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المسالك الدولية ـ خيار أنجليزية
الدورة العادية 2017
ـ الموضوع ـ

NS 34E

المملكة المغربية
وزارة التربية الوطنية والتكوين المهني والتعليم العالي والبحث العلمي
المركز الوطني للتقويم والامتحانات والتوجيه

المادة	علوم الحياة والارض	مدة الإنجاز	3
الشعبة أو المسلك	مسلك العلوم الفيزيائية – خيار أنجليزية	المعامل	5

Candidates may use non-programmable calculators

Section I : Knowledge Retrieval (5 pts)

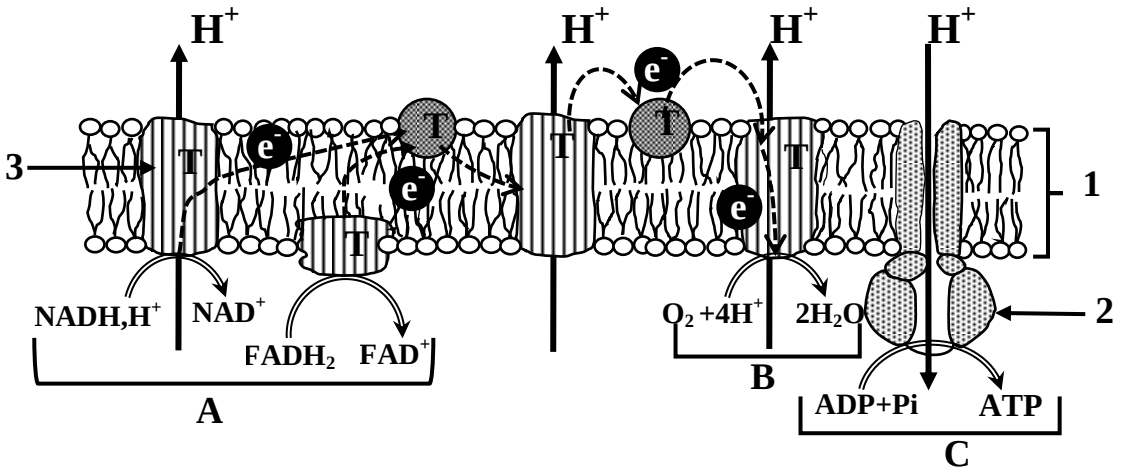
I. **Define** the following notions: - Muscle twitch – Mitochondrion. **(1pt)**

II. For each of the propositions numbered from 1 to 4, there is only one correct suggestion in each set. **Copy down** these pairs (1 ; ..), (2 ; ..), (3 ; ..), (4 ; ..), and **match** each number with its corresponding letter. **(2 pts)**

1. Complete tetanus is the result of the fusion of many muscle twitches due to a succession of excitations, so that the next excitation occurs: **a-** during the contraction phase of the previous muscle twitch. **b-** during the relaxation phase of the previous muscle twitch. **c-** after the previous muscle twitch. **d-** during the latent phase of the previous muscle twitch.	**2. During muscle contraction there is a decrease in the length of the:** **a-** dark band and the H-band. **b-** clear band and the H-band. **c-** dark band and clear band, while the H-band retains its length. **d-** dark, clear and the H bands.
3. Lactic acid fermentation: **a-** releases 4 molecules of ATP from a glucose molecule. **b-** has a common stage with respiration called glycolysis. **c-** produces organic waste in the form of CO_2. **d-** produces 2 molecules of ATP due to the appearance of the H^+ gradient on either side of the inner membrane of mitochondrion.	**4. The reactions of the Krebs cycle**: **a-** do not produce energy. **b-** release carbon dioxide (CO_2). **c-** take place in the inner membrane of the mitochondrion. **d-** are common between respiration and fermentation.

