

الدورة الإستثنائية للعام 2009	امتحانات شهادة 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 recommended**

### First Exercise (7 points)

#### Renewable Energy

**Read carefully the following selection then answer the questions that follow**

« The energy we consume these days in heating, transportation purposes, and electric energy production originates mainly from fossil fuels and nuclear sources.

However, in addition to the fact that fossil fuels are exhaustible and nuclear wastes lead to a dangerous problem, a great part of the emitted gases are mainly formed of carbon dioxide causing the greenhouse effect.

To solve these problems, renewable sources of energy give a great opportunity. Thus, windmills convert wind energy and hydroelectric power plants convert the energy of the system (water, Earth); the solar panels and the photovoltaic cells convert solar energy..., geothermal energy the heat inside the Earth, certain turbines use energy of waves or that of tides. »

Extracted from an internet site

#### Questions

- 1) Draw from the selection one disadvantage of fossil fuels.
- 2) Give the names of two fossil fuels.
- 3) The combustion of fossil fuels produces polluting gases. Give the names of two of these gases and indicate their effect on public health.
- 4) Classify the sources of energy mentioned in the selection into polluting and non-polluting.
- 5) Draw from the selection the name of one secondary source of energy.
- 6) Specify the energy conversions that take place in:
  - a) Windmills ;
  - b) Hydroelectric power plants ;
  - c) Solar panels.

### Second Exercise (7 points)

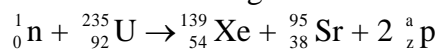
#### Electric Energy

In this exercise, we intend to find out to what extent nuclear energy may be replaced by wind energy in the production of electric energy.

**Given:**  $1 \text{ u} = 1.66 \times 10^{-27} \text{ kg}$ ; speed of light in vacuum:  $c = 3 \times 10^8 \text{ m/s}$ .

#### A – The nuclear power plant

In a nuclear power plant, a nucleus of uranium 235 undergoes the following reaction under the impact of a slow neutron (thermal neutron):



- 1) a) i) Determine z and a specifying the laws used.  
ii) Identify the particle  ${}_z^a\text{p}$ .
- b) Is this reaction spontaneous or provoked? Justify your answer.

- c) This reaction is a nuclear fission reaction. Why?
- 2) The mass defect in this reaction is  $\Delta m = 0.193 \text{ u}$ . Calculate the value  $E$  of the energy liberated by this reaction.
  - 3) The average electric power of this power plant is  $P = 8 \times 10^8 \text{ W}$ . Show that the value of the electric energy furnished by this power plant in one year is  $E_1 = 2.52 \times 10^{16} \text{ J}$ .

### B – The windmill

A major effort is done, these days, to transform wind energy into electric energy. In a region well exposed to wind, a windmill of diameter 35 m may produce, on the average, an electric energy of  $3.6 \times 10^{12} \text{ J}$  per year.

- 1) The source of this energy is renewable. Why?
- 2) Calculate the number of such windmills needed to obtain an electric energy equal to that produced by the nuclear power plant in one year.

### C – Comparison

An environmentally minded man said: “...If windmills replace the nuclear power plants, we thus have a “clean” technology, but this will obviously lead to many problems...”. Comment on this statement.

## Third Exercise (6 points)

### The « Tenth » Planet of the Solar System

Read carefully the following selection then answer the questions that follow

“...While it was believed for decades that the number of the planets of the solar system was limited to nine, the team of Mike Brown, of the California Institute of technology, has just announced the discovery of a celestial object of diameter not less than 2300 km, larger than Pluto, and of about three times farther than the ninth planet of the Solar System: at 97 astronomical units (A .U).

The candidate for the tenth planet, temporarily named 2003-UB313, seems to be an object formed of rock and methane ice, like Pluto and all those that orbit the Sun beyond the orbit of Neptune, in what is known as Kuiper's Belt. This celestial object was observed on October 2003...It turns around the Sun in about 560 years, and it is now close to its farthest position on its orbit. By comparison, Pluto is at 39 astronomical units, and has a period of revolution of 248 years...Meanwhile, we still have to give a convenient name for 2003-UB313...”

