1. a, b, c are three distinct non-zero real numbers such that $\frac{a}{b}, \frac{b}{c}, \frac{c}{a}$ form an arithmetic sequence.

Which of the following must be equal to the value of $\frac{b^2-ca}{c^2-ab}$?

A) $\frac{b}{c}$
B) $\frac{b}{a}$
C) $\frac{a}{b}$
D) $\frac{c}{b}$
E) 1

(Benar +2, Salah 0, Kosong 0)

2. MC E wants to put his 20 identical scarves into a raft containing of 4 boxes in vertical arrangement. He can put the scarves in any box but he must put fewer scarves in the higher box. Moreover, each box must contain at least one scarf.
With that in mind, in how many ways can he arrange his scarves into the raft?

A) 24
B) 23
C) 26
D) 25
E) 27

(Benar +2, Salah 0, Kosong 0)

3. MC E noted that this semester he had participated in eight mathematics exams. The exam score is given on a scale of 100. MC E's records show that the average score after the 7th test increased by 3 points compared to the average score until the 6th test. While the average score until the 8th test also increased by 5 points compared to the average score of first seven test.
The difference between the 8th and 7th exam scores is _____ points.

A) 20
B) 14
C) 8
D) 22
E) 31

(Benar +2, Salah 0, Kosong 0)

4. Andy and Ben are about to cast a pair of dice simultaneously. Beforehand they both guessed the total number that would be shown on the two dices. Andy guessed that the total number would be 4 while Ben guessed the that number would be 7.
Assuming that both dice are fair, what would be the probability that one of the two guesses are correct?

A) $\frac{1}{3}$
B) $\frac{1}{2}$
C) $\frac{2}{3}$
D) $\frac{1}{4}$
E) $\frac{1}{6}$

(Benar +2, Salah 0, Kosong 0)

5. P is a quadratic function with form $P(x) = x^2 + 2x - 16$ and Q is a linear function with gradient 2. The graphs of two function meet at two points with distance $d = \sqrt{5} \cdot 8$ to each other.

Where does Q intersect the y-axis?

A) $y = -2$
B) $y = -1$
C) $y = 0$
D) $y = 1$
E) $y = -3$

(Benar +2, Salah 0, Kosong 0)

6. Find the minimum integer value of x that satisfies the following system of inequalities.

$$\frac{2}{x} - \frac{x}{8} \leq 0$$

$$\frac{3 - 2x}{3x + 7} \leq -1$$

A) 0
B) 4
C) -4
D) -3
E) -10

(Benar +2, Salah 0, Kosong 0)

7. Three identical urns are placed next to each other. The first one cotains one black ball and three white balls. The second one contains two black balls and one white ball, and the third one contain one black ball and one white ball. All the ball are identicals except for their colors. A person is told to take one ball from any urn randomly.

If the person took a black ball, what is the probability that he took it from the third urn?

A) $\frac{1}{9}$
B) $\frac{1}{3}$
C) $\frac{1}{2}$
D) $\frac{1}{5}$
E) $\frac{1}{4}$

(Benar +2, Salah 0, Kosong 0)

8. In a group of 70 people, 37 like cold drinks and 44 like hot drinks and each person likes at least one of the two drinks.

How many like both cold and hot drinks?

A) 9
B) 10
C) 12
D) 11
E) 8

(Benar +2, Salah 0, Kosong 0)

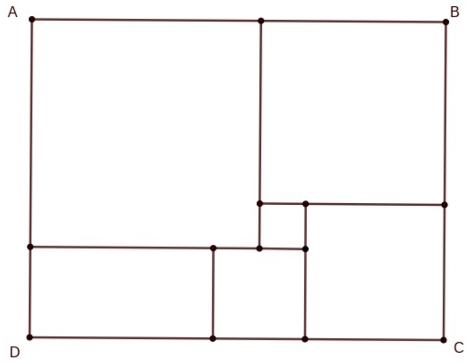
9. Find all solutions of the simultaneous equations.

