



International Vedic Maths Olympiad 2023

Senior

Time allowed - 1 Hour

Questions 1 - 25: Score 2 marks for each correct answer.

1. $2(1 + 2(1 + 2(1 + 2(1 + 2(1 + 2(1 + 2))))))$

A 63

B 126

C 127

D 254

E 274

2. Which of the following is not a multiple of 9?

A 768321

B 224433

C 891548

D 243756

E 830106

3. Which of the following gives $0.321876 \times 0.0430156$ correct to 2 significant figures?

A 0.012

B 0.013

C 0.014

D 0.0013

E 0.01

4. What is the whole number remainder when 242871 is divided by 897?

A 487

B 851

C 475

D 206

E 681

5. The working below shows the division, $259781 \div 11243 = 227$ remainder 320, using the Vedic Transpose and Apply method. What are the digits for ABC?

$$\begin{array}{r|l}
 1143 & 259781 \\
 \hline
 143 & 286 \\
 & ABC \\
 & 429 \\
 \hline
 & 23\bar{3}/320 \\
 & 227/320
 \end{array}$$

A $\bar{4}\bar{2}\bar{9}$

B $\bar{1}\bar{2}\bar{9}$

C $\bar{1}\bar{4}\bar{3}$

D 286

E 081

6. 2023 has a square factor whose square root ends in 7. What is that square root?

A 7

B 17

C 27

D 37

E 47

7. 992^2

A 978464

B 987664

C 976764

D 984064

E 988264

8. What are the vinculum digits in the Nikhilam multiplication of 524×492 when using a working base of 500 and a real base of 1000?

A $\overline{144}$

B $\overline{192}$

C $\overline{326}$

D $\overline{808}$

E $\overline{162}$

9. What is the area of a rectangular floor measuring 15 ft 3 in. by 12 ft 9 in.? (1 foot = 12 inches)

A $162 \text{ ft}^2 93 \text{ in}^2$

B $178 \text{ ft}^2 23 \text{ in}^2$

C $194 \text{ ft}^2 63 \text{ in}^2$

D $180 \text{ ft}^2 27 \text{ in}^2$

E $192 \text{ ft}^2 36 \text{ in}^2$

10. The One Day International Cricket World Cup Final took place at Narendra Modi Stadium in Ahmedabad on 19th November 2023. It was a sell-out event. The stadium is the largest in the world and can seat 132000 people. The total takings from sale of tickets was \$46 596 000. What was the mean price of each ticket?

A \$343

B \$283

C \$335

D \$348

E \$353

11. 79^3

A 493039

B 627429

C 534149

D 467229

E 510239

12. What are the last five digits in the recurring pattern of the decimal equivalent of $\frac{1}{49}$?

A ...25641

B ...77551

C ...20408

D ...16327

E ...02551

13. After the decimal point, how many non-recurring digits are there in the decimal equivalent for $\frac{17}{384}$?

A 3

B 4

C 5

D 6

E 7

14. The digits 2, 3, 4, 5, 6 are placed in the grid to form two three-digit square numbers. Which number must be placed in the central square?

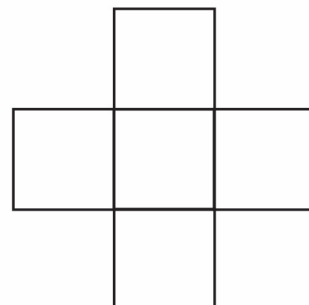
A 2

B 3

C 4

D 5

E 6



15. $\sqrt{100(2023-2000)+4}$

A 768

B 144

C 96

D 48

E 36

16. Mr Elongate Musketeer owns 19 companies each with over a ten thousand employees. Which of the following could be the number of employees?

