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

First exercise (7 points)   Traffic jam

Read carefully the following selection then answer the questions that follow.
«...The problem of traffic jam became one of the basic concerns for officials and ecologists in all countries…wasting time and energy, stress, overheating and pollution of the surrounding air we breath; these are the consequences of traffic jam in large cities…knowing that, in a traffic jam, each car consumes around 3 liters of gasoline per hour. In this case, the efficiency of its engine is very poor; 15 % of the energy liberated by the combustion of gasoline is used to drive the car and 85 % of this liberated energy heats up the surrounding air…The most serious is the $^{<<}$ smog $^{>>}$ polluting air of towns…»

Questions
1) Gasoline stores energy.
   a) In what form is this energy stored?
   b) The text indicates the transformation of this energy into two other forms. What are they?
2) a) What kind of gasoline is recommended to use for cars? Why?
   b) The exhaust pipes of cars eject into air some polluting gases. One of these gases is responsible for the global warming.
      i) Give the name of this gas.
      ii) Explain how air pollution warms up our planet.
   c) Give the names of two oxides that constitute the $^{<<}$ smog $^{>>}$ and specify three effects of the smog on health.
3) Referring to the text,
   a) calculate the amount of energy liberated in one hour by a car during traffic jam, knowing that the combustion of 1 liter of gasoline liberates 3.7×10^7 J;
   b) pick up from the text the statement that shows that traffic jam wastes energy;
   c) calculate the energy wasted in one hour by a car during a traffic jam.

Second exercise (7 points)   Radioactivity in medicine

Read carefully the following selection then answer the questions that follow.
"…In medicine, the radionuclides are used in the diagnosis and in the treatment of a large numbers of diseases. They are used as tracers in order to collect information about the suspected organ of the body or as a source of intensive radiation in order to destroy infected cells that are more sensitive to radiation than healthy one.
One technique based on radioactivity consists of implanting needles containing iridium 192 around the cancerous cells…"
Given: $1u = 1.66 \times 10^{-27}$ Kg; speed of light in vacuum: $c = 3 \times 10^8$ m/s.

Questions:

1. The symbol of the Iridium nucleus is $^{192}_{77}\text{Ir}$.

   a) What do the numbers 77 and 192 represent for this nucleus?

   b) The nuclides $^{191}_{77}\text{Ir}$ and $^{192}_{77}\text{Ir}$ are isotopes. Why?

2. The Iridium 192 isotope is radioactive and a β^+ emitter.

   a) Identify the particle β^+ .

   b) Write down the equation of the disintegration of $^{192}_{77}\text{Ir}$, knowing that the

   daughter nucleus is the Osmium (^A_ZOs). Calculate A and Z specifying the used laws.

3. The β^+ decay is often accompanied with the emission of γ radiation.

   a) Due to what is the emission of this radiation?

   b) What is the nature of this radiation?

4. The mass defect due to the disintegration of an $^{192}_{77}\text{Ir}$ nucleus is $\Delta m = 0.002$ u.

   Calculate, in J, the energy liberated by each disintegration.

5. The text mentions the use of radionuclides in medicine.

   Give the name of two techniques used in diagnosis.

Third exercise (6 points)   The planets

Read the following selection and answer the questions that follow.
"…Nine planets make up our solar system. Starting from the nearest to the farthest from the Sun, they are: Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune and Pluto.
Four planets are called Terrestrial and four others are called Jovian…
The 9 planets orbit the sun. This orbiting is called "*revolution*".

Encyclopedia Larousse

Questions:
1) Pick up from the text the sentence referring to the heliocentric theory.
2) Why the four closest planets to the Sun are called Terrestrial?
3) Pluto is not Jovian. Why?
4) Each moon has three motions. Specify these motions.
5) Mars is called as the red planet. Why?
6) In the text, we read about the term "*revolution*".

   a) What is the duration T_E of one revolution of the Earth?

   b) The duration T_P of Pluto is larger than T_E. Why?

First exercise (7 points)

Part of the Q	Answer	Mark
1.a	Chemical energy	0.50
1.b	- Mechanical energy - Thermal energy	1.00
2.a	Un-leaded fuel. Since lead contained in air polluted by car exhausts cause cancer	1.00
2.b.i	Carbon monoxide .	0.50
2.b.ii	carbon dioxide and other gases trap heat in Earth's atmosphere (Green-house effect)	0.75
2.c	Carbon monoxide, nitrogen oxide. (Sulfur oxide). Irritation of eyes, nose and the throat; risk of cancer, heart troubles	1.25
3.a	$3 \times 3.7 \times 10^7 = 11.1 \times 10^7$ J	0.75
3.b	«15 % of the energy liberated ………………in order to drive the car»	0.50
3.c	$\dfrac{3.7 \times 10^7 \times 3 \times 85}{100} = 9.43 \times 10^7$ J.	0.75

Second exercise (7 points)

Part of the Q	Answer	Mark
1.a	77 is the number of protons and 192 is the number of nucleons	1
1.b	They have same charge number and different mass numbers.	0.50
2.a	A positron $_{+1}^{0}e$.	0.50
2.b	$_{77}^{192}\mathrm{Ir} \rightarrow {}_{Z}^{A}\mathrm{Os} + {}_{+1}^{0}e$ The law of conservation of the charge number gives: $192 = A + 0 \Rightarrow A = 192$ The law of conservation of the mass number gives: $77 = Z + 1 \Rightarrow Z = 76$ The daughter nucleus is then the Osmium 192 and the equation becomes $_{77}^{192}\mathrm{Ir} \longrightarrow {}_{76}^{192}\mathrm{Os} + {}_{+1}^{0}e$	1.50
3.a	This radiation is because the daughter nucleus is born excited.	0.50
3.b	It is an electromagnetic wave.	0.50
4	$\Delta m = 0.002 \times 1.66 \times 10^{-27} = 3.32 \times 10^{-30}$ Kg $E = \Delta mc^2 = 3.32 \times 10^{-30} \times 9 \times 10^{16} = 2.988 \times 10^{-13}$ J	1.50
5	Scintigraphy ; tomography	1

1

Third question (6 points)

Part of the Q	Answer	Mark
1	The 9 planets rotate around the Sun	0.50
2	They have properties similar to those of the Earth	0.50
3	Jovian planets are gaseous and Pluto is solid	1
4	A moon revolves around its planet and around himself and around the Sun.	1.50
5	The red color of Mars is due to the abundance of iron on its surface .	0.50
6.a	1 year or 365 days.	0.50
6.b	The period of revolution of a planet increases with its average distance from the Sun.	1.50