مسابقة في الثقافة العلمية: مادة الفيزياء
المدة: ساعة واحدة

الاسم:
الرقم:

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

Exercise 1 (6 pts)

Motion on two different ramps

A block (S), considered as a particle of mass m = 0.5 kg, is released from point A at a height h_A = 3.25 m above the ground. (S) slides without friction along a ramp AB, and it reaches point B situated at a height h_B = 2 m with a speed V_B.

Take:

- the ground as a reference level for the gravitational potential energy of the system [(S) , Earth];
- g = 10 m/s^2.

1) First case: Curved ramp

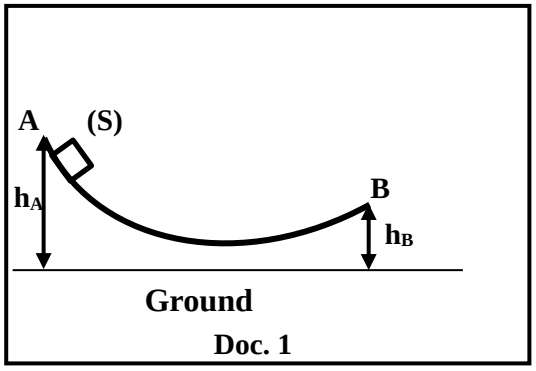
(S) is released from rest from the top A of a curved ramp AB as shown in document 1.

1.1) Calculate the values of the gravitational potential energy of the system [(S) , Earth] at A and B.

1.2) Deduce that the value of the mechanical energy of the system [(S) , Earth] at A is ME_A = 16.25 J.

1.3) Determine the value of the kinetic energy KE_B of (S) at point B by applying the conservation of mechanical energy for the system [(S) , Earth].

1.4) Show that the speed of (S) at B is V_B = 5 m/s.



Doc. 1

2) Second case: Plane ramp

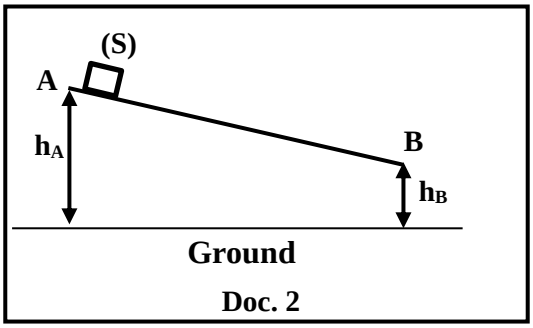
(S) is released from rest from the top A of a plane ramp AB as shown in document 2.

Choose the correct answer. Justify your answer without calculation.

a) The speed of (S) at B is V_B < 5 m/s.

b) The speed of (S) at B is V_B = 5 m/s.

c) The speed of (S) at B is V_B > 5 m/s.



Doc. 2

Exercise 2 (7 pts)

Hydroelectric power plant

Read carefully the selection of document 3 and then answer the questions.

Heat from the Sun turns water into water vapor thus forming clouds. The water vapor of the clouds turns into water as rain falls. Water stored in mountain lakes or behind dams is directed at the blades of huge turbines in order to produce electricity in hydroelectric power plants. Some countries like Norway have many natural lakes high in the mountains. In other countries rivers have to be dammed.

Doc. 3

Questions

1) Pick out from document 3:
- **1.1)** the source of energy used in hydroelectric power plants;
- **1.2)** the statement that shows the transformation of mechanical energy into electrical energy.

2) Name two sources of energy, one renewable and one non-renewable.

3) Electricity is a secondary source of energy. Why?

4) Some electric power plants in Lebanon are hydroelectric.
- **4.1)** Name one of these power plants.
- **4.2)** Write two advantages of hydroelectric power plants.

5) The efficiency of a hydroelectric power plant is: $r = \frac{\text{Furnished power}}{\text{Received power}} = 0.4$. The output electric power of this power plant is 100 MW. Calculate the mechanical power received by this power plant.

Exercise 3 (7 pts)

Polonium-210

One of the polonium isotopes, $^{210}_{84}Po$, decays (disintegrates) into a lead nucleus $^{206}_{Z}Pb$ by emitting an alpha (α) particle according to the following equation:

$$^{210}_{84}Po \rightarrow {}^{206}_{Z}Pb + \alpha$$

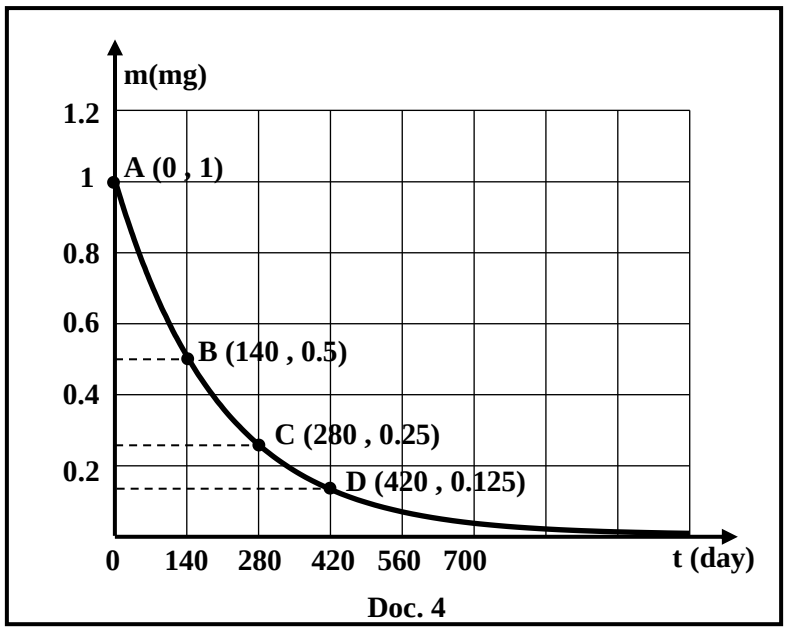
1) Indicate the name and the symbol of the emitted alpha (α) particle.

