Open International Vedic Maths Olympiad 2022
Time allowed - 1 Hour

Questions 1 - 25 each carry 2 marks

1. $5.0 - 0.5 + 0.05 - 0.005 + 0.0005$

A 4.5555 **B** 4.4545 **C** 4.5454 **D** 4.4555 **E** 4.5455

2. Which of the following is **not** divisible by 9?

A 277227722772 **B** 90817263542 **C** 432234432234 **D** 1234545678 **E** 623637613683

3. When using Vertically and crosswise to calculate 367×482, what is the result of the third step before any carry digits are included?

A 72 **B** 78 **C** 80 **D** 82 **E** 92

4. Given that $3 \times 37 = 111$, calculate $999999 \div 37$.

A 54054 **B** 45045 **C** 36036 **D** 18018 **E** 27027

5. What is the square root of 0.00005625?

A 0.075 **B** 0.0075 **C** 0.00075 **D** 0.000075 **E** None of these

6. One of the following shows the correct working for 329×989 using Nikhilam multiplication. Which one?

A
$$\begin{array}{r} 329 - 671 \\ \times\ 989 - 001 \\ \hline 325\ /_7 3_7 8_1 1 \end{array}$$

B
$$\begin{array}{r} 329 - 671 \\ \times\ 989 - 111 \\ \hline 325\ /_7 3_7 8_1 1 \end{array}$$

C
$$\begin{array}{r} 329 - 671 \\ \times\ 989 - 011 \\ \hline 325\ /_7 3_7 8_1 1 \end{array}$$

D
$$\begin{array}{r} 329 - 671 \\ \times\ 989 - 011 \\ \hline 325\ /_6 3_7 8_1 1 \end{array}$$

E
$$\begin{array}{r} 329 - 670 \\ \times\ 989 - 011 \\ \hline 325\ /_7 3_7 8_1 1 \end{array}$$

7. The devinculated form of $6\overline{2}$ is 58. What is the devinculated form of $300\overline{23}7\overline{48}$?

A 29977662 **B** 20077662 **C** 20087652 **D** 29977652 **E** 29976652

8. What are the final four digits of 99999999987^2?

A 0169 **B** 9169 **C** 9983 **D** 0113 **E** 0913

9. Using Nikhilam division for 24219 ÷ 897, some workings are shown below. What are the three missing digits for A, B and C?

897	24/219
	A B C
	618
	27/000

A 328 **B** 283 **C** 206 **D** 308 **E** 204

10. Which fraction is the largest?

A $\frac{24}{2972}$ **B** $\frac{12}{1483}$ **C** $\frac{6}{745}$ **D** $\frac{3}{373}$ **E** $\frac{1}{124}$

11. Which sutra is most appropriate for solving Question 10?

A Vertically and crosswise

B By elimination and retention

C Proportionately

D All from 9 and the last from 10

E By one more than the one before

12. 78^3

A 474552 **B** 551368 **C** 548552 **D** 474462 **E** 475552

13. What are the last five digits of the recurring pattern in the decimal equivalent of $\frac{1}{39}$?

A …26341̇ **B** …13941̇ **C** …27341̇ **D** …26641̇ **E** …25641̇

14. Find the integer remainder for 12345678 ÷ 89789

A 13585 **B** 24685 **C** 42785 **D** 44585 **E** 68285

15. Which of the following is both a square and a cube?

A 49^8 **B** 81^7 **C** 125^3 **D** 216^5 **E** 343^6

16. What is the Lowest Common Multiple (LCM) of 38808 and 1320?

A 64 680 **B** 194 040 **C** 582 120 **D** 1 552 320 **E** 2 134 440

17. $\sqrt{123454321}$

A 1111111 **B** 111111 **C** 11111 **D** 1111 **E** 111

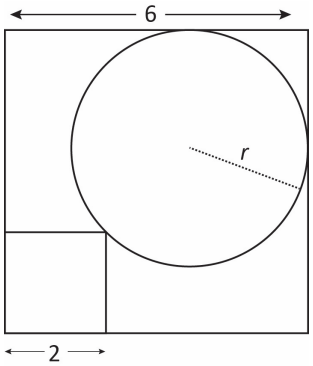
18. Which of the following can be expressed as the difference of two cubes and also the product of two consecutive integers?

