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المملكة المغربية  
وزارة التربية الوطنية  
والتكوين المهني  
والتعليم العالي والبحث العلمي

الأطر المرجعية المكيفة الخاصة بالامتحان الوطني الموحد لنيل شهادة البكالوريا – دورة 2020 –  
المسالك الدولية : خيار أنجليزية  
الإطار المرجعي لمادة علوم الحياة والأرض  
شعبة العلوم التجريبية  
مسلك العلوم الفيزيائية



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الإطار المرجعي لاختبار مادة علوم الحياة والأرض (المسالك الدولية خيار أنجليزية) – شعبة العلوم التجريبية : مسلك العلوم الفيزيائية  
مديرية التقويم وتنظيم الحياة المدرسية والتكوينات المشتركة بين الأكاديميات- المركز الوطني للتقويم و الامتحانات والتوجيه  
الهاتف 05.37.71.44.53 /52 – الفاكس : 05.37.71.44.08 البريد الإلكتروني : [cnebac@gmail.com](mailto:cnebac@gmail.com) ص 1 من 11

Taking into account the exceptional circumstances that our country is currently undergoes due to the "Covid 19" epidemic, which led to the suspension of studies in the classroom. since March 16, 2020, and in order to ensure equal opportunities between candidates, the Ministry of National Education, professional Training, Higher Education and Scientific Research has decided that the national exam of the International Options of the Moroccan Baccalaureate " English Option " session 2020 will take place according to revised reference framework that take into account the lessons realized in the classroom.

In this context, adjustments have been made to the reference framework of the national Baccalaureate examination in life and earth sciences, physical sciences option. These adjustments mainly concern the engineering of the examination subject; the candidate will have the choice to answer one of the two exercises related to area of knowledge 3 (use of organic and inorganic matter) and to area 4 (geological phenomena accompanying the formation of mountain ranges and their relationship with plate tectonics) in addition to the obligatory exercises associated with each of the knowledge areas 1 and 2: consumption of organic matter and energy flow and the nature of genetic information and the mechanism of its expression - Transmission of genetic information during sexual reproduction.



## I. I. Areas of assessment:

### 1. The specific competences covered by the assessment:

#### 1.1. Competencies related to the areas that the candidate must achieve obligatory:

- Acquire knowledge about the consumption of the organic matter and the flow of energy at the cellular level in order to understand the importance of energy in the cellular activity and raising awareness of its role in the support of the vital functions of the organism.
- To deepen knowledge on the nature of genetic information and the mechanisms of gene expression, with the purpose of using it to understand and explain the phenomenon of heredity among living beings;
- To acquire knowledge on the transmission of genetic information by the sexual reproduction and use this knowledge to solve some of the problems related to the transmission of hereditary characteristics.
- Use an appropriate scientific approach to address problems related to the consumption of organic matter and the flow of energy at the cellular level and related to genetics;
- Use the various modes of expression (oral, written and graphic) to communicate and represent phenomena related to the consumption of organic matter and energy flow within the cell and related to genetics.

#### 1.2. For the competences which the candidate will have to deal with at choice

- To acquire knowledge on geological phenomena related to the formation of the mountain ranges (deformation, metamorphism, granitisation) and be able to locate these phenomena in space and in time in the context of plate tectonics;
- To acquire knowledge on the use of organic and inorganic matter and be aware of the danger of the pollutants caused by this use and propose environmental alternatives for preserving the safety of natural environments and the health of living beings.
- Use an appropriate scientific approach to address problems related to the use of organic and inorganic matter and geological phenomena in relation to the formation of mountain ranges;
- Use the various modes of expression (oral, written and graphic) to communicate and represent phenomena related to the use of organic and inorganic matter and geological phenomena related to the formation of mountain ranges.

## 2. The content

### 2.1. The areas that the candidate must achieve obligatory

#### 2.1.1. Area 1: Consumption of organic matter and energy flows.

This area aims to complement the pupils' achievements related to the production of organic matter and energy flows through the knowledge of aspects of the consumption of organic matter and energy flows at the level of the cell. The objective is to bring the students to understand the mechanism of the use of organic matter by the living cell in order to supply energy that is necessary for its activity.