$xy = 6$
$xz = 8$
$yz = 12$

A) $x = 2, y = 2, z = 6$
B) $x = 3, y = 4, z = 2$
C) $x = 2, y = 6, z = 4$
D) $x = 3, y = 3, z = 4$
E) $x = 2, y = 3, z = 4$
(Benar +2, Salah 0, Kosong 0)

10. For an integer x whose digits are nonzero, we define its nemesis y with digit that of x, inverted. For example if $x = 23$ its nemesis would be $y = 32$. A number x is called a happy number if it's a two-digit positive integer, all its digit are nonzero, and it divides is nemesis.
How many happy number are there?
A) 18
B) 9
C) 12
D) 11
E) 22
(Benar +2, Salah 0, Kosong 0)

11. In the given rectangle **ABCD,** we draw 5 squares and a rectangle. The area of the largest square is $25\ cm^2$ and the smallest one is $1\ cm^2$.
Find the area of the rectangle **ABCD**.



A) $63\ cm^2$
B) $64\ cm^2$
C) $81\ cm^2$
D) $36\ cm^2$
E) $49\ cm^2$
(Benar +2, Salah 0, Kosong 0)

12. Find the greatest integer that divides $n^3 + 35n$ for every positive integer n.
A) 6
B) 4
C) 7
D) 5
E) 8
(Benar +2, Salah 0, Kosong 0)

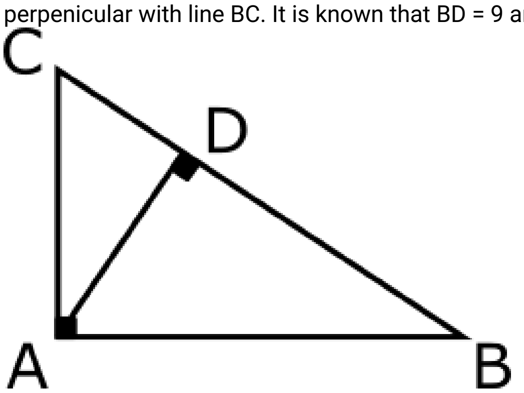
13. In a competition, a school awarded medals in different categories. 12 medals in mathematics, 10 medals in physics and 14 medals in chemistry. These medals went to a total of 20 persons and only 3 persons got medals in all the three categories.

How many received medals in exactly two of these categories?

A) 12
B) 9
C) 10
D) 11
E) 19

(Benar +2, Salah 0, Kosong 0)

14. The ABC triangle below is a right triangle where the right angle is at A. D is on the line BC and the line AD is perpenicular with line BC. It is known that BD = 9 and CD = 4.



What is the area of the right triangle ABC?

A) 48
B) 96
C) 39
D) 24
E) 78

(Benar +2, Salah 0, Kosong 0)

15. If m is an integer, what are the possible values of $\sin(\pi \cdot \cos(\pi \cdot \tan m\pi))$?

A) 1
B) -1 and 0
C) 0 and 1
D) 0
E) -1

(Benar +2, Salah 0, Kosong 0)

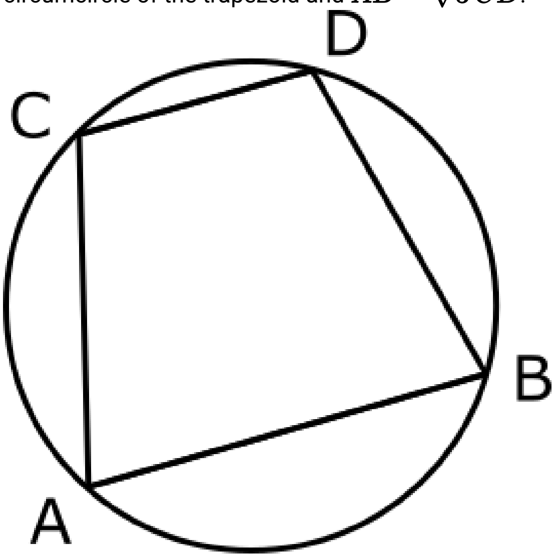
16. In the following inequality, a is a positive real number.
$1 - \sqrt{x} - x + x\sqrt{x} > a$

What is the minimum value of a such that the solution set for the inequality consists of only one continuous interval?

