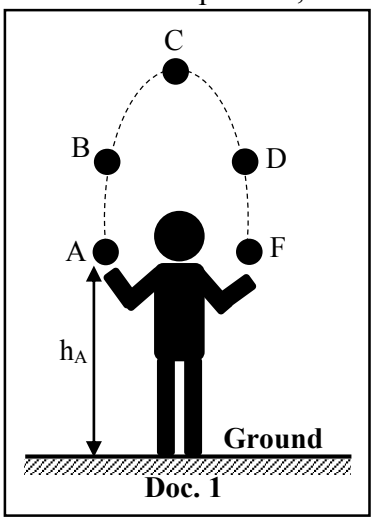
مسابقة في الثقافة العلمية: مادة الفيزياء	الاسم:
المدة: ساعة واحدة	الرقم:

يتكوّن هذا الامتحان من خمسة تمارين، موزعة على أربع صفحات. يجب اختيار **ثلاثة تمارين فقط**.
إقرأ الأسئلة كلّها بشكل عام وشامل، ومن ثمّ حدّد اختياراتك.
ملاحظة: في حال الإجابة عن أكثر من ثلاثة تمارين، عليك شطب الإجابات المتعلقة بالتمارين التي لم تعد من ضمن اختيارك، لأن التصحيح يقتصر على إجابات التمارين الثلاث الأولى غير المشطوبة، بحسب ترتيبها على ورقة الإجابة. يمكن الاستعانة بالآلة الحاسبة غير القابلة للبرمجة. . تعطى نصف علامة على وضوح الخط والترتيب.

Exercise 1 (6.5 pts)

Juggler's ball

A juggler throws a ball, considered as a particle of mass m, upwards. The ball is launched from point A, which is at an altitude h_A above the ground. The ball leaves the juggler's right hand with a speed V_A, passes through points B, C, D, and F where it reaches the juggler's left hand of altitude $h_F = h_A = 1.6$ m (Doc.1).



Doc. 1

Take:

- The ground as a reference level for gravitational potential energy;
- $g = 10$ m/s².

1) Choose with justification the correct answer.

1.1) The gravitational potential energy of the system (Ball – Earth) during the motion of the ball from A to C:

a) increases
b) decreases
c) remains the same

1.2) The gravitational potential energies of the system (Ball – Earth) at A (GPE_A) and at F (GPE_F) are:

a) $GPE_A < GPE_F$
b) $GPE_A = GPE_F$
c) $GPE_A > GPE_F$

2) The table below shows some values of the gravitational potential energy (GPE) of the system (Ball, Earth) and the kinetic energy (KE) of the ball at positions A, B, D, and F.

Position	A	B	D	F
GPE (J)	2.4	3	3	…..
KE (J)	2.7	2.1	2.1	2.7

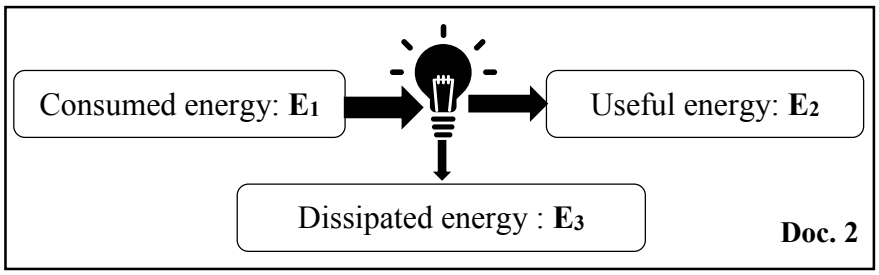
Using the table:

2.1) Indicate the value of the gravitational potential energy of the system (Ball – Earth) at point F.
2.2) Show that the mass of the ball is m = 0.15 kg.
2.3) Deduce the speed of the ball at point A.
2.4) Calculate the mechanical energies of the system (Ball – Earth) at A, B, D and F.
2.5) Deduce that air resistance on the ball is negligible.

Exercise 2 (6.5 pts)

Two types of lamp

A lamp consumes a from of energy E_1 and produces a useful energy E_2 and a dissipated energy E_3 (Doc.2).



Doc. 2

1) Name the form of each energy E_1, E_2 and E_3 shown in document 2.

2) Consider two types of lamps emitting the same luminosity in the same room: incandescent lamp and light-emitting diode (LED). The table below shows some information for each lamp.

Type of the lamp	Voltage across the lamp (U)	Current through the lamp (I)	Bulb Temperature
Incandescent	220 V	$I_1 = 0.4$ A	200 to 250°C
Light-emitting diode (LED)	220 V	$I_2 = 0.025$ A	30 to 50 °C

2.1) Calculate the energy E_1 consumed by each lamp during an operating time of t = 1 hour, knowing that $E_1 = U \times I \times t$.

2.2) The two lamps produce the same useful energy $E_{2(\text{incandescent})} = E_{2(\text{LED})} = 15\,840$ J during an operating time of 1 hour.
Calculate the dissipated energy E_3 given by each lamp during an operating time of t = 1 hour.

