# International Vedic Maths Olympiad 2024
## Senior
## Time allowed - 1 Hour

This Olympiad consists of 40 multiple choice questions.

2 marks are awarded for correct answers for questions 1 - 25

3 marks are awarded for correct answers for questions 26 - 35 and -1 mark for each incorrect answer.

4 marks are awarded for correct answers for questions 36 - 40 and -2 marks for each incorrect answer.

Negative marks for incorrect answers for questions 26 - 40 are to discourage guessing.


Answers, A, B, C, D or E, must be written on the answer sheet provided.


### *Rules*

Rough workings can be done on plain paper.

Electronic devices such as computers, calculators, smart watches and mobile phones are not allowed.

Measuring or drawing instruments are not allowed.

**1.**
$$9 - 8\left(7 - 6\left(5 - 4\left(3 - 2\left(1 - 0\right)\right)\right)\right)$$

         **A** 0         **B** 1         **C** -1         **D** 2         **E** 9

**2.** $107 \times 106$

        **A** 10462         **B** 11342         **C** 11432         **D** 11742         **E** 11642

**3.** Which of the following is divisible by 18?

        **A** 11274         **B** 11282         **C** 11286         **D** 11296         **E** 11312

**4.** How many zeros are in the answer to 663663663221 ÷ 221?

        **A** 0         **B** 2         **C** 4         **D** 6         **E** 8

**5.** $987^2$

        **A** 984189         **B** 996269         **C** 984169         **D** 997196         **E** 974169

**6.** 478 X 994

        **A** 475132         **B** 472132         **C** 476132         **D** 475332         **E** 4723132

**7.** When using the Vertically and Crosswise method to multiply $6734 \times 2963$ what is the result of the fouth step before any carry digits have been added?

        **A** 65         **B** 75         **C** 85         **D** 95         **E** 105

**8.**
How many decimal digits are there in the non-recurring decimal equivalent of the fraction, $\dfrac{157}{320}$ ?

        **A** 4         **B** 5         **C** 6         **D** 7         **E** 8

**9.** What is the digit showing as A in the calculation, $83 \times 87 = 7A21$?

      **A** 1         **B** 2         **C** 3         **D** 4         **E** 5

**10.** What is the remainder for $256379 \div 12101$?

      **A** 2258       **B** 3644       **C** 2735       **D** 6434       **E** 5363

**11.** Which is the most suitable sutra for the calculation in the previous question?
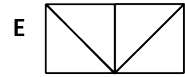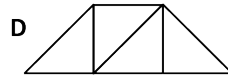
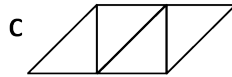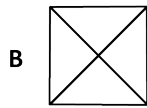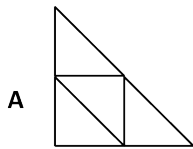      **A** All from 9 and the last from 10

      **B** By the last digits

      **C** Vertically and crosswise

      **D** Transpose and Apply

      **E** By Addition and Subtraction

**12.** Each shape is made of four identical right-angled isosceles triangles. Which shape has the smallest perimeter?



**13.** Which of the following is the equation of the straight line which passes through the point $(7,-10)$ and and has gradient $-2$?

    *A* $2x+y=24$     *B* $2x+y=4$     *C* $2x-y=4$     *D* $2x+y=-24$     *E* $2x-y=24$

**14.**
Given that $x^2-6x+3=0$, what is the value of $x+\dfrac{3}{x}$?

      **A** 1.5       **B** 3       **C** 6       **D** $\dfrac{6+\sqrt{24}}{2}$       **E** $4+\frac{2}{3}\sqrt{6}$

**15.** One of the following is divisible by 47. Which is it?

      **A** $2024+3$       **B** $2024+1$       **C** $2024$       **D** $2024-1$       **E** $2024-3$

**16.** What is the last digit of $3^{2024}$ ?

**A** 1      **B** 3      **C** 5      **D** 7      **E** 9

**17.** A truncated icosahedron has 12 pentagon faces and 20 hexagon faces. Faces are joined along their edges. How many edges are there?
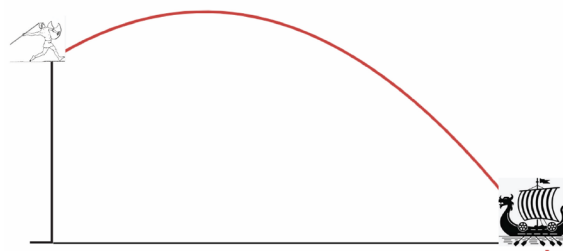
**A** 20      **B** 32      **C** 60

**D** 90      **E** 120

**18.** Which of the following is equivalent to $2^{22} \times 3^{33}$ ?

**A** $6^{55}$      **B** $27^{11}$      **C** $108^{11}$      **D** $18^{11}$      **E** $6^{66}$

**19.** From the top of a 96 metre vertical cliff, Odysseus throws a spear at a Trojan ship and hits it at sea level. The path of the spear is modelled as,

$$h(x) = 96 + 2x - \frac{x^2}{25},$$

where $h$ is the height of the spear above sea level and $x$ is the horizontal distance from the cliff.