#### The study of reactions responsible for the release of the energy stored in organic matter in the cell:

- Be limited to essential reactions allowing ATP production during respiration and during the fermentation;
- Determine the energy balance of these reactions;
- Know the cellular structures responsible for ATP production ;
- Compare energy yield of respiration and fermentation.

#### The study of the role of the striated muscle skeletal in energy conversion consists of:

- Showing that the muscle cell is the structural and functional unit of muscle contraction through the study of the structure and the ultra-structure of this cell;
- Showing the relationship between the structure and the ultra-structure of the muscle cell on the one hand, and the mechanism of muscle contraction and the accompanying phenomena on the other;

- Highlighting the conversion of chemical energy (ATP) in mechanical energy during muscle contraction;
- Determining the different tracks for ATP regeneration in the muscle cell.

**At the end of this field, it is necessary to build a diagram balance summarizing the relationships between the different reactions that release energy and those that consume it by putting the emphasis on the role of the molecule of ATP as energy intermediary.**

### 2.1.2. Area 2: the nature of genetic information and the mechanism of its expression - transmission of genetic information in the course of sexual reproduction.

This field allows the learner to acquire knowledge in relation to the nature of the genetic information, its transmission of a cell mother to daughter cells, the mechanisms of its expression as well as its transmission during sexual reproduction.

**The construction of the concept of genetic information is to:**

- Highlight the location of genetic information in the cell of unicellular living beings and in multi-cellular living beings;
- Determine the mechanism by which the genetic information is transmitted from one cell to another;
- Build the concept of cell cycle from the study of the phases of the mitotic and inter-phase as well as the description of the behavior of chromosomes to deduce the notion of consistent reproduction;
- Highlight the chemical nature of genetic information and determine the structure of the DNA and the mechanism of its replication with emphasis on the relationship between the evolution of the amount of DNA and that of chromosomes during the cell cycle;
- Define the concepts of character, gene, allele and mutation and establish the relationship character-protein and the relationship gene-protein, which allows to deepen the concepts of mutation and the gene and to build the concept of the genetic code;
- Highlight the relationship between genetic information and the synthesis of proteins through the study of the mechanisms and stages of the expression of genes inside the cell: The use of the genetic code to explain the expression of a gene (transcription and translation).
- **In order to study the transmission of genetic information by sexual reproduction, it must show the role of the meiosis and fertilization in the retention of the karyotype, and in the brewing and genetic diversity. For this it is necessary to:**
  - o Define the phenomenon of the meiosis, identify its different phases and show its role in the agitation of the alleles (mixing intra-chromosome and brewing inter-chromosomal) and therefore deduce the genetic diversity of gametes;
  - o Define the phenomenon of fertilization and show its role in the genetic diversity of individuals of the same species;
  - o Show the role of the meiosis and fertilization in the retention of the karyotype among individuals of the same species.
- **To study the statistical laws of the transmission of hereditary characteristics/traits in the diploids, it must:**
  - o Build the concepts of genotype, pure lineage (wild and mutant) and hybridization;
  - o Know the laws of Mendel and their exceptions through the study of examples of monohybridism that are not related to sex / autosomal (dominance and codominance, lethal gene) and those that are linked to the sex / heterosomal, and dihybridism (independent genes and inter-related genes);
  - o Highlight the role of the crossing-over (crossover/linkage) in the genetic diversity of generations and in the establishment of the factorial card.

## 2.2. The areas which the candidate will have to deal with at choice:

Candidates are invited to **achieve only one of the following two areas.**

### 2.2. 1. Area 3: The use of organic and inorganic matter



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This area aims to study:

- The household waste resulting from the use of organic matter;
- The pollution linked to the consumption of energy and the use of organic and inorganic materials in the food and mineral chemical industries;

**- The study of household waste originating from the use of organic matter is to:**

- o Put emphasis on the study of the methods of their elimination and the techniques of their treatment (sorting, recycling and the use in the industry);
- o Deduce the impact of garbage on health, the environment and the economy;
- o Raise the learners' awareness of the dangers of garbage and develop in them positive attitudes and a sense of responsibility towards their health and their environment.