III. **Give** the global reaction of glycolysis. **(0.5 pt)**

IV. The following document shows the respiratory chain.



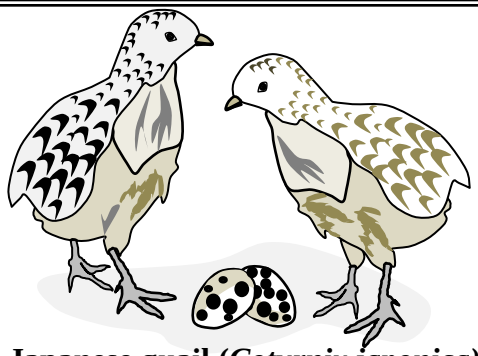
1- **Give** the appropriate name for each of the above numbered structures 1, 2 and 3. **(0.75 pt)**

2- **Name** each of the above reactions A, B and C. **(0.75 pt)**

Section II : Scientific reasoning and communication in graphic and written modes (15pts)

Exercise *1* (5 pts)

I. There are two lineages of the Japanese quail (*Coturnix japonica)*: a black-brown spotted plumage lineage and a red - yellow spotted plumage lineage. In order to identify the cause of the plumage colour difference in the Japanese quail, studies have been carried out on the **Mc1-R gene** that codes the synthesis of the ***eumelanin*** pigment responsible for the black- brown spotted plumage and the ***pheomelanin*** pigment responsible for the red - yellow spotted plumage.



Japanese quail (*Coturnix japonica)*

Document 1 presents a part of the untranscribed strand of the allele responsible for the synthesis of *eumelanin* pigment in the Japanese quail.

Document 1

Number of Nucleotide triplets:	**225**	**226**	**227**	**228**	**229**	**230**	**231**	**232**	**233**	**234**	**235...**
Nucleotide sequence:	**CAG**	**CCC**	**ACC**	**ATC**	**TAC**	**CGC**	**ACC**	**AGC**	**AGC**	**CTG**	**A……**

1. Give the mRNA strand and the amino acid sequence product from the part of the allele responsible for the synthesis of the *eumelanin* pigment from nucleotide triplet 225 to nucleotide triplet 234. **Use** document 1 and document 2 (genetic code). **(1 pt)**

1st Base	2nd Base: U		2nd Base: C		2nd Base: A		2nd Base: G		3rd Base
U	UUU, UUC	Phe	UCU, UCC, UCA, UCG	Ser	UAU, UAC	Tyr	UGU, UGC	Cys	U, C
	UUA, UUG	Leu			UAA, UAG	stop	UGA	stop	A
							UGG	Trp	G
C	CUU, CUC, CUA, CUG	Leu	CCU, CCC, CCA, CCG	Pro	CAU, CAC	His	CGU, CGC, CGA, CGG	Arg	U, C, A, G
					CAA, CAG	Gln			
A	AUU, AUC, AUA	Ile	ACU, ACC, ACA, ACG	Thr	AAU, AAC	Asn	AGU, AGC	Ser	U, C
	AUG	Met			AAA, AAG	Lys	AGA, AGG	Arg	A, G
G	GUU, GUC, GUA, GUG	Val	GCU, GCC, GCA, GCG	Ala	GAU, GAC	Ac. asp	GGU, GGC, GGA, GGG	Gly	U, C, A, G
					GAA, GAG	Ac. Glu			

Document 2

A mutation resulting from the deletion of many nucleotides at the level of the **Mc1-R** gene leads to the appearance of a mutant allele responsible for the synthesis of the *pheomelanin* pigment.

Document 3 shows a part of the untranscribed strand of the mutant allele responsible for the synthesis of the *pheomelanin* pigment and the amino acid sequence produced.

Document 3

Number of nucleotide triplets:	**225**	**226**	**227**	**228**	**229**	**230**	**231**	**232**
Nucleotide sequence:	**CAG**	**CCC**	**ACC**	**GCA**	**CCA**	**GCA**	**GCC**	**TGA**
Amino acid sequence:	**Gln**	**- Pro -**	**Thr -**	**Ala**	**- Pro**	**- Ala**	**- Ala**	

2. Determine the location and the number of nucleotides lost by deletion that have led to the appearance of the mutant allele, and **show** the trait-gene relationship. **(1.25 pts)**

II- In addition to the colour difference in eggs, Japanese quail can be affected by diabetes insipidus, which is an inherited disease characterised by excessive thirst and excretion of abnormal quantities of very diluted urine.

