

## نموذج امتحان

متوافق مع الدروس المطلوبة لفرعي "الاجتماع والاقتصاد" و "الاداب والانسانيات" للعام 2022

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### I-(7 points)

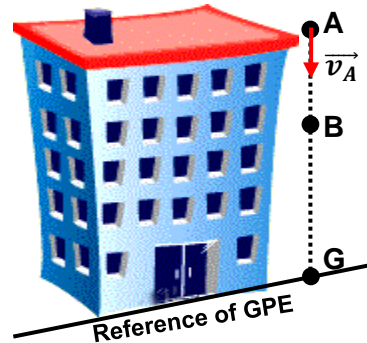
#### Non-Conservation of Mechanical Energy

A compressed ball of mass  $m = 200g$  is launched from point A, at the top of a building formed of 5 floors each of height  $3m$ , with an initial vertical downwards speed of  $v_A = 8m/s$ .

The ground is taken as a reference level of gravitational potential energy for the system [ball, Earth].

Take:  $g = 10m/s^2$ .

- Justify that the height of the building (point A) is  $15m$ .
- Show that the gravitational potential energy of the system [ball, Earth] at the top A of the building is  $30J$ .
- Deduce the mechanical energy of the system [ball, Earth] at A is  $36.4J$ .
- The mechanical energy of the system at B,  $10m$  above ground was found to be  $30J$ .
  - Justify that the ball is subjected to a force of friction.
  - Determine the kinetic energy of the ball at B.
  - Deduce the speed of the ball at B.
- The system loses 45% of its initial mechanical energy just before it hits the ground at G. Determine the mechanical energy of the system just before it reaches the ground at G.



### II-(6 points)

#### Roads Yielding Electricity

Read carefully the following selection. Then, answer the questions that follow.

An engineer dream! To benefit from paved roads, photovoltaic cover resisting the cross of heavy weights and transforming the road network into an electrical power plant is becoming real. Defeating the many challenges, a prototype of the solar slab is now available, and plans are set that  $1000 km$  of roads in France would be equipped before year 2020.

In 2015, the production of electricity in France using photovoltaic cells increased to  $6.7 \times 10^9 kWh$ , thus forming 1.4% of the total consumption in France.



Science & Vie - May 2016

- Pick up, from the text, the statement that justifies that the development of solar slabs was exhausting.
- Solar energy is a renewable energy.
  - Define a "renewable source of energy".
  - What is the source of solar energy?
  - Give two renewable energy sources that are not mentioned in the text.
- The average number of hours of sunshine in Paris is 1662 hours per year. Two photovoltaic cells one placed on the rooftop and the second used to pave the road.

Choose, justifying your reasoning, the convenient number of sunshine hours for each cell.

| Average number of sunshine hours per year | 1480 hours | 1662 hours | 1800 hours |
|---|------------|------------|------------|
| Location of the cell                      |            |            |            |

- Complete the following sentence.  
Solar slabs and solar.....convert the.....energy into.....energy
- Solar energy is called green energy. Explain the meaning of this name.
- Determine the total consumption of electricity in France for a whole year.

### III-(7 points)

#### Radioactive Materials in Medicine

*Read carefully the following selection. Then, answer the questions that follow.*

Radioactive materials are widely used in the medical domain either as a diagnosis technique or for therapy; the isotopes used in medicine are characterized by relatively short periods. In both techniques, a substance containing a radioactive isotope is injected to the patient. The radiations alpha and beta plus are used for diagnosis, whereas beta minus and gamma are used for therapy.

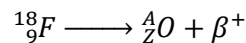
Fluorine-18 ( $^{18}_9F$ ), is beta plus emitter, of period 108 minutes. This short period is very important to ensure quick elimination. A patient is injected with a sample whose initial activity is  $3.5 \times 10^8$  disintegrations per second.



*Richard Zimmermann-EDP. Sciences 2006*

#### Questions:

- Referring to the text, pick out:
  - two medical applications of radioactive materials.
  - the radiations used for therapy.
- In the text, we read: «Fluorine-18 ( $^{18}_9F$ ) is a beta plus emitter.»
  - Give the constituents of fluorine-18 nucleus.
  - Identify the radiation beta plus.
  - The equation of disintegration of fluorine-18 is written:



Determine  $A$  &  $Z$  indicating the used laws.