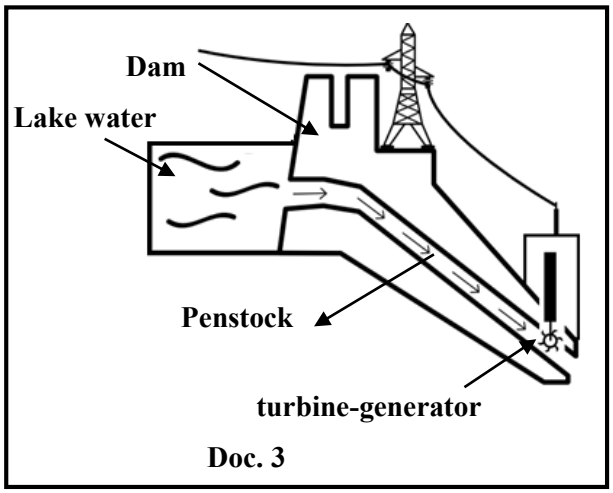
2.3) Deduce the cause of the difference in bulbs temperature.

Exercise 3 (6.5 pts)

Hydroelectric power plant

Document 3 is a simplified diagram of the hydroelectric power plant in Lebanon located in « Markaba ».

Water from « Karaoun » lake is brought to this power plant through penstocks.



Doc. 3

1) Name another hydroelectric power plant in Lebanon.

2) Write two advantages of hydroelectric power plants.

3) Indicate the form of energy stored in the system (Lake water - Earth).

4) Choose the correct answer:

4.1) When water flows through a penstock from the lake water to the turbine, there is a conversion of:
- **a)** kinetic energy of water into electrical energy.
- **b)** gravitational potential energy of the system (Lake water - Earth) into kinetic energy of water.
- **c)** electrical energy into kinetic energy of the water.

4.2) At the turbine-generator system, there is a conversion of:
- **a)** kinetic energy of the water into electrical energy.
- **b)** kinetic energy of the water into gravitational potential energy of the system (Lake water - Earth).
- **c)** electrical energy into mechanical energy.

5) The useful electrical energy provided by the power plant is 14×10^6 J each second. The efficiency of this power plant is $r = \frac{\text{provided useful energy}}{\text{received energy}} = 35\ \%$. Calculate, in each second, the energy received by this power plant.

Exercise 4 (6.5 pts)

The environmental impact of photovoltaic panels production

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

Photovoltaic panels (solar cells) manufacturing involves multiple steps, each step requires energy and emits greenhouse gases. The disposal of decommissioned photovoltaic panels can lead to environmental contamination and health risks.
However, there are solutions such as recycling and resource recovery to mitigate these challenges.
Some argue that the environmental benefits are more important than the negative impacts, while others raise concerns about the carbon footprint of manufacturing and disposal processes.

Doc. 4 https://green.org/

Questions

1) Referring to document 4, indicate the negative effects related to:
- **1.1)** the manufacturing of solar panels;
- **1.2)** the disposal of end-of-life solar panels.

2) Name the principle gas responsible for greenhouse effect.

3) Pick out from document 4, two solutions to combat the negative impact caused by the production of solar panels.

4) Document 4 mentions: « Some argue that the environmental benefits are more important than the negative impacts ».
Explain this expression by giving two advantages of using photovoltaic panels.

5) Other than the Sun, Lebanese people use other sources of energy to produce electricity.
Name two of these sources: one renewable and one non-renewable.

Exercise 5 (6.5 pts)

Radioactive Isotopes of Beryllium

Beryllium (Be) has 12 known isotopes with mass numbers ranging from 5 to 16. One of these isotopes is beryllium-10 which is a β^- emitter and decays into boron ${}^{A}_{Z}B$ according to the following disintegration:

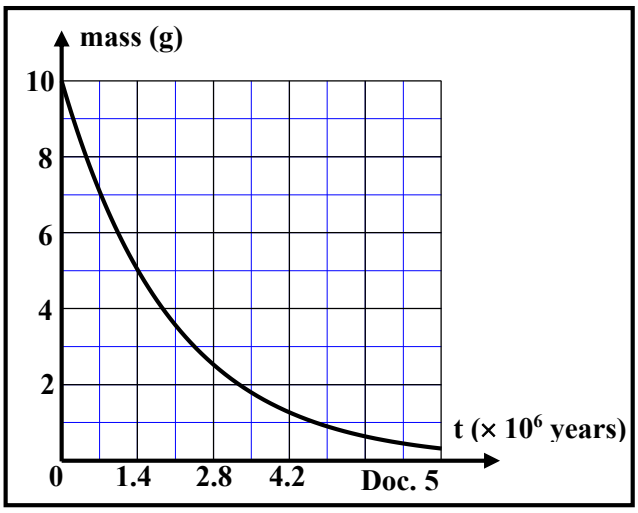
$$ {}^{10}_{4}Be \rightarrow {}^{A}_{Z}B + \beta^- $$

1) Define isotopes of a chemical element.

2) Indicate the name and the symbol of β^-.

3) Calculate A and Z stating the used laws.