A) 1
B) 1.5
C) 2
D) 0.5
E) 2.5

(Benar +2, Salah 0, Kosong 0)

17. Shown below is trapezoid $ABCD$,, where AB parallel to CD. The length of CD is equal to the radius r of the circumcircle of the trapezoid and $AB = \sqrt{3}CD$.



Calculate the perimeter of the trapezoid in terms of r.

A) $(1 + 4\sqrt{2} + \sqrt{3})r$
B) $(1 + \sqrt{2} + \sqrt{3})r$
C) $(1 + 2\sqrt{2} + \sqrt{3})r$
D) $2(1 + \sqrt{2} + \sqrt{3})r$
E) $(1 + 8\sqrt{2} + 2\sqrt{3})r$
(Benar +2, Salah 0, Kosong 0)

18. What is the maximum number of elements of S subset of set $\{1, 2, 3, \ldots, 2020\}$ such that the difference of any two elements in S is not 2 nor 5?

A) 598
B) 866
C) 1010
D) 673
E) 777
(Benar +2, Salah 0, Kosong 0)

19. Consider the following simultaneous equations.

$$\begin{cases} 2x - y = k \\ x^2 + y^2 = 13 \end{cases}$$

FInd k such that there is only one solution for x and y.

A) ± 3
B) $\pm\sqrt{65}$
C) ± 8
D) $\pm\sqrt{18}$
E) $\pm\sqrt{10}$
(Benar +2, Salah 0, Kosong 0)

20. Find the number of real solutions (x, y) of the equation

$$6y^4 + 4y^2x + 49y^2 + 4xy + 88y + x^2 + 32x + 328 + 4y^3 =$$

.

A) 0
B) 2
C) infinitely many
D) 4
E) 1
(Benar +2, Salah 0, Kosong 0)

21. Find the number of angle x with $0 \leq x \leq 90^\circ$ such that $\cos x \cdot \cos 2x \cdot \cos 4x \cdot \cos 8x = \frac{1}{16}$.

A) 8
B) 1
C) 0
D) 5
E) 9

(Benar +2, Salah 0, Kosong 0)

22. Given a function $f : \mathbb{R} \to \mathbb{R}$ such that *for all* real numbers x and y we have $x + y = f(f(y) - x)$.

If *for some* real numbers x and y we have $x - y = f(f(y) + x)$, then $f(y) + x$ *must be* equal to _____.

A) $f(1)$
B) 1
C) $x - y$
D) $f(0)$
E) 0

(Benar +2, Salah 0, Kosong 0)

23. How many perfect squares divide the number $N = 20 \times 19 \times 18 \times \cdots \times 3 \times 2 \times 1$?

A) 1152
B) 300
C) 2565
D) 32
E) 2020

(Benar +2, Salah 0, Kosong 0)

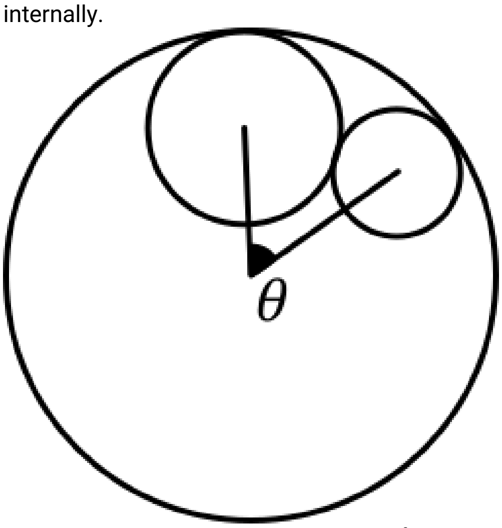
24. There is a class consisting of 7 olympiad students who are going to be selected for national team. After the first test was carried out, in the second test the proctor wants each of the students' seat position to be different from her/his previous position.

