| مسابقة في مادة الفيزياء | الاسم: |
| المدة: ساعة واحدة | الرقم: |

The exam is formed of three exercises.
The use of non-programmable calculators is recommended.

I-(07 points)
Sources of Energy
*Read carefully the following text. Then, answer the questions that follows.*

« In 1973, during the petroleum crisis, the price of a barrel of crude oil increases suddenly, eyes were then wide open on the problem of our dependence on petroleum. The suspects causing the above crisis were: cars, heaters and the production of electrical energy by power plants using fossil fuels. Thirty years later, the world is more and more depending on petroleum … In addition to its cost, this growing consumption of petroleum products gave rise to the problem of the polluting gases released into the atmosphere and the problem of the expected exhaust of the resources. There are, however, other sources of energy like wind, natural gas, coal that is accused of being more polluting, sunlight, whose exploitations are still very expensive and not easy to harness.

Today, nuclear energy partially used in the production of electrical energy whereas we note a timid appearance of electric vehicles».

Questions:
1. Classify the sources of energy mentioned in the text into renewable and non-renewable sources.
2. Two sources of non-polluting energy are mentioned in the text.
   Name these two sources and give the name of a third one.
3. Draw, from the text, the three reasons for which we have to limit our consumption of petroleum.
4. A solution is suggested in the text to limit the consumption of petroleum in transportation.
   Specify this solution.
5. Give the name of two possible fields of applications of the solar energy.
6. The combustion of the petroleum products releases some gases into the atmosphere.
   a) Name two of these gases.
   b) One of the released gases is responsible for the global warming.
      Name this gas and specify the name of the corresponding effect.

II-(07 points)
Fission of Uranium 235
A nuclear power plant consumes uranium 235 to produce electric energy. One of the possible reactions of the uranium is the following:
$$^{235}_{92}U + ^{1}_{0}n \longrightarrow ^{A}_{Z}Sr + ^{139}_{54}Xe + 3 ^{1}_{0}n$$
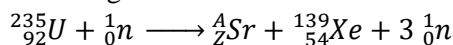
Given the masses of the nuclei in the atomic mass unit:

$\bowtie m\left(^{235}_{92}U\right) = 235.044u;$ $\qquad m\left(^{A}_{Z}Sr\right) = 93.895u;$

$\bowtie m\left(^{139}_{54}Xe\right) = 138.888u;$ $\qquad m\left(^{1}_{0}n\right) = 1.009u;$

$\qquad 1u = 1.66 \times 10^{-27}kg;$ $\qquad$ & $\qquad c = 3 \times 10^{8}m/s.$

1. a) This reaction is said to be provoked. Why?
   b) The above reaction is nuclear fission. Why?

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c) Determine, specifying the laws used, the values of A and Z.

2. A mass defect takes place in the preceding reaction.
   a) Calculate, in u and then in kg, this mass defect.
   b) Calculate, in joules, the energy liberated by the fission of one nucleus of uranium 235.
   c) An amount of uranium 235, of mass $1kg$, contains 2.56×10^{24} nuclei.
      Calculate the energy liberated in the fission of that amount of uranium.
   d) Knowing that the combustion of $1kg$ of coal liberates $3 \times 10^{7} J$, calculate the mass of coal that can liberate the same amount of energy as that liberated by the fission of $1kg$ of uranium 235. Conclude.

III-(06 points)
Development of Astronomy
Read carefully the following selection. Then, answer the questions that follow.
"In ancient times, Man observed, with his eye, stars, the Sun, the Moon and five planets.
He assumed that these celestial bodies rotate around the Earth and attributed a divine character and a supernatural action on his life …."
"With the time and upon using certain instrument, some scientists discovered the three outer planets and the moons of the planets; they found out that all planets orbit the Sun along trajectories that are governed by certain laws ….With scientific progress, we were able to collect further information about the position, the structure and the evolution of these celestial bodies."

Questions:
1. In the text, two sentences refer to two theories about astronomy.
   a) Name these two theories.
   b) According to Ptolemy, each planet describes a small circle whose center describes a large circle around the Earth. What do we call the small circle and the large circle?
2. a) The last sentence of the text describes a branch of science. Give the name of this science.
   b) From the text, pick up the statement referring to astrology.
3. a) Give the name of the first instrument used to discover some of the moons of Jupiter.
   b) Give the name of one of the planets that could not be seen by the naked eye.
4. In the text, we read "… along trajectories that are governed by certain laws".
   Give the statement of Kepler's law that describes the shape of trajectory of planet.

First Exercise (6 points)

Part	Answer	Mark
1	Renewable: wind and Sun Non-renewable: petrol, the coal, and natural gas.	1.25
2	Non-polluting: wind and Sun and the other one is waves.	1
3	The rejection of pollutants into the atmosphere - The depletion of reserve – The cost.	0.75
4	Using electric cars that are able to limit the petroleum consumption in transportation.	0.25
5	The solar energy can be converted into thermal energy (solar heaters) or electric energy (photovoltaic cell)	1
6.a	Carbon dioxide CO_2, sulfur oxide, and lead oxide.	1
6.b	It is carbon dioxide that, when ejected into atmosphere, produces the greenhouse effect, that is responsible for the global warming	0.75

Second Exercise (8 points)

Part	Answer	Mark
1.a	This fission reaction is called provoked since it is performed with the intervention of an external factor (bombarded neutron on uranium).	0.5
1.b	A heavy nucleus bombarded by a neutron and spitted into two lighter nuclei	0.75
1.c	By applying the conservation of mass number: $235 + 1 = A + 193 + 3 \Rightarrow A = 194$ By applying the law of conservation of charge number: $92 + 0 = Z + 54 + 0 \Rightarrow Z = 38$	1
2.a	$\Delta m = m_b - m_a = [m(^{235}_{92}U) + m(^{1}_{0}n)] - [m(^{194}_{38}Sr) + m(^{139}_{54}Xe) + 3m(^{1}_{0}n)] = [235.044u + 1.009u] - [93.895u + 138.888u + 3 \times 1.009u] = 0.243u$ Thus, in kg $\Delta m = 0.243 \times 1.66 \times 10^{-27} = 4.03 \times 10^{-28}kg$	2.5
2.b	$E = \Delta mc^2 = (4.03 \times 10^{-28})(3 \times 10^8)^2 = 3.63 \times 10^{-11}J$	1
2.c	$E' = N \times E = 2.56 \times 10^{24} \times 3.63 \times 10^{-11} = 9.29 \times 10^{13}J$	0.75
2.d	$1kg\ coal \rightarrow 30 \times 10^6 J$ $m \rightarrow 9.29 \times 10^{13}J$ Then $m = \frac{1 \times 9.29 \times 10^{13}}{30 \times 10^6} = 3.1 \times 10^6$ kg. **Conclusion:** to obtain the same energy, we need a quantity of coal having a mass 3.1 million times that of the uranium 235.	1.5

Third Exercise (6 points)

Part	Answer	Mark
1.a	Geocentric (Earth is the center of universe) Heliocentric (Sun is the center of universe)	1
1.b	Small circle: epicycle Large circle: deferent	1
2.a	Astronomy	0.5
2.b	attributed a divine character and a supernatural action on his life	0.75
3.a	Galileo's telescope.	0.75
3.b	Pluto, or Uranus, or Neptune.	0.75
4	Planets describe around the Sun elliptical orbits; the Sun occupies one of the foci of these ellipses.	1.5