

Questions for the App – Italy

MATHEMATICS

1) The following equation $12(x - 4) + 3(2 - x) = 48$ is verified for...

A $x = 10$

B $x = 0$

C $x = 2$

D $x = -1$

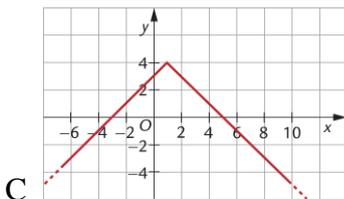
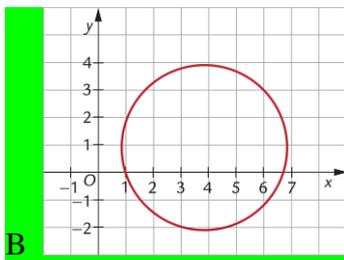
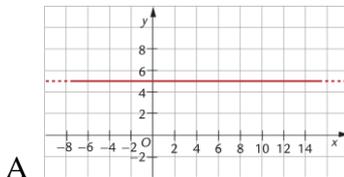
Theory and hints

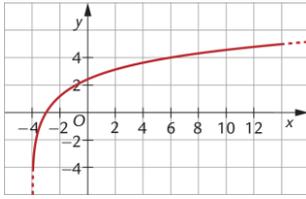
1 – Remove two incorrect answers

2 – Carry out the multiplications and write the x terms on the first member and the numerical ones on the second member (changing the signs, if necessary), add the terms on the first second member and determine x if possible

3 – Need to find x ? Look at the answers and replace the numbers in the x , it will be right that will verify the equality

2) Indicate which of those proposed does NOT represent a function.





D

3) Which of the following is not an arithmetic progression?

A 2 ; 0 ; -2 ; -4 ; -6

B 0,15 ; -0,1 ; -0,35 ; -0,7

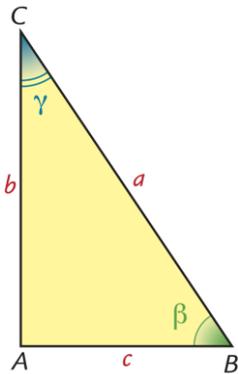
C 7 ; 14 ; 21 ; 28 ; 35

D $-\frac{1}{2}$; 1 ; $\frac{5}{2}$; 4 ; $\frac{11}{2}$

Theory and hints

In an arithmetic progression the difference between each term following the first and the previous one is constant.

4) Consider the triangle in the figure for which we have $b = 6$, $\gamma = 30^\circ$.



So:

A $a = 3\sqrt{3}$, $c = 3$, $\beta = 105^\circ$

B $a = 4\sqrt{3}$, $c = 2\sqrt{3}$, $\beta = 105^\circ$

C $a = 4\sqrt{3}$, $c = 2\sqrt{3}$, $\beta = 60^\circ$

D $a = 3\sqrt{3}$, $c = 3$, $\beta = 60^\circ$

Theory and hints

The sum of the interior angles of a triangle is 180° and $b = a \sin \beta$

PHYSICS

1) Principles of inertia

Two carriages of a small train (the first with mass $m_1 = 0.38 \text{ kg}$ and the second with mass $m_2 = 760 \text{ g}$) can move without appreciable friction on a straight track. When they collide, the former experiences an acceleration of 4.00 m/s^2 .

What is the magnitude of the acceleration experienced by the second wagon in the collision?

- A** The acceleration of the second car is half that of the first.
- B** The acceleration of the second car is twice that of the first.
- C** The acceleration of the first car is three times that of the first.
- D** The acceleration of the first car is one third of that of the first.

Theory and hints

The force experienced by the first car has the form:

$$F_1 = m_1 a_1$$

According to the third law of dynamics, the magnitude of the force experienced by the second wagon is equal to that of the force experienced by the first wagon:

$$F_1 = F_2 \Rightarrow m_1 a_1 = m_2 a_2$$

So the acceleration to which the second wagon is subjected is:

$$a_2 = m_1 a_1 / m_2 = (0,380 \text{ kg}) \times 4,00 \text{ m/s}^2 / 0,76 \text{ kg} = 2,00 \text{ m/s}^2$$

<https://openstax.org/books/college-physics-2e/pages/4-4-newtons-third-law-of-motion-symmetry-in-forces>

2) Conservation of mechanical energy

A 20 kg body is slid down a 5 m high inclined plane. Knowing that it reaches the ground with a kinetic energy of 920 J, you can conclude that:

- A** a constant power acted upon the body.
- B** Kinetic energy is conserved but potential energy is not.
- C** mechanical energy is conserved.
- D** 60 J was dissipated.

