. Ramon wants to cut a rectangular board into square pieces. If the board is 18 inches by 30 inches, what is the least number of square pieces he can cut without wasting any of the board?
    a) 15 b) 9 c) 12 d) 4
13. How many whole numbers are between $\sqrt{77}$ and $\sqrt{257}$?
    a) 7 b) 10 c) 9 d) 8

14. In a parallelogram ABCD, OA and OB are the bisectors of the angles A and B respectively at O, then an angle AOB equals?
    a) 60^0 b) 75^0 c) 90^0 d) 120^0
15. For which of the following positive integers is the square of that integer divided by the cube root of the same integer equal to nine times that an integer?
    a) 64 b) 8 c) 16 d) 27
16. If $4x < x < x^3 < x^2$, which of the following is possible value of x ?
    a) $-\sqrt{3}$ b) $-\frac{3}{2}$ c) -1 d) $-\frac{4}{5}$
17. In the XY-plane, what is the area of the triangle formed by the line $3y - 4x = 24$ and the X and Y axes?
    a) 6 b) 14 c) 24 d) 36
18. A bag contains an equal number of 5 rupee, 1 rupee, 50 paisa & 25 paisa coins respectively. If the total value is 135, how many coin of each type of there?
    a) 22 b) 16 c) 24 d) 20
19. Auto lot has a 2:1 ratio of blue cars to red cars and a 6:1 ratio of red cars to orange cars on the lot. What could be the total number numbers of blue, red and orange cars on the lot?
    a) 37 b) 38 c) 39 d) 40
20. Each of 5 people had a blank card on which they wrote a positive integer. If the average (Arithmetic mean) of these integers is 15, what is the greatest possible that could be on one of the cards?
    a) 70 b) 71 c) 72 d) 65
21. Which of the following choices of 'a' will results in a system of equations $9x - 14y = -3, 2x - ay = -6$ with no solution?
    a) $-\frac{9}{14}$ b) $-\frac{28}{9}$ c) $\frac{9}{14}$ d) $\frac{28}{9}$
22. The original price of an article was reduced by 20%. During a special sale, the new price was decreased by 10%. The price of an article now has to bring back to the original price by 2 successive mark ups. If the second mark up is 25%, what is the first mark up approximately?
    a) 5% b) 16.67% c) 11.11% d) 12.5%
23. What is the minimum y value of the function $y = x^2 + 6x + 13$ in the real domain?
    a) 3 b) 5 c) 4 d) 6
24. If P is a perimeter of a triangle with one side of 7 and another side of 9, what is the range of possible values for P?
    a) $2 < P < 16$ b) $3 < P < 17$ c) $18 < P < 32$ d)$18 < P < 33$
25. How many liters of pure Alcohol must be added to a 90 liters solution that is 20% Alcohol in order to produce a solution that is at least 25% Alcohol?
    a) 4.5 b) 5 c) 5.5 d) 6.5
26. The number that is 50% greater than 60 is what percent less than the number that is 20% less than 150?
    a) 15% b) 20% c) 25% d) $33\frac{1}{3}\%$
27. Kabir's college is 12 miles from his home. He travels 6 miles from the college to basketball practice, and then 4 miles to a computer class. If he is D miles from home, what is the range of possible values for D?
    a) $10 \leq D \leq 12$ b) $2 \leq D \leq 16$ c) $10 \leq D \leq 22$ d) $2 \leq D \leq 22$
28. Louise is three times as old as mary. Mary is twice as old as Natalie. If Louise is L years old, what is the average (arithmetic mean) age of three women, in terms of L?
    a) $\frac{L}{3}$ b) $\frac{2L}{3}$ c) $\frac{L}{2}$ d) $\frac{L}{6}$

