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المملكة المغربية
وزارة التربية الوطنية
والتكوين المهني
والتعليم العالي والبحث العلمي

# *Framework*

# *of the joint competition for access to the faculties of Medicine, Pharmacy and Dentistry*

**- 2020/2021 -**

- The competition for access to the faculties of Medicine, Pharmacy and Dentistry consists of four components, each lasting 45 minutes:
    - **Component 1**: Life Sciences test (Biology);
    - **Component 2**: Physics test;
    - **Component 3**: Chemistry test;
    - **Component 4**: Maths test.

- Each component has 20 questions and each question has only one correct answer;
- The questions will be scored according to a weighting ranging from 1 to 3;
- A mark less than or equal to 3/20 in a component will be an eliminatory note;
- The use of calculators is not allowed.

# Component 1: Life Sciences test (Biology)

The domain of Assessment of Learning Outcomes in Life Sciences (Biology) targets two important levels of mastery: Mastery of knowledge and mastery of scientific reasoning. The duration of the test is 45 minutes.
The first level evaluates the candidate's knowledge in the field of genetics.
As for the second level, it allows the evaluation of scientific reasoning, in other words, the ability to use study and action processes and tools (laws, procedures, operational acts, etc.).

## 1. Area and sub-areas of knowledge covered by the competition test

| Area : Genetics | | |
|---|---|---|
| **Sub-areas** | **Content** | **Coverage** |
| **The notion of genetic information, gene expression mechanisms and genetic engineering** | - The role of chromosomes in the transmission of genetic information from one cell to another:<br>• phases of mitosis in plant and animal cells;<br>• The cell cycle.<br>- The chemical nature of genetic material:<br>• Composition and structure of chromosomes and DNA;<br>• Mechanism of DNA replication.<br>- The notions of inherited characteristics/traits, gene, allele and mutation;<br>- The relationship between trait -protein and gene-protein;<br>- The meaning of gene mutation;<br>- The genetic code.<br>- Structure of mRNA.<br>- Transcription and translation.<br>- The stages of gene transfer - the notion of genetic transformation:<br>• natural gene transfer from *Agrobacterium Tumefaciens* to a plant.<br>• techniques and steps of transferring a gene to a bacterium;<br>• some examples of applying the genetic engineering principles;<br>• industrial production of human insulin<br>• Industrial production of toxic proteins to fight against harmful insects. | **30%** |

| | | |
|---|---|---|
| **The transmission of genetic information through sexual reproduction Mendel's laws of the transmission of hereditary characteristics/traits in the diploid organisms** | - Stages/phases of meiosis;<br>- Karyotypes of diploid species;<br>- Role of meiosis and fertilisation in allelic recombination/ recombination of alleles (genetic recombination of homologous chromosomes by linkage/crossing-over and chromosomes independent assortment) and in karyotype stability across generations.<br>- Mendel's laws of the transmission of hereditary characteristics/traits;<br>- Monohybridism/ Monohybrid Cross;<br>- Dihybridism/dihybrid cross;<br>- Pure lineage and wild type, homozygosity and heterozygosity, hybridisation, test cross/back cross;<br>- Punnett squares;<br>- Autosomal heredity (independent of sex) and sex-linked heredity;<br>- Dominance, codominance and lethal gene.<br>- Unlinked genes (genes of independent assortment);<br>- Linkage/crossing-over, genetic recombination of homologous chromosomes by linkage/crossing-over and genetic diversity.<br>- Gene maps. | **35%** |
| **Human genetics And population genetics** | - Notions of pedigree and karyotype.<br>- Hereditary autosomal diseases.<br>- Hereditary sex-linked diseases.<br>- Chromosomal abnormalities and their consequences.<br>- Chromosomal interpretation of hereditary diseases.<br>- Criteria of genetic equilibrium of population<br>- The evolutionary factors and their impact on the genetic structure of a population<br>- Criteria specifying of a species. Definition of a species | **35%** |

## 2. The levels of mastery (skills) targeted by the competition test

The test targets two levels of mastery: The restitution of knowledge and scientific reasoning using multiple-choice questions (MCQ).

| Skills areas | | Weighting in (%) |
|---|---|---|
| **Knowledge Retrieval** | This level aims to assess the candidate's level of knowledge related to the genetics. | **50%** |
| **Scientific reasoning** | This level aims to evaluate, in the candidate, the degree of mastery of study and action processes and tools (laws, procedures, operational acts, ...). | **50%** |

# Component 2: Physics test

The field of the evaluation of acquired **Physics** targets two important levels of mastery: Use of resources and Scientific reasoning.
The first level aims to check the level of mastery of the use of resources (essential learning acquired during lessons and practical work);
As for the second level, it allows to assess the mastery of scientific reasoning.