Theory and hints

Before sliding, the body has only potential energy, E_p , given by the product of the mass ($m = 20$ kg), the height of the top ($h = 5$ m) and the acceleration due to gravity ($g = 9,8$ m/s²); you have:

$$E_p = m g h = 980 \text{ J.}$$

The body arrives on the ground with kinetic energy, E_c , equal to 920 J. During the journey, the difference between the initial potential energy and the final kinetic energy was dissipated:

$$E_p - E_c = 60 \text{ J.}$$

<https://collegedunia.com/exams/conservation-of-mechanical-energy-physics-articleid-2192>

3) First law of thermodynamics

One mole of an ideal gas expands at a constant pressure of $1,00 \times 10^5$ Pa, going from 24.5 L to 27.5 L. During the expansion, the gas absorbs 100 cal.

Calculate:

- **the work done by the gas;**
- **the change in internal energy of the gas.**

A The work is 600 J and the change in internal energy -181 J.

B The work is 300 J and the change in internal energy is 119 J.

C The work is -300 J and the change in internal energy is 719 J.

D The work is 200 J and the change in internal energy is 100 J.

Theory and hints

The gas expands at constant pressure p , so the work is:

$$W = p \cdot \Delta V = (1,00 \times 10^5 \text{ Pa}) \cdot (27,5 - 24,5) \times 10^{-3} \text{ m}^3 = 300 \text{ J}$$

From the first law of thermodynamics we get the change in internal energy:

$$\Delta U = Q - W = (100 \times 4,186) \text{ J} - 300 \text{ J} = (419 - 300) \text{ J} = 119 \text{ J}$$

<https://www.khanacademy.org/science/physics/thermodynamics/laws-of-thermodynamics/a/what-is-the-first-law-of-thermodynamics>

4) Energy transformations in an electric circuit

A circuit contains a 9.0 V battery and two resistors, connected in series, of resistance of respectively $R_1 = 2.0 \Omega$ e $R_2 = 7.0 \Omega$.

- **Calculate the power dissipated by the resistor R_1 .**
- **Calculate the time it takes for the same resistor to emit energy W equal to 0.7 kWh. (Express the result in hours.)**

A Dissipated power = 5.0 W and time = 140 h

B Dissipated power = 2.0 W and time = 350 h

C Dissipated power = 7.0 W and time = 100 h

D Dissipated power = 9.0 W and time = 78 h

Theory and hints

The equivalent resistance of the circuit, R_e , is given by the sum of the two resistances:

$$R_e = R_1 + R_2 = 2,0 \, \Omega + 7,0 \, \Omega = 9,0 \, \Omega$$

From Ohm's first law we obtain the current flowing through the circuit and therefore the current that goes through R_2 :

$$i = \Delta V / R_e = 9,0 \, \text{V} / 9,0 \, \Omega = 1,0 \, \text{A}$$

From the formula for the dissipated power we get:

$$P = R_2 i^2 = 7,0 \, \Omega (1,0 \, \text{A})^2 = 7,0 \, \text{W}$$

From the definition of power $P = W / \Delta t$, we obtain:

$$\Delta t = W / P = 0,7 \times 10^3 \, \text{Wh} / 7,0 \, \text{W} = 100 \, \text{h}$$

<https://ohmlaw.com/>

INFORMATION TECHNOLOGY

1) Which of these is not an input device?

A keyboard

B mouse

C screen

D scanner

Theory and hints

The input device is a type of device that inputs data to the PC's main memory working in a unidirectional manner.

2) With the term “algorithm” we mean...

A A program

B A finite set of instructions

C An endless procedure

D A complex calculation formula

Theory and hints

An algorithm is a finite set of instructions used to solve a problem.

3) **What is the difference between a while loop and a do while loop?**

- A the do while loop always terminates
- B the statements are executed at least once in the while loop
- C they are the same thing
- D none of the previous answers**

Theory and hints

The do-while loop is similar to the while loop except that the body of the loop is executed at least once. For example, if the condition is initially false, the body of a while loop is never executed, but the body of a do-while loop is still executed the first time.

4) **What is meant by primary key in a database?**

- A an attribute that uniquely recognizes an entity**
- B An integrity constraint between one or more tables.
- C A strengthened attribute
- D A key that initializes the table and is on the first record in the table.