A 588728

B 290585

C 422121

D 540037

E 202101

17. When the denominator of $\frac{3\sqrt{3}}{3-\sqrt{3}}$ is rationalised, the answer is,

A $\frac{\sqrt{3}+1}{1}$

B $\frac{3\sqrt{3}-3}{4}$

C $\frac{3\sqrt{3}+3}{2}$

D $\frac{\sqrt{3}+3}{2}$

E $\frac{3\sqrt{3}-1}{9}$

18. What is the simplified form of, $(2x^2+3x+1)^2-(x^2-3x-1)^2$?

A $3x^2(x^2+6x+2)$

B $3x^2(x^2+6)$

C $3x^4+20x^2+12x$

D $3x^4+20x^2-1$

E $3x^2(x^2-6x-2)$

19. What is the equation for the straight line with gradient $\frac{2}{3}$ and which passes through the point (6, -2)?

A $2x-3y=24$

B $2x+3y=6$

C $3x-2y=22$

D $3x+2y=14$

E $2x-3y=18$

20. Which of the following is an equation of the straight line which passes through the point (-3, 2) and also perpendicular to the line with equation, $5x-3y=19$?

A $3x+5y=-9$

B $3x+5y=1$

C $y=-\frac{5}{3}x-3$

D $y=-\frac{3}{5}x-\frac{9}{5}$

E $5y=3x+19$

21. The function, $f(x)=\frac{3x+4}{2-x}$. Which of the following is the inverse function, $f^{-1}(x)$?

A $\frac{2x-4}{3+x}$

B $\frac{3x-4}{3-x}$

C $\frac{2x-4}{3-x}$

D $\frac{4x-2}{x-3}$

E $\frac{4x-3}{x+3}$

22. What is the value of x for which, $2^{2x} \times 8^{x-1} = 16^{x+3}$?

A 0

B 9

C 15

D 16

E 48

23. A square has centre (3, 4) and one corner at (1, 5). Where is another corner?

A (1, 3)

B (5, 5)

C (4, 2)

D (2, 2)

E (5, 2)

24. Which of the following is a factor of $3x^3 + 11x^2 + 30x + 72$?

A $(x+1)$

B $(x+2)$

C $(x+3)$

D $(x+4)$

E $(x+6)$

25. What is the radius of the circle with equation, $x^2 + y^2 + 2x - 4y + 1 = 0$?

A 1

B 2

C $\sqrt{2}$

D $\sqrt{5}$

E 5

Questions 26 - 35: Score 3 marks for each correct answer.

26. Triangle ABC has vertices with coordinates, (3, 5), (6, 9) and (11, 7).

In square units, what is the area of the triangle?

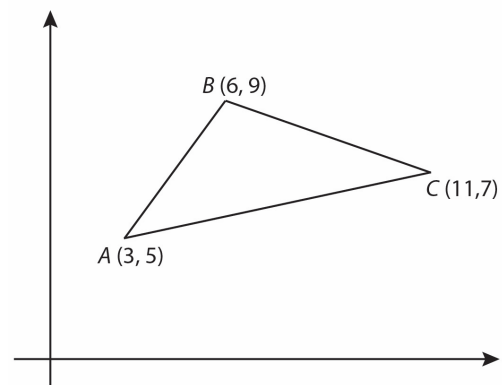
A 11

B 13

C 15

D 22

E 26



27. Two of the pyramids at Giza in Egypt are Khufu, with a height of 280 Royal Cubits, and Menkaure, with a height of 112 Royal Cubits. They can be treated as similar shapes. If the volume of Menkaure is 1.2×10^6 Cubic Royal Cubits, what is the volume of Khufu, in the same units?

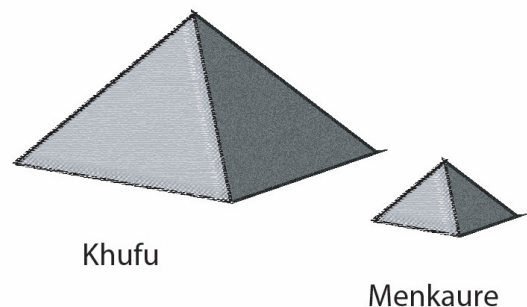
A 3.125×10^7

B 7.5×10^6

C 1.875×10^7

D 9×10^6

E 1.625×10^6



28. Andria and Bertha both run 100 metres in times A and B seconds. The difference between the squares of their times is four times the sum of their times. The sum of their times is eight times the difference between their times. How long did it take for the slowest of the two runners?

A 15 s

B 16 s

C 17 s

D 18 s

E 19 s

29. The graph of a parabola has y-intercept at (0, 13) and turning point at (-4, -3). Which of the following is the equation for the parabola?

