1. Suppose x and y are real numbers such that $-4 \le x \le 3$ and $-9 \le y \le 7$. If $a \le x^2 - y \le b$, then find the value of $|ab|$.

2. Given y is directly proportional to the square of x. Calculate the percentage increase in y when x is increased by 35%.

3. Given a and b are real numbers and satisfy the equations $a^2 - b^2 = 16$, $ab = 15$ and $a + b > 0$, what is the value of $a + b$?

4. Let $p(x) = x^3 + ax^2 + bx + c$ where a, b, c, d be real numbers. It is known that $p(1) = 27$ and $p(-1) = 1$. Find $\dfrac{p(3) - p(-3)}{3}$.

5. Given $a > 0$ that satisfies the equation $a^2 + (a+1)^2 + (a+2)^2 = (a+3)^2 + (a+4)^2$, what is the value of a?

6. Find the positive value of x that satisfies the equation $x^3 - 37x - 84 = 0$.

7. Find the largest integer values of n that satisfies the inequality $3n^2 - 14 < 2n^2 + 9n - 22 \leq 3n^2 - 11n + 69$.

8. Find the sum of all the roots of the equation $x^{x^2-289} = 3^{x^2-289}$.

9. Let α and β be solutions of an equation $x^2 - x - 1 = 0$. Find the value of $\left(|\alpha|^3 + |\beta|^3\right)^2$.

10. There are 6 men who wear a red hat or a blue hat. The man wearing a blue hat always tells the truth. But the man wearing a red hat always lies. Each man can see the hat of each other. Each man says the following:

    A: I can see 5 blue hats.

    B: I can see only 1 blue hat.

    C: I can see 3 red hats.

    D: I can see 3 blue hats and 2 red hats.

    E: I can see 4 blue hats and a red hat.

    F: I don't say anything.

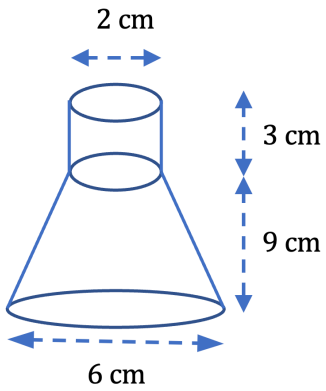
    How many men who wear blue hats are there?

11. Let $\overline{AB}$ is a diameter of a semicircle with center O, the point C is on the opposite arc, and the angle OAC has a measure of 75 degrees. If D and E are points that divide the arc CB into three equal parts, what is the magnitude of angle OEB?

12. Define $\lfloor n \rfloor$ is the largest integer which is less than or equal n.
Suppose that a square pyramid with a base of 8 cm has an inscribed sphere with radius 2 cm. A volume of this pyramid is equal to V. Find a value of $\lfloor V \rfloor$.

13. A sphere with a radius of 2 cm is inscribed in a square pyramid with a side length of base of 8 cm. If the ratio between slant height and the side length of the base of a square pyramid is k, what is the value of $60k$.

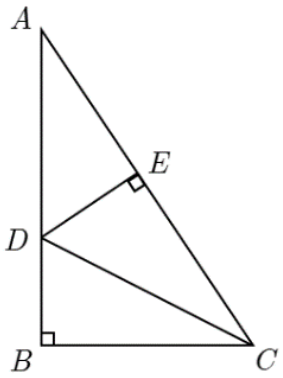
14. In a chemical laboratory, a conical flask is an equipment which consists of two geometries being a conical frustum and cylinder. Find the volume of the conical flask as shown in the figure below. (Given $\pi = \frac{22}{7}$.)



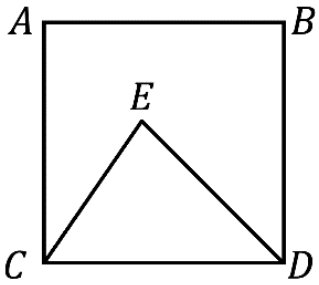
15. Let ABC be a right triangle at C. Points D and E are on the side AB. If the ratio of sides $AD:DE:EB=1:1:1, AC=15$ and $CD^2+CE^2=845$, find the length of the side CB.

