

الاسم: مسابقة في الثقافة العلمية: مادة الفيزياء
الرقم: المدة: ساعة واحدة

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

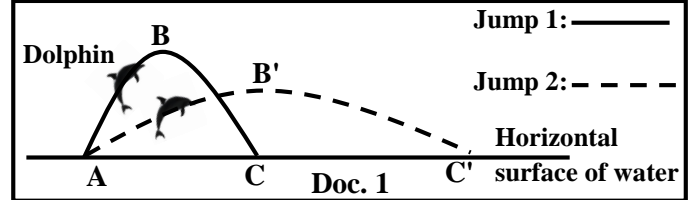
Exercise 1 (7 pts)

Jumps of a Dolphin

A dolphin, considered as a particle of mass $m = 160$ kg, jumps out from point A on water surface with a speed $V_A = 10$ m/s. The dolphin performs two jumps with the same initial speed V_A but in two different directions. Air resistance is neglected during both jumps.

Document 1 shows, for each jump, the trajectory followed by the dolphin during its motion.

The aim of this exercise is to compare the speeds of the dolphin at the highest point of its trajectory in each of the two jumps.



Take:

- the horizontal surface of water passing through point A as the reference level for the gravitational potential energy of the system (dolphin, Earth);
 - $g = 10$ m/s².
- 1) During jump 1, the dolphin passes through B the highest point of its trajectory, located at a height $h_B = 3.5$ m from water surface, with a speed V_B , then reaches the surface of water at point C (Doc. 1).
 - 1.1) Determine the mechanical energy ME_A of the system (dolphin, Earth) at A.
 - 1.2) Calculate the gravitational potential energy GPE_B of the system (dolphin, Earth) at B.
 - 1.3) Applying the conservation of mechanical energy of the system (dolphin, Earth), determine the kinetic energy KE_B of the dolphin at B.
 - 1.4) Deduce V_B .
 - 2) During jump 2, the dolphin passes through B' the highest point of its trajectory, at a height $h_{B'}$ from water surface ($h_{B'} < h_B$) with a speed $V_{B'}$, then reaches the surface of water at point C' (Doc. 1). Choose with justification the correct answer.
 - 2.1) ME'_A the mechanical energy of the system (dolphin, Earth) at A during jump 2 is such that:

a) $ME'_A > ME_A$	b) $ME'_A = ME_A$	c) $ME'_A < ME_A$
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 - 2.2) $GPE_{B'}$ the gravitational potential energy of the system (dolphin, Earth) at B' is such that:

a) $GPE_{B'} > GPE_B$	b) $GPE_{B'} = GPE_B$	c) $GPE_{B'} < GPE_B$
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 - 2.3) The speed $V_{B'}$ of the dolphin at B' is such that:

a) $V_{B'} > V_B$	b) $V_{B'} = V_B$	c) $V_{B'} < V_B$
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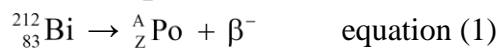
Exercise 2 (6.5 pts)

Decay of bismuth-212

Read carefully document 2 and then answer the questions.

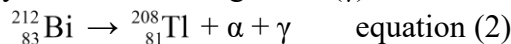
Bismuth-212 ($^{212}_{83}\text{Bi}$) is an unstable nuclide.

- 64% of the ^{212}Bi nuclei decay into polonium (^A_ZPo) with the emission of a beta-minus (β^-) radiation:



- 36 % of the ^{212}Bi nuclei decay into thallium ($^{208}_{81}\text{Tl}$) with the emission of an alpha (α) radiation.

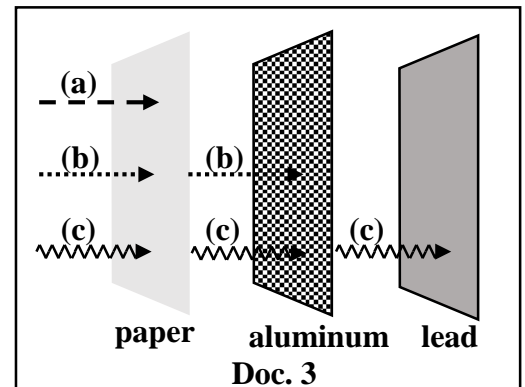
This decay is often accompanied by the emission of gamma (γ) radiations:



Doc. 2

Questions

- 1) Indicate the composition of the nucleus of bismuth ${}_{83}^{212}\text{Bi}$.
- 2) Document 2 mentions three types of radioactive radiations: α , β^- and γ .
 - 2.1) Indicate the name and symbol of each of the radiations α and β^- .
 - 2.2) What causes the emission of γ radiation?
 - 2.3) Match each of these three radiations with one of the radiations (a), (b), and (c) shown in document 3.
- 3) Calculate Z and A of polonium in equation (1), indicating the laws used.
- 4) The obtained polonium nuclei are radioactive of half-life (radioactive period) T. Consider a sample of polonium of initial mass $m_0 = 20$ g.
 - 4.1) Define the half-life of a radioactive substance.
 - 4.2) Determine the number of half-lives so that the remaining mass of this polonium sample is $m = 5$ g.



Exercise 3 (6.5 pts)

The Environmental Cost of War in Lebanon

Read carefully the selection of document 4 and then answer the questions.