In order to study the mode of transmission of the two hereditary characteristics (traits), the colour of the eggs and the disease of diabetes insipidus in two lineages of the Japanese quail - one that gives blue eggs and is affected by diabetes insipidus and the other that gives green eggs and is not affected by diabetes insipidus, we suggest the exploitation of the results of the two following crosses:

- **First cross between two lineages**: a lineage that gives blue eggs and is affected by diabetes insipidus and a lineage that gives green eggs and is not affected by diabetes insipidus. The first generation obtained (F_1) is composed of individuals who give blue eggs and are not affected by diabetes insipidus.

- **Second cross between F_1 individuals:**

The second generation obtained (F_2) is composed of:
- 10 individuals that give green eggs and are affected by diabetes insipidus.
- 33 individuals that give green eggs and are not affected by diabetes insipidus.
- 33 individuals that give blue eggs and are affected by diabetes insipidus.
- 82 individuals that give blue eggs and are not affected by diabetes insipidus.

3. Analyse the results of the two crosses and **show** the mode of transmission of the two hereditary traits studied. **(1.5pts)**

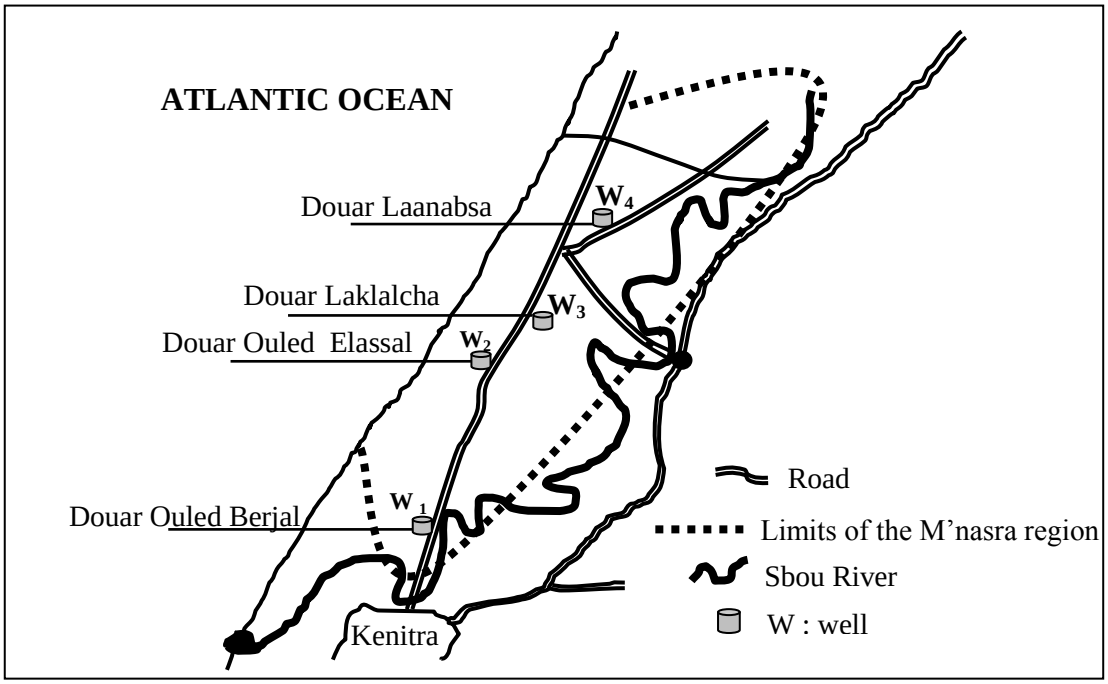
4. Interpret and **use** Punnett square to **explain** the results obtained in the first and the second crosses.**(1.25pts)**

Use the symbols **B** *and* **b** *for the character " colour of the eggs " and the symbols* **D** *and* **d** *for the character " diabetes insipidus ".*

Exercise 2 : (5 pts)

The M'nasra region near Kenitra city is characterised by an important agricultural activity which consists mainly of cattle breeding and farming using cattle manure (animal waste) which is rich in ammoniac (NH^+_4) and which is often used in soil fertilisation. The groundwater of the M'nasra region is estimated to be about 80×10^6 m^3 and it is the main resource for drinking water and agricultural use. The M'nasra phreatic nape (groundwater table) gets water supplies from rainwater but it is exposed to pollution.

