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المديرية العامة للتربية	فرعا : الإجتماع والاقتصاد والآداب	
دائرة الامتحانات	والإنسانيات	

	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-(06 points)
Seeking New Energy Sources
Read carefully the following selection. Then, answer the questions that follow.

« Each century is marked with the source of energy that dominates in it. In the XIXth century, the coke (coal) was the main source of energy used by man… »

Since XXth century, coke was gradually replaced by petroleum (easier to be made use of) … the consumption of petroleum increased faster after 1940. The will to reduce the consumption of petroleum in many countries was manifested in two ways:

✎ research in saving energy …

✎ revitalization of the research for new sources of energy or the use of neglected sources of energy that were considered not efficient enough.

Outer than solar, wind and hydraulic energy, scientists are mainly interested in three sources of energy: nuclear, geothermal and biomass….

From « Dossiers illustrés »

Questions:
1. a) According to text, why was coke replaced by petroleum?
   b) Each century was marked with the energy source that dominated in it.
   Name the source of energy used by man long before the XIXth century.
2. Name the energy sources mentioned in the text that are:
   a) renewable.
   b) non-renewable.
   c) fossil.
3. Among the energy sources, some are pollutant:
   a) name two polluting sources and two non-polluting sources mentioned in the text.
   b) the pollutants are two types. How can they be distinguished?
4. The wasting of energy increases the consumption. Give two ways that may help in reducing the wasting of energy.
5. The energies mentioned in the text may be converted into electrical energy.
   Choose two of these energies and name the apparatus that may allow this conversion.

II-(07 points)
Mechanical Energy of a System

The object of this exercise is to use a table in order to determine the values of some physical quantities. A body, taken as a particle of mass $m = 0.2kg$, is released from rest from a point B_0 on an inclined plane.
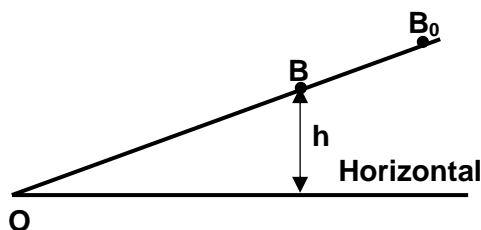
Take: $g = 10 m/s^2$.

The table below gives the kinetic energy (KE) of the body and the gravitational potential energy (GPE) of the system [body, Earth] in different positions.

The values of GPE are valid when the horizontal plane through O is taken as gravitational potential energy reference.

Position	B_0	B_1	B_2	B_3	B_4
$KE(J)$	…	0.1	0.3	0.5	0.9
$GPE(J)$	…	0.8	0.6	0.4	…

1. Calculate the mechanical energy of the system [body, Earth] in each of the positions B_1, B_2 & B_3. Conclude.
2. Determine:
   a) the value of the kinetic energy of the body in B_0.
   b) the values of the gravitational energy of the system [body, Earth] in B_0 and B_4.
      Deduce the position of B_4.
3. The body passes through the position B, at a height of $h = 10cm$, with the speed v.
   a) Calculate, in B, the gravitational potential energy of the system [body, Earth].
   b) Determine the kinetic energy of the body in B. Deduce the value of v.

III-(07 points)
Dangers of Radioactive Radiation
In April 1986, an explosion took place in the reactor of the nuclear power station of Chernobyl.
Many radioactive nuclides spread into the atmosphere reaching many European countries thus causing the death of many people and the high rate of cancer casualties. Among these nuclides, there were the iodine-131 (^{131}I) and the cesium-137 (^{137}Cs).

The object of this exercise to know which of these two nuclides is responsible for these harmful effects.

Charge Number	51	52	53	54	55
Element	Sb	Te	I	Xe	Cs

1. Give the composition of each of these nuclides.
2. The iodine-131 is a β^- emitter.
   a) Identify β^-.
   b) Write the balanced equation of the corresponding nuclear transformation of this emission.
3. The iodine-131 and the cesium-137 have respectively, the periods (Half-life) $T_1 = 8.1$ days and $T_2 = 11,000$ days.
   a) Complete the adjacent table that gives the variation of the mass of the iodine-131 with time.

