وزارة التربية والتعليم العالي المديرية العامة للتربية دائرة الامتحانات	امتحانات الشهادة الثانوية العامة فرعا الإجتماع والإقتصاد والآداب والإنسانيات	دورة العام 2010 الإستثنائية
	مسابقة في مادة الفيزياء المدة: ساعة واحدة	الاسم: الرقم:

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

<u>First Exercise</u>: (7 points) Work and energy

A car, of mass m = 1500 kg, starts from rest at the instant $t_0 = 0$, on a straight and horizontal road under the action of a constant horizontal motive force $\vec{F}_m$ of magnitude $F_m = 3500$ N. At the instant t_1, the car attains a speed of 25 m/s after covering a distance of 150 m.
We denote by (S) the system (car, Earth), and we take the horizontal plane passing through the center of gravity of the car as a reference level of the gravitational potential energy.

1) ***a)*** The mechanical energy E_0 of (S) at the instant $t_0 = 0$ is zero. Why?
b) Between the instants t_0 and t_1, the gravitational potential energy of (S) does not vary. Why?
c) Calculate the value of the mechanical energy E_1 of (S) at the instant t_1.

2) Calculate the work $W(\vec{F}_m)$ done by the force $\vec{F}_m$ between the instants $t_0 = 0$ and t_1 .

3) Between the instants t_0 and t_1 , the external forces acting on the car are reduced to two: the motive force $\vec{F}_m$ and a force $\vec{F}'$. Knowing that $E_1 - E_0 = W(\vec{F}_m) + W(\vec{F}')$,
a) calculate $W(\vec{F}')$, the work done by $\vec{F}'$ between the instants t_0 and t_1;
b) is $\vec{F}'$ a motive or a resistive force? Why?

4) During the motion of the car, four forms of energy exist. Name these forms of energy.

<u>Second Exercise</u>: (6 points) Nuclear Fusion

The Sun is composed of hydrogen, helium and other elements.
In its core, the pressure and the temperature are very high, and the fusion of hydrogen nuclei that occurs is the origin of the radiant energy.
The most likely fusion reactions take place according to the following equations:

$$ {}_1^1H + {}_1^1H \longrightarrow {}_{Z_1}^{A_1}X + {}_{+1}^{0}e \ ; $$
$$ {}_{Z_1}^{A_1}X + {}_1^1H \longrightarrow {}_2^3He \ ; $$
$$ {}_2^3He + {}_2^3He \longrightarrow {}_{Z_2}^{A_2}Y + 2\,{}_1^1H \, . $$

<u>Given</u>: mass of the nucleus: $({}_1^1H) = 1.0073$ u ; mass of the nucleus $({}_2^4He) = 4.0015$ u;
mass of the particle $({}_{+1}^{0}e) = 0.0006$ u ;
$1\text{ u} = 1.66\times10^{-27}$ kg ; speed of light in vacuum $c = 3\times10^8$ m/s.

1) Give the definition of a nuclear fusion reaction.
2) The fusion reaction requires a very high temperature in order to take place. Why?
3) Name the particle ${}_{+1}^{0}e$.
4) Calculate A_1, Z_1 , A_2 and Z_2 specifying the laws used.
5) The overall equation of the fusion of hydrogen has the form : $4\,{}_1^1H \longrightarrow {}_2^4He + 2\,{}_{+1}^{0}e$.
a) Determine the mass defect in this reaction.
b) Calculate the energy liberated by this reaction.

Third Exercise: (7 points) **The solar system**

The following table summarizes certain characteristics of the planets of the solar system.