29. Seven consecutive numbers are selected from the integers 1 to 100, and each number is divided by 7. What is the sum of remainder obtained?
    a) 21 b) 20 c) 22 d) 19
30. If $\frac{52}{x}$ is a positive integer, how many integer values are possible for x ?
    a) Six b) Five c) Seven d) Four
31. When three positive integers a , b , c are multiplied together, their product is 100. Suppose $a < b < c$. In how many ways the number be chosen?
    a) 2 b) 3 c) 4 d) 5
32. The traffic lights at three different road crossing changes after 48sec, 72sec & 108sec. If they all changes simultaneously at 8:20:00 hours, at what time will they again changes simultaneously?
    a) 8:30:12 hrs. b) 8:29:12 hrs. c) 8:28:12 hrs. d) 8:27:12 hrs.
33. If an ant climbing a pole completes climbing in 5 days. Ant climbs 4 meters in a day and slips down 3 meters in a night. What is the height of pole ?
    a) 9m b) 8m c) 7m d) 5m
34. A rectangular floor having perimeter 16 meters is to be covered with square carpets that measure 1 meter by 1 meter each and cost Rs 6 apiece. What is the maximum possible cost for the number of square carpets needed to cover the rectangular floor if the sides of the floor are integers?
    a) Rs 42 b) Rs 72 c) Rs 90 d) Rs 96
35. The equation of the image of the line $2x + 3y = 6$ under the reflection by y-axis is
    a) $2x - 3y = 6$ b) $2x - 3y + 6 = 0$ c) $2x + 3y + 6 = 0$ d) $2x + 3y = 6$
36. A 60m long train is travelling with a uniform speed of 72 kmph. How much time does it take to cross a 240m long bridge?
    a) 15 seconds b) 10 seconds c) 20 seconds d) 25 seconds
37. A wooden cuboid has external dimensions $6m \times 3m \times 2m$. A rod is inserted into the cuboid. What should be the maximum length of the rod to pass through the cuboid?
    a) 7m b) 11m c) 36m d) 1m
38. In a race of 1km among 3 persons A, B and C; if A beats B by 80m and B beats C by 90m. By what distance (in meter) is C beaten by A?
    a) 170m b) 85m c) 162.8m d) 172.8m
39. The product of 99 integers is 99. Which of the followings can be the appropriate sum of these integers?
    a) 999 b) 997 c) 199 d) 197
40. There are 8 people in a village. They consume 8 coconuts altogether. Each man consumes 2 coconuts, each woman consumes half coconut and each child consumes a quarter coconut. What is the number of men there?
    a) 3 b) 2 c) 1 d) 4
41. A man travels 21km due north from a point. Then he turns to the east and travels 56 km along east and again he turns to the north and travels 21 km due north. At last, how far was he from the starting point?
    a) 98km b) 56km c) 70km d) 42km
42. For any natural number n, which of the followings is exactly divisible by 8?
    a) $3^n - 1$ b) $5^n + 1$ c) $3^{2n} - 1$ d) $3^{3n} - 1$
43. If $a + b + c = 9$, $b + c + d = 12$, $a + b + d = 10$ and $a + c + d = 11$, what is the value of $a + b + c + d$?
    a) 17 b) 15 c) 16 d) 14

44. What is the simplified value of: $\frac{1}{\sqrt{1}+\sqrt{2}}+\frac{1}{\sqrt{2}+\sqrt{3}}+\frac{1}{\sqrt{3}+\sqrt{4}}\ldots+\frac{1}{\sqrt{99}+\sqrt{100}}$?

a) 10 b) 9 c) 11 d) 100

45. Three identical squares are connected one after another as shown in **(Fig. 1)** which point A is joined with the points G, F and E. Without measuring by any instrument, find the sum of the angles AGH, AFH and AEH in degrees.

a) 90° b) 78.75° c) 22.5° d) 95°

46. A six –pointed regular star is painted as shown **(Fig. 2).** What is the ratio the shaded region to the whole area?

a) 0.67 b) 0.4 c) 0.5 d) 0.6

47. In the figure given alongside **(Fig. 3),** ABCD is a cyclic quadrilateral with diagonals AC and BD. If AB = 4cm, BC = 4.5cm, CD = 3.6cm and AD = 2.8cm, what is the value of $AC \times BD$ in sq. cm ?

