

Mathematics (SAMPLE)

- Consider the number 30^{19} , we divide it by 3 and then we divide the result by 10^5 . At the end we have the number:
 - The number is too big and I cannot compute it
 - $2^{14} \cdot 3^{18} \cdot 5^{14}$
 - 10^{14}
 - 30^{14}
 - $3^{19} \cdot 10^{14}$
- An investor buys shares with a value of 100,000 Euro. The next month he reads in a newspaper that his shares have increased their value by 20%. Another month passes and his shares were reduced in value by 20%. He then decides to sell his shares. The total value is:
 - 80,000 Euro
 - 96,000 Euro
 - 100,000 Euro
 - 92,000 Euro
 - 120,000 Euro
- The circle C has a diameter of 4 m (meters); the square S has a side of 2 dm (decimeters) and is completely contained in C . The area of the region contained in C and lying outside C' is:
 - $(4^2\pi - 2^2) \text{ dm}^2$
 - 0
 - $(20 - 2)^2\pi \text{ dm}^2$
 - $(20^2\pi - 2^2) \text{ m}^2$
 - $(20^2\pi - 2^2) \text{ dm}^2$
- The inequality $1 + \sin 3x \geq 2$ is verified:
 - for all real x
 - if $x = \frac{\pi}{6} + \frac{2k\pi}{3}$ (k is an integer number)
 - only if $x = \frac{\pi}{2} + \frac{2k\pi}{3}$ (k is an integer number)
 - only if $x = 2k\pi$ (k is an integer number)
 - for no real value of x
- The equation $x^4 - 3x^2 + 2 = 0$
 - has at least three solutions with the same sign
 - has two (and only two) real solutions
 - has no real solutions
 - has only negative solutions
 - has four real solutions
- The circle c has equation $x^2 + y^2 = 1$ and the circle d has equation $(x - 2)^2 + y^2 = 9$. One of the following statements is correct. Which one?
 - They intersect in two distinct points
 - They intersect in four distinct points
 - They intersect in one point and d is contained in c
 - They intersect in one point and c is contained in d
 - They have no points of intersection
- A common divisor of the monomials $4a^2b^5$, $2a^2b^3c$, $8a^3b^2$ is
 - a^2b
 - $64a^7b^{10}c$
 - $2ab^2c$
 - $4a^2b$
 - ab^3
- Two springs A and B initially at rest have the same length $L = 6$ cm. When the same mass is hung from them, the length of A becomes equal to 10 cm and that of B to 8 cm. What can we say about the elastic constants of the two springs?
 - $k_B = \frac{1}{2}k_A$
 - $k_B = k_A$
 - $k_B = \frac{4}{5}k_A$
 - $k_A = \frac{4}{5}k_B$
 - $k_A = \frac{1}{2}k_B$

9. The set of real numbers that satisfy the inequality $(x^2 + 5)(x + 2) \leq 0$, from the geometrical point of view, is composed by

- (a) One segment
- (b) One half line
- (c) Two segments
- (d) Two half lines
- (e) One segment and one half line

10. The product of 40 integer numbers is positive. From this information we can deduce that it is necessarily true that:

- (a) 20 factors are positive and 20 factors are negative
- (b) at least two factors are negative
- (c) 2 factors are positive and 38 factors are negative
- (d) the number of positive factors is either zero or an even number
- (e) all factors are positive

11. The number $x = \frac{(9^3)^2}{((11^2)^3)^2}$

- (a) $(\frac{9}{11})^{12}$
- (b) $\frac{9^8}{11^7}$
- (c) $(\frac{9}{11})^6$
- (d) $(\frac{9}{11})^{12} 9^6$
- (e) $(\frac{9}{11})^{18}$

12. The real number $\sqrt{7 \sqrt[3]{7} \sqrt[3]{\frac{3}{7^4}} + 2 \sqrt[3]{3}}$ equals to:

- (a) $7 \sqrt[3]{3}$
- (b) $21 \sqrt{21}$
- (c) $\sqrt[3]{3^2}$
- (d) $\sqrt{2} \sqrt[3]{3}$
- (e) $\sqrt{3^3 + \sqrt[3]{3}}$

13. A high school is made by 25 pupils, of which 13 swim, 11 cycle and 8 go skiing. There is no one practicing all three

sports. In yesterday's test the sportsmen (those practicing at least one sport) went pretty well: they all got 8 or 9 (out of 10) as a mark. There were 9 pupils who got less than 8. We can therefore deduce that:

- (a) one sportsman might have gotten a 10
- (b) for cyclists can also ski
- (c) someone in the class got a 10
- (d) three cyclists only can ski as well
- (e) every cyclist can also ski

14. The equation $\log_3(2 - x) = 3$ has the solution:

- (a) $x = -25$
- (b) $x = -\log_3 2$
- (c) $x = -\log_2 3$
- (d) $x = -1$
- (e) $x = 3^{3+\log_3 2}$

