مسابقة في الثقافة العلمية- مادة الفيزياء	الاسم:
المدة ساعة واحدة	الرقم:

<u>This exam is formed of three exercises in two pages.</u>
<u>The use of non-programmable calculator is recommended</u>

<u>Exercise 1</u>: (7 ½ points)

Mechanical energy

A girl standing on a platform throws a stone, considered as a particle of mass m = 0.1 kg, vertically upwards from point A found at a height h_A = 30 m above sea level. The stone is launched from point A with a speed V_A = 12 m/s, reaches its maximum height at point B, and then it falls down to reach point C at sea level.

Take:
- the sea level as a gravitational potential energy reference for the system [stone, Earth];
- $g = 10\ m/s^2$.

1- Calculate, at point A, at the launching instant:
- **1-1)** the kinetic energy of the stone;
- **1-2)** the gravitational potential energy of the system [stone, Earth];
- **1-3)** the mechanical energy of the system [stone, Earth].

2- In this part, air resistance is neglected.
- **2-1)** Specify the value of the mechanical energy of the system [stone, Earth] at point B.
- **2-2)** Determine the maximum height h_B reached by the stone above sea level.
- **2-3)** Determine the speed V_C of the stone as it reaches point C.

3- In reality air resistance is not neglected. The stone reaches point C with a speed V'_C = 21 m/s.
- **3-1)** Calculate the new value of the mechanical energy of the system [stone, Earth] at point C.
- **3-2)** Calculate the decrease in the mechanical energy of the system [stone, Earth] between points A and C.
- **3-3)** In what form of energy does this decrease in mechanical energy appear?

<u>Exercise 2</u>: (6 ½ points)

The americium-241 nucleus

The americium nucleus $^{241}_{95}Am$ is a radioactive nucleus which is usually used in archeology.

1- Indicate the number of protons and that of nucleons in the nucleus of americium $^{241}_{95}Am$.

2- The reaction of disintegration of americium $^{241}_{95}Am$ is given by :

$$^{241}_{95}Am \rightarrow {}^{237}_{93}Np + {}^{A}_{Z}X + \gamma$$

2-1) Define radioactivity.

2-2) Calculate A and Z indicating the used laws.

2-3) Indicate the name and the symbol of the emitted particle $^{A}_{Z}X$.

2-4) This disintegration is accompanied with the emission of γ radiation. Indicate:

2-4-1) the cause of the emission of the γ radiation;

2-4-2) the nature of the γ radiation.

3- The energy liberated due to this disintegration of the americium-241 nucleus is E = 5.63 MeV. Calculate, in kg, the mass defect Δm due to this disintegration.

Given:

1 MeV = 1.6×10^{-13} J ; speed of light in vacuum c = 3×10^{8} m/s.

<u>Exercise 3</u>: (6 points)

Mars

Mars, the red planet, is the fourth planet according to its average distance from the Sun.
It is a terrestrial planet which can be observed by the naked eye.
The period of revolution of Mars is T_M = 1.881 years, whereas that of Earth is T_E = 1 year = 365.25 days.

Doc. 1

1- Name the terrestrial planets of our solar system.

2- Pick out from document 1 an indicator which shows that Mars:

2-1) is a rocky planet;

2-2) contains large quantities of iron oxide in the rocks and stones scattered on its surface.

3- Document 1 indicates the periods of revolution of Mars and Earth.

3-1) What does the « period of revolution » of a planet represent?

3-2) Calculate, in days, the period of revolution of Mars.

3-3) Using the periods of revolution of Mars and Earth, specify which of the two planets is closer to the Sun.

3-4) State Kepler's law which confirms the answer of question (3-3).