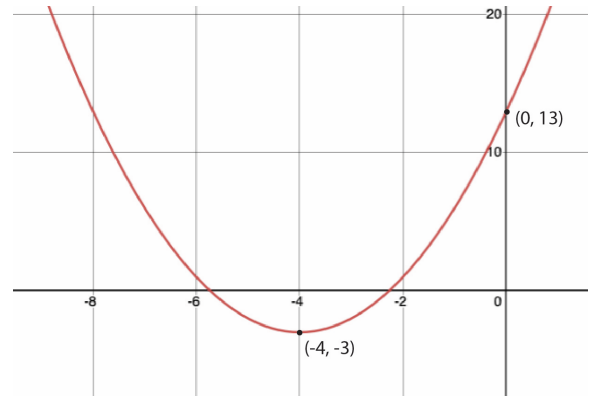
A $y = 2x^2 - 4x + 13$

B $y = x^2 + 7x + 9$

C $y = 3x^2 + 16x + 13$

D $y = x^2 + 8x + 13$

E $y = 4x^2 + 48x - 13$



30. In this magic square, the products of numbers in each row, each column and each diagonal are all the same. The missing numbers are 2, 4, 5, 10, 25, 50 and 100. Which number must be placed in the square labelled M?

A 2

B 4

C 5

D 10

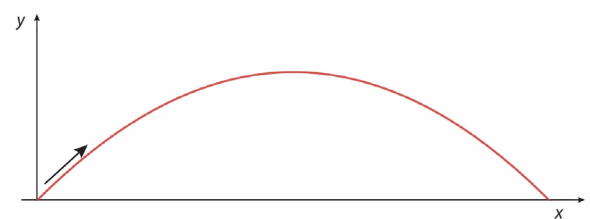
E 25

	1	20
M		

31. When a javelin is thrown it follows the path of a parabola and the maximum distance achieved is when the angle of throw is 45° to the horizontal. The graph of a record breaking throw is described by the equation,

$$y = x - \frac{x^2}{98}$$

where, x and y are measured in metres.



What is the maximum height of this throw?

A 24.5 m

B 49 m

C 28.5 m

D 98 m

E 12.5 m

32. How many three-digit numbers can be written as the sum of five different powers of 3, including 3^0 ?

A 6

B 7

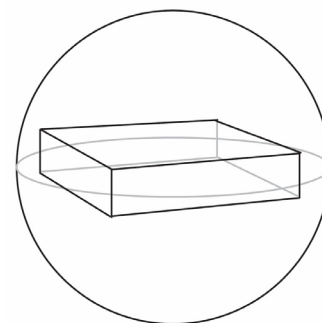
C 8

D 9

E 10

33. A cuboid, measuring 2 by 10 by 22 units, is placed inside a sphere with its eight vertices touching the surface. What is the edge length of the largest cube that can fit inside a sphere of the same size?

A 7 B $7\sqrt{3}$ C 14
D $14\sqrt{3}$ E $3\sqrt{7}$



34. What is the value of p , given that,

$$(4x^2 - 3px + 2)(x^2 + px + 1) = 4x^4 + px^3 - 7px^2 - px + 2$$

A 1 B 3 C 5 D 7 E 9

35. What is the remainder when $1 + 3x + 5x^2 + 7x^3 + \dots + 99x^{49}$ is divided by $x - 1$?

A 1000 B 2000 C 2500 D 5000 E 5500

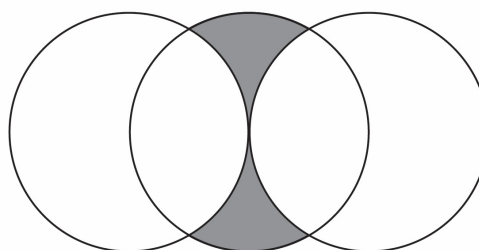
Questions 36 - 40: Score 4 marks for each correct answer.

36. Three circles, each with a radius of one unit, are set out as shown with the circumference of the middle circle passing through the centres of the outer two circles.

What is the area of the shaded region in terms of π ?