**- The study of pollution resulting from the consumption of energy materials and the use of organic and inorganic matter is to:**

- o Raise the learners' awareness of the dangers of the various pollutants on the natural environments and their impact on health, the environment and the economy, with emphasis on the study of polluted areas in order to:
- o Get the learners to question the problems related to the pollution of the natural environments and its impact on health, the environment and the economy through the treatment of data, by analyzing and comparing the results of studies and research;
- o Bring the learners to come up with on polluting alternatives related to energy consumption and the use of organic and inorganic products in the industrial field;
- o Develop in the learners behaviors along with positive and accountable attitudes for the preservation of their health and their environment.

NB: The chapter related to "radioactive materials and nuclear energy" and the chapter related to "quality control and environmental health" are removed from this domain.

## 2.2. 2. Area 4: geological phenomena accompanying the formation of the mountain ranges and their relationship with the tectonic plates.

This field allows the learner to acquire some knowledge related to:

- The recent **mountain ranges** and their relationship with the plate tectonics;
- The nature of the tectonic deformations characterizing the chains of subduction and strings of a collision;
- The metamorphism and its relationship with the plate tectonics;
- The granitization and its relationship with the metamorphism phenomenon.

This field ends by an overview of the relationship between the various geological phenomena studied with the plate tectonics.

### **The study of recent mountain ranges and their relationship with the plate tectonics aims to:**

- o Consolidate /acquire the knowledge of the learner on the petrographic characteristics and structural features of ranges resulted by subduction, by obduction and by collision;
- o Show the relationship between the recent **mountain ranges** and the plate tectonics through the reconstitution of the stages of the formation of these ranges and to determine the conditions of their formation/development.

### **The study of tectonic deformations that characterize the ranges of subduction and collision aims to:**

- o Consolidate/ deepen the knowledge of the learners on the characteristics of the main tectonic deformations;
- o Highlight the tectonic constraints responsible for the creation of these mountain ranges.

### **The study of metamorphism and its relationship with the plate tectonics aims to:**

- o Determine the structural and petrographic characteristics of metamorphic rocks in subduction zones and in areas of collision and infer/release conditions of temperature and pressure that are responsible for the formation of these rocks;
- o Build the concept of the mineral index/indicator and that of the metamorphic facies series;

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- Build the concepts of the dynamic metamorphism and the thermodynamic metamorphism and their relationship with the geophysical conditions of formation of the ranges of subduction and those of collision.

NB: The chapter related to granitisation and its relationship to metamorphism is removed from this domain.