- What is meant by period of a radioactive element?
- The doctor recommends that the patient should stay isolated for about 9 hours after treatment.
  - Define the activity of a radioactive sample.
  - How many periods are there during this duration?
  - Determine the activity of this sample after 9 hours.

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### Mark Scheme

| Exercise I (07 Points) |  |   |
|------------------------|--|---|
| 1.                     | The height of the building (A): $h_A = 5 \text{ floors} \times 3 \text{ m} = 15 \text{ m}$               | ½ |
| 2.                     | $GPE_A = m g h_A = 0.2 \times 10 \times 15 = 30 \text{ J}$ .   | 1 |
| 3.                     | The kinetic energy at A: $KE_A = \frac{1}{2} m v_A^2 = 0.5 \times 0.2 \times 8^2 = 6.4 \text{ J}$        | 1 |
|                        | The mechanical energy at A: $ME_A = KE_A + GPE_A = 30 \text{ J} + 6.4 \text{ J} = 36.4 \text{ J}$        | 1 |
| 4.a)                   | $ME_B = 30 \text{ J} < ME_A = 36.4 \text{ J}$ , friction exists  | ½ |
| 4.b)                   | The gravitational potential of the system at B: $GPE_B = 0.2 \times 10 \times 10 = 20 \text{ J}$         | ½ |
|                        | The kinetic energy at B: $KE_B = ME_B - GPE_B = 30 \text{ J} - 20 \text{ J} = 10 \text{ J}$              | ½ |
| 4.c)                   | $KE_B = \frac{1}{2} m v_B^2 = 10 \text{ J}$ ; so $v_B = \sqrt{2 \times \frac{10}{0.2}} = 10 \text{ m/s}$ | 1 |
| 5.                     | At G: $ME_G = ME_A - 45\%ME_A = 36.4 - 0.45 \times 36.4 \approx 20 \text{ J}$                            | 1 |

| Exercise II (06 Points) |   |       |
|-------------------------|---|-------|
| 1.                      | "Defeating the many challenges"   | ½     |
| 2.a)                    | A renewable source of energy is a source that is reproduced by natural procedures and is inexhaustible  | ¾     |
| 2.b)                    | The Sun   | ½     |
| 2.c)                    | wind energy and hydroelectric energy  | ½ & ½ |
| 3.                      | On roof top: 1662 hours because it is exposed   | ½     |
|                         | On road : 1480 hours because traffic hours and when vehicles are on roads   | ½     |
| 4.                      | Cells, solar, electrical  | ¾     |
| 5.                      | A green energy source is a nonpolluting energy (eco-friendly)   | ½     |
| 6.                      | $\eta = \frac{E_{\text{photovoltaic}}}{E_{\text{total}}}$ ,<br>So $E_{\text{total}} = \frac{E_{\text{photovoltaic}}}{\eta} = \frac{6.7 \times 10^9 \text{ kWh}}{1.4 \times 10^{-2}} = 4.8 \times 10^{11} \text{ kWh}$ . | 1     |

| Exercise III (7 Points) |  |        |
|-------------------------|--|--------|
| 1.a)                    | The radioactive materials are used as "a diagnosis technique" or for "therapy"   | ½      |
| 1.b)                    | The radiations beta minus & gamma are used for therapy   | ½      |
| 2.a)                    | $Z = 9$ protons & $N = 18 - 9 = 9$ neutrons  | ½      |
| 2.b)                    | Beta plus radiation corresponds to the emission of a positron  | ½      |
| 2.c)                    | Conservation of mass number: $18 = A + 0$ , then $A = 18$ ;<br>Conservation of charge number: $9 = Z + 1$ , then $Z = 9 - 1 = 8$   | ¾<br>¾ |
| 3.                      | The period of a radioactive sample is the duration at the end of which half the number of nuclei would be disintegrated  | 1      |
| 4.a)                    | The activity of a radioactive sample is the number of disintegrations per unit of time   | ½      |
| 4.b)                    | During $\Delta t = 9\text{hours} = 9 \times 60\text{min} = 540\text{min}$ .<br>The number of periods is $n = \frac{\Delta t}{T} = \frac{540\text{min}}{108\text{min}} = 5$ | 1      |
| 4.c)                    | The activity after $5T$ becomes $A = \frac{A_0}{2^n} = \frac{3.5 \times 10^8}{2^5} = 1.1 \times 10^7 \text{decays/s}$  | 1      |