In order to study the impact of the agricultural activity on the quality of groundwater in M'nasra region, chemical and biological analyses have been conducted on sample waters of four wells as indicated in document 1. The results of these analyses are shown in document 2.



Document 1

The wells / Parameters	W1	W2	W3	W4	Drinking water standards
Ammoniac NH^+_4 (in mg/L)	0,00	0,00	0,28	0,00	$\leq$ 0,5mg/L
Nitrites NO^-_2 (in mg/L)	0,007	0,003	0,004	0,002	$\leq$ 0,1mg/L
Nitrates NO^-_3 (in mg/L)	26,16	107,76	114,47	198,46	$\leq$ 50mg/L
FC per 100mL Number of	380	57	120	0	$\leq$ 0/100 mL
Number of FS per 100mL	1250×10^3	8×10^3	$5,8\times10^3$	$2,5\times10^3$	$\leq$ 0/100 mL

FC: Faecal Coliforms - FS: Faecal Streptococci

- Faecal Coliforms and Faecal Streptococci are bacteria encountered in human and animal faeces (faecal material);
- In the soil, the ammoniac (NH_4^+) is transformed into nitrite (NO^-_2), then into nitrate (NO^-_3);
- To identify the origin of coliforms and streptococci faecals detected in the water of the four wells studied, we calculate the $\frac{FC}{FS}$ ratio. The bacteria are of animal origin if the $\frac{FC}{FS}$ ratio is $\leq$ 0,7.

Document 2

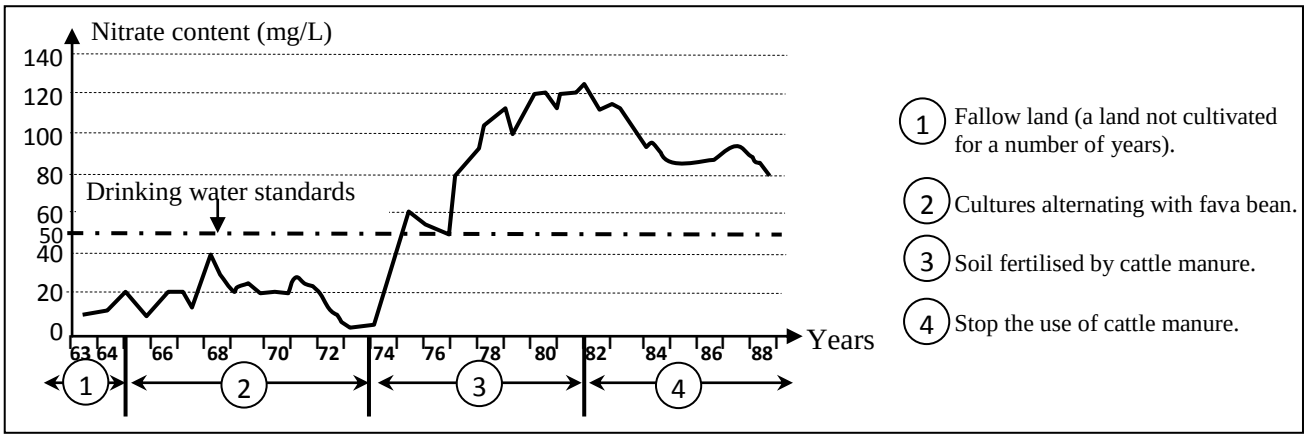
1. Based on the data in document 2, **compare** the values of NO^-_3, FC and FS recorded in the water of the four wells with the drinking water standards, and **deduce** the water potability of these wells (whether the water of each will is drinkable or not). **(1.25 pts)**

