



الأطر المرجعية المكيفة الخاصة بالامتحان الوطني الموحد لنيل شهادة البكالوريا – دورة 2020 –

المسالك الدولية: خيار إنجليزية

الإطار المرجعي لمادة الفيزياء والكيمياء

شعبة العلوم التجريبية

مسلك العلوم الفيزيائية



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مديرية التقويم وتنظيم الحياة المدرسية والتكوينات المشتركة بين الأكاديميات -المركز الوطني للتقويم و الامتحانات والتوجيه

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First Principal Part: Physics

The First Topic: Waves

1-Progressive Mechanical Waves

- Define a mechanical wave and its wave speed.
- Define a transverse wave and a longitudinal wave.
- Define a progressive wave.
- Know the relationship between displacement of a point from the propagation medium and the source displacement: $y_M(t) = y_S(t - \tau)$.
- Exploit the relationship between time delay, distance and wave speed.
- Exploit experimental documents and data in order to determine:
 - * distance;
 - * time delay;
 - * wave speed.
- Suggest a scheme of experimental set-up (mounting) to measure time delay or to determine the wave speed during the wave propagation.

2- Periodic Progressive mechanical waves

- Recognize a periodic progressive wave and its period.
- Define sinusoidal progressive wave, period, frequency and wavelength.
- Know (Recall) and use the relationship $\lambda = v.T$
- Know the condition to have the diffraction phenomenon: aperture/slit length is less or equal wavelength.
- Know (Recall) the characteristics of the diffracted wave.
- Define a dispersive medium.
- Exploit the experimental documents to recognize the diffraction phenomenon and highlight the characteristics of the diffracted wave.
- Suggest a scheme of an experimental set-up to highlight the phenomenon of the diffraction in the case audible and ultrasonic mechanical wave.

3- Propagation of a light wave

- Know that light has a wave aspect, based on the diffraction phenomenon.
- Know the influence of the size of the slit (opening) or of the obstacle on the diffraction phenomenon.
- Exploit a document or a diffraction pattern in the case of light waves.
- Know (Recall) and exploit the relationship: $\lambda = \frac{c}{\nu}$.
- Define a monochromatic and a polychromatic light.
- Know the boundaries of wavelengths and their colours for the visible spectrum in the vacuum.
- Know the frequency of a monochromatic radiation does not change as it passes from one transparent medium to another.
- Know that the transparent media are more or less dispersive.
- Know (Recall) and exploit the relationship: $n = \frac{c}{v}$.



- Determine (find out) the refractive index of transparent medium for a given frequency.
- Suggest the scheme of an experimental set-up allowing us to highlight the diffraction phenomenon in the case of light waves.
- Know (Recall) and exploit the relationship $\theta = \lambda/a$; and know the units and the meaning of θ and λ .
- Exploit experimental measurements to verify the relationship $\theta = \lambda/a$.

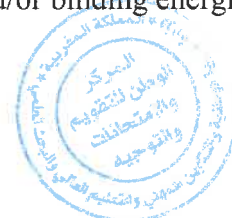
The Second Topic: Nuclear Transformations

1-Radioactive Decay

- Know the meaning (significance) of the symbol ${}^A_Z X$ and give the corresponding composition of the nucleus.
- Recognize the isotopes of a chemical element.
- Recognize the areas of stability and instability of the nuclei on the N-Z diagram.
- Exploit the N-Z diagram
- Define a radioactive nucleus.
- Know and exploit the two laws of conservation.
- Define the radioactivity: α , β^+ & β^- and the γ -radiation.
- Write the equation of a nuclear reaction by applying the two conservation laws.
- Recognize the type of radioactivity using the equation of a nuclear reaction.
- Know and exploit the law of the radioactive decay, and exploit its curve.
- Know that 1Bq is equal to one decay per second.
- Define the time constant τ and the half-life $t_{1/2}$.
- Exploit the relationships between τ , $t_{1/2}$ and λ (decay constant).
- Use the dimensional analysis to determine the units of λ and τ .
- Determine the suitable radioactive element in order to date a given event.

2- Nucleus, Mass and Energy

- Define and calculate the mass defect and the binding energy.
- Define and calculate the binding energy per nucleon and exploit it.
- Use different units of mass, energy and the relationships between their units.
- Exploit the binding energy per nucleon curve (Aston curve) to identify the most stable nucleus.
- Know the relationship of the mass-energy equivalence; and calculate the energy of mass.
- Define the fission and fusion.
- Analyze the binding energy per nucleon curve (Aston curve) to emphasize the energetic interest of fission and fusion.
- Write the equations of nuclear fission and fusion by applying the two laws of conservation.
- Recognize the type of nuclear reaction using the reaction equation.
- Establish the energy balance ΔE of a nuclear reaction using: mass energies and/or binding energies and/or the energy diagram.
- Calculate the energy released (produced) by a nuclear reaction: $E_{pro} = |\Delta E|$.
- Recognize some applications of radioactivity.
- State some risks of radioactivity.