4) The radioactive decay of a sample of beryllium-10 is represented by the curve in document 5.
- **4.1)** Referring to document 5, indicate the initial mass of this sample.
- **4.2)** Define the half-life of a radioactive substance.
- **4.3)** Deduce, using document 5, the half-life T of beryllium-10.



Doc. 5

مسابقة في مادة الفيزياء
أسس التصحيح - إنكليزي

Exercise 1 (6,5 pts)	**Juggler's Ball**	
Part	**Answer**	**grade**
1.1	**a)** increases GPE = mgh ; Since the altitude above the ground increases, therefore, the gravitational potential energy increases (with m and g being the same)	**1**
1.2	**b)** $GPE_A = GPE_F$ GPE = mgh ; since $h_A = h_F$, m and g are the same	**1**
2.1	$GPE_A = GPE_F = 2.4$ J	**0.5**
2.2	$GPE_A = mgh_A$ $2.4 = m \times 10 \times 1.6$ $m = 0.15$ kg $= 150$ g	**1**
2.3	$KE_A = ½\ mV^2_A$ $2.7 = ½ \times 0.15 \times V^2_A$ $V_A = 6$ m/s	**1**
2.4	$ME_A = 2.4 + 2.7 = 5.1$ J $ME_B = 3 + 2.1 = 5.1$ J $ME_D = 3 + 2.1 = 5.1$ J $ME_D = 2.4 + 2.7 = 5.1$ J	**1**
2.5	The mechanical energy of the system (ball, Earth) is constant. Therefore, the air resistance on the ball is negligible.	**1**

Exercise 2 (6,5 pts)	**Two Types of Lamp**	
Part	**Answer**	**Grade**
1	E_1 : electrical energy E_2 : radiant (light) energy E_3 : thermal energy	**1** **1** **1**
2.1	incandescent lamp : $E_1 = U \times I \times t = 220 \times 0.4 \times 3600 = 316\ 000$ J LED : $E_1 = U \times I \times t = 220 \times 0.025 \times 3600 = 19\ 800$ J	**1** **1**
2.2	Incandescent lamp : $E_3 = E_1 – E_2 = 316\ 800 - 15\ 840 = 300\ 960$ J LED : $E_3 = E_1 – E_2 = 19\ 800 - 15\ 840 = 3\ 960$ J	**0.5** **0.5**
2.3	Incandescent lamp: the energy dissipated as thermal energy is large, which raises the temperature of the bulb ($E_{dissipated} = 300\ 960$ J) LED: the energy dissipated as thermal energy is low (3 960 J), so the temperature of the bulb is not too high.	**0.25** **0.25**

Exercise 3 (6,5 pts)		
Part	**Answer**	**grade**
1	Charles Helou / Nahr Ibrahim	**0.5**
2	two avantages - 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.	**1** **1**
3	Gravitational potential energy	**1**
4.1	b) gravitational potential energy of the system (lake water - Earth) into kinetic energy of the water.	**0.75**
4.2	a) mechanical energy of the water into electrical energy.	**0.75**
5	$r = \frac{\text{useful energy provided}}{\text{Energy received}} = 35\ \%$ Received energy $= \frac{\text{Useful energy provided}}{r} = \frac{14 \times 10^6}{0.35} = 40 \times 10^6$ J each second	**1.5**

Exercise 4 (6.5 pts) The Environmental Impact of Solar Panel Production		
Part	**Answer**	**grade**
1.1	The manufacturing of photovoltaic panels: - Requires energy - Emits greenhouse gases.	**0.5** **0.5**
1.2	The disposal of end-of-life photovoltaic panels: - Environmental contamination - Potential health risks.	**0.5** **0.5**
2	Carbon dioxide	**1**
3	Recycling and resource recovery help address these challenges	**1**
4	Despite the negative impacts associated with the production and disposal of photovoltaic panels, their environmental benefits outweigh them. Two advantages: 1. The energy source (Sun) used is non-polluting. 2. The energy source (Sun) used is renewable. 3. Photovoltaic panels generate electricity without producing greenhouse gases. 4. The lifespan of photovoltaic panels can reach 30 to 40 years, so the amount of energy a solar panel produces over its lifetime will completely offset the number of carbon emissions produced to create the panel itself.	**0.75** **0.75**
5	Renewable source: Water, wind… Non-renewable source: Petroleum, fuel oil, …	**0.5** **0.5**

Exercise 5 (6.5 pts) Radioactive Isotopes of Beryllium		
Part	**Answer**	**grade**
1	The isotopes of an element are nuclides having the same atomic number Z.	**1**
2	Name: electron; symbol: ${}^{0}_{-1}e$	**1**
3	the law of conservation of charge number: $4 = Z - 1$; $Z = 5$ the law of conservation of mass number: $10 = A + 0$; $A = 10$	**1** **1**
4.1	$m_0 = 10$ g	**0.5**
4.2	The half-life of a radioactive substance (or the radioactive period) is the time during it half of the radioactive substance is decayed.	**1**
4.3	At $t = T_2$; $m = m_0/2 = 5$g Based on the curve, this corresponds to : $T_2 = 1{,}4 \times 10^6$ years	**1**