



Royaume du Maroc
Ministère de l'Éducation Nationale, de la Formation Professionnelle
de l'Enseignement Supérieur & de la Recherche Scientifique

Reference framework
for the joint competition for access to the
faculties of Medicine, Pharmacy and
Dentistry

- July 2021 -

- The competition for access to the faculties of Medicine, Pharmacy and Dentistry consists of four components, of a total duration of 3 hours.
 - Component 1: Life Sciences test (Biology);
 - Component 2: Physics test;
 - Component 3: Chemistry test;
 - Component 4: Maths test.
- Each component consists of 20 multiple choice questions (*MCQ*);
- Each multiple choice question has only one correct answer;
- Questions will be scored using a weighting ranging from 1 to 3.
- A mark less than or equal to 5/20 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**" and the field of "**The organic matter consumption and the flow of energy at the cellular level**".

As for the second level, it allows the evaluation of scientific reasoning linked to the two previous fields in other words, the ability to use the processes and tools of study and action (use of laws operative acts, procedures ...).

It should be noted that both levels of mastery will be assessed using multiple-choice questions (MCQ).

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

Area 1: The organic matter consumption and the flow of energy at the cellular level. (Coverage: 20%)		
Sub-areas	Content	Coverage
The reactions responsible for the release of the stored energy in organic matter in the cell	<ul style="list-style-type: none">- Notion of respiration;- Notion of fermentation;- The main stages of glycolysis;- Energy yield from glycolysis;- Mitochondrion structure and ultra-structure;- The main stages of the Krebs cycle;- Energy yield of the Krebs cycle;- Electron Transport Chain and oxidative phosphorylation;- Energy yield of respiration;- The main stages of fermentation;- Energy yield of fermentation;- Energy efficiency.	10%
The role of the skeletal striated muscle in energy conversion	<ul style="list-style-type: none">- The myogram: the muscle twitch, the complete and incomplete tetanus;- Thermal and chemical phenomena accompanying the muscle contraction;- Skeletal muscle structure and ultra-structure;- Molecular structure of the myofilaments;- Source of the energy necessary for the muscle contraction;- Muscle contraction mechanism;- Metabolic pathways of ATP regeneration.	10%

Area 2 : Genetics (Coverage : 80%)

<p>The notion of genetic information The gene expression mechanisms: Protein synthesis stages Genetic engineering: its principles and techniques</p>	<ul style="list-style-type: none"> - The role of chromosomes in the transmission of genetic information from one cell to another: <ul style="list-style-type: none"> • phases of mitosis in plant and animal cells; • The cell cycle. - The chemical nature of genetic material: <ul style="list-style-type: none"> • Composition and structure of chromosomes and DNA; • Mechanism of DNA replication. - The notions of inherited characteristics/traits, gene, allele and mutation; - The relationship between trait -protein and gene-protein; - The meaning of gene mutation; - The genetic code; - Structure of mRNA; - Transcription; - Translation (initiation, elongation and termination). - The stages of gene transfer - the notion of genetic transformation: <ul style="list-style-type: none"> • natural gene transfer from <i>Agrobacterium Tumefaciens</i> to a plant; • techniques and steps of transferring a gene to a bacterium; - Some examples of applying the genetic engineering principles: <ul style="list-style-type: none"> • industrial production of human insulin; • Industrial production of toxic proteins to fight against harmful insects. 	<p>20%</p>
<p>The transmission of genetic information through sexual reproduction and Mendel's laws of the transmission of hereditary characteristics/traits in the diploid organisms</p>	<ul style="list-style-type: none"> - 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; <ul style="list-style-type: none"> • Stages/phases of meiosis; • Karyotypes of diploid species; - Mendel's laws of the transmission of hereditary characteristics/traits; - Monohybridism/ Monohybrid Cross; - Dihybridism/dihybrid cross; - Pure lineage and wild type, homozygosity and heterozygosity, hybridisation, test cross/back cross; - Punnett squares; - Autosomal heredity (independent of sex) and sex-linked heredity; - Dominance, codominance and lethal gene; - Unlinked genes (genes of independent assortment); - Linkage/crossing-over, genetic recombination of homologous chromosomes by linkage/crossing-over and genetic diversity; - Gene maps. 	<p>40%</p>

Human genetics and Population genetics	<ul style="list-style-type: none"> - Notions of pedigree and karyotype; - Hereditary autosomal diseases; - Hereditary sex-linked diseases; - Chromosomal abnormalities and their consequences; - Chromosomal interpretation of hereditary diseases; - Criteria of genetic equilibrium of population; - The Hardy-Weinberg law: A theoretical equilibrium; - The evolutionary factors and their impact on the genetic structure of a population; - Criteria specifying of a species; Definition of a species. 	20%
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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).