How far from the cliff is the Trojan ship?

**A** 30 m      **B** 55 m      **C** 80 m      **D** 96 m      **E** 108 m

**20.** In the *Proportionately* method for finding the cube of 32, what are the missing values, *A* and *B*?

27   18   12   8
      *A*   *B*
——————————

**A** 18   12      **B** 36   24      **C** 54   36      **D** 12   18      **E** 24   36

**21.** $2\log 3 + 3\log 2 - 3\log 6$ simplified as a single log is,

**A** $2\log 6$      **B** $-\log 6$      **C** $-\log 3$      **D** $\log 3$      **E** $2\log 3$

**22.** The point *M* lies inside a cube. Lines drawn from *M* to each vertex form six pyramids where the faces of the cube are the square bases of the pyramids.
Volumes of five of the pyramids are 150, 250, 300, 500 and 600 cubic units.
What is the volume of the sixth pyramid?

**A** 100 **B** 200 **C** 350

**D** 450 **E** 550
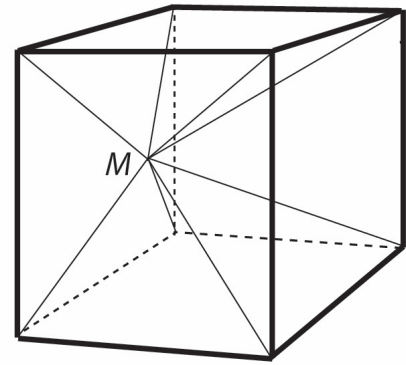


**23.** Michael used a working base of 250 to calculate $246 \times 232$, but came up with the wrong answer (912288) at the final step. What should his final step have been?

```
  246 − 004
× 232 − 018
4)228  072
  912  288
```
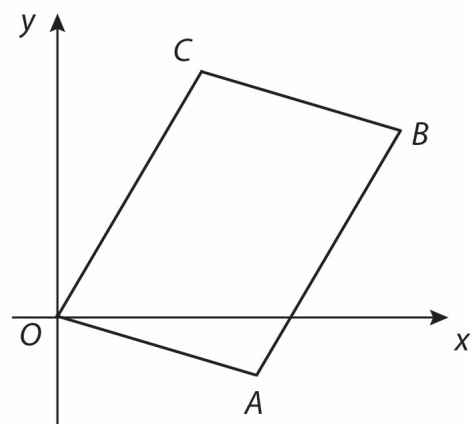
**A** Divide 072 by 4 but leave 228 alone

**B** Divide 228 by 4 but leave 072 alone

**C** Divide 228072 by 4

**D** Multiply 228 by 4 but leave 072 alone

**E** Multiply 072 by 4 but leave 228 alone

**24.** What is the minimum value of $x^2 + y^2 + 2xy + 8x + 8y + 12$ ?

**A** -8 **B** -6 **C** -4 **D** -2 **E** 0

**25.** The parallelogram, OABC, has area 50 square units.
The vertex *C* lies at (4, 6). The *y*-coordinate of *A* is -2.
What is the *x*-coordinate of *A*?

**A** 5.5 **B** 6 **C** 6.5

**D** 7 **E** 7.5

**26.** What is the third derivative of $(3x-1)^3$ ?

        **A** 0         **B** 54         **C** 81         **D** 108         **E** 162

**27.** What is the smallest value of *k* for which *k!* is divisible by 2024?

        **A** 11         **B** 18         **C** 21         **D** 23         **E** 26

**28.** How many parallelograms are in the figure?

    A  441         B  225         C  196

        D  37         E  36
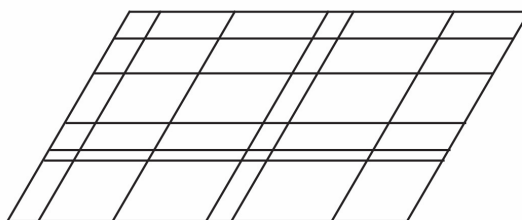
**29.** Given that, $a=75$     $b=36\sqrt{5}$     $c=72$     $d=32\sqrt{5}$ , which of the following is true?

  **A** $a>b>c>d$     **B** $a>c>b>d$     **C** $b>a>c>d$     **D** $b>a>d>c$     **E** $a>b>d>c$

**30.** After the decimal point, what is the 7th digit in the decimal equivalent of 7/79?

        **A** 1         **B** 3         **C** 5         **D** 7         **E** 9

**31.** Points A(-1, 3) and B(1, 1) lie on a circle whose centre lies on the line, $x+y+4=0$ .

What is the radius of the circle?

        **A** 1         **B** 2√5         **C** 2√2         **D** 2.5         **E** 3

**32.** Given that, $ax^4+bx^3+cx^2+dx+e = (2x^2+Ax+7)(3x^2+2x+4)$

and that, $a+b+c+d+e = 108$ , what is the value of *A*?