15. How can you insert the + (plus) or the - (minus) sign in the following sequence of numbers:

10 11 12 13 14

in order to have +10 as a result

(An example: if I insert + - in the

sequence 5 6 7 the result is $5 + 6 - 7 = +4$, if I insert - + the result is $5 - 6 + 7 = +6$)

- (a) - - + +
- (b) - + + -
- (c) - - - +
- (d) + + - -
- (e) - + - +

16. If $a > 0$, which of the following statements is true:

- (a) $\log_3 a = \frac{1}{2} \log_2 a$
- (b) $\log_4 a = 2 \log_2 a$
- (c) all the other statements are false
- (d) $\log_4 a = \sqrt{\log_2 a}$
- (e) $\log_4 a = (\log_2 a)^2$

17. The equation $3^{2x} - 12 \cdot 3^x + 27 = 0$

- (a) has the solutions: $x_1 = 0, x_2 = 1, x_3 = 2$
- (b) has the solutions: $x_1 = -1, x_2 = 1$
- (c) has the solutions: $x_1 = 3, x_2 = 9$
- (d) has no solutions
- (e) has the solutions: $x_1 = 1, x_2 = 2$

18. The measure of the angle α is 3 radians;
then we can say that:

- (a) $\sin \alpha$ and $\cos \alpha$ are both negative
- (b) $\cos \alpha > 0$
- (c) the measure of α in degrees is bigger than 180°
- (d) $\cos \alpha < 0$
- (e) $\sin \alpha < 0$

Physics (SAMPLE)

1. A bullet of mass $m = 2 \text{ g}$ is fired with speed $v = 300 \text{ m/s}$ into a wooden block (fixed to the floor). The bullet penetrates into the block for a distance $s = 20 \text{ cm}$, then it stops and remains embedded in the block. Calculate the frictional force that the wood exerts on the bullet, supposed to be constant.

 - (a) $F = 225 \text{ N}$
 - (b) $F = 450 \text{ N}$
 - (c) $F = 150 \text{ N}$
 - (d) $F = 300 \text{ N}$
 - (e) $F = 90 \text{ N}$
2. A mass $m = 10 \text{ kg}$ is hung from a dynamometer whose upper end is fixed to the ceiling of an elevator. If the dynamometer reads a force $F = 95 \text{ N}$, what can we say about the motion of the elevator? (assume $g = 10 \text{ m/s}^2$).

 - (a) the elevator has an acceleration $a = 9.5 \text{ m/s}^2$ directed downward
 - (b) the elevator has an acceleration $a = 9.5 \text{ m/s}^2$ directed upward
 - (c) the elevator has an acceleration $a = 0.5 \text{ m/s}^2$ directed downward
 - (d) the elevator is moving upward
 - (e) the elevator has an acceleration $a = 0.5 \text{ m/s}^2$ directed upward
3. A referee tosses the coin to decide which team has to start the match. If the coin reaches a height of 150 cm above the release point, which was its initial speed? (assume for simplicity that $g = 10 \text{ m/s}^2$)

 - (a) about 30 m/s
 - (b) about 4.5 m/s
 - (c) about 3 m/s
 - (d) about 5.5 m/s
 - (e) it is impossible to answer unless the mass of the coin is given
4. A body can move along the x axis. At $t = 0$ it is at rest, then starts moving with acceleration $a = 1.2 \text{ m/s}^2$. What is its position after 10 seconds?

 - (a) 6 m
 - (b) 12 m
 - (c) 60 m
 - (d) 120 m
 - (e) there are not enough data to answer
5. The turntable of a record player is turning at 45 rounds per minute. A small object is at rest on the turntable, at a distance $d = 10 \text{ cm}$ from the center. Its velocity:

 - (a) is tangent to the circumference of radius d and has a magnitude of about 47 m/s
 - (b) is directed radially and has a magnitude of about 0.47 m/s
 - (c) is tangent to the circumference of radius d and has a magnitude of about 4.7 m/s
 - (d) is directed radially and has a magnitude of about 47 m/s
 - (e) is tangent to the circumference of radius d and has a magnitude of about 0.47 m/s
6. Consider two vectors \vec{a} and \vec{b} such that $|\vec{a}| = |\vec{b}| = 2$. Their scalar product $\vec{a} \cdot \vec{b}$ is equal to 2 as well. Which of the following sentences is correct?