## 1. Domain major and sub-domains contents targeted by the competition

The content table presents the domains of content subject to the assessment and the list of essential objectives (knowledge and know-how) relating to each content area. This knowledge and know-how constitute the minimum threshold to be assessed by candidates.

| First Major Part : Physics | | |
|---|---|---|
| **Sub-areas** | **Content** | **Coverage** |
| **The First Topic: Waves** | **1-Progressive Mechanical Waves**<br>- Define a mechanical wave and its wave speed.<br>- Define a transverse wave and a longitudinal wave.<br>- Define a progressive wave.<br>- Know the relationship between elongation of a point from the propagation medium and the source elongation: $y_M(t) = y_S(t-\tau)$.<br>- Exploit the relationship between time delay, distance and wave speed.<br>- Exploit experimental documents and data in order to determine:<br>* distance;<br>* time delay;<br>* wave speed.<br>- Suggest a schema of experimental set-up (mounting) to measure time delay or to determine the wave speed during the wave propagation.<br><br>**2- Periodic Progressive mechanical waves**<br>- Recognise a periodic progressive wave and its period.<br>- Define sinusoidal progressive wave, period, frequency and wavelength.<br>- Know (recall) and use the relationship $\lambda = v.T$<br>- Know the condition to have the diffraction phenomenon: aperture/slit length is less or equal wavelength.<br>- Know (recall) the characteristics of the diffracted wave.<br>-Define a dispersive medium.<br>- Exploit the experimental documents to recognise the diffraction phenomenon and highlight the characteristics of the diffracted wave.<br>- Suggest a schema of an experimental set-up to highlight the phenomenon of the diffraction in the case of audible and ultrasonic mechanical wave. | **60%** |

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| | **3- Propagation of a light wave**<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>- Know (recall) and exploit the relationship: $\lambda = c/\upsilon$.<br>- Define a monochromatic and a polychromatic light.<br>- Know the boundaries of wavelengths and their colours for the visible spectrum in the vacuum.<br>- Know that the frequency of a monochromatic radiation does not change as it passes from one transparent medium to another.<br>- Know that the transparent media are more or less dispersive.<br>- Know (recall) and exploit the relationship: $n = c/v$<br>- Determine (find out) the refractive index of transparent medium for a given frequency.<br>- Suggest the schema of an experimental set-up allowing us to highlight the diffraction phenomenon in the case of light waves.<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 $\theta = \lambda/a$. | |
| **The Second Topic: Nuclear Transformations** | **1. Radioactive Decay**<br>- Know the meaning (significance) of the symbol ${}^{A}_{Z}X$ and give the composition of the corresponding nucleus.<br>- Recognise the isotopes of a chemical element.<br>- Recognise the areas of stability and instability of the nuclei on the N-Z diagram.<br>- Exploit the N-Z diagram<br>- Define a radioactive nucleus.<br>- Know and exploit the two laws of conservation.<br>- Define the radioactivity: $\alpha$, $\beta^+$ & $\beta^-$ and the $\gamma - radiation$.<br>- Write the equation of a nuclear reaction by applying the two conservation laws.<br>- Recognise the type of radioactivity using the equation of a nuclear reaction.<br>- Know and exploit the law of the radioactive decay, and exploit its curve.<br>- Know that 1Bq is equal to one decay per second.<br>- Define the time constant $\tau$ and the half-life $t_{1/2}$.<br>- Exploit the relationships between $\tau$, $t_{1/2}$ and $\lambda$ (decay constant).<br>- Use the dimensional analysis to determine the units of $\lambda$ and $\tau$.<br>- Determine the suitable radioactive element in order to date a given event. | **40%** |

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|---|---|---|
| | **2. Nuclei, Mass and Energy**<br>- Define and calculate the mass defect and the binding energy.<br>- Define and calculate the binding energy per nucleon and exploit it.<br>- Use different units of mass, energy and the relationships between their units.<br>- Exploit Aston's curve to identify the most stable nuclei.<br>- Know the relationship of the mass-energy equivalence; and calculate the energy of mass.<br>- Establish the energy balance $\Delta E$ of a nuclear reaction using: mass energies and/or binding energies and/or the energy diagram.<br>- Calculate the energy released (produced) by a nuclear reaction: $E_{pro} = \lvert \Delta E \rvert$.<br>- Recognise some applications of radioactivity.<br>- State some risks of radioactivity. | |

## 2. Levels of mastery targeted by the competition

The test targets two skill levels: **Resources use** and **Scientific reasoning** using multiple choice questions (MCQ).

| Mastery levels | | Weight |
|---|---|---|
| **Resources use** | This level aims to assess, in the candidate, the degree of mastery of knowledge and skills relating to waves, and nuclear transformations. | **70%** |
| **Scientific reasoning** | This level aims to assess, in the candidate, the degree of mastery of the elements of the scientific approach (critical thinking, argumentation, etc.). | **30%** |

# Component 3: Chemistry

The field of the evaluation of acquired Chemistry targets two important levels of mastery: Use of resources and Scientific reasoning.
The first level aims to check the level of mastery of the use of resources (essential learning acquired during lessons and practical work),
As for the second level, it allows to assess the mastery of scientific reasoning.

