| الصفحة 1 / 4 | الامتحان الوطني الموحد للبكالوريا<br>المسالك الدولية<br>الدورة الاستدراكية 2021<br>- عناصر الإجابة - | المملكة المغربية<br>وزارة التربية الوطنية<br>والتكوين المهني<br>والتعليم العالي والبحث العلمي<br>المركز الوطني للتقويم والامتحانات |
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|---|---|---|---|
| 4h | مدة الإنجاز | الفيزياء والكيمياء | المادة |
| 7 | المعامل | شعبة العلوم الرياضية (أ) و (ب) (خيار إنجليزية) | الشعبة أو المسلك |

**Exercise1 : Chimistry( 7 points)**

| Question | Element of answers | Scale | Reference of the question in the Reference Framework |
|---|---|---|---|
| **Part I**<br>**1-1** | Equation of the reaction. | **0,5** | -Determine the pH for an aqueous solution.<br>-Know that the ionic product of water $K_w$, is the equilibrium constant associated with the equation of the reaction of water autoprotolysis (self-ionization of water).<br>-Determine the pH value of aqueous solution based on the molar concentration of ions $H_3O^+$ or $HO^-$.<br>-Use the relationship linking the conductance G of a solution part to the effective molar concentrations [Xi] of Xi ions in the solution.<br>-Know that when the state of equilibrium of the system is reached, the amount of substances will remain steady, and that this equilibrium state is dynamic.<br>-Give and use the expression of the reaction quotient $Q_r$ through the reaction equation.<br>-Know that, the reaction quotient in equilibrium $Q_{r,eq}$, associated to the reaction equation of a chemical system, takes a value independent of concentrations, called equilibrium constant K.<br>-Know that, for a given transformation, the final progress rate depends on the equilibrium constant and the initial state of the chemical system.<br>-Define the final progress rate of a reaction, and determine it using experimental data.<br>-Determine the equilibrium constant associated to the equation of acid-base reaction using the acid dissociation constants of existing pairs.<br>-Write the equation of titration reaction (use only one arrow).<br>-Exploit the curve or the results of the titration.<br>-Write and use the expression of the acid dissociation constant $K_A$ associated with the reaction of an acid with water.<br>-Know the relationship $pK_A = -\log K_A$<br>-Indicate the predominant chemical specie taking into consideration pH of aqueous solution and $pK_A$ of pair acid/base |
| **1-2** | $\tau = \dfrac{\sigma - C(\lambda_2 + \lambda_3)}{C(\lambda_1 - \lambda_2)}$ ; $\tau \simeq 0,035\%$ | **0,5+0,25** | |
| **1-3** | $K_A = \dfrac{C.\tau^2}{1-\tau}$ ; verification. | **0,5+0,25** | |
| **1-4** | -Predominance diagram.<br>- The predominant species is the acid. | **0,5**<br>**0,25** | |
| **1-5** | 2 | **0,75** | |
| **2-1** | Equation of the reaction. | **0,5** | |
| **2-2** | $K = \dfrac{K_A}{K_e}$ ; $K \simeq 6,3.10^4$ . | **0,25+0,25** | |
| **2-3** | Yes ; Justification. | **0,25+0,5** | |

| Question | Element of answers | Scale | Reference of the question in the Reference Framework |
|---|---|---|---|
| Part II :1 | Overall equation. | 0,5 | -Draw the progress table of a reaction and exploit it.<br>-Determine the direction flow of the charge carriers in a cell using the criterion of spontaneous evolution.<br>-Interpret the functioning of a battery based on: the direction of electric current flow, the electromotive force (emf), the electrode reactions, the polarity of electrodes or the movement of charge carriers.<br>-Write the half-equation that occurred in each electrode (use double arrows) and write the overall equation of the reaction during the battery functioning (use one arrow).<br>-Establish the relationship between the amount of substance of chemical specie produced or consumed, the current intensity and the operating duration of a battery. Use this relationship to determine other quantities (quantity of charge, progress of the reaction, change of the mass...). |
| 2 | Method ; $Q_{max} = 9,65.10^{2}\ C$. | 2x0,25 | |
| 3 | Method ; $\left[Ni^{2+}_{(aq)}\right] \simeq 0,12\ mol.L^{-1}$ . | 0,5+0,25 | |

## Exercise2 : Waves (2 points)

| Question | Element of answers | Scale | Reference of the question in the Reference Framework |
|---|---|---|---|
| 1 | No. | 0,25 | -Define a mechanical wave and its wave speed.<br>-Know that light has a wave aspect, based on the diffraction phenomenon.<br>-Know the influence of the size of the slit (opening) or of the obstacle on the diffraction phenomenon.<br>-Exploit a document or a diffraction pattern in the case of light waves.<br>-Define a monochromatic and a polychromatic light.<br>-Know that the transparent media are more or less dispersive.<br>-Know (Recall) and exploit the relationship $\theta = \lambda/a$ ; and know the units and the meaning of $\theta$ and $\lambda$.<br>-Exploit experimental measurements to verify the relationship $\theta = \lambda/a$. |
| 2 | a is of the order of $\lambda$ . | 0,25 | |
| 3 | 2. | 0,5 | |
| 4-1 | Method ; $\lambda = 0,6\ \mu m$ . | 2x0,25 | |
| 4-2 | Method ; $a_1 = 60\ \mu m$ . | 2x0,25 | |

