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

المسالك الدولية : خيار أنجليزية

الإطار المرجعي لمادة الفيزياء والكيمياء

شعبة العلوم الرياضية

مسلك العلوم الرياضية " أ " والعلوم الرياضية " ب "

1. Types of assessment and exam layout:

Summative assessment in the second year Baccalaureate cycle aims to cover a set of elements and check the candidate's level of mastery of these elements through familiar or new learning situations associatedwith the basic learning acquired in the classroom.These situations have to be tested through centred around one theme. These exercises, which may increase in difficulty in a gradual way, can start with an assessment situation and can be subdivided into independent parts.

The theme-based exercises should be related to the basic learning acquired in the classroom during courses and laboratory work, and should also be based on familiar situations and syntheses. They allow using both knowledge and skills related to the compounds of the school programme and the adoption of the scientific approach as suggested by skill levels. All this is well defined in this reference framework.

While dealing with the testing situations targeted by this summative assessment, the knowledge and the know-how to be tested should be exploited through scientific applications closely related to the real world and to the different parts of the programme with the possibility of expanding the assessment of the knowledge and skills to include physical or chemicalquantities related to the fundamental quantities mentioned in the Framework.

1.1. Types of Assessment:

The exam paper may present evaluation situations designed to assess the knowledge and the know-how using test items such as:

- MCQ (multiple choice questions);
- T/F (True/False);
- Matching…;
- Short-answer questions;
- Essay questions;
- Synthesis questions, Complex issues (whose solutions require the use of knowledge and know-how related to one or more areas).

1.2. The layout of the national Bac exam:

✓ **The exam paper Components :**

- The Physics and Chemistry national Bacexam test paper covers the whole school year programme and takes place at the end of the secondary school education.
- The Physics and Chemistry national exam test paper, Mathematical Sciences section: A and B – consists of 4 or 5 thematic exercises.

✓ **Completion time:** four (4) hours.

✓ **The candidate is authorized to use:** a non-programmable scientific calculator, writing and drawing pens and pencils.

- ✓ **Correction Grid**: It should include the number of the test items and the mark assigned to them; the questions' numbers; the key and marking scale the mark; a column mentioning the question reference according to the Framework.

2. Table of Contents:

The table of contents presents the content areas targeted by the assessment and the list of essential objectives (knowledge and skills) related to each content area. This knowledge and skills constitute the minimum threshold to assess in candidates.

List of the required knowledge and skills

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

- 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 scheme of an experimental set-upto 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: $\lambda = \frac{c}{v}$.
- 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 exploitthe 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 exploitthe relationship $\theta = \lambda/a$; and know the units and the meaningof 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.
- 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 equalto 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.
-Analysethe 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.
-Recognise 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: $E_{pro} = |\Delta E|$.
- 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 $\mu F, nF \text{ and } pF$.
- Determine the capacitance of a capacitor graphically or by calculation.
- Know the capacitance of the equivalent capacitor in series orin parallelassemblies; and recallthe 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.
- Recognise and represent the variation curves of $u_C(t)$ between the capacitorterminals and different physical quantities associated to it, and exploit them.
- Recognise 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:
  * 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's type (transient orsteady) and the time interval for each one.
- Suggest the scheme of the experimental assemblythat allowsstudying 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 quantitiesinvolved 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.
- Recognise and represent the variation curves of current intensity $i(t)$ in terms of time across the inductor and different physical quantitiesassociated 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 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 aninductor.
- Know and exploit the expression of the magnetic energy stored in ainductor.

3-RLC Series Circuit

- Define and Recognisethe undamped (periodic), the underdamped (pseudo-periodic) and the overdamped (non-periodic)states.
- Recognise 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 thecharge $q(t)$ 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 compensatesthe 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 dampingstates;
  * highlight the influence of R, L and C on the oscillation phenomenon;
  * determine the values of the period and the natural period.
- 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.
- Distinguish between free and forced oscillations.
- Know the role of the driver and the resonating system.
- Know and exploit the expression $|\varphi| = \frac{2.\pi.\tau}{T}$ of the phase of physical quantity relative to another.
- Know and exploit the impedance expression $Z = \frac{U}{I}$ of a circuit.
- Know the unit of the impedance (Ω)
- Recognise the electric resonance phenomenon and its characteristics.
- Know and exploit the quality factorexpression $Q = \frac{N_\circ}{\Delta N}$
- Exploit experimental documents in order to:
  * know the influence of the resistance on the quality factor.
  * determine the width of the passband.
- Recognise the phenomenon of theovervoltage.
- Know the instantaneous power in the alternating sinusoidal state.
- Find out and exploit the average power expression $P = U.I.\cos\varphi$
- Know the power factor.

