This exam is formed of three exercises on two pages.
The use of a non-programmable calculator is recommended.

First exercise: (7 points)

Electric power plants

The system (turbine-alternator) produces electric energy while receiving another form of energy.
Hydroelectric, wind, thermal and nuclear power plants are some kinds of electric power plants.
Given: $g = 10$ m/s^2.

1) Associate for each electric power plant mentioned in the text the convenient source of energy from the following list of sources: falling water, uranium 235, fossil fuel and wind.
2) Indicate, with justification, the electric power plant which causes air pollution.
3) Name, referring to the text, the electric power plant which does not exist in Lebanon.
4) Classify the above mentioned sources of energy (falling water, uranium 235, fossil fuel and wind) into two groups: renewable and non-renewable.
5) In a hydroelectric power plant, a quantity (Q) of water of mass m = 10^4 kg falls in each second from a height h = 100 m above the axis of the turbine which is taken as a reference level of gravitational potential energy.
   a) Calculate the gravitational potential energy PE$_g$ of the system [(Q), Earth] when (Q) is at the height h.
   b) Knowing that the efficiency of this power plant is r $= \dfrac{E_e}{PE_g} = 0.6$, where E$_e$ is the electric energy furnished by the power plant:
   i) calculate the electric energy furnished by this power plant in one second;
   ii) deduce the electric energy furnished in one day.

Second exercise: (7 points)

Radioactive radiations

Read carefully the following selection then answer the questions
« In radioactivity, the most common types of radiations are: alpha (α), beta (β) and gamma (γ).
Alpha (α) radiations
They are helium nuclei that are not very penetrating; barely few centimeters in air and few hundredths of a millimeter in living tissues. These particles may disturb the molecular structure of the living cells and may lead to cancer.
Beta (β) radiations
These particles are more penetrating than alpha particles; few meters in air and few millimeters in living tissues. They are dangerous if they are absorbed by a living organism.
Gamma (γ) radiations
Radioactive nuclei may produce gamma rays. They are very penetrating; they can cross 15 cm of lead or 1 meter of concrete».

Questions:
1) Indicate the two types of β radiation.
2) For each of the particles: alpha (α), electron and positron:
   a) give the symbol;
   b) give the sign of the electric charge.

3) The radioactive radiations are dangerous for humans. Referring to the text:
   a) classify these radiations by an increasing order of their penetrating power;
   b) pick up from the text a harmful effect resulting from the exposure to radioactive radiations.
4) **a)** Complete, indicating the laws used, the three following nuclear reactions:

   i) $^{24}_{11}\text{Na} \rightarrow \ ^{24}_{12}\text{Mg} + \ldots\ldots$

   ii) $^{30}_{15}\text{P} \rightarrow \ ^{30}_{14}\text{Si} + \ldots\ldots.$

   iii) $^{235}_{92}\text{U} \rightarrow \ ^{231}_{90}\text{Th} + \ldots\ldots$

   b) Indicate the type of the radioactive decay for each of the above reactions.

Third exercise: (6 points)

Two groups of planets

Read carefully the following text then answer the questions

«Today, the solar system is believed to be composed of one star, nine planets and their moons, asteroids, meteoroids and comets. These planets revolve around the Sun, and they are all subjected to gravitational forces of attraction exerted by the Sun.
The planets are classified into two groups:
The terrestrial planets (Mercury, Venus, the Earth and Mars), are located at a distance smaller than 2 astronomical units (AU) from the Sun, and surrounded by a layer of gas made of nitrogen, carbon dioxide and water vapor. Each of these planets is characterized by a relatively high density (from 4 to 5.5 g/cm^3).

Except for Pluto which is the farthest, the smallest and solid, the other planets (Jupiter, Saturn, Uranus and Neptune) are called Jovian, and they have large volumes. Their density is low (between 0.7 and 1.6 g/cm^3). Jovian planets are composed mainly of hydrogen and helium, they are surrounded by rings and each one has many moons. The planets of this group are located at a distance longer than 5 AU from the Sun».