Theory and hints

In relational databases, the primary key is that attribute that uniquely allows the recognition of the entity. (Ex. Tax code).

BIOLOGY

1) **What is the percentage of oxygen present in the air we breathe?**

- A 5%
- B 21%**
- C 75%
- D 90%

Theory and hints

An oxygen percentage higher than 21% would not allow the current form of life on Earth

2) **The prokaryotic cell is:**

- A more complex than the eukaryotic one
- B larger than the eukaryotic one
- C more primitive than the eukaryotic one**
- D very similar to the eukaryotic one

Theory and hints

The prokaryotic cell represents the first form of life on Earth

3) All and only eukaryotic cells have:

- A nuclear cladding
- B chloroplasts
- C ribosomes
- D chromosomes

Theory and hints

Nucleus is a component of eukaryotic cells, chloroplasts of plant eukaryotes, ribosomes and chromosomes are not exclusive features of eukaryotic cells.

4) Laws of Mendel. In guinea pigs, the allele that determines black fur color (N) is dominant over the allele that determines white fur color (n). Can two black-haired parents generate one or more white-haired children?

- A No, the recessive trait can only manifest itself in the second generation.
- B Yes, because they could both be heterozygous (Nn).
- C Yes, as long as one of the two parents is homozygous recessive.
- D No, because black-haired parents can only produce black children.

Theory and hints

By elaborating Punnet's square it can be verified that a quarter of the filial generation can be born with white hair.

CHEMISTRY

1) What is the chemical symbol of hydrogen?

- A I
- B Ig
- C H
- D Hg

Theory and hints

Hydrogen is the first chemical element in the Periodic Table (atomic number 1) and the lightest. The H symbol comes from Latin *hydrogenium* and means “generator of water”.

https://youtu.be/U-MNKK20Z_g

2) In a chemical reaction, the sum of the masses of the reactants must equal the sum of the masses of the products. Who formulated this law?

- A Proust
- B Lavoisier
- C Dalton
- D Avogadro

Theory and hints

In 1789, the scientist Antoine-Laurent Lavoisier formulated the law of conservation of mass, stating that "Nothing is created, nothing is destroyed, everything is transformed", after having experimentally demonstrated that matter cannot be created or destroyed, but only transformed.

<https://youtu.be/M-De2IMayco>

3) One of the following chemical compounds belongs to the category of hydroxides. Which?

A H_2CO_3

B H_2S

C N_2O_3

D $\text{Mg}(\text{OH})_2$

Theory and hints

Hydroxides are ternary compounds formed from a metal, oxygen and hydrogen. The formulas of the hydroxides can be recognized by the fact that the symbol of the metal precedes the grouping (**OH**), present in the formula with an index equal to the oxidation number of the metal.

<https://youtube.com/shorts/Ia2dEdhfUyY?feature=share>

4) $\text{Zn} + \text{H}_2\text{SO}_4 \rightarrow \text{ZnSO}_4 + \text{H}_2$ In this redox reaction which element is oxidized?

A Sulfur

B Hydrogen

C Oxygen

D Zinc

Theory and hints

Redox or redox reactions are reactions in which the oxidation number of atoms changes. The chemical species that oxidizes gives up electrons and increases the oxidation number, the chemical species that decreases acquires those electrons, decreasing the oxidation number. In this redox reaction, zinc loses electrons and is therefore oxidized, hydrogen acquires them and is therefore reduced, while the oxidation number of sulfur and that of oxygen do not change.

<https://www.youtube.com/watch?v=1tn6Q6rxs-w>

ELECTROTECHNICS

1) The resistance is:

A Directly proportional to the current

B Inversely proportional to current

C Current independent

D None of the above

2) Identify the correct correspondence between element and physical law:

- | | |
|------------|-----------------|
| 1. Sweater | to. current law |
| 2. Branch | b. voltage law |
| 3. Node | c. ohm's law |

A 1-c, 2-a, 3-b

B 1-b, 2-a, 3-b

C 1-b, 2-c, 3-a

D None of the previous answers

3) Assign the correct unit of measure to each quantity

- | | |
|------|----------|
| 1. B | a. Henry |
| 2. H | b. Tesla |
| 3. L | c. Weber |

A 1-b, 2-c, 3-a

B 1-b, 2-a, 3-b

C 1-a, 2-c, 3-b

D None of the previous answers

4) Germanium and silicon are substances:

A conductors

B semiconductors

C insulators

D none of the answers