2) In addition to alpha (α) particle, beta minus (β^-), beta plus (β^+), and gamma (γ) are three types of radioactive radiation.
Match each radiation in the adjacent table to its appropriate radiation: (α), (β^-), (β^+) or (γ).

Radiation (1)	It is emitted as the nucleus formed after decay drops to a lower energy state, and it is uncharged.
Radiation (2)	It is positively charged and very penetrating.
Radiation (3)	It is positively charged and emitted by heavy nuclei.
Radiation (4)	It is negatively charged.

3) Calculate Z and indicate the used law.

4) The curve of document 4 represents the mass m (in mg) of a sample of polonium-210 as a function of time (in day).
- **4.1)** Define the half-life (radioactive period) T of a radioactive substance.
- **4.2)** Choose among the points A, B, C, and D the one whose abscissa represents the half-life T of polonium-210. Justify.
- **4.3)** Deduce the mass remaining in the sample of polonium-210 after three half-lives.



Doc. 4

وزارة التربية والتعليم العالي
المديرية العامّة للتربية
دائرة الامتحانات الرسميّة

امتحانات الشهادة الثانوية العامة
فرعا: الاجتماع والاقتصاد والآداب والإنسانيات

دورة العام 2022 الإستثنائية

مسابقة في الثقافة العلمية: مادة الفيزياء
المدة: ساعة واحدة

الاسم:
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Exercise 1 (6 pts)	Motion on two different ramps	
Part	**Answer**	**Mark**
1.1	$GPE_A = m.g.h_A = 0.5 \times 10 \times 3.25 = 16.25$ J $GPE_B = m.g.h_B = 0.5 \times 10 \times 2 = 10$ J	**1** **0.5**
1.2	(S) is released from rest, then $KE_A = 0$; $ME_A = KE_A + GPE_A = 0 + 16.25 = 16.25$ J	**1**
1.3	Friction is neglected, then the mechanical energy is conserved. $ME_A = ME_B$ $16.25 = KE_B + GPE_B$, so $16.25 = KE_B + 10$, then $KE_B = 6.25$ J	**1**
1.4	$KE_B = \frac{1}{2} m v_B^2$, then $6.25 = \frac{1}{2} \times 0.5 \times V_B^2$; hence, $V_B = \sqrt{25} = 5$ m/s	**1**
2	b) $V_B = 5$ m/s In both cases, the mechanical energy does not change and the gravitational potential energy remains the same (same height). So, the kinetic energy is the same; hence V_B is the same in both cases.	**0.5** **1**

Exercise 2 (7 pts)	Hydroelectric power plant	
Part	**Answer**	**Mark**
1.1	Falling Water	**0.5**
1.2	Water stored in mountain lakes or behind dams is directed at the blades of huge turbines in order to produce electricity	**1**
2	Renewable source: Sun - Wind – Waves - Tides – Geothermal energy sources Non-renewable source: Nuclear fuel - Fossil fuels	**0.5** **0.5**
3	Because electricity is generated from a primary energy source. Or: Electricity depends on a primary energy source to run the generator.	**1**
4.1	Markaba - Charles Helou - Nahr Ibrahim	**1**
4.2	- Water is a non-polluting energy source - Water is a renewable source of energy - Water is available in many areas all over the world (abundant) - Water is an inexpensive energy source.	**2**
5	$r = \frac{\text{Furnished power}}{\text{Received power}} = 0.4$, then $0.4 = \frac{100\ MW}{P_{mechanical}}$; hence, $P_{mechanical} = 250$ MW	**0.5**

Exercise 3 (7 pts)	Polonium-210	
Part	**Answer**	**Mark**
1	Name : Helium-4 nucleus ; Symbol : ^4_2He	**1**
2	***Radiation 1*** ↔ gamma radiation (γ) ***Radiation 2*** ↔ beta plus radiation (β^+) ***Radiation 3*** ↔ alpha radiation (α) ***Radiation 4*** ↔ beta minus radiation (β^-)	**0.5** **0.5** **0.5** **0.5**
3	Law of conservation of charge number: $84 = Z + 2$, then $Z = 82$	**1**
4.1	The half-life of a radioactive substance is the time it takes for half of the radioactive substance to decay.	**1**
4.2	T corresponds to $m = \frac{m_0}{2} = 0.5$ mg Graphically: for $m = 0.5$ mg , $t = T = 140$ days which is the abscissa of point B.	**1**
4.3	$3\ T = 3 \times 140 = 420$ days Graphically: When $t = 420$ days, the remaining mass is $m = 0.125$ mg **Or** by calculation	**1**