Questions:
1) The solar system has one star. Name this star.
2) Define the astronomical unit (AU).
3) Pick up from the text:
   a) the constituents of the atmosphere of the terrestrial planets;
   b) the statement which refers to the heliocentric theory.
4) In the text we mentioned a force of gravitational attraction.
   a) Name the scientist who discovered this force.
   b) Name the factors on which this force depends.
5) **a)** Give another name for each group of planets.
   b) Pick up from the text:
      i) two differences between the two groups of planets;
      ii) two differences between Pluto and the other planets of its group.

وزارة التربية والتعليم العالي
المديرية العامة للتربية
دائرة الامتحانات الرسميّة

امتحانات الشهادة الثانوية العامة
فرعا : الاجتماع والاقتصاد والآداب والإنسانيات

دورة العام 2016 الاستثنائية
الإثنين 8 آب 2016

مشروع معيار التصحيح

مسابقة في الثقافة العلمية: مادة الفيزياء
المدة: ساعة واحدة

First exercise: (7 points)

Part of the Q	Answer	Mark
1	Falling water: hydroelectric power plant ; Uranium 235: nuclear power plant; Fossil fuel: thermal power plant ; Wind: wind power plant.	2.00
2	The pollutant plant is the **thermal plant** because it emits in the atmosphere pollutant gases .	1.00
3	The **nuclear** power plant or **wind** power plant	0.50
4	**Water** and **wind** are **renewable** sources of energy; **fossil fuel** and **uranium** are **non-renewable** sources of energy.	1.00
5.a	$PE_g = mgh = 10^4 \times 10 \times 100 = 10^7$ J.	1.00
5.b.i	The electric energy furnished in one second: $E = 10^7 \times 0.6 = 6 \times 10^6$ J	0.75
5.b.ii	t = 1 day = 24×3600 s = 86400 s. The electric energy furnished in one day: $E_1 = E_e \times t = 5184 \times 10^8$ J	0.75

Second exercise: (7 points)

Part of the Q	Answer	Mark
1	The types are β^- and β^+	1.00
2.a	α : $_2^4He$; electron : $_{-1}^0e$; positron : $_1^0e$.	0.75
2.b	α: positive ; β^- : negative ; β^+ : positive.	0.75
3.a	Alpha, beta, gamma	0.75
3.b	May disturb the molecular structure Or Risk of leading to cancer.	1
4.a.i	Soddy's law : $_{11}^{24}Na \rightarrow {}_{12}^{24}Mg + {}_{-1}^0e$	1
4.a.ii	$_{15}^{30}P \rightarrow {}_{14}^{30}Si + {}_1^0e$	0.5
4.a.iii	$_{92}^{235}U \rightarrow {}_{90}^{231}Th + {}_2^4He$	0.5
4.b	**i.** β^- decay **ii.** β^+ decay **iii.** α decay	0.75

Third exercise (6 points)

Part of the Q	Answer	Mark
1	The Sun	0.50
2	The astronomical unit is the unit of distance used to study the solar system. It is the average distance between Earth and Sun	1.00
3.a	gas : **nitrogen** , **carbon dioxide** and **water vapor**	0.75
3.b	The heliocentric theory : these planets revolve around the Sun.	0.50
4.a	Newton.	0.25
4.b	It depends on the **masses** of the objects (or the product of the masses) that attract each other and the **distance** separating their centers of gravity.	0.50
5.a	**Terrestrial planets: Inner planets (or Rocky planets)** **Jovian planets** : **Outer planet**	0.50
5.b.i	**The inner planets** have **larger densities** than those of the **outer planets .** **The inner planets** are **closer** to the Sun than the **outer planets**	1.00
5.b.ii	**Pluto** is **smaller** than the **other outer** planets **Pluto** is **solid** ,while the **other outer** planets are **gaseous** .	1.00