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

المسالك الدولية : خيار أنجليزية

الإطار المرجعي لمادة الفيزياء والكيمياء

شعبة العلوم التجريبية

مسلك علوم الحياة والأرض

List of the required knowledge and skills

First Major 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 elongation of a point from the propagation medium and the source elongation: $y_M(t) = y_S(t-\tau)$.
- 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 schema of experimental set-up (mounting) to measure time delay or to determine the wave speed during the wave propagation.

2- Periodic Progressive mechanical waves

- Recognise 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 recognise the diffraction phenomenon and highlight the characteristics of the diffracted wave.
- Suggest a schema of an experimental set-up to highlight the phenomenon of the diffraction in the case of 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: $\lambda = c/\upsilon$.
- Define a monochromatic and a polychromatic light.
- Know the boundaries of wavelengths and their colours for the visible spectrum in the vacuum.

- Know that 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: $n = c/v$
- Determine (find out) the refractive index of transparent medium for a given frequency.
- Suggest the schema 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 composition of the corresponding nucleus.
- Recognise the isotopes of a chemical element.
- Recognise 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 $\gamma - radiation$.
- Write the equation of a nuclear reaction by applying the two conservation laws.
- Recognise 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. Nuclei, 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 Aston's curve to identify the most stable nuclei.
-Know the relationship of the mass-energy equivalence; and calculate the energy of mass.
- 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: $E_{pro} = |\Delta E|$.
- Recognise some applications of radioactivity.
- State some risks of radioactivity.

The Third Topic: Electricity

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 μF, 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 current intensity in the circuit and the capacitor charge.
- Recognise and represent the variation curves of $u_C(t)$ between the capacitor terminals and different physical quantities associated to it, and exploit them.
- Recognise that the voltage between capacitor terminals is a continuous function of time, 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:
  * recognise 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 type (transient or steady) and the time interval for each one.
- Suggest the schema 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.
- 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's (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's terminals and the resistor terminals.
- Recognise 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:
  * recognise the observed voltages;
  * highlight the influence of R and L on the response of a RL dipole;
  * determine the time-constant.
- Suggest the schema 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.
- Know and exploit the expression of the magnetic energy stored in an inductor.

3. RLC Series Circuit

- Recognise the undamped (periodic), the underdamped (pseudo-periodic) and the overdamped (non-periodic) states.
- Recognise and represent the variation curves of the voltage between the 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's 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:
  * recognise the observed voltages;
  * recognise 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.
- Suggest the schema 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 visualize the different voltages.

Second Major 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 amount of substance of a chemical species, or its concentration, or the advancement of reaction or pressure of a gaz.
- Draw the progress table of a reaction and exploit it.
- Know the expression of the volumetric 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 one of the plotted evolution's curves.
- Determine graphically the value of the volumetric rate of reaction.
- 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.

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

3. 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.

4. Equilibrium State of a Chemical System

- Use the relationship linking the conductance G of a part of the solution to the effective molar concentrations [Xi] of Xi 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 exploit the expression of the reaction quotient Q_r through the reaction equation.
- Know that, the reaction quotient in equilibrium $Q_{r,eq}$, associated with 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.

5. Transformations associated with the acid-base reactions in aqueous solution

- Know that the ionic product of water K_e, is the equilibrium constant associated with the equation of the reaction of water autoprotolysis (self-ionization of water).
- Know the relationship $pK_e = -\log K_e$
- 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 exploit 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 with the equation of acid-base reaction using the acid dissociation constants of existing pairs.
- Indicate the predominant chemical species taking into consideration pH of aqueous solution and pK_A of the acid/base pairs.
- 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.

6. 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.