« During the past year, war raged¹ in Lebanon. Most of the trees were destroyed or burned in villages along the front lines, while others lost their fruit prematurely² [...]. Toxic chemicals from banned weapons, such as phosphorus and lead, polluted the environment, with rain carrying the pollutants deeper into groundwater³ [...]. Generators, often used due to the lack of electricity, produce toxic emissions. Combined with debris⁴ from airstrikes⁵ and other war-related activities, these emissions created a persistent black haze over the capital [...]. It will take decades to repair the damage caused over the past year [...]. Wars also generate significant greenhouse gases that are rarely accounted for [...].»

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1. Raged: happened with great violence or intensity.
2. Prematurely: earlier than expected or normal.
3. Groundwater: underground layers where water collects and can be drawn from.
4. Debris: broken pieces or remains left after destruction.
5. Airstrikes: attacks carried out by military aircraft dropping bombs or firing weapons.

Doc. 4

Questions

- 1) Document 4 mentions pollution caused by war. Pick out from the selection:
 - 1.1) one water pollution cause related to war;
 - 1.2) one air pollution cause related to war.
- 2) The « persistent black haze » mentioned in document 4, is called smog.
 - 2.1) Name two pollutant gases that are found in this haze.
 - 2.2) Indicate two effects of this haze on the human health.
- 3) Document 4 mentions the production of greenhouse gases.
 - 3.1) Name the main gas responsible for the greenhouse effect.
 - 3.2) Indicate the effect of this phenomenon on Earth's temperature.
- 4) Document 4 mentions the use of generators due to the lack of electricity.
 - 4.1) Explain why these generators are dangerous on the environment.
 - 4.2) Propose two alternative ways to produce electricity that are less harmful on the environment.

مسابقة في مادة الفيزياء
أسس التصحيح - إنكليزي

Exercise 1 (7 pts)		Jumps of a Dolphin	
part	Answers	grade	
1.1	$ME_A = KE_A + GPE_A$ $ME_A = \frac{1}{2} mV_A^2 + 0$ $ME_A = \frac{1}{2} 160 \times 10^2 = 8\ 000\ J$	1	
1.2	$GPE_B = mgh_B$ $GPE_B = 160 \times 10 \times 3,5$ $GPE_B = 5\ 600\ J$	1	
1.3	<p>The mechanical energy of the system (dolphin, Earth) is conserved because the air resistance on the dolphin is negligible.</p> $ME_A = ME_B$ $8\ 000 = KE_B + GPE_B$ $8\ 000 = KE_B + 5\ 600$ Then $KE_B = 2\ 400\ J$	1	
1.4	$KE_B = \frac{1}{2} mV_B^2$ $2\ 400 = \frac{1}{2} \times 160 \times V_B^2$ $V_B = 5.47\ m/s$	1	
2.1	b) $ME'_A = ME_A$ Because the dolphin performs the second jump, with the same initial speed V_A , therefore the same KE And point A is located on the reference level of GPE then $GPE = 0$ Then ME is the same	1	
2.2	c) $GPE_{B'} < GPE_B$ $GPE = mgh$; since $h_{B'} < h_B$; m and g are the same	1	
2.3	a) $V_{B'} > V_B$ $ME_B = ME_{B'}$ $KE_B + GPE_B = KE_{B'} + GPE_{B'}$ Since $GPE_{B'} < GPE_B$ Then $KE_{B'} > KE_B$ and $KE = \frac{1}{2} mV^2$ and m is the same then $V_{B'} > V_B$	1	

Exercise 2 (6.5 pts)		Decay of bismuth-212	
part	Answers		grade
1	Number of protons Z = 83 Number of neutrons N = 212 – 83 = 129		0.25 0.5
2.1	Radiation α	Radiation β^-	1
	Name: Helium nucleus Symbol : ${}^4_2\text{He}$	Name: electron Symbol : ${}^0_{-1}\text{e}$	
2.2	Gamma radiation is emitted during the de-excitation of the daughter nucleus formed.		1
2.3	(a) \rightarrow radiation α ; (b) \rightarrow radiation β^- ; (c) \rightarrow radiation γ		0.75
3	The law of conservation of mass number: $212 = A + 0$; A = 212		0.5
	The law of conservation of charge number: $83 = Z - 1$; Z = 84		0.5
4.1	The half-life of a radioactive substance (or the radioactive period) is the time it takes for half of the radioactive substance to decay.		1
4.2	$m_0 = 20$ g after $t = 1$ T the remaining mass is $m = 10$ g		0.75
	after $t = 2$ T the remaining mass is $m = 5$ g So it needs two half-lives .		0.25

Exercise 3 (6.5 pts)		The Environmental Cost of War in Lebanon	
part	Answer		grade
1.1	Toxic chemicals from banned weapons, such as phosphorus and lead, polluted the environment, with rain carrying the pollutants deeper into groundwater		1
1.2	- Generators, often used due to the lack of electricity, produce toxic emissions.		1
	or - debris from airstrikes and other war-related activities, these emissions created a persistent black haze		
2.1	Two gases:		0.5
	Sulfur oxides		0.5
	Nitrogen oxides Carbon monoxide		
2.2	Two effects of this smog on health:		0.5
	Irritation of eyes, nose, and throat / Risk of cancer / Heart problems		0.5
3.1	Carbon dioxide (CO_2)		0.5
3.2	Increase in temperature (global warming)		0.5
4.1	They produce toxic emissions that pollute the air		0.5
4.2	Two other ways to produce electricity:		0.5
	Solar panels – photovoltaic cells		0.5
	Wind turbines		0.5
	Hydroelectric power plant		0.5