A 721 **B** 875 **C** 936 **D** 973 **E** 992

19. In how many ways can 96 be expressed as the difference of two square integers?

A 0 **B** 1 **C** 2 **D** 3 **E** 4

20. Two squares of side length 2 units and 6 units touch a circle as shown. What is the radius of the circle?



A 3 - √2

B 6 - 2√2

C 6 - √2

D 1 + √2

E 8 - 4√2

21. Simplify,

$$(x+2y+1)^2 - (x-2y-1)^2$$

A $8xy+4x$ **B** $x^2+8xy+8y$ **C** $4xy+8x$ **D** $5x^2+8y^2+2$ **E** $2x^2+4xy+8y^2$

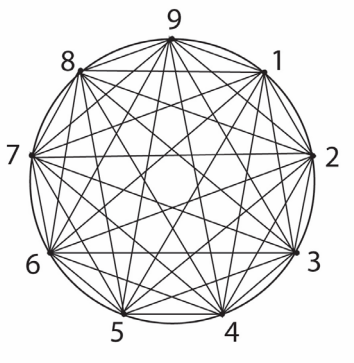
22. What is the square root of, $x^4-6x^3+17x^2-24x+16$?

A $x^2-4x+16$ B x^2+4x+4 C x^2-3x-4 D x^2-3x+4 E x^2+3x-4

23. Given that $3x^2+3x-5$ is a factor of $6x^4-9x^3-7x^2+43x-30$, which of the following is another factor?

A $2x^2-6x+6$ **B** $2x^2-7x+6$ **C** $2x^2+7x+6$ **D** $2x^2+5x+6$ **E** $2x^2-5x+6$

24. On the circle of nine points each number is joined to every other number with a line. The two numbers on the end of each line are mutliplied. How many answers will be even?



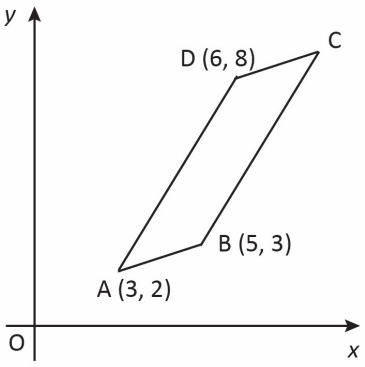
A 14 **B** 18 **C** 22 **D** 26 **E** 30

25. a ,b and c are positive integers that satisfy, $5a + \dfrac{5}{b+\frac{1}{c}} = 19$. What is the value of c?

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

Questions 26 - 35 each carry 3 marks

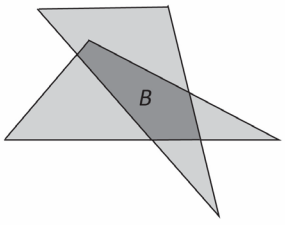
26. A parallelogram, *ABCD*, is drawn on a graph with vertices as shown. What is the numerical value of the area of the parallelogram?



A 9 **B** 10 **C** 12 **D** 14 **E** 15

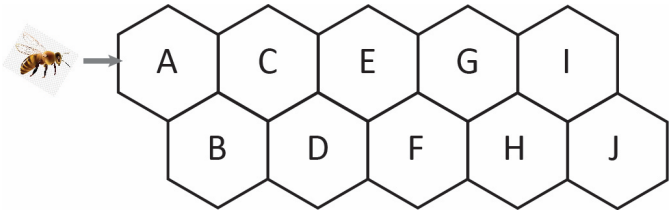
27. Two identical triangles overlap. The area of the overlapping region, B, is one sixth the area of the whole shaded region.

