

دورة العام 2001 العادية	امتحانات الشهادة الثانوية العامة الفروع : إجتماع و إقتصاد و آداب و إنسانيات	وزارة التربية والتعليم العالي المديرية العامة للتربية دائرة الامتحانات
الاسم: الرقم:	مسابقة في مادة الفيزياء المدة ساعة	

This exam is formed of three exercises in two pages
The use of non-programmable calculators is allowed

First Exercise (6points)

The Car and the Environment

A car of mass 1000kg moves on a horizontal and straight path at the speed of 90km/h. The horizontal plane containing the center of gravity of the car is taken as the gravitational potential energy reference.

1. Calculate the mechanical energy of the car during its motion.
2. The car consumes, at this speed, 10 liters of fuel over a distance of 100km. The complete combustion of one liter of this fuel liberates 44.5×10^6 J.
 - a) In what form is the energy stored in the fuel?
 - b) Calculate the amount of energy liberated by the combustion of the fuel over the 100-km distance.
 - c) A part of this energy is converted, in the car, into other forms of energy. Name two of these forms.
3. The gases resulting from the combustion of the fuel are ejected to the surroundings. Specify the effects of these gases on the environment and on public health. Name two of these gases.

Second Exercise (8points)

Radioactivity of Radium

1. The Radium isotope ${}^{226}_{88}\text{Ra}$, of period (or half-life) T, is an alpha (α) emitter.
 - a) What is meant by the isotope of an element?
 - b) The α radiation indicates a nuclide. Name this nuclide.
 - c) Define the period of a radioactive substance.
2. The radio-nuclide ${}^{226}_{88}\text{Ra}$ decays into radon Rn according to the equation:
$${}^{226}_{88}\text{Ra} \rightarrow \dots\dots + {}^A_{86}\text{Rn}$$
 - a) Complete the equation and specify the law used.
 - b) A sample of ${}^{226}_{88}\text{Ra}$ has a mass $m_0=8\text{g}$ at the instant $t=0$. Find the mass of radium remaining at the instant $t=3T$.
 - c) The decay of a nucleus of ${}^{226}_{88}\text{Ra}$ liberates an amount of energy of 4.881MeV. Find the value of this energy in joules and calculate the corresponding mass defect.
Take: $1\text{MeV}=1.6 \times 10^{-13}\text{J}$
Speed of light in vacuum: $c=3 \times 10^8\text{m/s}$.
3. The α decay is generally accompanied with the emission of another radiation.
 - a) Identify this radiation (name and nature).
 - b) This radiation is dangerous. Why?

Third Exercise (6points)

Solar System

Read carefully the following text:

“The study of the motion of the objects in our Solar system is based on Newton’s law of universal gravitation.

What is most astonishing in our solar system is its apparent regularity: the planets orbit the Sun in almost the same plane (except for Mercury and Pluto), along trajectories that are approximately circular. The revolution of each planet around the Sun is anticlockwise (direct sense) just as the direction of the rotation of the Sun around itself. Except for Mercury and Venus, each of the planets as well as of the asteroids, rotates around itself within a few hours. This rotation takes place generally, in the same direction of rotation as that of their revolution around the Sun. However, this has two exceptions: Venus and Uranus...”

Translated from: Dossier pour la Science
Hors série. Avril 1999

Questions:

1. What is the number of the planets that form our Solar system? Name three of these planets that are not mentioned in this text.
2. According to the text, “the planets orbit the Sun in almost the same plane”. What do we call this plane?
3. Give the form of the trajectories described by these planets:
 - a) according to the text;
 - b) according to Kepler’s first law.
4. According to the text, the revolution of the planets around themselves and around the Sun takes place in the direct sense except for two planets. What are these planets?
5. The study of the motion of the objects in our Solar system is based on a law. State this law.

دورة العام 2001 العادية	امتحانات الشهادة الثانوية العامة الفروع : إجتماع و إقتصاد و آداب و إنسانيات	وزارة التربية والتعليم العالي المديرية العامة للتربية دائرة الامتحانات
الاسم: الرقم:	مسابقة في مادة الفيزياء المدة ساعة	مشروع معيار التصحيح

First Exercise (6 points)

Part	Answer	Mark
1	$M.E = K.E + G.P.E = \frac{1}{2}mV^2 + mgh = \frac{1}{2}(1000)\left(\frac{90}{3.6}\right)^2 = 312\,500\text{J}$	1.5
2.a	Chemical energy	0.5
2.b	$E = 44.5 \times 10^6 \times 10 = 445 \times 10^6\text{J}$	1
2.c	Mechanical energy while moving and electric energy in the lamps.	1
3	Sulfur dioxide (SO ₂) that causes bronchitis. Carbon monoxide (CO) that causes cardiac troubles Particles of lead and mercury can cause cancer Carbon dioxide (CO ₂) that is responsible for the greenhouse effect	2

Second Exercise (8 points)

Part	Answer	Mark
1.a	The isotopes of an element are nuclides that have the same charge number Z and different mass number A.	1
1.b	Helium nucleus ${}^4_2\text{He}$	0.50
1.c	Half-life: time needed by a radioactive sample to decay into half its initial value.	1
2.a	The disintegration equation can be written as: ${}^{226}_{88}\text{Ra} \rightarrow {}^4_2\text{He} + {}^A_{86}\text{Rn}$ The law of conservation of the charge number gives: $226 = 4 + A \Rightarrow A = 222$ then ${}^{226}_{88}\text{Ra} \rightarrow {}^4_2\text{He} + {}^{222}_{86}\text{Rn}$	1.50
2.b	$m = \frac{m_0}{2^n} = \frac{8}{2^3} = 1\text{g}$	1
2.c	$E = 4.881 \times 1.6 \times 10^{-13} = 7.81 \times 10^{-13}\text{J}$ $E = \Delta mc^2 \Rightarrow \Delta m = \frac{E}{c^2} = \frac{7.81 \times 10^{-13}}{(3 \times 10^8)^2} = 0.868 \times 10^{-29}\text{kg}$	1.5
3.a	Name: gamma radiation γ . Nature: electromagnetic radiation.	1
3.b	High penetrating power	0.5

First Exercise (6 points)

Part	Answer	Mark
1	Our Solar system is of nine planets. Earth, Mars, Jupiter, Saturn and Neptune, are not mentioned in the text (only 3 are required).	2
2.a	Ecliptic plane	1
2.b	Circular	1
2.c	Elliptical	0.5
3	Mercury and Venus.	0.50