Date (days)	0	8.1	16.2	40.5
Mass	…	$1g$	…	…

   b) Would a mass of $1g$ of cesium, practically, change after 40.5 days? Why?
   c) Which of these two nuclides caused the death and the high rate of cancer causality?

First Exercise (7 points)

Part	Answer	Mark
1.a	Petroleum has progressively replaced by coal due to the fact that is easier to exploit	0.25
1.b	Long before the 19th century, man has used wood as a main source of energy	0.25
2.a	Sun, wind, water, and geothermal energy	1
2.b	Coal, petroleum, and the atomic nucleus	0.5
2.c	Coal and petroleum	0.5
3.a	The polluting sources: coal and petroleum The non-polluting sources: the wind and the Sun	1
3.b	There exist two types of pollutants: the biodegradable and non-biodegradable pollutants We can distinguish them as such The biodegradable pollutants decompose easily in nature. The non biodegradable pollutants do not decompose or not easily decomposed	1.5
4	Among the means that help reducing the waste energy: The control of the abused usage in water and electricity Urging the public to use means of transportation.	1
5	Among the energies that can be converted into electric energy: The solar energy that can be converted into electric energy by the photovoltaic-cells. The hydraulic energy that can be converted into electric energy by the hydroelectric turbine-alternator.	1

Second Exercise (7 points)

Part	Answer	Mark
1	$M.E = K.E + G.P.E$ $M.E_1 = K.E_1 + G.P.E_1 = 0.1 + 0.8 = 0.9J$ $M.E_2 = K.E_2 + G.P.E_2 = 0.3 + 0.6 = 0.9J$ $M.E_3 = K.E_3 + G.P.E_3 = 0.5 + 0.4 = 0.9J$ $M.E = 0.9J$ = constant; then the mechanical energy is conserved	2
2.a	$K.E_0 = \frac{1}{2}mV_0^2 = 0J$ since the body is released from rest ($V_0 = 0m/s$)	0.75
2.b	$M.E_0 = K.E_0 + G.P.E_0 \Rightarrow G.P.E_0 = M.E_0 - K.E_0 = 0.9J$ $G.P.E4 = M.E_4 - K.E_4 = 0.9 - 0.9 = 0J$ then B_4 is on the reference that is at O.	1.25
3.a	$G.P.E = mgh = (0.2)(10)(0.1) = 0.2J$	1
3.b	$K.E = M.E - G.P.E = 0.9 - 0.2 = 0.7J$ $K.E = \frac{1}{2}mV^2$ then $V = \sqrt{\frac{2K.E}{m}} = \sqrt{\frac{2\times0.7}{0.2}} = \sqrt{7}m/s = 2.65m/s$	2

Third Exercise (6 points)

Part	Answer	Mark
1	For iodine $Z = 53$ protons and $N = A - Z = 131 - 53 = 78$ neutrons For Cesium $Z = 55$ protons and $N = A - Z = 137 - 55 = 82$ neutrons	1.5
2.a	Electron $_{-1}^{0}e$	0.5
2.b	The decay equation $_{53}^{131}I \rightarrow {}_{Z}^{A}X + {}_{-1}^{0}e$ By applying the law of conservation of mass number: $131 = A + 0 \Rightarrow A = 131$ By applying the law of conservation of charge number: $53 = Z - 1 \Rightarrow Z = 54$ The daughter nucleus is $_{54}^{131}Xe$ Thus $_{53}^{131}I \rightarrow {}_{54}^{131}Xe + {}_{-1}^{0}e$	1
3.a	At $t = 0$; $m = m_0$ At $t = T = 8.1$ days; $m = \frac{m_0}{2} \Rightarrow m_0 = 2m = 2 \times 1 = 2g$ At $t = 2T = 16.2$ days; $m = \frac{m_0}{2^n} = \frac{2}{2^2} = 0.5g$ At $t = 5T = 40.5$ days; $m = \frac{m_0}{2^n} = \frac{2}{2^5} = 0.0625g$	1.5
3.b	Because the interval of 40.5 days is a very small duration in comparison with the radioactive period of the cesium (11000days), the mass of 1g of cesium will practically remain the same after duration of 40.5days.	1
3.c	As the iodine 131 has a short half-life of 8.1dayss, Then the 131 iodine disintegrates rapidly and emits harmful radiations, Then, this 131 iodine is the cause of deaths and high risk for cancer	0.5