The level of mastery. (Skills)		Coverage in (%)
Knowledge Retrieval	This level aims to assess the candidate's level of knowledge related to the consumption of organic matter and energy flow and genetics.	50%
Scientific reasoning	This level aims to evaluate, in the candidate, the degree of mastery to use the processes and tools of study and action (use of laws, operative acts, procedures ...).	50%

Component 2: Physique

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 learning outcomes (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	Learning outcomes	Coverage
The First Topic: Waves	<p>1-Progressive Mechanical Waves</p> <ul style="list-style-type: none"> - 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: <ul style="list-style-type: none"> * distance and wavelength ; * 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. <p>2- Periodic Progressive mechanical waves</p> <ul style="list-style-type: none"> - 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. 	35%

	<p>3- Propagation of a light wave</p> <ul style="list-style-type: none"> - 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: $\lambda = c/\nu$. - 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: $n = c/\nu$ - 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 $\theta = \lambda/a$. 	
<p>The Second Topic: Nuclear Transformations</p>	<p>1. Radioactive Decay</p> <ul style="list-style-type: none"> - Know the meaning (significance) of the symbol A_ZX 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 γ – 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. <p>2. Nuclei, Mass and Energy</p> <ul style="list-style-type: none"> - Define and calculate the mass defect and the binding energy. - Define and calculate the binding energy per nucleon and exploit it. 	<p>30%</p>

	<ul style="list-style-type: none"> - 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. 	
<p style="text-align: center;">The Third Topic: Electricity</p>	<p>RC Dipole</p> <ul style="list-style-type: none"> - 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: 	<p>35%</p>

	<ul style="list-style-type: none"> * 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. 	
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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 the fields: <ul style="list-style-type: none"> - Waves; - Nuclear transformations; - Electricity. 	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 learning outcomes (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	Learning outcomes	Coverage
The First Topic: Fast and Slow Transformations of a Chemical System	1. Fast and slow transformations <ul style="list-style-type: none">- 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 <ul style="list-style-type: none">- 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.- 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.- Know the influence of the concentration of the reactants and temperature on the half-life reaction.	35%

**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.

2. Equilibrium State of a Chemical System

- Use the relationship linking the conductance G of a part of the solution 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 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.

3. 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.
- Represent and exploit the predominance diagrams of acidic and basic chemical species existing in aqueous solution.

55%

	<ul style="list-style-type: none"> - 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	Spontaneous evolution of a chemical system <ul style="list-style-type: none"> - 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. 	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 the following areas: <ul style="list-style-type: none"> - rapid and slow transformations of a chemical system; - non-total transformations of a chemical system; - 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

- ✓ 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.
- ✓ The questions will focus on content and skills that relate to the following areas:

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

First main domain: Analysis		
Sub-domain	skills	Coverage
Numerical Sequences	<p>1.1.1. Use geometric sequences and arithmetic sequences to study examples of sequences.</p> <p>1.1.2. Use the limits of the reference sequences and the convergence criteria in order to determine the limits of numerical sequences.</p> <p>1.1.3. Determine the limit of the composite of a numerical sequence and a continuous function (Sequence in the form $v_n = f(u_n)$)</p> <p>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.</p> <p>1.1.5. Use numerical sequences to solve various problems from mathematic.</p>	75%
Continuity, differentiation, study of functions and calculus of integral	<p>1.2.1. Study the continuity of a numerical function at a point using limits calculation.</p> <p>1.2.2. Determine the image of an interval or a segment by a continuous function or by a continuous and strictly monotonic function.</p> <p>1.2.3. Apply the Intermediate Value Theorem to study some equations and inequations or to study the sign of some expressions...</p> <p>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: $f(x) = \lambda$</p>	

- 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.
- 1.2.7. Determine the monotonicity of a function.
- 1.2.8. Determine the sign of a function using its variations table.
- 1.2.9. Solve application problems about minimum values and maximum values.
- 1.2.10. Use the first derivative and the second derivative to study a numerical function and to prove some inequalities...
- 1.2.11. Determine the primitive functions of usual functions.
- 1.2.12. Use derivation formulas to determine the primitive functions of a function on an interval.
- 1.1.13. Master the algebraic calculation on Logarithms and exponentials.
- 1.2.14. Master and solve logarithmic equations, inequalities and systems.
- 1.2.15. 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 $10^x \geq a$)
- 1.2.16. Master and apply the basic limits of the Napierian exponential function.
- 1.2.17. Master and apply the basic limits of the Napierian logarithm function.
- 1.2.18. Master the study of functions containing the Napierian exponential function and the Napierian logarithm.
- 1.2.19. 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

Sub-domain	skills	Coverage
Complex numbers	<p>2.1. Master algebraic calculations on the complex numbers (In their writings : algebraic, trigonometric and exponential)</p> <p>2.2. Go from the algebraic form to the trigonometric form of a complex number and inversely.</p> <p>2.3. Linearize trigonometric monomials using the exponential form of a complex number.</p> <p>2.4. Interpret, using the complex tool, the following geometrical concepts: distance between two points, measurement of angles, collinearity of points, collinearity and orthogonality of vectors.</p> <p>2.5. Express the translation, the homothety and the rotation using complex tools.</p> <p>2.6. Recognize a translation, homothety or rotation from their complex expressions.</p> <p>2.7. Using complex numbers to solve geometric problems (collinearity, orthogonality...)</p> <p>2.8. Solve a second-degree equation with one variable and real coefficients.</p> <p>2.9. Solve equations which lead to a second-degree equation with one variable and real coefficients.</p>	25%

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

The test targets three levels of skills :

Skill Level	Importance Rate
1. Direct application of knowledge (a definition, a property, a theorem, an algorithm, a formula, a technic,)	30 %
2. Evoke and apply non-explicit knowledge in a question in familiar situation.	50 %
3. Deal with unfamiliar situations using knowledge synthesis and results.	20 %
Total	100%