## 1. Domain major and sub-domains contents targeted by the competition

The content table presents the domains of content subject to the assessment and the list of essential objectives (knowledge and know-how) relating to each content area. This knowledge and know-how constitute the minimum threshold to be assessed by candidates.

| First Major Part : Chemistry | | |
|---|---|---|
| **Sub-areas** | **Content** | **Coverage** |
| **The First Topic: Fast and Slow Transformations of a Chemical System** | **1. Fast and slow transformations**<br>- Write the equation of the reaction associated with a redox (oxidation-reduction) transformation, and identify the two pairs involved.<br>- Determine from experimental results the effect of kinetic factors on the rate of reaction.<br><br>**2. Temporal Monitoring of a Chemical Transformation – Rate of Reaction**<br>- Justify the different operations carried out during the monitoring of the time-evolution of a system and exploit the experimental results.<br>- Determine the point of equivalence during a titration and exploit it.<br>- 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.<br>- Draw the progress table of a reaction and exploit it.<br>- Know the expression of the volumetric rate of reaction.<br>- Know the effect of reactant concentration and the temperature on the volumetric rate of reaction.<br>- Explain qualitatively the reaction rate change using one of the plotted evolution's curves.<br>- Determine graphically the value of the volumetric rate of reaction.<br>- Define the half-life $t_{1/2}$ of a chemical reaction.<br>- Determine the half-life $t_{1/2}$ of the chemical reaction graphically or through exploiting the experimental results. | **35%** |

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| **The Second Topic: Non-Completion Transformations of a Chemical System** | **1. Reversible chemical transformations**<br>- Define an acid and a base according to Bronsted.<br>- Write the equation of the acid-base reaction and identify the two pairs involved.<br>- Determine the pH for an aqueous solution.<br>- 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.<br>- Define the final progress rate of a reaction, and determine it using experimental data.<br>**2. Equilibrium State of a Chemical System**<br>- 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.<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 exploit the expression of the reaction quotient $Q_r$ through the reaction equation.<br>- 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.<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>**3. Transformations associated with the acid-base reactions in aqueous solution**<br>- 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).<br>- Know the relationship $pK_e = -\log K_e$<br>- Determine the nature of aqueous solution (acid, basic or neutral) based on its pH value.<br>- Determine the pH value of aqueous solution based on the molar concentration of ions $H_3O^+$ or $HO^-$.<br>- Write and exploit 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>- Determine the equilibrium constant associated with the equation of acid-base reaction using the acid dissociation constants of existing pairs. | **55%** |

| | | |
|---|---|---|
| | - Indicate the predominant chemical species taking into consideration pH of aqueous solution and $pK_A$ of the acid/base pairs.<br>- Exploit the predominance and distribution diagrams of acidic and basic chemical species existing in aqueous solution.<br>- Write the equation of titration reaction (use only one arrow)<br>- Know the experimental set-up of an acid-base titration.<br>- Exploit the curve or the results of the titration.<br>- Determine and exploit the point of equivalence.<br>- Justify the choice of a suitable indicator to determine the equivalence. | |
| **The Third Topic: Evolution Direction of a Chemical System** | **Spontaneous evolution of a chemical system**<br>- Calculate the value of the quotient of reaction $Q_r$ of a chemical system in given state.<br>- Determine the direction of spontaneous evolution of a chemical system. | **10%** |

## 2. Levels of mastery targeted by the competition

The test targets two skill levels: **Resources use** and **Scientific reasoning** using multiple choice questions (MCQ).

| Mastery levels | | Weight |
|---|---|---|
| **Resources use** | This level aims to assess, in the candidate, the degree of mastery of knowledge and skills related to:<br>- rapid and slow transformations of a chemical system;<br>- non-total transformations of a chemical system;<br>- direction of evolution of a chemical system. | **70%** |
| **Scientific reasoning** | This level aims to assess, in the candidate, the degree of mastery of the elements of the scientific approach (critical thinking, argumentation, etc.). | **30%** |

# Component 4: Mathematics test

* The math test in this competition is a multiple choice quiz.

* This 45-minute test consists of 20 independent questions, two by two.

* Each question has five answers including exactly one exact answer.