A $2\sqrt{3} - \frac{2\pi}{3}$ B $\frac{2\sqrt{3} - \pi}{6}$ C $\frac{2\pi}{3} - \sqrt{3}$

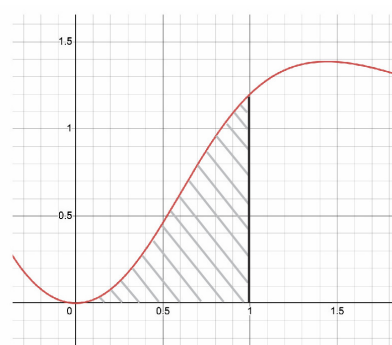
D $\frac{4\pi}{3} - \sqrt{3}$ E $\sqrt{3} - \frac{\pi}{3}$



37. What is the area of the shaded region given by,

$$A = \int_0^1 \frac{6x^2}{2x^3 + 3} dx$$

A $\ln 6$ B $\ln \frac{3}{4}$ C $\ln \frac{4}{3}$
D $\ln 3$ E $\ln \frac{5}{3}$



38. Given that $|x| < \frac{1}{2}$, which power series, to three terms, corresponds to the expansion of,

$$\frac{3x-1}{2x^2+3x-2} ?$$

- A** $\frac{3}{2} + \frac{3}{4}x - \frac{9}{16}x^2 + \dots$
B $\frac{1}{2} - \frac{9}{4}x + \frac{3}{8}x^2 + \dots$
C $\frac{1}{2} - \frac{9}{4}x - \frac{31}{4}x^2 + \dots$
D $\frac{1}{2} - \frac{3}{4}x - \frac{5}{8}x^2 + \dots$
E $\frac{1}{3} + \frac{1}{4}x - \frac{3}{8}x^2 + \dots$

39. The function, $y = e^{kx}$ satisfies the equation,

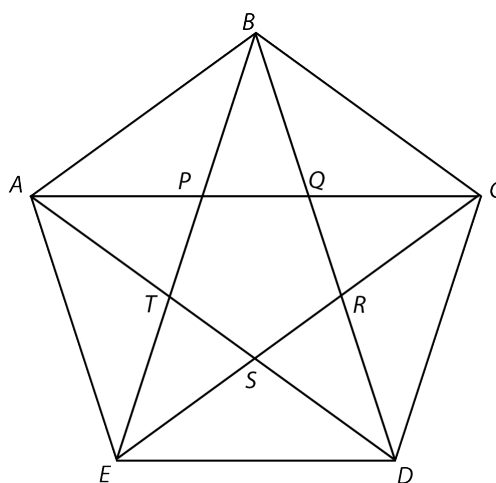
$$\left(\frac{d^2y}{dx^2} + \frac{dy}{dx} \right) \left(\frac{dy}{dx} - y \right) = y \frac{dy}{dx}$$

for

- A** no values of k
B exactly one value of k
C exactly two distinct values of k
D exactly three distinct values of k
E infinitely many distinct values of k

40. A pentagram is drawn within a regular pentagon. The area of the inner pentagon, $PQRST$, is one unit. Given that $BC : BQ = BQ : PQ$, what is the area of the large pentagon, $ABCDE$?

- A** $\frac{3\sqrt{5}+7}{2}$
B $\frac{5+2\sqrt{5}}{4}$
C $\frac{\sqrt{5}+1}{2}$
D $\frac{4\sqrt{5}+3}{4}$
E $\frac{\sqrt{5}-1}{2}$



Answer Key Senior IVMO 2023

Questions 1 - 25: Score 2 marks for each correct answer.

Questions 26 - 35: Score 3 marks for each correct answer.

Questions 36 - 40: Score 4 marks for each correct answer.

1. D	11. A	21. A	31. A
2. C	12. B	22. C	32. E
3. C	13. E	23. D	33. C
4. E	14. A	24. C	34. B
5. A	15. D	25. B	35. C
6. B	16. D	26. B	36. E
7. D	17. C	27. C	37. E
8. B	18. A	28. D	38. D
9. C	19. E	29. D	39. C
10. E	20. B	30. B	40. A

Answer Sheet Senior IVMO 2023

Write your name in Block Capitals here

--

Write yours answers, A, B, C, D or E in the boxes below.

1.		11.		21.		31.	
2.		12.		22.		32.	
3.		13.		23.		33.	
4.		14.		24.		34.	
5.		15.		25.		35.	
6.		16.		26.		36.	
7.		17.		27.		37.	
8.		18.		28.		38.	
9.		19.		29.		39.	
10.		20.		30.		40.	