2. Calculate the $\frac{FC}{FS}$ ratio of the four wells and **deduce** the origin of coliforms and streptococci faecals detected in the water. **(1 pts)**

3. Based on the data in documents 1 and 2 and on your knowledge, **explain** how the groundwater in the M'nasra region is polluted by NO_3^-. **(1.25 pts)**

In order to find solutions to the problem of groundwater pollution by NO_3^-, the following data are suggested:
Fava bean culture contributes to the enrichment of the soil with mineral nitrogen used by plants. For example, winter fava bean culture leaves in soil round 67% of nitrogen needs for other cultures, like wheat.

Document 3 shows the variation in nitrate content in groundwater according to agricultural practices in the southwest of France during the period 1963-1988.



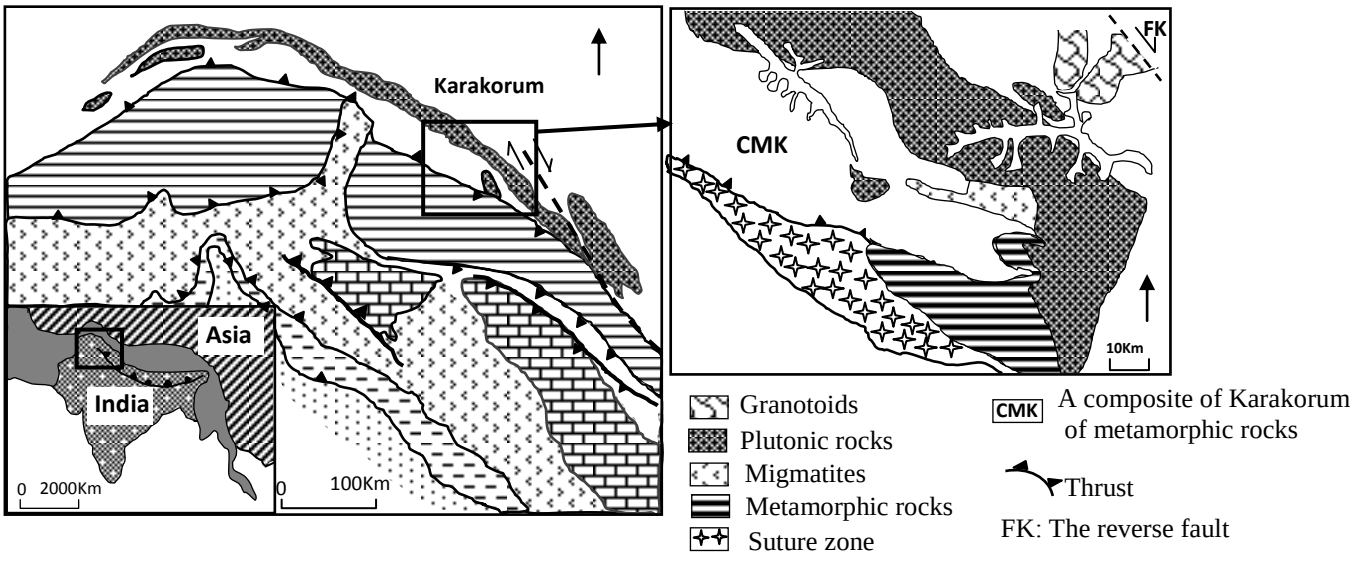
Document 3

4. Describe the variation in nitrate content in groundwater **according** to the agricultural practices illustrated in document 3, and **suggest** an appropriate solution to improve the quality of groundwater in the M'nasra region. **(1.5pts)**

Exercise 3 : (5 pts)

Karakorum is a mountain range located in the North-West of the Himalayas and extends from northern Pakistan to the South of Kashmir. In order to determine the stages of formation of this mountain chain, many studies were carried out on the tectonic and petrographic characteristics of rocks of Karakorum region.

Document 1 presents a simplified map of the studied area.