1- RC Dipole (RC Circuit)

- Represent the voltages (Electric Potential Difference) u_R and u_C using the receiver convention; and show the polarity of capacitor plates.
- Know and exploit the relationship $i = \frac{dq}{dt}$ for a capacitor in receiver convention.
- Know and exploit the relationship $q = C.u$.
- Know the capacitance of a capacitor, its unit F and their submultiples $\mu F, nF$ and pF .
- Determine the capacitance of a capacitor graphically or by calculation.
- Know the capacitance of the equivalent capacitor in series or in parallel assemblies; and recall the interest of each one.
- Find out the differential equation and verify its solution when the RC dipole is submitted to a step voltage.
- Determine the voltage expression $u_C(t)$ between capacitor terminals when the RC dipole is submitted to a step voltage, and deduce both the expression of the intensity current in the circuit and the capacitor charge.
- Recognize and represent the variation curves of $u_C(t)$ between the capacitor terminals and different physical quantities associated to it, and exploit them.
- Recognize that the voltage between capacitor terminals is a continuous function of time at $t=0$, and the current intensity is a discontinuous function at $t=0$.
- Know and exploit the time-constant expression.
- Use the dimensional analysis (dimensional equations).
- Exploit experimental documents in order to:
 - * recognize the observed voltages.
 - * highlight the influence of R and C on the charging and the discharging processes.
 - * determine the time-constant and charge duration.
 - * determine the state's type (transient or steady) and the time interval for each one.
- Suggest the scheme of the experimental assembly that allows studying the response of the RC dipole submitted to a step voltage.
- Know how to connect an oscilloscope and a datalogger to monitor different voltages.
- Determine the influence of R and C and the amplitude of the step voltage on the RC dipole response.
- Find out the expression of the electric energy stored in a capacitor.
- Know and exploit the expression of the electric energy stored in a capacitor.



2- RL Dipole (RL Circuit)

- Represent the voltages (Electric Potential Difference) u_R and u_L using the receiver convention.
- Know and exploit the voltage expression $u = r.i + L.\frac{di}{dt}$ between the inductor (coil) terminals using the receiver convention.
- Know the meaning of the physical quantities involved in the expression of the voltage u between the inductor's terminals and their units.
- Determine the two characteristics of the inductor (the inductance L, the resistance r) exploiting experimental results.
- Find out the differential equation and verify its solution when the RL dipole is submitted to a step voltage.

- Determine the current intensity expression $i(t)$ when the RL dipole is submitted to a step voltage, and deduce the voltage expressions between the inductor terminals and the resistor terminals.
- Recognize and represent the variation curves of current intensity $i(t)$ in terms of time across the inductor and different physical quantities associated to it, and exploit them.
- Know that the inductor delays the appearance and the disappearance of the current, and that the current intensity is a continuous function but the voltage between their terminals is a discontinuous function at $t=0$.
- Know and exploit the time-constant expression.
- Use the dimensional analysis (dimensional equations).
- Exploit experimental documents in order to:
 - * recognize the observed voltages;
 - * highlight the influence of R and L on the response of a RL dipole;
 - * determine the time-constant.
- Suggest the scheme of the experimental assembly that allows studying the response of the RL dipole which is submitted to a step voltage.
- Know how to connect an oscilloscope and a datalogger to monitor different voltages.
- Determine the influence of R and L and the amplitude of the step voltage on the RL dipole's response.
- find out the expression of the electro-magnetic energy stored in an inductor.
- Know and exploit the expression of the magnetic energy stored in a inductor.

3-RLC Series Circuit

- Define and recognize the undamped (periodic), the underdamped (pseudo-periodic) and the overdamped (non-periodic) states.
- Recognize and represent the variation curves of the voltage between capacitor terminals in terms of time for the three states mentioned above; and exploit them.
- Find out the differential equation for the voltage between the capacitor terminals or for its charge $q(t)$ in the negligible damping case and verify its solution.
- Know and exploit the expression of the charge $q(t)$ and deduce the current intensity expression $i(t)$ flowing in the circuit and exploit it.
- Know and exploit the natural period expression.
- Explain energetically the three regimes.
- Know and exploit the energetic diagrams.
- Know and exploit the expression of the total energy in the circuit.
- Find out the differential equation for the voltage between the capacitor terminals or for its charge $q(t)$ in the damping case.
- Know the role of the oscillation maintenance device which compensates the energy dissipated by Joule effect in the circuit.
- 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: $u_G(t) = k.i(t)$
- Exploit experimental documents in order to:
 - * recognize the observed voltages;
 - * recognize the damping states;
 - * highlight the influence of R, L and C on the oscillation phenomenon;
 - * determine the values of the period and the natural period.