Planet	Mercury	Venus	Earth	Mars	Jupiter	Saturn	Uranus	Neptune	Pluto
Distance from the Sun (A.U)	0.38	0.72	1	1.52	5.2	9.53	19.19	30	39.53
Diameter (km)	4878	12104	12756	6794	142796	120660	50800	48600	2300
Mass (M_E)	0.055	0.815	1	0.107	318	95	15	17	0.002
Period of revolution	88 days	224.7 days	365.25 days	687 days	11.87 years	29.41 years	84 years	164.8 years	247.6 years
Period of rotation	58.65 days	243 days	0.997 day	1.025 day	9 hours 55 minutes	10 hours 40 minutes	17 hours 14 minutes	16 hours	6.4 days
Temperature (°C)	–170 to 450	480	22	–170 to 35	–150	–180	–200	–210	–230
Atmosphere	none	CO_2	N_2, O_2	CO_2	H_2, He	H_2, He	H_2, He CH_4	H_2, He CH_4	N_2

1) Define: ***a)*** Period of revolution of a planet;
b) Period of rotation of a planet.

2) Referring to the above table, tell how the period of revolution of a planet varies with its distance from the Sun.

3) One of the planets has a period of rotation larger than its period of revolution. Which one?

4) Venus is farther from the Sun than Mercury, however its temperature is higher. Why?

5) The planets of the solar system are classified into two groups.
- ***a)*** What are these two groups? Name two planets of each group.
- ***b)*** Pluto differs from the other planets of its group. Give two differences.
- ***c)*** These two groups are separated by a belt. Of what is this belt formed?

6) Referring to the table, tell why:
- ***a)*** Venus is considered as the twin sister of the Earth;
- ***b)*** human life on Venus is impossible.

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First Exercise: (7 points)

Part of the Ex.	Solution	Mark
1.a	$ME_0 = KE + PE_g$; $PE_g = 0$ and $V = 0 \Rightarrow KE = 0 \Rightarrow ME_0 = 0$.	1
1.b	Because there is no variation of height,	0.75
1.c	$E_1 = \frac{1}{2}mV^2 + 0 = \frac{1}{2}\times 1500\times(25)^2 \Rightarrow E_1 =$ 468 750 J	1
2	$W(\vec{F}_m) = F_m \times d = 3500\times 150 \Rightarrow W(\vec{F}_m) = 525\,000$ J.	1
3.a	$E_1 - E_0 = = 468750 - 0 = 525000 + W(\vec{F}') \Rightarrow W(\vec{F}') =$ - 56250 J	0.75
3.b	Resistive. because $W(\vec{F}') < 0$	0.5
4	Chemical ; Kinetic, Thermal ; electric	2

Second Exercise (6 points)

Part of the Ex.	Solution	Mark
1	Nuclear fusion reaction : two light nucleii combine together to form a heavier one.	1
2	In order to overcome the repulsive electrostatic force between the nuclei.	0.5
3	Positron	0.5
4	Soddy's Law: conservation of mass number: $A_1 = 2$; and $A_2 = 4$. conservation of charge number $Z_1 = 1$; and $Z_2 = 2$.	1.5
5.a	$\Delta m = m_{bef} - m_{after} \Rightarrow \Delta m =$ 0.0265 u.	1
5.b	$E = \Delta m\times c^2 = 0.0265\times 1.66\times 10^{-27}\times(3\times 10^8)^2 = 0.39591\times 10^{-11}$ J.	1.5

Third Exercise (7 points)

Part of the Ex.	Solution	Mark
1.a	Period of revolution : is the duration of one rotation of a planet around the Sun.	0.5
1.b	Period of rotation : is the duration of one rotation of a planet around its axis .	0.5
2	As the distance from the Sun increases the period of revolution increases .	0.5
3	Venus	0.5
4	Existence of $CO_2 \Rightarrow$ Green house effect	0.5
5.a	Inner (Mercury, Earth, Mars, Venus) Outer (Jupiter, Uranus, Saturn, Neptune, Pluto)	1.5
5.b	Pluto is: * solid * small mass or (small diameter)	1

5.c	Asteroids.	0.5
6.a	Because its mass and dimensions are slightly different from that of Earth	1
6.b	CO_2 , (temp. 480^0C)	0.5