وزارة التّربية والتّعليم العالي	امتحانات الشّهادة الثانوية العامة	دورة العام ٢٠١٩ العاديّـة
المديريّة العامّة للتّربية	فرعا الاجتماع والاقتصاد	الخميس ٢٠ حزيران ٢٠١٩
دائرة الامتحانات الرّسميّة	والآداب والإنسانيات	للمكفوفين
	مسابقة في الثقافة العلمية: مادّة الفيزياء	الاسم:
	المدّة: ساعة واحدة	الرّقم:

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

Exercise 1 (7 points) Mechanical energy

Sami kicks a ball (S), considered as a particle of mass m = 0.4 kg, horizontally at point A, situated at a height $h_A = 4.8$ m above the ground with a speed $V_A = 10$ m/s.
The motion of (S) between A and the ground is translational motion.
Take:

- the ground as a reference level for gravitational potential energy;
- $g = 10 \text{ m/s}^2$.

1) Calculate, at the instant of kicking (S) at A, the:
  1-1) kinetic energy of (S);
  1-2) gravitational potential energy of the system [(S), Earth];
  1-3) mechanical energy of the system [(S), Earth].

2) Air resistance is supposed negligible. The ball (S) reaches the ground at point B.
  2-1) Indicate the value of the gravitational potential energy of the system [(S), Earth] at point B. Justify.
  2-2) Determine, using the conservation of mechanical energy, the kinetic energy of (S) just before reaching the ground at B.
  2-3) Deduce that the speed of (S), just before reaching the ground at B is $V_B = 14$ m/s.

3) In reality, air resistance is not negligible and the ball (S) reaches the ground at point C with a speed $V_C = 12$ m/s.
  3-1) Determine, at point C, the value of the mechanical energy of the system [(S), Earth].
  3-2) Deduce the value of the mechanical energy lost by the system [(S), Earth] during the motion of (S) between A and C.

Exercise 2 (7 points) Radioactivity of iodine

The isotope ${}^{131}_{53}\mathrm{I}$ of iodine disintegrates into a daughter nucleus xenon ${}^{131}_{54}\mathrm{Xe}$ by emitting a particle ${}^{A}_{Z}\mathrm{X}$ according to the following equation: ${}^{131}_{53}\mathrm{I} \rightarrow {}^{131}_{54}\mathrm{Xe} + {}^{A}_{Z}\mathrm{X}$.
Given:
mass of the nucleus ${}^{131}_{53}\mathrm{I}$: m(${}^{131}_{53}\mathrm{I}$) = 130.90612 u;
mass of the nucleus ${}^{131}_{54}\mathrm{Xe}$: m(${}^{131}_{54}\mathrm{Xe}$) = 130.90507 u;
mass of the particle ${}^{A}_{Z}\mathrm{X}$: m(${}^{A}_{Z}\mathrm{X}$) = 0.00055 u;
speed of light in vacuum: $c = 3\times10^{8}$ m/s.
$1 \text{ u} = 1.66\times10^{-27}$ kg;

1) Calculate Z and A, indicating the laws used.
2) Indicate the name and the symbol of the particle ${}^{A}_{Z}\mathrm{X}$.

3) Calculate, in u and in kg, the loss of mass Δm that occurs in this disintegration.
4) Calculate, in joules, the energy liberated by this disintegration.
5) The table below (Doc. 2), represents the mass m (in mg) of a sample of iodine $^{131}_{53}I$ as a function of time t (in days).

T (days)	0	8.1	16.2	24.3	32.4
m (mg)	80	40	20	10	5

Doc. 2

5-1) Define the half-life T of a radioactive substance.
5-2) Using the table of document 2:
5-2-1) specify the value of the half-life T of iodine $^{131}_{53}I$;
5-2-2) indicate the remaining mass of the sample of iodine $^{131}_{53}I$ after three half-lives.

6) One of the medical applications uses the radioactive isotope $^{131}_{53}I$ to visualize, localize, study and control the functioning of the thyroid. Name this application.

Exercise 3 (6 points) The Earth and its movements

Read carefully the text of document 3 and then answer the questions.

The planet Earth turns around itself and around the Sun. These two movements explain the cycle of the seasons and the succession of the days and nights. The Earth, according to its distance from the Sun, is the third planet in our solar system, after Mercury and Venus.
The average distance between the Earth and the Sun is about 150×10^6 km. Astronomers denote this distance astronomical unit (AU). In reality, the distance between the Earth and the Sun varies throughout the year. This distance is 147.1×10^6 km on January 3 and 152.1×10^6 km on July 6.
The speed of the planet Earth increases as it approaches the Sun and decreases as it moves away from the Sun.

Encyclopedia Larousse, the Universe (Adapted)

Doc. 3

Questions

1) The text of document 3 mentions the two movements of the Earth. One of these two movements is responsible for the succession of days and nights. Which one?
2) The planets Mercury, Venus and Earth belong to one of the two groups of our solar system.
2-1) Name this group.
2-2) The fourth planet of this group is not mentioned in the text of document 3. Name this planet.
3) Pick up from the text of document 3:
3-1) an indicator showing that the trajectory described by the Earth around the Sun is not circular;
3-2) the sentence that is in agreement with Kepler's second law.
4) The average distance of Venus and that of Uranus from the Sun are $d_1 = 0.72$ AU and $d_2 = 19.19$ AU respectively.
4-1) Pick up from the text of document 3 the definition of the astronomical unit (AU).
4-2) The period of revolution of one of these two planets is 84 years and that of the other planet is 224.7 days. Which one is the period of Venus? Justify.