## II. Organisation of notional and methodological areas.

### 1. Table of content relating to the required domains (which the candidate must achieve obligatory)

| Area 1: Consumption of organic matter and energy flow<br>(Coverage 35% to 40%)                     |  |  |
|--|--|--|
| Sub-areas  | Content  | Basic objectives ( notional / methodological)  |
| 1.The reactions responsible for the release of the energy stored in the organic matter in the cell | <ul style="list-style-type: none"> <li>- Concept of respiration;</li> <li>- Concept of fermentation;</li> <li>- The main phases of glycolysis;</li> <li>- Energy yield of glycolysis;</li> <li>- Mitochondrion structure and ultra-structure .</li> <li>- The main stages/phases of the Krebs cycle.</li> <li>- Energy yield of the Krebs cycle;</li> <li>- Electrons Transport Chain /ETC and oxidative phosphorylation</li> <li>- Energy yield of respiration.</li> <li>- The mainstages/phases of fermentation.</li> <li>- Energy yield of fermentation.</li> <li>- Energy efficiency.</li> </ul>  | <ul style="list-style-type: none"> <li>- <b>Compare</b> respiration and fermentation through the analysis of data based on observation and experimentation/experiments/lab test.</li> <li>- <b>Show / highlight</b> the relationship between respiration, fermentation and the cellular structures involved through the use of data based on observation and experimentation.</li> <li>- <b>Apply</b> scientific reasoning (<b>formulate</b> a problem, <b>propose</b> and <b>test/ verify</b> a hypothesis, <b>propose</b> an experimental protocol...) on data related to respiration and fermentation.</li> <li>- <b>Deduce</b> the conditions of respiration and fermentation through the use of data based on observation and experimentation;</li> <li>- <b>Determine</b> the main stages of the reactions responsible for the release of the energy stored in organic matter, and <b>deduce</b> its energy yield.</li> <li>- <b>Describe</b> the components, the structure and ultra structure of the mitochondrion and relate them to the reactions of cellular respiration.</li> <li>- <b>Compare</b> the energy yield of respiration and fermentation.</li> <li>- <b>Calculate</b> energy efficiency of respiration and fermentation;</li> <li>- Graphically represent the aspects of respiration and fermentation;</li> <li>- <b>Draw up/make</b> a summary diagram of the energy yield of respiration and fermentation.</li> </ul> |
| The role of the skeletal striated muscle in energy conversion                                      | <ul style="list-style-type: none"> <li>- The myogram: the muscle twitch, the perfect and the imperfect tetanus.</li> <li>- Thermal and chemical phenomena (consumption of O<sub>2</sub> and glucose...) concurrent to the muscle contraction.</li> <li>- Skeletal muscle structure and ultra-structure.</li> <li>- Molecular structure of the myofilaments</li> <li>- Origin of the energy necessary for the muscle contraction;</li> <li>- Muscle contraction mechanism.</li> </ul>   | <ul style="list-style-type: none"> <li>- <b>Analyze</b> and <b>interpret</b> myogrammes;</li> <li>- <b>Compare</b> the state of a muscle fiber at rest and during a contraction;</li> <li>- <b>Apply</b> scientific reasoning (<b>formulate</b> a problem, <b>propose</b> and <b>test/ verify</b> a hypothesis, <b>propose</b> an experimental protocol...) on data related to muscle contraction;</li> <li>- <b>Using</b> the structure and ultra-structure of the skeletal muscle cell in order to <b>explain</b> the mechanisms of muscle contraction.</li> <li>- <b>Determine</b> Thermal and chemical Phenomena</li> </ul>  |

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|  |  |   |
|--|--|---|
|  | - Metabolic pathways of ATP regeneration . | concurrent to the muscle contraction;<br>- <b>Show / highlight</b> the relationship between thermal and chemical phenomena and muscle contraction;<br>- <b>Deduce</b> metabolic pathways for ATP regeneration required for muscle contraction;<br>- <b>Show / highlight</b> the relationship between the pathways of ATP regeneration and the type of physical effort;<br>- <b>Draw up/make</b> diagrams of muscle contraction mechanism. |
| <b>1.3. Outcome: Diagram/flow chart of organic matter consumption and energy flow in the cell.</b> | Pre-requisite knowledge in this domain.    | - <b>Draw up</b> a flow chat of the consumption of organic matter and energy flow in the cell.  |

**Area 2 : Nature of genetic information and the mechanism of its expression - Transmission of genetic information during sexual reproduction  
(Coverage 35% to 40%)**

