Mathlete Training Centre
WMI 2022 GRADE 10A

1. Find the value of the constant term in the expansion of $(x - \frac{1}{x^3})^4$

**(A)** 4 **(B)** 6 **(C)** $-4$ **(D)** $-6$



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2. Set real numbers $x$ and $y$ satisfy $x^2 + y^2 = 1$. If the maximum value and the minimum value of $(1 - xy)(1 + xy)$ are $M$ and $m$, respectively, find $M + m$.

**(A)** $\frac{5}{4}$ **(B)** $\frac{3}{2}$ **(C)** $\frac{3+\sqrt{2}}{4}$ **(D)** $\frac{7}{4}$

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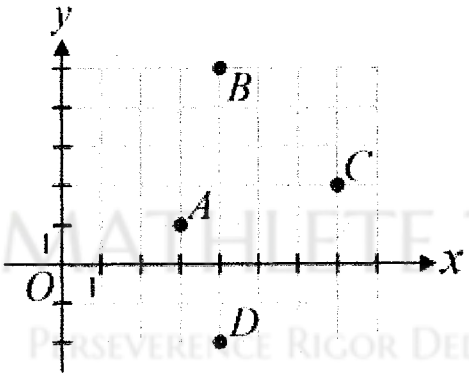
3. Look at the picture. As $L : y - 3 = m(x - 5)$ passes through which coordinates of the point below will make the value of the slope $m$ the smallest?




**(A)** $A$ **(B)** $B$ **(C)** $C$ **(D)** $D$



4.

$$f(x) = \begin{cases} 1 + log_2(26 - x) & x < 9 \\ 2^{x-1} & x \geq 9 \end{cases}$$

$f(-2022) + f(log_2 2022) =?$

**(A)** 2024 **(B)** 2033 **(C)** 1022 **(D)** 1023

5. In an opaque bag are 4 yellow balls and several red balls and blue balls. Take two balls from the bag at will. The probability that they are both yellow balls is $\frac{1}{6}$, the probability that one is a yellow ball and one is a red ball is $\frac{1}{3}$, find the probability that they are both blue balls.

**(A)** $\frac{1}{36}$ **(B)** $\frac{1}{12}$ **(C)** $\frac{1}{6}$ **(D)** $\frac{1}{4}$



6. Find the relation among $\angle A, \angle B$ and $\angle C$ in $\triangle ABC$.

$$\overline{AB} = \sqrt{6}+1 \text{ , } \overline{BC} = \frac{1}{2-\sqrt{3}} \text{ , } \overline{AC} = \sqrt{7+2\sqrt{10}}$$

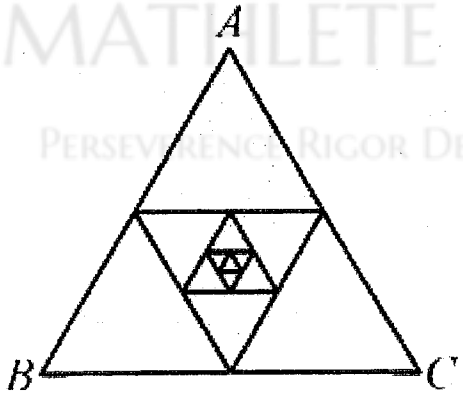
**(A)** $\angle A > \angle B > \angle C$ **(B)** $\angle B > \angle A > \angle C$ **(C)** $\angle C > \angle B > \angle A$
**(D)** $\angle A > \angle C > \angle B$

7. Set $f(x) = x^4 - 3x^3 - 5x^2 + 29 - 30$. Given that 2 - $i$ is a root of $f(x) = 0$. If the result of $f(x) \leq 0$ is $a \leq x \leq b$, find $a + b$

   **(A)** 2 **(B)** $-2$ **(C)** $-1$ **(D)** $-4$



8. Look at the picutre. The perimeter of a regular $\triangle ABC$ is 48. Use the midpoint on each side as the apex to from little triangles which are also regular triangles. Find the sum of the perimeters of the five different sizes of triangles.






**(A)** 96 **(B)** 93 **(C)** 90 **(D)** 87

9. Given three points $A(5,-2i)$, $B(1,-6i)$ and $C(a-1,-ai)$ on the complex plane. If $\triangle ABC$ is a right triangle, find the sum of all the possible values of $a$'s.

   **(A)** 7 **(B)** 8 **(C)** 10 **(D)** 12



10. Danny finds an old password lock. He only remembers that the 4-digit password is formed by 1, 5, 7 and 9. If 1 is not the first digit, 9 is not the last digit, how many times does he need to try at most to open this lock successfully?

    **(A)** 18 **(B)** 16 **(C)** 14 **(D)** 12

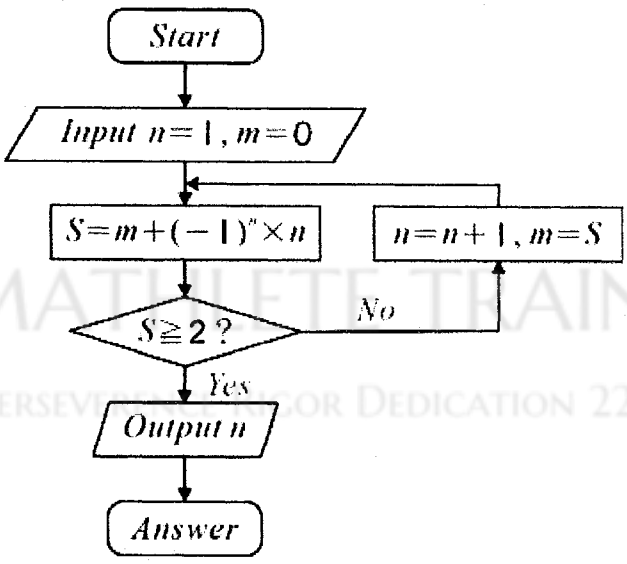
11. How many values of $a$'s satisfy $A \cap B = \{3\}$?

**(A)** 1 **(B)** 2 **(C)** 3 **(D)** 4



12. $\dfrac{5}{1+\dfrac{2022}{\dfrac{1}{\sqrt{7-4\sqrt{3}}}+\dfrac{1}{\sqrt{7+4\sqrt{3}}}}} = \dfrac{p}{q}, (p,q) = 1, p+2q = ?$

**(A)** 1033 **(B)** 1031 **(C)** 2026 **(D)** 2036




13.

**(A)** 2 **(B)** 3 **(C)** 4 **(D)** 5



14. $x = sin60°, \dfrac{1}{1-\sqrt{1-x}} + \dfrac{1}{1+\sqrt{1+x}} = a^{2x}, \dfrac{a^{5x} - a^{3x} + a^x}{a^x - a^{-x} + a^{-3x}} = ?$

**(A)** 4 **(B)** 9 **(C)** 16 **(D)** 27

15. Quidditch is a wizarding sport played on broomsticks. Team A has 40 new students. In the practice, 4 of them choose the position of Seeker, and the others choose 1 or 2 positions among Chaser, Beater, and Keeper. Given that the numbers of students who practice in the positions of Chaser, Beater, and Keeper are 26, 15, and 13, respectively; the number of students who practice in both positions of Chaser and Beater is 6; the number of students who practice in both positions of Beater and Keeper is 4. How many students practice in both positions of Chaser and Keeper?

**(A)** 7 **(B)** 8 **(C)** 9 **(D)** 12