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- Suggest the scheme of the experimental assembly that allows the study of the free oscillations in the RLC series circuit.

- Know how to connect an oscilloscope and a datalogger to monitor different voltages.

4-Applications:

- know the main processes necessary to transform information into oral or written messages.

- Know the transmission speed of the information.

- Know that the light is part of the electromagnetic waves and that it corresponds to specific boundaries of frequency.

- Know that for a transmitting antenna, the electromagnetic wave emitted has the same frequency as that the transmitted electrical signal.

- Know that in the receiving antenna, the electromagnetic wave generates an electric signal that has the same frequency.

- Know the mathematical expression of the sinusoidal voltage.

- Know that the transmission of information by electromagnetic waves takes place through energy transfer without transfer of matter.

- Know that the antenna can be used as both transmitter and receiver (the mobile phone for example).

- Know that the amplitude modulation process is to transform the modulated amplitude voltage to affine function of the modulating voltage.

- know the required conditions to avoid over modulation.

- Recognize the stages of the amplitude modulation.

- Exploit the different experimental obtained curves.

-Recognize the different stages of amplitude modulation and amplitude demodulation through their corresponding assembly schemes.

- Know the role of different used filters.

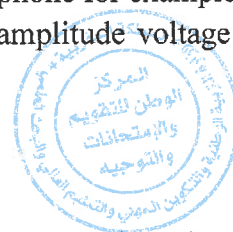
- Know and exploit the frequency spectrum.

- Know the stages of demodulation.

- Know the conditions allowing to get an amplitude modulation and a high quality detection envelope.

- Know the selective role of the LC (bung circuit) for the modulated voltage.

- Recognize the essential components required to assemble an AM radio, and their roles in the demodulation.



The Fourth Topic: Mechanics

1-Newton's Laws

- Know and exploit expressions of the instantaneous velocity vector and the acceleration vector.

- Know the unit of acceleration.

- Know the components of the acceleration vector in Cartesian coordinate system and in Frenet frame.

- Exploit the dot product $\vec{a} \cdot \vec{v}$ to determine the nature of motion (accelerated or decelerated).

- Know the Galilean frame of reference.

- Know Newton's second law $\vec{\Sigma F}_{ext} = m \cdot \frac{\Delta \vec{V}_G}{\Delta t}$ and $\vec{\Sigma F}_{ext} = m \cdot \vec{a}_G$ and its range of validity.

- Recognize the role of mass in the inertia of a system

- Apply Newton's second law to determine the kinetic quantities \vec{v}_G and \vec{a}_G and dynamic quantities and exploit them.

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- Know and use Newton's third Law.
- Use of the dimensional analysis (dimensional equations).

2-Applications

- Know and exploit the two models of frictional fluids (viscous forces): $\vec{F} = -k.v.i$ and $\vec{F} = -k.v^2.i$
- Exploit the curve $v_G = f(t)$ to determine:
 - * the terminal speed;
 - * the characteristic time τ ;
 - * the initial state and the steady state.
- Apply Newton's second law to find out the differential equation of a solid's centre of inertia motion in frictional vertical fall.
- Know and apply the Euler's method to solve approximately differential equation.
- Define the vertical free fall.
- Apply Newton's second law to find out the differential equation of a solid's centre of inertia motion in vertical free fall and solve it.
- Know and exploit the characteristics of the uniformly accelerated straight line motion and its parametric equations (t is the parameter).
- Exploit the velocity-time graph: $v_G = f(t)$.
- Select the appropriate frame of reference to study motion.
- Apply Newton's second law to find out the differential equation of a system's centre of inertia motion in horizontal or inclined plane and determine the characteristics of kinetic and dynamic quantities of motion.



Second Principal Part: Chemistry

The First Topic : Fast and Slow Transformations of a Chemical System

1- Fast and slow transformations

- Write the equation of the reaction associated with a redox (oxidation-reduction) transformation, and identify the two pairs involved.
- Determine from experimental results the effect of kinetic factors on the rate of reaction.