| Sub-areas                                  | Content  | Basic objectives ( notional / methodological)   |
|--|--|---|
| <b>2.1. Concept of genetic information</b> | <ul style="list-style-type: none"> <li>- The location of genetic information in the cell nucleus.</li> <li>- The role of chromosomes in the transmission of genetic information from cell to cell.               <ul style="list-style-type: none"> <li>o The mitosis phases in plant and the animal cell;</li> <li>o Cell cycle.</li> </ul> </li> <li>- The chemical nature of genetic material:               <ul style="list-style-type: none"> <li>o Composition and structure of chromosomes and DNA</li> <li>o mechanism of DNA Replication/Duplication.</li> </ul> </li> <li>- The notions of inherited characteristics, gene, allele and mutation.</li> <li>- The relationship characteristic-protein and gene-protein;</li> <li>- The meaning of genetic mutation. The genetic code.</li> </ul> | <ul style="list-style-type: none"> <li>- <b>Deduce</b> the location of genetic information in the cell nucleus through <b>data analysis</b>.</li> <li>- <b>Describe</b> and <b>identify</b> mitosis phases.</li> <li>- <b>Construct</b> and <b>represent</b> the cell cycle and <b>deduce</b> its role in the stability of genetic information;</li> <li>- <b>Deduce</b> the role of chromosomes in the transmission of genetic information from cell to cell through <b>the use/exploitation</b> of observation and experimentation data.</li> <li>- <b>Determine</b> the chemical nature of genetic material through <b>the use/exploitation</b> of observation and experimentation data by <b>applying scientific reasoning (formulate problem, propose and test/verify a hypothesis, propose an experimental protocol...)</b>;</li> <li>- <b>Show/ highlight</b> the relationship between chromosomes and DNA molecule;</li> <li>- <b>Show/ highlight</b> the role of the DNA duplication in the stability of genetic information;</li> <li>- <b>Show/ highlight</b> the relationship characteristic-protein and gene-protein through <b>data exploitation</b>;</li> <li>- <b>Deduce</b> the meaning of genetic mutation by using genetic code.</li> <li>- <b>Draw up</b> graphic representation related to mitosis phases and to the chemical nature of genetic material.</li> </ul> |



|  |  |   |
|--|--|---|
| <b>2.2. Mechanism of the expression of genetic Information: Protein synthesis stages.</b>    | <ul style="list-style-type: none"> <li>- NRA structure.</li> <li>- Transcription.</li> <li>- Translation (Initiation, elongation and termination).</li> </ul>  | <ul style="list-style-type: none"> <li>- <b>Describe and explain</b> the transcription mechanism of mRNA molecule;</li> <li>- <b>Show / highlight</b> the relationship between DNA, mRNA and protein by using genetic code (the meaning of the genetic code);</li> <li>- <b>Describe</b> the stages of protein synthesis ;</li> <li>- <b>Draw up a diagram</b> summarizing the stages of proteins synthesis.</li> </ul>   |
| <b>2.3. Transmission of genetic information during sexual reproduction.</b>                  | <ul style="list-style-type: none"> <li>- The meiosis phases;</li> <li>- Karyotypes of diploid species;</li> <li>- The role of meiosis and fertilisation in the recombination of alleles (inter-chromosomal and intra-chromosomal mixing) and in the karyotype stability ( stability in the number of chromosomes) from generation to generation.</li> </ul>  | <ul style="list-style-type: none"> <li>- <b>Describe and recognize</b> the meiosis phrases;</li> <li>- <b>Analyze</b> karyotypes of diploid species;</li> <li>- <b>Deduce</b> the role of meiosis and fertilization in the recombination of the alleles and in the stability of karyotype in the same species from generation to generation and their role in genetic diversity through data observation and experimentation;</li> <li>- <b>Draw up/Make</b> diagrams related to the meiosis phases.</li> </ul>   |
| <b>2.4. Statistical laws of the transmission of genetic characteristics in the diploids.</b> | <ul style="list-style-type: none"> <li>- Mendel's laws in the transmission of hereditary characteristics;</li> <li>- Monohybridisme and dihybridisme;</li> <li>- Pure lineage and hybrids, homozygosity and heterozygosity, hybridization, crossing-test (test -Cross/ back/cross)</li> <li>- Punnett square/combinations grid</li> <li>- Dominance and co-dominance;</li> <li>- The lethal gene;</li> <li>- Sex-linked and non sex-linked inheritance</li> <li>- Crossover (crossing-over), intrachromosomal mixing; and genetic diversity</li> <li>- The genetic-linkage map.</li> </ul> | <ul style="list-style-type: none"> <li>- <b>Analyze and interpret</b> the results of the transmission of a couple of alleles through the study of a specific example (in the case of a sex-linked gene and in the case of a non-sex-linked gene/autosomal gene).</li> <li>- <b>Analyze and interpret</b> the results of the transmission of two couples of alleles through the study of a specific example (in the case of two independent genes and two linked -genes)</li> <li>- <b>Draw up a diagram of</b> genetic inter-chromosomal and intra-chromosomal mixing, according to the example studied;</li> <li>- <b>Calculate</b> the distance between genes and <b>sketch</b> the genetic-linkage map.</li> </ul> |