Pour la science. September 2005

### Questions

- 1) The nine planets of the Solar System are classified into two groups.
  - a) Give the names of these two groups.
  - b) Classify the planets mentioned in the selection into their corresponding group.
  - c) In the selection, we read « the ninth planet ». Give its name.
- 2) Why do we use in the selection the **average distance** of the Earth from the Sun?
- 3) Pluto has a solid nature. What is the nature of Neptune?
- 4) Pick up from the selection:
  - a) The statement that shows that the planet 2003-UB313 and Pluto have the same nature ;
  - b) The value of the period of revolution of the planet 2003-UB313 ;
  - c) An indicator that shows that the orbit of the planet 2003-UB313 is not circular.
- 5) Justify that the numerical given data verify Kepler's 3<sup>rd</sup> law.

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First exercise (7 points)	Second exercise (7 points)	Third exercise (6 points)
<p>1) The fossil fuels are exhaustible, or produce green house effect. (1/2)</p> <p>2) Coal ; petroleum or natural gas. (1)</p> <p>3) Carbon oxide : cardiac troubles; (3/4) Sulfur oxide : bronchitis. (3/4)</p> <p>4) Fossil fuels and nuclear are polluting ; windmills ; hydraulic ; Sun ; geothermic ; waves and tides are non polluting. (2)</p> <p>5) Electricity (1/2)</p> <p>6) a) Wind mills : E(kinetic of the wind) → E(electric) ; (1/2)</p> <p>b)Hydraulic power plant : E(potential) → E(electric) ; (1/2)</p> <p>c) Solar panels : E( radiant) → E(thermal) (1/2)</p>	<p>A –</p> <p>1) a) i) Conservation of the mass number : <math>236 = 139 + 95 + 2a \Rightarrow a = 1</math> Conservation the charge number : <math>92 = 54 + 38 + 2z \Rightarrow z = 0 ; (1)</math></p> <p>ii) <math>{}_z^a p \equiv {}_0^1 n</math> (neutron) (1/4)</p> <p>b) Provoked , since it happens due to the intervention of an external agent. (The impact of a neutron) (3/4)</p> <p>c) A heavy nucleus splits into two lighter nuclei under the impact of a slow neutron. (3/4)</p> <p>2) <math>E = \Delta m \times c^2</math> <math>= 0.193 \times 1.66 \times 10^{-27} \times 9 \times 10^{16}</math> <math>= 2.88 \times 10^{-11} \text{ J} (1\frac{1}{4})</math></p> <p>3) <math>E_1 = P \times t = 8 \times 10^8 \times 365 \times 24 \times 3600</math> <math>= 2.52 \times 10^{16} \text{ J.} (1\frac{1}{4})</math></p> <p>B –</p> <p>1) This source of energy is renewable as long as the air around the Earth is exposed to solar radiation that produces <u>differences in temperature.</u> (1/4)</p> <p>2) The number of windmills : <math>n = \frac{2.52 \times 10^{16}}{3.6 \times 10^{12}} = 7000 \text{ windmills.} (1)</math></p> <p>C – "Clean" technology: wind energy is not pollutant (does not produce hazardous wastes). Among the these problems: occupation of land, changing the landscape... (1/2)</p>	<p>1) a) The inner planets or terrestrial – the outer planets. (1/2)</p> <p>b) Earth (inner planets) ; Pluto and Neptune (outer planets) (3/4)</p> <p>c) Pluto (1/4)</p> <p>2) As the Earth's orbit is elliptical, the <u>distance from the Sun is not the same in all points</u> of its orbit, that is why we are talking about an "average" distance. (3/4)</p> <p>3) Neptune is gaseous (1/2)</p> <p>4) a) According to the text: "2003-UB313 appears to be a body of rock and methane ice ", so this planet has a solid nature as Pluto.. (3/4)</p> <p>b) "It rotates around the sun in about 560 years", and therefore its period of revolution is 560 years (1/2)</p> <p>c) " and it is now in its farthest distance on its orbit " This shows that its orbit is not circular (1)</p> <p>5) The planet 2003-UB313 is at an average distance from the Sun of 97 AU and Pluto is at 39 AU. The period of revolution of Pluto (248 years) smaller than that of 2003-UB313 (560 years). (1)</p>