2- Temporal Monitoring of a Chemical Transformation – Rate of Reaction

- Justify the different operations carried out during the monitoring of the time-evolution of a system and exploit the experimental results.
- Determine the point of equivalence during a titration and exploit it.
- Exploit the different curves of time-evolution of the following:
 - the amount of substance of a chemical specie, its concentration, the progress of a reaction, conductivity, conductance, pressure and volume.
- Draw the progress table of a reaction and exploit it.
- Know the expression of the volume rate of reaction.
- Know the effect of reactant concentration and the temperature on the volumetric rate of reaction.
- Explain qualitatively the reaction rate change using the plotted evolution's curves,.
- Determine graphically the value of the volumetric rate of reaction.

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- Define the half-life $t_{1/2}$ of a chemical reaction.
- Determine the half-life $t_{1/2}$ of the chemical reaction graphically or through exploiting the experimental results.
- Interpret the effect of concentration of one of the reactants and/or temperature on the number of effective collisions per unit of time.

The Second Topic : Non-Completion Transformations of a Chemical System

1- Reversible chemical transformations

- Define an acid and a base according to Bronsted.
- Write the equation of the acid-base reaction and identify the two pairs involved.
- Determine the pH for an aqueous solution.
- Calculate the final progress of the reaction that occurs between an acid and water taking into consideration the value of both the concentration and this acid's pH aqueous solution; then, compare it with the maximum progress.
- Define the final progress rate of a reaction, and determine it using experimental data.
- Interpret the chemical equilibrium state at a microscopic level.

2- Equilibrium State of a Chemical System

- Use the relationship linking the conductance G of a solution part to the effective molar concentrations $[X_i]$ of X_i ions in the solution.
- 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.
- Give and use the expression of the reaction quotient Q_r through the reaction equation.
- 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 .
- Know that, for a given transformation, the final progress rate depends on the equilibrium constant and the initial state of the chemical system.

3- Transformations associated with the acid-base reactions in aqueous solution

- 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).
- Know the relationship $pK_W = -\log K_W$
- Determine the nature of aqueous solution (acid, basic or neutral) based on its pH value.
- Determine the pH value of aqueous solution based on the molar concentration of ions H_3O^+ or HO^- .
- Write and use the expression of the acid dissociation constant K_A associated with the reaction of an acid with water.
- Know the relationship $pK_A = -\log K_A$.
- Determine the equilibrium constant associated to the equation of acid-base reaction using the acid dissociation constants of existing pairs.
- Indicate the predominant chemical specie taking into consideration pH of aqueous solution and pK_A of pair acid/base.
- Exploit the predominance and distribution diagrams of acidic and basic chemical species existing in aqueous solution.
- Write the equation of titration reaction (use only one arrow)
- Know the experimental set-up of an acid-base titration.



- Exploit the curve or the results of the titration.
- Determine and exploit the point of equivalence.
- Justify the choice of a suitable indicator to determine the equivalence.

The Third Topic: Evolution Direction of a Chemical System

1- Spontaneous evolution of a chemical system

- Calculate the value of the quotient of reaction Q_r of a chemical system in given state.
- Determine the direction of spontaneous evolution of a chemical system.

2- Spontaneous transformations in batteries and recovery of energy

- Draw a cell diagram / diagram of an electrochemical cell (battery)
- Determine the direction flow of the charge carriers in a cell using the criterion of spontaneous evolution.
- 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.
- 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).
- 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...).



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المملكة المغربية
وزارة التربية الوطنية
والتكوين المهني
والتعليم العالي والبحث العلمي

جدول التخصيص



Contents and their weights

The following table highlights the weight of each content.

Principal Part	Topic	Weight
PHYSICS	Waves	15 %
	Nuclear transformations	12 %
	Electricity	27 %
	Mechanics	12 %
CHEMISTRY	Fast and slow transformations of a chemical system	10 %
	Non-completion transformation of a chemical system	15 %
	Evolution direction of a chemical system	9 %

Specification Table

The table of specification presents:

- The contents and their weights;
- The skill levels and their weights;
- Contents and skill levels expressed in percentage.



Principal Part	Skill levels	Using resources	Applying an experimental solution	Solving the problem	TOTAL
		50%	15 %	35 %	
PHYSICS	Waves	7,5 %	9,9 %	5,25 %	15 %
	Nuclear Transformations	6%		4,20 %	12 %
	Electricity	13,5 %		9,45 %	27 %
	Mechanics	6 %		4,20%	12 %
CHEMISTRY	Fast and Slow Transformations of a Chemical System	5%	5,1 %	3,50%	10 %
	Non-completion transformation of a chemical system	7,50%		5,25 %	15 %
	Evolution direction of a chemical system	4,50%		3,15 %	9 %
TOTAL		50 %	15 %	35 %	100 %