Find the number of possibilities of the new seating arrangement.

A) 1134
B) 1962
C) 1626
D) 1728
E) 1854

(Benar +2, Salah 0, Kosong 0)

25. Two small circles with radii 3 and 2 are placed inside a big circle with radius 8. The small circles are touching each other externally and both are touching the big circle internally.



What is the cosine of the acute angle θ formed by the two lines joining the center of the big circle and that of the small circles?.

A) $\frac{4}{5}$
B) $\frac{3}{5}$
C) $\frac{7}{8}$
D) $\frac{5}{8}$
E) $\frac{3}{8}$

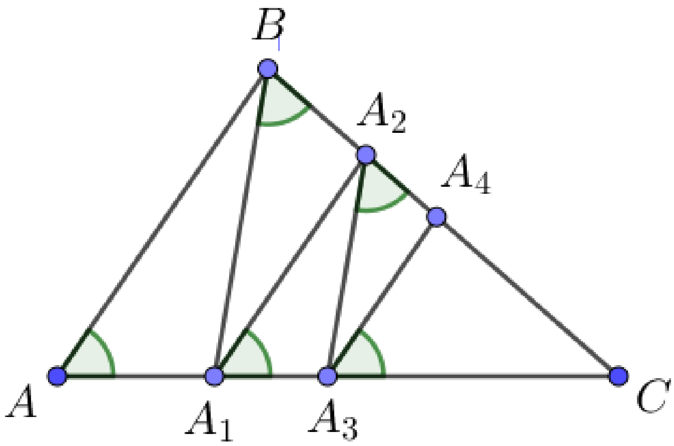
(Benar +2, Salah 0, Kosong 0)

26. Find all positive integers x, y such that $y^3 - 100 = 5^x$

A) $(2, 6)$
B) $(2, 5)$
C) infinitely many solutions
D) $(2, 1)$
E) $(3, 5)$

(Benar +2, Salah 0, Kosong 0)

27. GIven a triangle ABC with $AB = 4, BC = 5, CA = 6$, and $\angle BAC = x$. Point A_1 is on segment AC such that $\angle A_1BC = x$, point A_2 is on segment BC such that $\angle A_2A_1C = x$, point A_3 is on segment A_1C such that $\angle A_3A_2C = x$, and so on.

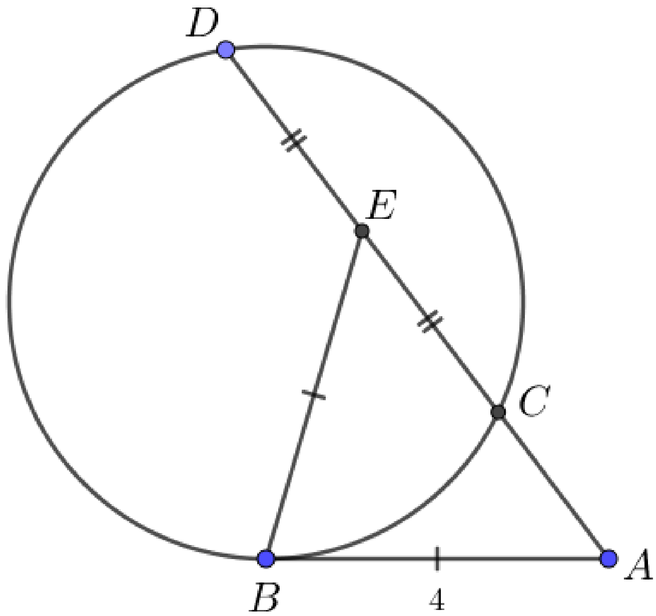


Find the infinite sum $A_1A_2 + A_3A_4 + A_5A_6 + \cdots$.