## Exercise3 : Nuclear transformations (1,5 points)

| Question | Element of answers | Scale | Reference of the question in the Reference Framework |
|---|---|---|---|
| 1 | Equation of the reaction. | 0,25 | -Know and exploit the two laws of conservation.<br>-Write the equation of a nuclear reaction by applying the two conservation laws.<br>-Use different units of mass, energy and the relationships between their units.<br>-Calculate the energy released (produced) by a nuclear reaction: $E_{pro} = \lvert\Delta E\rvert$ . |
| 2 | $\lvert\Delta E\rvert \simeq 2,645.10^{-11}\ J$. | 0,25 | |
| 3 | Method ; $\lvert\Delta E'\rvert \simeq 3,389.10^{12}\ J$ . | 2x0,25 | |
| 4 | Method ; $m \simeq 3,97.10^{4}\ kg$ . | 2x0,25 | |

## Exercise 4 : Electricity (5 points)

| Question | Element of answers | Scale | Reference of the question in the Reference Framework |
|---|---|---|---|
| 1-1 | Différential equation . | 0,5 | -Know and exploit the relationship $i=\frac{dq}{dt}$ for a capacitor in receiver convention.<br>-Know and exploit the relationship q = C.u.<br>-Represent the voltages (Electric Potential Difference) $u_R$ and $u_C$ using the receiver convention; .<br>-Know and exploit the voltage expression $u=r.i+L.\frac{di}{dt}$ between the inductor (coil) terminals using the receiver convention.<br>--Find out the differential equation for the voltage between the capacitor terminals or for its charge $q(t)$ in the damping case.<br>-Know and exploit the expression of the total energy in the circuit.<br>-Know and exploit the natural period expression.<br>-Exploit experimental documents<br>-Know and exploit the expression of the electric energy stored in a capacitor.<br>-Know and exploit the expression of the magnetic energy stored in an inductor.<br>-Know and exploit the energetic diagrams.<br>-Know the role of the oscillation maintenance device which compensates the energy dissipated by Joule effect in the circuit.<br>-Find out the differential equation for the voltage between the capacitor terminals or for its charge $q(t)$ in the RLC circuit that is maintained by using a generator delivering a voltage which is proportional to the current intensity: $u_G(t)=k.i(t)$. |
| 1-2 | Verification. | 0,5 | |
| 1-3-1 | Demonstration. | 0,5 | |
| 1-3-2 | Method ; $t_R \simeq 0,46\,s$ . | 2x0,25 | |
| 1-3-3 | Proposition. | 0,25 | |
| 2-1 | $k=6\,\Omega$ | 0,5 | |
| 2-2 | $I_m=2\,mA$ ; $C=40\,nF$ ; $Q_0=0,4\,\mu C$ . | 3x0,25 | |
| 3-1 | $R_1 \rightarrow$ (b) +justification. | 0,25 | - Know the mathematical expression of the sinusoidal voltage.<br>-Know and exploit the impedance expression $Z=\frac{U}{I}$ of a circuit.<br>-Know the unit of the impedance $(\Omega)$.<br>-Recognise the electric resonance phenomenon and its characteristics.<br>-Know and exploit the quality factor expression $Q=\frac{N_\circ}{\Delta N}$.<br>-Exploit experimental documents in order .... |
| 3-2 | $N_0 \simeq 800\,Hz$ | 0,25 | |
| 3-3 | $\Delta N=160\,Hz$ ; $Q \simeq 5$ . | 2x0,25 | |
| 3-4 | Method ; $R_1 \simeq 1002\,\Omega$ . | 2x0,25 | |

## Exercise 5: Mechanics (4,5 points)

| Question | Element of answers | Scale | Reference of the question in the Reference Framework |
|---|---|---|---|
| I- 1-1 | Demonstration | 0,5 | -Apply Newton's second law to determine the kinetic quantities $\overrightarrow{v_G}$ and $\overrightarrow{a_G}$ and dynamic quantities and exploit them.<br>-Know and exploit the two models of frictional fluids (viscous forces): $\vec{F}=-k.v.\vec{i}$ and $\vec{F}=-k.v^2.\vec{i}$ .<br>-Apply Newton's second law to find out the differential equation of a solid's centre of inertia motion in frictional vertical fall. |
| 1-2 | $v_\ell=\frac{2r^2g}{9\eta}(\rho_H-\rho_A)$ . | 0,25 | |
| 1-3 | Verification. | 0,5 | |
| 2-1 | Method<br>$q=\frac{4\pi.r^3.d.g}{3U_0}(\rho_H-\rho_A)$ . | 0,5<br>0,25 | |
| 2-2 | Method ; $N=10$ . | 2x0,25 | |
| II- 1-1 | Uniformly varied straight line motion. | 0,5 | -Know and exploit the characteristics of the uniformly accelerated straight line motion and its parametric equations .<br>-Know and exploit the relationships $\vec{F}=q\vec{E}$ and $E=\frac{U}{d}$ .<br>-Know the characteristics of Lorentz force and the rule to determine its direction.<br>-Apply Newton's second law in the charged particle case inside a uniform magnetic field, with $\vec{B}$ perpendicular to $\overrightarrow{v_0}$ in order to:<br>* determine the type of motion;<br>* calculate the magnetic deflection. |
| 1-2 | $x(t)=\frac{1}{2}\frac{eU_0}{m_1d}t^2$ ; $v(t)=\frac{eU_0}{m_1d}t$ . | 2x0,25 | |
| 1-3 | Deduce the expression. | 0,5 | |
| 2 | $MN=\frac{2}{B}\sqrt{\frac{2U_0}{e}}(\sqrt{m_2}-\sqrt{m_1})$<br>$MN\simeq 2,54\,cm$ . | 0,5 | |

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