a) 54 b) 108 c) 181.44 d) 27

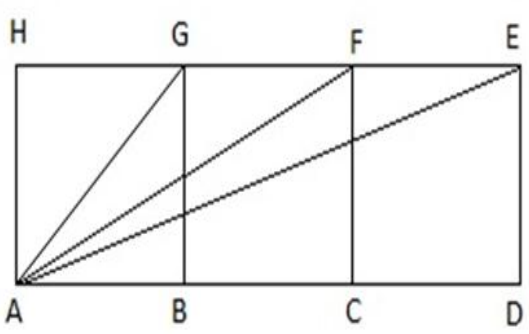

Fig. 1

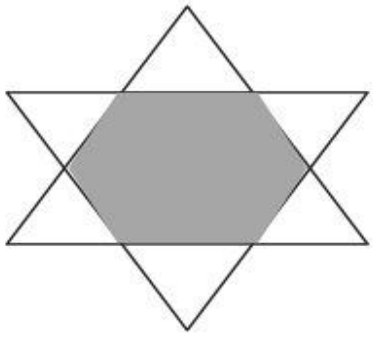

Fig. 2

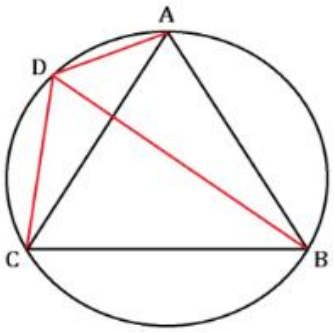

Fig. 3

48. In the adjoining figure **(Fig.4),** what is the value of x?

a) $15\sqrt{2}$ b) $12\sqrt{5}$ c) $10\sqrt{6}$ d) $9\sqrt{5}$

49. How many triangles are there in the figure **(Fig. 5)?**

a) 19 b) 24 c) 22 d) 20

50. A piece of paper in the shape of an equilateral triangle **(Fig.6)** having one corner folded over is shown alongside. What is the value of x in degrees?

a) 60° b) 80° c) 100° d) 40°

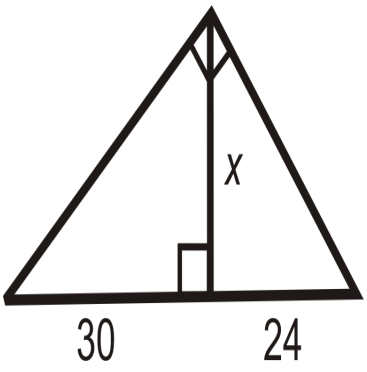

Fig. 4

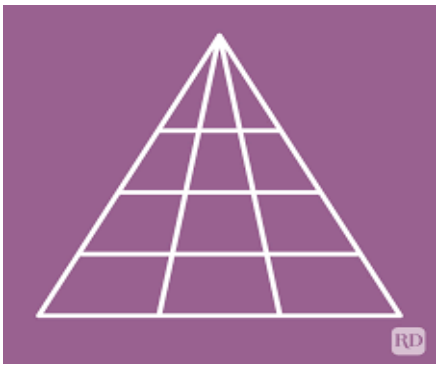

Fig. 5

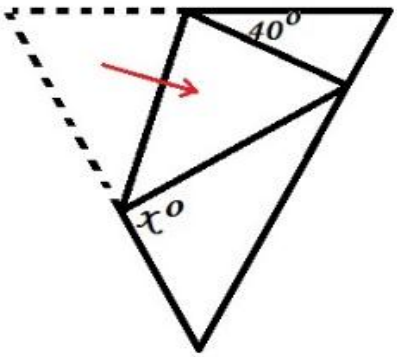

Fig. 6