المركز التربوي للبحوث والإنماء	الهيئة الأكاديميّة المشتركة قسم : العلوم	المادة: الفيزياء الشهادة: الثانوية العامّة الفرع: الإقتصاد والإنسانيات نموذج رقم 1 المدّة : ساعة واحدة

نموذج مسابقة (يراعي تعليق الدروس والتوصيف المعدّل للعام الدراسي 2016-2017 وحتى صدور المناهج المطوّرة)

This Test Includes Three Exercises. The Use of A Non-programmable Calculator Is Allowed.

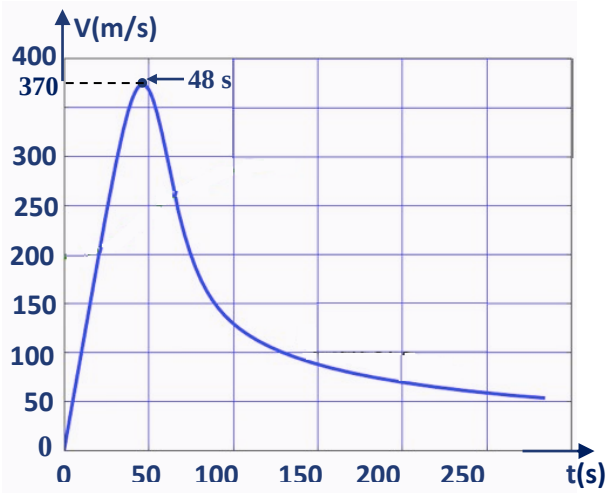
Exercise 1 (6 pts) Felix Jump

On October 14, 2012, Felix Baumgartner broke the speed of sound reaching a maximum speed of 370 m/s.

Felix climbed to 39000 m in a helium-filled balloon, and then he jumped back towards ground. Felix's entire trip back to earth lasted 9 minutes and 3 seconds.

The aim of this exercise is to study the motion of Felix before opening his parachute. This motion is composed of two phases: the first one during the time interval [0 ; 48 s] and the second one during [48 s ; 260 s].

The graph of the adjacent figure shows the variation of the speed of Felix during [0 ; 260 s] as a function of time.



Given:
Mass of Felix and his equipment: m = 110 kg.
The height of Felix relative to ground is 32155 m at t = 48 s.

We suppose that the gravitational acceleration g is constant during the whole journey; g = 10 N/kg.
The ground is taken as a reference level for gravitational potential energy.

1) Refer to the text to indicate height from which Felix jumped, and the duration of his whole journey.

2)

2-1) Use the graph to calculate the kinetic energy of Felix at $t_o = 0$ and at t = 48 s.

2-2) Determine the gravitational potential energy of the system (Felix ; Earth) at $t_o = 0$ and at t = 48 s.

2-3) Deduce the mechanical energy of the system (Felix ; Earth) at $t_o = 0$ and at t = 48 s.

3)

3-1) Calculate the variation in the mechanical energy of the system (Felix ; Earth) during the time interval [0 ; 48 s].

3-2) Deduce the work done by air resistance $\vec{f}$ during [0 ; 48 s] knowing that $\Delta E_m = W(\vec{f})$.

3-3) Deduce whether air resistance is neglected during [0 ; 48 s].

4)

4.1. Refer to the figure to prove that the mechanical energy of the system (Felix ; Earth) decreases during the time interval [48 s ; 260 s].

4.2. Indicate the energy transformation that takes place during the time interval [48 s ; 260 s].

Exercise 2 (7 pts) Trouble in the thyroid

A patient has a trouble in the thyroid. To detect this trouble, the doctor injects the thyroid by 1.5×10^{11} nuclei of the iodine nuclide $^{131}_{53}\text{I}$.
This nuclide has a period (half-life) of 8 days and it is a β^-emitter.
The disintegration of the nuclide $^{131}_{53}\text{I}$, gives rise to a daughter nucleus $^{A}_{Z}\text{Xe}$ supposed at rest.

1) Define radioactivity.
2) Identify the β^-particle.
3)
- **3-1)** Write the equation of the disintegration of $^{131}_{53}\text{I}$ nucleus.
- **3-2)** Determine A and Z.

4) This disintegration is accompanied by the emission of γ-rays. Justify.
5) Calculate the number of the remaining nuclei at the end of 16 days. Deduce the number of the decayed nuclei during this time.
6)
- **6-1)** The energy liberated due to the decay of one nucleus of iodine-131 is E = 1.55376×10^{-13} J. Calculate the energy liberated by the decay of iodine during the 16 days.
- **6-2)** The thyroid absorbs 92.8 % of the liberated energy. Calculate the energy absorbed by the thyroid during the 16 days.