## 1. Domain and sub-domain of skills covered by the competition test :

| First main domain: Analysis | | |
|---|---|---|
| **Sub-domain** | **skills** | **Coverage** |
| **Numerical Sequences** | **1.1.1.** Use geometric sequences and arithmetic sequences to study examples of sequences in the form: $u_{n+1} = au_n + b$ or $u_{n+1} = \dfrac{au_n + b}{cu_n + d}$<br>**1.1.2.** Use the limits of the reference sequences and the convergence criteria in order to determine the limits of numerical sequences.<br>**1.1.3.** Determine the limit of the composite of a numerical sequence and a continuous function (Sequence in the form $v_n = f(u_n)$)<br>**1.1.4.** Study the convergence of a sequence $(u_n)$ in the form $u_{n+1} = f(u_n)$ where $f$ is a continuous function on an interval $I$ verifying $f(I) \subset I$ and determine its limit.<br>**1.1.5.** Use numerical sequences to solve various problems from different fields. | **75%** |
| **Continuity, differentiation, study of functions and calculus of integral** | **1.2.1.** Study the continuity of a numerical function at a point using limits calculation.<br>**1.2.2.** Determine the image of an interval or a segment by a continuous function or by a continuous and strictly monotonic function.<br>**1.2.3.** Apply the Intermediate Value Theorem to study some equations and inequations or to study the sign of some expressions…<br>**1.2.4**. Apply the Intermediate Value Theorem, in the case of a continuous and strictly monotonic function on an interval, to prove the uniqueness of the solution of the equation: $f(x) = \lambda$<br>**1.2.5.** Study the Differentiability of a numerical function at a point and on an interval. | |

| | | |
|---|---|---|
| | **1.2.6.** Determine the derivative function of a numerical function.<br>**1.2.7.** Determine the monotonicity of a function.<br>**1.2.8.** Determine the sign of a function using its variations table.<br>**1.2.9.** Determine the sign of a function from its graphical representation.<br>**1.2.10.** Solve graphically equations in the form $f(x)=g(x)$ and inequalities in the form $f(x)\leq g(x)$<br>**1.2.11.** Determine the derivative and the monotonicity of the inverse function of a continuous and strictly monotonic function on an interval and represent it graphically.<br>**1.2.12.** Solve application problems about minimum values and maximum values.<br>**1.2.13.** Use the first derivative and the second derivative to study a numerical function and to prove some inequalities…<br>**1.2.14.** Study and represent graphically functions and composite functions among the functions included in the syllabus (domain of definition, elements of symmetry, periodicity, monotonicity, infinite branches, tangent lines, concavity, inflexion points…)<br>**1.2.15.** Determine the primitive functions of usual functions.<br>**1.2.16.** Use derivation formulas to determine the primitive functions of a function on an interval.<br>**1.2.17.** Master the algebraic calculation on Logarithms.<br>**1.2.18.** Master and solve logarithmic equations, inequalities and systems.<br>**1.2.19.** Recognize and apply the decimal logarithm (in particular to solve equations in the form $10^x=a$ and inequalities in the form $10^x\leq a$ or $10^x\geq a$ )<br>**1.2.20.** Master the study and graphical representation of functions containing the Napierian logarithm<br>**1.2.21.** Master and solve equations, inequalities and systems that contain Napierian exponentials.<br>**1.2.22.** Master and apply the basic limits of the Napierian exponential function.<br>**1.2.23.** Master the study and graphical representation of functions containing the Napierian exponential function and the Napierian logarithm.<br>**1.2.24.** Use a primitive function or the technique of integration by parts in order to calculate the integral of a function. | |

| Second main domain: Algebra and Geometry | | |
|---|---|---|
| **Complex numbers** | **2.4.1.** Master algebraic calculations on the complex numbers ( In their writings : algebraic, trigonometric and exponential)<br>**2.4.2.** Go from the algebraic form to the trigonometric form of a complex number and inversely.<br>**2.4.3.** Linearize trigonometric monomials using the exponential form of a complex number.<br>**2.4.4.** Interpret, using the complex tool, the following geometrical concepts: distance between two points, measurement of angles, collinearity of points, collinearity and orthogonality of vectors.<br>**2.4.5.** Express the translation, the homothety and the rotation using complex tools.<br>**2.4.6.** Recognize a translation , homothety or rotation from their complex expressions.<br>**2.4.7.** Using complex numbers to solve geometric problems (collinearity, orthogonality…)<br>**2.4.8.** Solve a second degree equation with one variable and real coefficients.<br>**2.4.9.** Solve equations which lead to a second degree equation with one variable and real coefficients. | **25%** |

## 2. The levels of skills targeted by the competition test:

The test targets three levels of skills:

| Skill Level | Importance Rate |
|---|---|
| Direct application of knowledge (a definition, a property, a theorem, an algorithm, a formula, a technic, ... ..) | **40%** |
| Evoke and apply non-explicit knowledge in a question in familiar situation. | **40%** |
| Deal with unfamiliar situations using knowledge synthesis and results. | **20 %** |
| **Total** | **100%** |