16. Let $ABCD$ be a square whose area is 4 square units. Points M and N lie on the sides BC and CD, respectively. If AMN is an equilateral triangle whose side is x unit long, what is the value of $\lfloor 100x \rfloor$?
(Note that $\lfloor n \rfloor$ is the largest integer, which is less than or equal n,
$\sqrt{2}=1.414, \sqrt{3}=1.732, \sqrt{5}=2.236$)

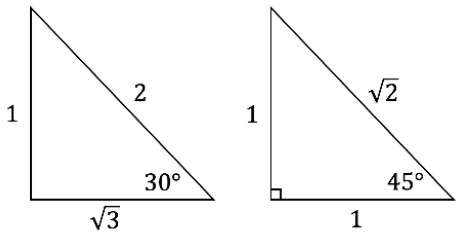
17. From Figure below, a triangle ABC has a right angle at B. Points D and E lie on the sides AB and AC of the triangle ABC, respectively. The line segment DC bisects the angle BCA, a line DE is perpendicular to the side AC. If $DC=5$, $BC=4$ and $AB=\frac{a}{b}$, where $\gcd(a,b)=1$, what is the value of $a+b$?



18.Let $ABCD$ be a square with a side length $a+b\sqrt{c}$ unit, see Figure below. The ratio between the angle ACE and the angle ECD is $1:2$. The line segment DE bisects the angle CDB. The area of a triangle CDE is $\frac{48\sqrt{3}}{\sqrt{3}-1}$. What is the value of $a^2+b^2+c^2$?



Hint:



19. A data series contains 5 numbers whose first, second, and third quartiles are 98, 105, and 127, respectively. Find the arithmetic mean of this data series.

20. A Jar contains 10 marbles, some are green, and others are blue. Jack randomly picks out three marbles from the jar, the probability of picking at least one red marble is $\frac{29}{30}$. How many green marbles are in the Jar?

21. Find the value of x^2 that satisfies the equation $7^x + 2^x = 2417$.

22. Let (x, y) be a solution of the following system:

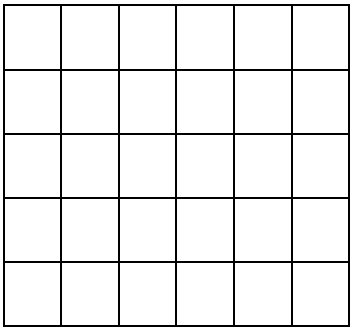
$$\frac{3}{x} + \frac{5}{y^2} = 11 \text{ and } \frac{5}{x} + \frac{9}{y^2} = 21.$$

How many solutions are there?

23. Let ABC is an isosceles triangle in which $AC = BC$, with a circle inscribed in a triangle. The line segment DE is tangent to an inscribed circle and is parallel to the side AB. If $DE = 12$ and $AB = 48$, find the radius of an inscribed circle.

24. Tang Hu Lu is a traditional Northern Chinese snack that is a fruit coated in hardened sugar syrup. Tommy wants to make Tang Hu Lu by coating 100 grapes whose shape of each is a sphere with a radius of 1 cm. The thickness of hardened sugar syrup is 0.1cm. Find the volume of sugar syrup that he uses to make them. Round off the answer to the nearest ten and $\pi = \frac{22}{7}$.

25. In the rectangular grid shown below, each cell is rectangular. How many rectangles can be observed in the grid?



ANSWERS M.3

No.	Answer	No.	Answer
1	175.00	14	132.00
2	82.25	15	36.00
3	8.00	16	207.00
4	42.00	17	103.00
5	10.00	18	169.00
6	7.00	19	111.00
7	7.00	20	4.00
8	0.00	21	16.00
9	20.00	22	2.00
10	0.00	23	12.00
11	65.00	24	140.00
12	113.00	25	315.00
13	72.00		