Exercice 3 (7 pts) The sun of our solar system

Read the following text carefully and then answer the corresponding questions:

The sun is a star, a hot ball of glowing gases at the heart of our solar system. Without the sun's intense energy and heat, there would be no life on Earth.
The temperature at the sun's core is about 15,600,000 K, while at the sun's surface is about 5,800 K.
The mass of the Sun changes slowly over time as Sun converts hydrogen to helium in its core.
The Sun orbits the center of the Milky Way at a distance of approximately 24,000 to 26,000 light-years from the center of the galaxy.

1) One of the planets orbiting the sun is mentioned in the text.
- **1-1)** Name this planet and indicate the group to which it belongs;
- **1-2)** Name the other planets in this group.

2) Pick out from the text the statement which shows that:
- **2-1)** Our sun like all other stars does not have a solid surface.
- **2-2)** Fusion reaction takes place in the core of the sun.
- **2-3)** The condition of fusion reaction is satisfied in the sun.

3) A scientist stated in his theory that the sun is immobile and is at the center of the universe.
- **3-1)** Name this scientist and name his theory.
- **3-2)** Pick out from the text a statement that contradicts his statement.

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أسس التصحيح (تراعي تعليق الدروس والتوصيف المعدّل للعام الدراسي 2016-2017 وحتى صدور المناهج المطوّرة)

Exercise 1 (6 pts) Felix Jump

Question	Answer	Mark
1	The height is 39 000 meters and the duration of his journey is 9 minutes and 3 seconds.	¼ ¼
2-1	$KE = \frac{1}{2}mv^2$ $KE_o = (0.5)\ (110)\ (0)^2 = 0$ J $KE = (0.5)\ (110)\ (370)^2 = 7529500$ J	½ ½ ½
2-2	GPE = m.g.h At t = 0 $GPE_o = (110)\ (10)\ (39000) = 42\ 900\ 000$ J. At t = 48 s GPE = (110) (10) (32155) = 35 370 500 J.	½ ¼ ¼
2-3	ME = KE + GPE At t = 0 $ME_o = 0 + 42\ 900\ 000 = 42\ 900\ 000$ J. At t = 48 s ME = 7 529 500 + 35 370 500 = 42 900 000 J.	½ ¼ ¼
3-1	$\Delta ME = ME - ME_o = 42900\ 000 - 42900\ 000 = 0$	½
3-2	$\Delta ME = 0 \Rightarrow W(\vec{f}) = 0$ so the work done by air resistance is zero.	½
3-3	The work done by air resistance is zero during [0 ; 48 s], then air resistance is neglected during this time interval.	½
4-1	During [48 s ; 260 s], the speed of Felix decreases and then his KE decreases. Also GPE of the system (Felix ; Earth) decreases since Felix's height decreases. ME = GPE + KE then decreases.	1
4-2	The loss in gravitational potential energy and kinetic energy is transformed into heat energy.	½

Exercise 2 (7 pts) Trouble in the thyroid

Question	Answer	Mark
1	Spontaneous transformation of a nucleus to a more stable one with the emission of radioactive particles.	1
2	It is an electron $_{-1}^{0}e$	½
3-1	$^{131}_{53}I \longrightarrow {}^{A}_{Z}Xe + {}^{0}_{-1}e + {}^{0}_{0}\bar{\nu}$.	½
3-2	By applying Soddy's laws: $131 = A + 0 + 0 \Rightarrow A = 131$ $53 = Z - 1 + 0 \Rightarrow Z = 54$	½ ½ ½
4	This emission is due to the de-excitation of the daughter nucleus (Xenon).	½
5	$n = \frac{t}{T} = \frac{16}{8} = 2$, but $N = \frac{N_o}{2^n} = \frac{1.5 \times 10^{11}}{2^2} \Rightarrow N = 3.75 \times 10^{10}$ nuclei. $N_{decay} = N_o - N = 1.5 \times 10^{11} - 3.75 \times 10^{10}$ $\Rightarrow N_{decay} = 1.125 \times 10^{11}$ nuclei.	1 ½
6-1	$E_{total} = N_{decay} \times E = 1.125 \times 10^{11} \times 1.55376 \times 10^{-13} \Rightarrow E_{total} = 0.01748$ J	1
6-2	$E_{absorbed} = 0.928 \times 0.01748 \Rightarrow E_{absorbed} = 0.01622$ J.	½

Exercice 3 (7 pts) **The sun of our solar system**

Question	Answer	Mark
1-1	Earth. Group of inner planets.	¾ ¾
1-2	Mercury. Venus. Mars.	½ ½ ½
2-1	The sun is a star, a hot ball of glowing gases.	½
2-2	Sun converts hydrogen to helium in its core.	½
2-3	The temperature at the sun's core is about 15 600 000 K.	½
3-1	Copernicus. The Heliocentric theory.	½ ½
3-2	The Sun orbits the center of the Milky Way.	½