A) $\frac{25}{11}$
B) $\frac{100}{11}$
C) 100
D) 11
E) 6

(Benar +2, Salah 0, Kosong 0)

28. Point A lies outside of a circle with radius 3. A line drawn from A is tangent to the circle at B. Another line drawn from A intersects the circle at two distinct points C and D.



If E is the midpoint of CD with $EB = BA = 4$, then the length of AE is ____.

A) 1
B) 5
C) $\frac{7}{5}$
D) $\frac{24}{5}$
E) $\sqrt{5}$

(Benar +2, Salah 0, Kosong 0)

29. Find the last two digits of the number 13^{2020}.

A) 61
B) 13
C) 01
D) 69
E) 97

(Benar +2, Salah 0, Kosong 0)

30. Find a_n (the n-th term) and S_n (the sum of the first n terms) of arithmetic progression given that $a_2 + 2a_4 = 27, a_{17} = 50$.

A) $a_n = 3n + 1, S_n = \frac{n(3n+5)}{2}$
B) $a_n = 3n - 1, S_n = \frac{n(3n-1)}{2}$
C) $a_n = 3n + 1, S_n = \frac{n(3n+1)}{2}$
D) ,$a_n = 3n - 1, S_n = n(3n - 1)$
E) $a_n = 3n - 1, S_n = \frac{n(3n+1)}{2}$

(Benar +2, Salah 0, Kosong 0)

31. Andy forgot the PIN code for his ATM card. He only remembers three information :

1. His PIN code is a sequence of six single-digit numbers.
2. No two adjacent numbers are consecutive.
3. Andy's PIN code contains the sequence 2020.

Based on these information alone, how many different PIN codes are possible? (note : the first/leftmost digit can be 0)

(Benar +4, Salah 0, Kosong 0)

32. Andy is going to mark some n points on a triangular metal plate with side lengths 4 cm, 5 cm, and 6 cm. The marked points can be on the edge or interior of the triangle. Andy observes that no matter where he puts the marks, there will always be two points that are at most 3 cm apart.

What is the smallest value of n ?

(Benar +4, Salah 0, Kosong 0)

33. Find the value of $f^{-1}(4)$ for given function $f(2x+3) = \frac{6x-1}{4x+1}$.

(Note: f^{-1} denotes the inverse of f.)

(Benar +4, Salah 0, Kosong 0)

34. A sequence of real numbers is given recursively by $a_n = a_{n-1} + 2a_{n-2}$ for all $n \geq 3$, and $a_1 = 1$.

If the 2021'st term of the sequence is 1, then the summation of the first 2021 terms of this sequence is equal to _____.

(Benar +4, Salah 0, Kosong 0)

35. Consider a three-digit number. If we multiply the number by 4 and subtract the result by 120 we will get another three-digit number whose digits are those on the initial number except that they are in reverse order.

What is the sum of all the digits in the initial number?

(Benar +4, Salah 0, Kosong 0)

36. How many non-similar triangles have side lengths which form a geometric sequence with integer ratio?

(Benar +4, Salah 0, Kosong 0)

37. Find the number of integer k such that the equation
$\mathrm{LCM}(m,n) + k\,\mathrm{GCD}(m,n) = 2020m + 2021n$
has infinitely many integer solutions m, n.
(Benar +4, Salah 0, Kosong 0)

38. How many polynomials $P(x)$ with integer coefficient of degree 4 satisfy $P(1) = 2, P(4) = 1$?
(Benar +4, Salah 0, Kosong 0)

39. Consider the famous Fibonacci sequence, f_n, given as
$f_{n+2} = f_{n+1} + f_n$ for all $n > 0$ with $f_1 = 1, f_2 = 1$.
What is the value of GCD(f_{2020}, f_{30})?
(Benar +4, Salah 0, Kosong 0)

40. Positive integers x, y satisfies
$3x + 15xy - 5y = 2021$.
Find $3x + 5y$.
(Benar +4, Salah 0, Kosong 0)