        **A** 3         **B** 4         **C** 5         **D** 6         **E** 8
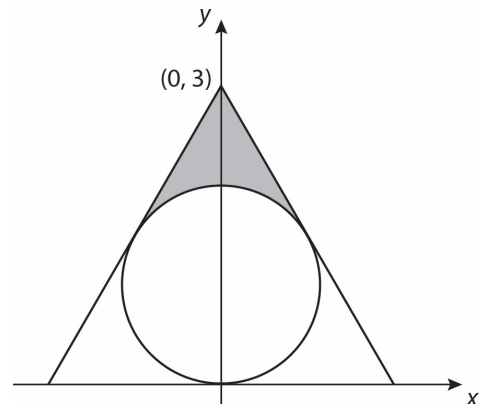
**33.** Given that $y = x^2 - 12x + 27$ and $4x + y = c$ have no common solutions, which inequality is true?

    **A** $c > -4$      **B** $c > 3$      **C** $c < 4$      **D** $c < -11$      **E** $c < 11$

**34.** Angle $A$ is denoted by the triple $A$) 2   1   √5.

Which of the following is a triple for $3A$?

    **A** 2  11  5√5      **B** 3  4  5      **C** 5  4  √41      **D** 2  5  √29      **E** √5  7  2√11

**35.** A circle has equation, $x^2 + y^2 - 2y = 0$.

Tangents to the circle intersect at (0, 3).

What is the area of the shaded region?

    **A** $2 - \frac{2}{3}\pi$      **B** $2\sqrt{3} - \frac{1}{3}\pi$      **C** $\sqrt{3} - \frac{1}{3}\pi$

    **D** $3 - \frac{1}{2}\pi$      **E** $\frac{\sqrt{3}}{2} - \frac{2}{3}\pi$



*Questions 36 - 40: Score 4 marks for each correct answer. -2 marks for each incorrect answer.*

**36.** In the power series expansion of $\dfrac{2}{1 + 4x + x^2}$, what is the coefficient of $x^3$?

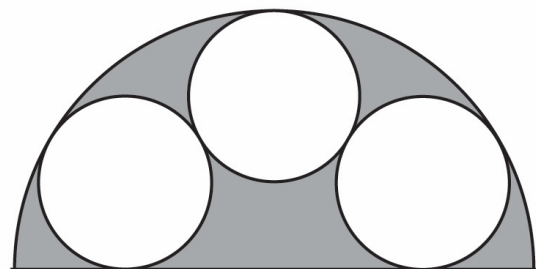    **A** -8      **B** -30      **C** 30      **D** -112      **E** -482

**37.** What is the area above the $x$-axis, bounded by the $x$-axis, the curve $y = \sqrt{x}$ and the line $y = x - 6$?

    **A** 18      **B** 13.5      **C** 9      **D** 7.5      **E** 4.5

**38.** Three touching circles, each of radius 1, touch the edge of a semicircle as shown.

What is the area of the shaded region?

    **A** $\frac{1}{2}\pi$      **B** $\pi$      **C** $\frac{3}{2}\pi$

    **D** $2\pi$      **E** $\frac{5}{2}\pi$

**39.**

Which expression corresponds to $\displaystyle\sum_{r=1}^{n}\frac{2}{(2r+1)(2r+3)}$ ?

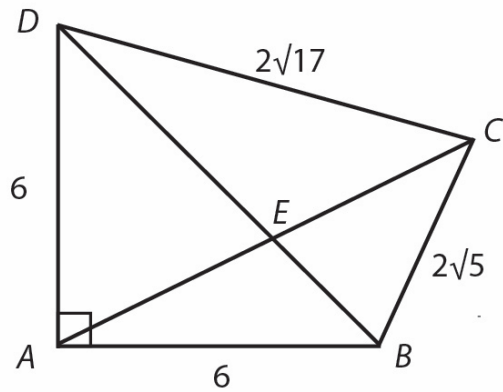**A** $\dfrac{3}{6n+4}$ **B** $\dfrac{n}{3n+9}$ **C** $\dfrac{3n}{5n+3}$ **D** $\dfrac{5}{3n+6}$ **E** $\dfrac{2n}{6n+9}$

**40.** *ABCD* is a quadrilateral with a right angle at *A*.
Side lengths as shown are 6, $2\sqrt{5}$, $2\sqrt{17}$ and 6.
The diagonals meet at *E*.
What is the ratio of lengths *AE* : *DE*?

A 1 : 2    B 3 : 5    C $\sqrt{2}$ : $\sqrt{5}$

D $\sqrt{5}$ : $2\sqrt{2}$    E $\sqrt{3}$ : $\sqrt{5}$

**Answer Key Senior IVMO 2024**

**Questions 1 - 25:** Score 2 marks for each correct answer, 0 marks for each incorrect answer.
*Questions 26 - 35: Score 3 marks for each correct answer, -1 mark for each incorrect answer.*
**Questions 36 - 40:** *Score 4 marks for each correct answer, -2 marks for each incorrect answer.*

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