What fraction of the area of one triangle is the area B?



A $\dfrac{2}{5}$ B $\dfrac{1}{6}$ C $\dfrac{2}{7}$ D $\dfrac{3}{8}$ E $\dfrac{2}{9}$

28. A bee enters cell A in a honeycomb with the aim of reaching cell J. The bee cannot go back into any cell with an earlier letter label. For example, to reach cell D, the bee can travel through ABCD or ACD or ABD but not ACBD.
How many possible ways are there for it to reach cell J?



A 96 **B** 84 **C** 72 **D** 64 **E** 55

29. Simplify,

$$\left(1+\frac{1}{x}\right)\left(1-\frac{1}{x}\right)\left(\frac{1}{x+1}+\frac{1}{x-1}\right)$$

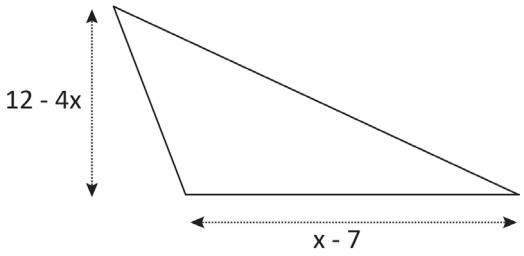
A $\frac{2}{x}$ **B** $\frac{2}{x^2}$ **C** $\frac{2}{x^2-1}$ **D** $\frac{2}{(x+1)(x-1)}$ **E** $\frac{2}{x^2(x+1)(x-1)}$

30. The equation, $x^2-98x+k=0$, has two distinct solutions. What value must k be less than?

A 0 **B** 14 **C** 98 **D** 2401 **E** 9604

31. A triangle has base, $x-7\,cm$, and height, $12-4x\,cm$, where x is a variable. What is its maximum area in cm^2?

A 4 **B** 5 **C** 8 **D** 16 **E** 42



32. Harry is tiling a floor with identical square tiles. When he forms a square of side n tiles has has 64 tiles left over. When he forms a square of side $(n + 1)$ tiles he has 25 too few.

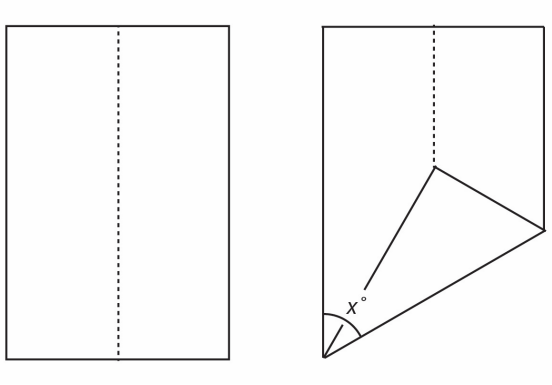
How many tiles does Harry have?

A 2025 **B** 2022 **C** 2000 **D** 1725 **E** 1225

33. Angle Q is defined by the triple $Q)$ 5 12 13.
What is the triple for the angle $\frac{1}{2}Q$?

A 3 4 5 **B** 3 2 $\sqrt{13}$ **C** 2 3 $\sqrt{13}$ **D** 13 5 $\sqrt{194}$ **E** $\sqrt{95}$ $\sqrt{5}$ $10\sqrt{5}$

34. Wajma folds a rectangular piece of paper in half and then unfolds it so that it has a centre line. She then folds one corner onto the centre line as shown.
What is the value of angle x?



