وزارة التربية والتعليم العالي
المديرية العامة للتربية
دائرة الامتحانات

امتحانات الشهادة الثانوية العامة
فرعا الآداب والإنسانيات
والاقتصاد والاجتماع

دورة سنة 2004 الاستثنائية

مسابقة في الفيزياء
المدة: ساعة واحدة

الاسم:
الرقم :

This exam is formed of 3 exercises in 2 pages
The use of non-programmable calculators is allowed

First Exercise **(*6 pts*)** ***Discovery of planets***

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

"On the 18th of February 1930, the young astronomer C. W. Tourbagh, 24 years old, observed through a telescope a planet which scientists were seeking for: Pluto. The position of this celestial body was found to be very close to the position predicted by calculation.

This event was preceded by two discoveries of great importance.

On the 13th of March 1781, F.W.Herschel pointed his finger at Uranus. An important discovery, because humanity had believed, for a very long time, that Saturn, with its rings, marked the ultimate borders of the solar system.

On the 23rd of September 1846, J.J Le Verrier identified, by calculation, Neptune which was seen by J.G. Galle from the Berlin observatory during the same day. However ,these two new planets seemed to be "disturbed". Specialists attributed this “disturbance” to an invisible 9th planet which, due to its gravitational attraction, makes its two neighbors unstable in their orbit" .

Questions

1. Give the names of four planets of the solar system that are not mentioned in the text.
2. Astronomy is a science that is based on the agreement observation-calculation.
   Pick out the two sentences, from the text, that justify this statement.
3. Specify the instrument, which is mentioned in the text, and used in the detection of planets.
4. **a**. Give the names of the planets, that are mentioned in the text, and whose motion is disturbed.
   b. Specify the phenomenon that this disturbance is due to.
   c. Give the name of the scientist who stated the law relative to this phenomenon.
5. Give the name of the plane containing the trajectories of most planets.

Second exercise *(7 pts)* *Wind energy*

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

"Since ancient times, wind energy was converted by windmills into rotational kinetic energy in order to grind grain. It was used to raise water from a well.
Nowadays, wind energy is also converted into electric energy by aero-generators (turbines).

An aero-generator receives, in one second, a wind energy of 28800 J. It converts 30 % of this energy into electric energy".

Questions

1. Give the names of two energy conversions mentioned in the text.
2. Determine the amount of electric energy produced by the aero-generator in one second.
3. Knowing that the average consumption of electric energy by one house is 1080 J in one second, calculate the number of houses whose need for electric energy can be provided by this aero-generator.
4. **a)** When the speed of wind decreases, the above aero-generator can no more provide the same amount of electric energy needed. Why?

   b) What is then the disadvantage of this wind energy?
5. Give two advantages of the wind energy.

Third exercise *(7 pts)* *Nuclear fusion*

Consider the following nuclear reaction: ${}_1^3H + {}_1^2H \rightarrow {}_2^4He + {}_Z^A X$

Given:

- mass of an ${}_1^3H$ nucleus = 3.015 u ;
- mass of an ${}_1^2H$ nucleus = 2.013 u ;
- mass of an ${}_2^4He$ nucleus = 4.002 u;
- mass of the particle ${}_Z^A X$ = 1.009 u;
- 1 u = 1.661×10^{-27} kg ;
- c = 3×10^8 m / s.

1. This reaction is a nuclear fusion reaction. Why?
2. Give the name of a natural source of energy within which nuclear fusion occurs.
3. Each of the nuclei ${}_1^2H$ and ${}_1^3H$ requires a great speed in order to approach each other enough to undergo fusion. Give the order of magnitude of the kinetic energy of each of the two nuclei.
4. **a)** Determine A and Z specifying the laws used.

   b) Identify then the particle X.
5. **a)** Calculate, in kg, the mass defect in the above reaction.

   b) Deduce the energy liberated by this reaction.

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First exercise (6 pts) Discovery of planets

1. Mercury, Venus, Earth, Mars, Jupiter. **(1 pt)**

2.
* Pluto as **observed** by the telescope was very close to the position predicted by calculation **(½ pt)**
* Le Verrier identified by calculation, Neptune which was seen by Galle from Berlin observatory during the same day **(½ pt)**

3. The telescope (½ pt)

4. **a.** The planets whose motion is disturbed are **Uranus** and **Neptune** **(1 pt**)

b. This phenomenon is the gravitational interaction **(1 pt)**

c. Name of the scientist is **Newton (½ pt)**

5. The plane where most of the trajectories lie is the **ecliptic plane (1 pt)**

Second exercise: (7 pts)
The wind energy

1. The mentioned energy conversions:
* Wind energy into kinetic energy of rotation
* Rotational Kinetic energy into gravitational potential energy
* Wind energy into electric energy **(2 pts)**

2. Electric energy produced :
28800 × 30/100 = 8640J **(1 pt)**

3. Number of houses: 8640/1080 = 8 **(1 pt)**

4. a. The speed of wind decreases implies kinetic energy of wind decreases thus the electric energy produced decreases **(1 pt)**
b. Disadvantage : irregular **(1 pt)**

5. Two advantages of the wind energy**:**
*** renewable (½ pt)**
*** Non-polluting (½ pt)**

Third exercise : (7 pts)
Nuclear fusion

1. Two light nuclei fuse to give a heavier one .**(1pt)**

2. The Sun or stars .**(1/2pt)**

3. About 0.1 Mev **(1/2pt)**

4. a. According to the laws of conservation of charge number and mass number **(1 pt)**
A = 1 and Z = 0 **(1 pt)**

b. the particle is neutron **(½ pt)**

5. a. The mass defect

$\Delta m = m_{before} - m_{after}$ **(1/2pt)**

$= (2.013 + 3.015) - (4.002 + 1.009)$

$= 0.017$ u **(1/2pt)**

$= 2.82 \times 10^{-29}$ kg. **(1/2pt)**

b . Liberated energy :

$\mathbf{E = \Delta m.c^2}$ **(1/2pt)**

$= 2.082 \times 10^{-29} \times 9 \times 10^{16}$

$= 2.538 \times 10^{-11}$ J. **(1/2pt)**