4-Applications: Production of electromagnetic waves and communication.

- 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 modulatedamplitude voltage to affine function of the modulating voltage.
- know the required conditions to avoid over modulation.
- Recognise the stages of the amplitude modulation.
- Exploit the different experimental obtained curves.
-Recognise 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 allowingto getan amplitude modulation and ahigh quality detection envelope.
- Know the selective role of the LC (bung circuit) for the modulated voltage.
- Recognise 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 Frenetframe.
- Exploit the dot product $\vec{a}.\vec{v}$ to determine the nature of motion (accelerated or decelerated).
- Know the Galilean frame of reference.
- Know Newton's second law $\Sigma\vec{F}_{ext} = m.\frac{\Delta\vec{V}_G}{\Delta t}$ and $\Sigma\vec{F}_{ext} = m.\vec{a}_G$ and its range of validity.
- Recognise the role of mass in the inertia of a system
- Apply Newton's second law to determine the kineticquantities $\vec{v}_G$ and $\vec{a}_G$ anddynamicquantities and exploit them.
- 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): $\vec{F} = -k.v.\vec{i}$ and $\vec{F} = -k.v^2.\vec{i}$
- Exploit the curve $v_G = f(t)$ to determine:
  * theterminal speed;
  * the characteristic time τ;
  * the initial state and the steady state.
- Apply Newton's second law to find outthe differential equation of a solid's centre of inertia motion in frictional vertical fall.

- Know and apply the Euler's method to solveapproximately 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 dynamicquantitiesof motion.
- Exploit a document representing the path (trajectory) of a projectile in a uniform gravitational field to:

* determine the type of the motion (plane);
* represent the velocity and the acceleration vectors;
* determine the initial conditions and some parameters characterizing motion.

- Apply Newton's second law in the case of a projectile to:

* find out differential equation of motion;
* deduce the parametric equations of motion and exploit them;
* establish the equation of the path (trajectory), find out the expressions of the range and the maximum height of the pathand exploit them;

- Know and exploit the relationships $\vec{F} = q\vec{E}$ and $E = \frac{U}{d}$
- Apply Newton's second law in the case of charged particleto:

* find out the differential equation of motion;
* establish the parametric equations of motion and exploit them.
* find the equation of the path and exploit it to calculate the electric deflection.

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 aredox (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.
- Exploitthe different curves of time-evolution of the following:

theamount of substance of a chemical specie, its concentration, the progress of a reaction, conductivity, conductance,pressure and volume.

- Draw the progress table ofa 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 changeusing 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.
- Interpret the effect of concentrationof one of the reactants and/or temperatureon 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 thereaction that occurs between an acid and water taking into consideration the value of both theconcentration 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 partto 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 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 constantK_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 specietaking into consideration pH of aqueous solution and pK_A of pair acid/base.
- Exploit the predominance and distribution diagrams of acidic and basicchemical species existing in aqueous solution.
- Write the equation of titration reaction (useonly one arrow)
- Know the experimental set-up of an acid-base titration.
- Exploit the curve or the results of thetitration.
- 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-equationthat occurredin 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 specieproduced or consumed, the current intensity andthe operating durationof a battery. Use this relationship to determine other quantities (quantity of charge, progressof the reaction, changeof the mass...).

المملكة المغربية
وزارة التربية الوطنية
والتكوين المهني
والتعليم العالي والبحث العلمي

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جدول التخصيص

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.

Skill levels / Topics	Using resources	Applying an experimental solution	Solving the problem	TOTAL
	45%	15%	40%	
Waves	5,18%-6,07%	10%	4,6%-5,4	11,5%-13,5%
Nuclear transformations	4,95%-5,85%		4,4%-5,2%	11%-13%
Electricity	12,15%-13,05%		10,8%-11,6%	27%-29%
Mechanics	6,52%-7,42%		5,8%-6,6%	14,5%-16,5%
CHEMISTRY	14,4%-15,3%	5%	12,8%-13,6%	32%-34%
Total	45%	15%	40%	100%