A 30° **B** 40° **C** 45° **D** 60° **E** 75°

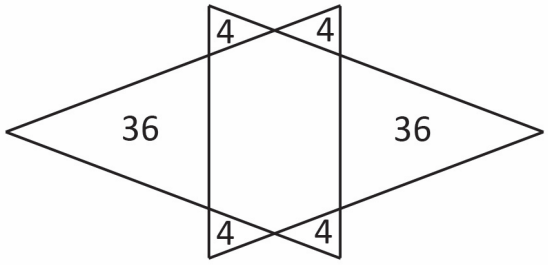
35. What is the coefficient of the independent term in the binomial expantion of,

$$\left(2x+\frac{1}{x}\right)^4 ?$$

A 6 **B** 12 **C** 24 **D** 48 **E** 96

Questions 36 - 40 each carry 4 marks

36. Two congruent isosceles triangles overlap producing a hexagon in the middle. The areas of the smaller triangles are 4 and the larger triangels, 36, as shown.
What is the area of the hexagon?



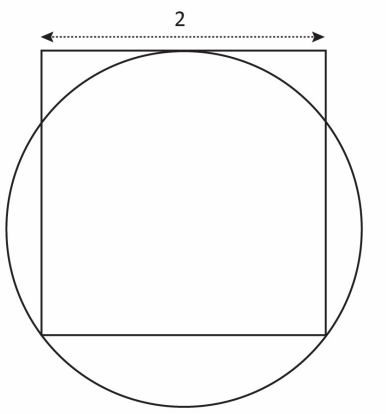
A 44 B 48 C 56 D 64 E 72

37. Given that $|x|<2$, what are the first three terms, in ascending powers of x, for the expansion of

$$\frac{4}{(2+x)^2} ?$$

A $1-4x+5x^2+\cdots$ **B** $1-x+\frac{3}{4}x^2+\cdots$ **C** $1+x-\frac{4}{5}x^2+\cdots$ **D** $1-x+\frac{5}{4}x^2+\cdots$ **E** $1+x+\frac{1}{4}x^2+\cdots$

38. Two corners of a square, with side length 2, touch the circumference of a circle. One side of the square is tangent to the circle.

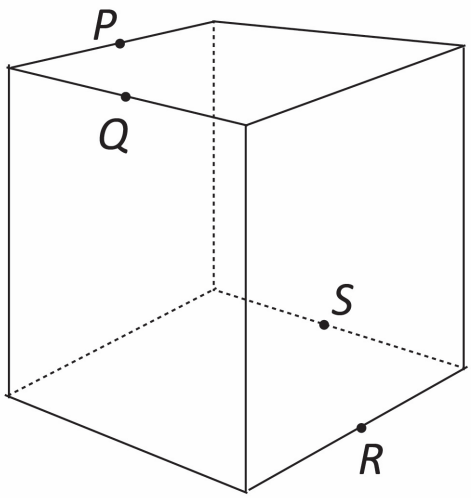


What is the circle's circumeference?

A $\sqrt{5}\pi$ **B** 2π **C** $2\sqrt{2}\pi$

D $\frac{4\sqrt{3}}{3}\pi$ **E** $\frac{5}{2}\pi$

39. A cube has edge length 2. It has a single cut that passes through points P, Q, R and S, which are the midpoints of edges.

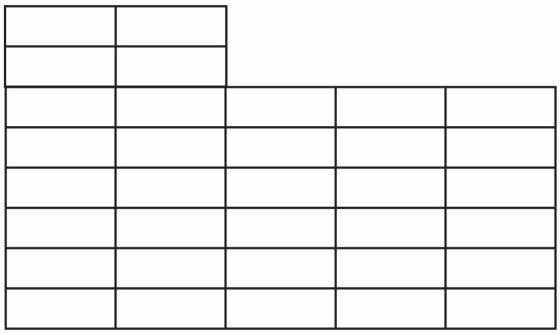


What is the area of cross-section?

A √3 **B** 3√3 **C** 6 **D** 6√2 **E** 8

40. How many rectangles of all types are there?

A 34 **B** 56 **C** 300 **D** 324 **E** 360



Answer Key Open IVMO 2022

2 Marks each for questions 1 - 25
3 marks each for questions 26 - 35
4 marks each for questions 36 - 40

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