 - (a) The two vectors are parallel.
 - (b) The angle between \vec{a} and \vec{b} is equal to 45°
 - (c) The angle between \vec{a} and \vec{b} is equal to 60°
 - (d) The angle between \vec{a} and \vec{b} is equal to 30°
 - (e) The angle between \vec{a} and \vec{b} is equal to 90°
7. A body of mass $m = 10 \text{ kg}$ moves along a curve trajectory from a point A at height $h_A = 3 \text{ m}$ above the ground to a

- point B at a height $h_B = 2$ m. What is the work W_{AB} done by the gravitational force? (assume $g = 10$ m/s²)
- (a) $W_{AB} = +10$ J
 (b) $W_{AB} = -100$ J
 (c) $W_{AB} = 0$ because the gravitational force is conservative
 (d) $W_{AB} = +100$ J
 (e) $W_{AB} = -10$ J
8. Which of these dimensional equations is correct?
- (a) $1 \text{ J} = 9.8 \text{ kg m/s}^2$
 (b) $1 \text{ J} = 9.8 \text{ kg/m}^2$
 (c) $1 \text{ J} = 1 \text{ kg m/s}^2$
 (d) $1 \text{ J} = 1 \text{ kg m}^2/\text{s}^2$
 (e) $1 \text{ J} = 1 \text{ kg m/s}$
9. Two springs A and B initially at rest have the same length $L = 6$ cm. When the same mass is hung from them, the length of A becomes equal to 10 cm and that of B to 8 cm. What can we say about the elastic constants of the two springs?
- (a) $k_B = \frac{1}{2}k_A$
 (b) $k_B = k_A$
 (c) $k_B = \frac{4}{5}k_A$
 (d) $k_A = \frac{4}{5}k_B$
 (e) $k_A = \frac{1}{2}k_B$
10. You are driving at a constant speed of 72 km/h. Suddenly you see an obstacle in front of you and violently press the pedal brake. The car stops in 20 m. What is the acceleration of your car, supposed to be constant, while you brake?
- (a) $a = -1$ m/s²
 (b) $a = -10$ m/s²
 (c) $a = 10$ m/s²
 (d) $a = 1$ m/s²
 (e) $a = -20$ m/s²
11. A spring of elastic constant $k = 8$ N/m is used to launch a steel ball of mass $m = 500$ g on a horizontal surface. If the spring was initially compressed of a length $x = 20$ cm, what is the final speed of the ball?
- (a) 0.08 m/s
 (b) about 1.6 m/s
 (c) about 16 m/s
 (d) 0.8 m/s
 (e) 8 m/s
12. A mass $m = 1$ kg is falling downward under the effect of gravity and of a kinetic upward force $F = 10$ N. Let's assume for simplicity that $g = 10$ m/s². Which of the following sentences is correct?
- (a) The mass falls with a decreasing speed
 (b) The mass falls at a vertical speed
 (c) The mass is at rest
 (d) The mass moves upward with decreasing speed
 (e) The mass falls with increasing speed

Logics (SAMPLE)

1. Tell which number fits in the sequence
76845 67845 68745 68475 ...
choosing among

- (a) 78564
- (b) 68457
- (c) 65487
- (d) 45078
- (e) 87654

2. Discussing their personal finances four friends (Feruzza, Gulzoda, Laziza and Nigora) state that:

- Feruzza has less money than Laziza
- Gulzoda has less money than Laziza
- Laziza has more money than Nigora
- Gulzoda has more money than Feruzza

Then, which of the following statements is NOT NECESSARILY correct?

- (a) Feruzza is the poorest among the friends
 - (b) Nigora has less money than Laziza
 - (c) the richest among the friends is Laziza
 - (d) the alphabetical order of the names is not the same as the (increasing order) of the money owned
 - (e) Gulzoda is not the poorest
3. In a car race
- Mona surpasses Mary
 - Megan is surpassed by Mary
 - Margaret surpasses Mona

Then, the correct order of arrival is:

- (a) Margaret – Mona – Mary – Megan
- (b) Mary – Megan – Mona – Margaret
- (c) Margaret – Mary – Megan – Mona
- (d) Mona – Mary – Megan – Margaret
- (e) Megan – Mona – Mary – Margaret

4. Which number fits in the sequence
33 17 9 5 ...
choosing among

- (a) 3
- (b) 4
- (c) 1
- (d) 2
- (e) 0

5. Laureen is talking with Humphrey: "If the weather is good on Sunday, I will go to the horse races. I will also bring my friend Sam with me, if he feels ok". On Sunday afternoon Humphrey meets Laureen in town. What is true?

- (a) Sam is not well
- (b) it is raining and Sam is not well
- (c) it is good weather, but Sam did not want to go to the horse races
- (d) it is good weather, but Sam is not well
- (e) it is raining

6. The 22 students of the course of History of Italian Opera must write a short paper about at least two composers; they have a better grade if they choose to write a paper about one more composer. Among the students, 17 choose Verdi, 15 choose Rossini and 15 Donizetti. How many students have chosen to write three papers?

- (a) 2 students
- (b) it is impossible to answer this question
- (c) 3 students
- (d) nobody has chosen three composers
- (e) 15 students