## 2. Table of contents relating to the areas which the candidates will have to achieve at their choice

Candidates are invited to discuss only one of the following two areas:

### Area 3: Use of organic and inorganic materials (Coverage 20% to 25 %)

| Sub-areas  | Content  | Basic objectives ( notional / methodological)   |
|--|--|---|
| 3.1. Household Waste resulting from the use of organic matter.   | <ul style="list-style-type: none"> <li>- Household waste and its nature;</li> <li>- Household waste disposal and its treatment: sorting, recycling, composting, methanisation and incineration;</li> <li>- The impact of waste on the environment, health and the economy.</li> </ul>      | <ul style="list-style-type: none"> <li>- <b>Formulate a problem</b> related to waste;</li> <li>- <b>Deduce</b> the characteristics of household waste;</li> <li>- <b>Determine</b> the means of waste disposal;</li> <li>- <b>Exploit data</b> related to the management of the household waste;</li> <li>- <b>Show/ highlight the importance</b> of recycling and treating household waste in economic and ecological environment;</li> <li>- <b>Show/ highlight</b> the negative impact of waste on the environment and the economy;</li> <li>- <b>Show/ highlight</b> the positive effect of household waste management on the environment and the economy;</li> <li>- <b>Propose measures</b> to reduce the negative effects of household waste on health and the environment.</li> </ul> |
| 3.2. The pollution due to the consumption of energy matter and the use of organic and inorganic matter in the chemical, food and mineral industries, | <ul style="list-style-type: none"> <li>- Pollutants and polluted environments;</li> <li>- The impact of pollutants on the environment, health and the economy;</li> <li>- The alternatives.</li> </ul>  | <ul style="list-style-type: none"> <li>- <b>Propose a problem</b> related to the pollution and formulate hypotheses;</li> <li>- <b>Exploit data</b> related to polluting agents and to the pollution of natural environment;</li> <li>- <b>Apply scientific reasoning</b> to solve a problem related to the pollution of natural environments;</li> <li>- <b>Show</b> the negative implications/hazards of pollutants on health, the environment and the economy;</li> <li>- <b>Express opinion</b> on the use of certain pollutants;</li> <li>- <b>Propose measures</b> to reduce the negative effects of pollutants on health, the environment and the economy.</li> </ul>  |

### Area 4: The geological phenomena accompanying the formation of the mountain ranges and their relationship with the plate tectonics. (Coverage 20% to 25 %)

|  |  |   |
|--|--|---|
| 4.1. The recent mountain ranges and their relationship with plate tectonics. | <ul style="list-style-type: none"> <li>- Different types of recent mountain ranges.</li> <li>- Structural and petrographic characteristics of subduction, obduction and collision zones</li> <li>- Relationship of recent Mountain ranges to plate tectonics.</li> </ul> | <ul style="list-style-type: none"> <li>- <b>Deduce</b> structural and petrographic characteristics of recent mountain ranges from the study of maps and geologic sections.</li> <li>- <b>Establish</b> the relationship between recent mountain ranges and plate dynamics.</li> <li>- <b>Determine</b> the stages of the genesis/formation of recent mountain ranges exploring data of geologic sections.</li> <li>- Graphically represent the conditions for the formation of recent mountain ranges.</li> <li>- <b>Draw up/Make</b> a synthesis diagram on the stages of recent mountain ranges formation.</li> </ul> |
| 4.2. Tectonic  | <ul style="list-style-type: none"> <li>- The main tectonic</li> </ul>  | <ul style="list-style-type: none"> <li>- <b>Classify</b> folds and faults.</li> </ul>   |

|   |   |   |
|---|---|---|
| <p>deformations characterizing subduction and collision zones</p> | <p>deformations (folds, flaws and thrust sheets) that characterize subduction and collision zones.</p> <ul style="list-style-type: none"> <li>- Relationship between the tectonic deformations and tectonic constraints.</li> </ul>   | <ul style="list-style-type: none"> <li>- <b>Analyze</b> maps and geologic sections of recent mountain ranges.</li> <li>- <b>Determine</b> the structural characteristics of thrust sheets.</li> <li>- <b>Establish</b> the relationship between deformations and tectonic constraints.</li> <li>- <b>Establish</b> the relationship between tectonic deformations and conditions of formation of subduction and collision zones.</li> <li>- <b>Draw up/ make a diagram</b> of tectonic deformations in relationship with tectonic constraints.</li> </ul>   |
| <p>4.3. Metamorphism and its relationship to plate tectonics.</p> | <ul style="list-style-type: none"> <li>- The concept of metamorphism.</li> <li>- Mineralogical and structural characteristics of metamorphic rocks in subduction and collision zones.</li> <li>- Temperature and pressure conditions responsible for the formation of metamorphic rocks.</li> <li>- The concepts of index mineral and metamorphic facies series.</li> <li>- The notions of dynamic metamorphism and regional metamorphism.</li> </ul> | <ul style="list-style-type: none"> <li>- <b>Determine</b> the mineralogical and structural characteristics of metamorphic rocks in subduction zones and in areas of collision through the study of samples of rocks and microscope slides and the analysis of data (tables of mineralogical and chemical composition).</li> <li>- <b>Determine</b> the zones of stability of index minerals in metamorphic rocks and metamorphism zones using PT diagram of the rocks.</li> <li>- <b>Establishing</b> the relationship between index minerals, metamorphic facies series and the dominant type of metamorphism in the ranges formed by subduction and collision.</li> <li>- <b>Distinguish / recognize</b> dynamic from regional metamorphisms.</li> <li>- <b>Graphically represent</b> the stages of metamorphism using PT diagram.</li> <li>- <b>Deduce</b>, from the study of maps and geologic sections, the mineralogical and structural characteristics of metamorphic rocks in subduction and collision zones related to plate tectonics.</li> </ul> |



## 2. Skills Table.

| Skills areas  | Skills   | Weighting in (%) |
|---|--|------------------|
| <b>Knowledge Retrieval</b>  | <p>This Section, knowledge retrieval, aims to assess the degree of mastery of content using the following:</p> <ul style="list-style-type: none"> <li>- Multiple choice questions (MCQ).</li> <li>- True/false statements.</li> <li>- Matching.</li> <li>- Classification/ seriation/ rearranging</li> <li>- Short-answer questions (give definitions, label a diagram or a graph, and know theories, laws, scientific terms, facts, signs, etc.).</li> </ul>  | <b>25%</b>       |
| <b>Scientific reasoning and communication in graphic and written modes.</b> | <p>This Section, <b>scientific reasoning and communication in graphic and written modes</b>, aims to assess the degree of mastery of skills and competencies:</p> <ul style="list-style-type: none"> <li>- <b>Determine</b> and <b>formulate</b> a scientific problem;</li> <li>- <b>Use</b> background knowledge, <b>select</b> and <b>organise</b> information in relation to the subject of study;</li> <li>- <b>Link</b> information with acquired knowledge to resolve a scientific problem;</li> <li>- <b>Make/formulate</b> a hypothesis in relation to a scientific problem;</li> <li>- <b>Use knowledge</b> to solve a scientific problem or to <b>explain</b> the phenomena under study;</li> <li>- <b>Suggest</b> appropriate tools to <b>test</b> hypotheses;</li> <li>- <b>Describe</b> and <b>analyse</b> scientific data;</li> <li>- <b>Compare</b> and <b>explain/interpret</b> results;</li> <li>- <b>Infer</b> and <b>generalise the results</b>;</li> <li>- <b>Use</b> principles, laws, models to <b>explain/interpret</b> scientific phenomena and data;</li> <li>- <b>Conduct a synthesis</b> of information and data and turn it into a text or a diagram;</li> <li>- <b>Give</b> an opinion and support it with arguments.</li> <li>- <b>Present</b> a structure or biological and geological phenomena using a diagram;</li> <li>- <b>Turn</b> numerical data into a chart, a graph or a text;</li> <li>- <b>Draw</b> a functional diagram;</li> <li>- <b>Achieve/realise</b> a synthetic flowchart.</li> </ul> | <b>75%</b>       |