Document 1

1. Based on document 1, **extract** two indicators showing that the studied region has undergone compressive tectonic forces, and two other indicators showing that it has undergone a collision preceded by a subduction. **(1 pt)**

The Karakorum metamorphic complex is characterised by the presence of the gneiss rocks (R_2) which are the result of metamorphic transformation of paragneiss rocks (R_1).

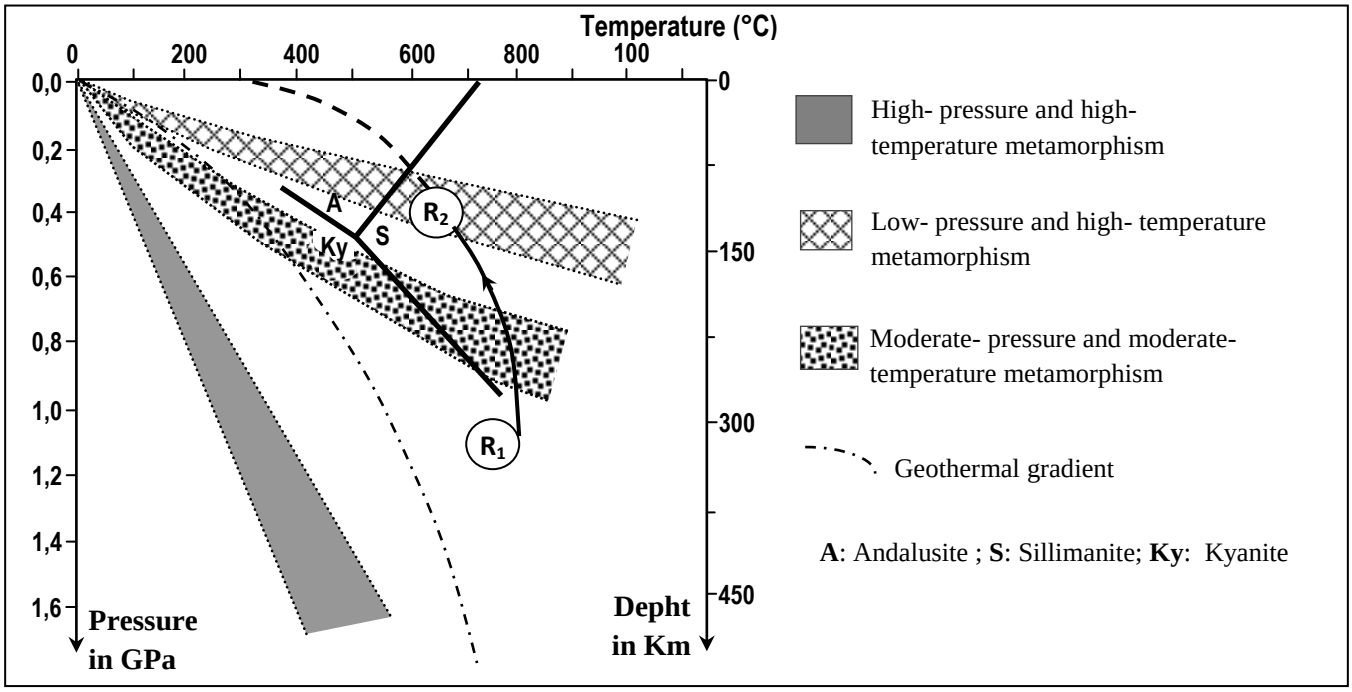
The table in **document 2** shows the mineralogical composition of the two rocks R_1 and R_2.

Document 3 shows the path of metamorphic evolution of these two rocks according to pressure and temperature variations.

Document 2

Minerals	Paragneiss (R_1)	Gneiss (R_2)
Quartz	+++	+++
Plagioclase	++	++
Biotite	+++	++
Muscovite	++	++
Garnet	++	++
Kyanite	++	-
Sillimanite	-	++

(+): Low proportion of mineral ; **(+++):** High proportion of mineral
(++): Average proportion of mineral ; **(-):** Absence of mineral

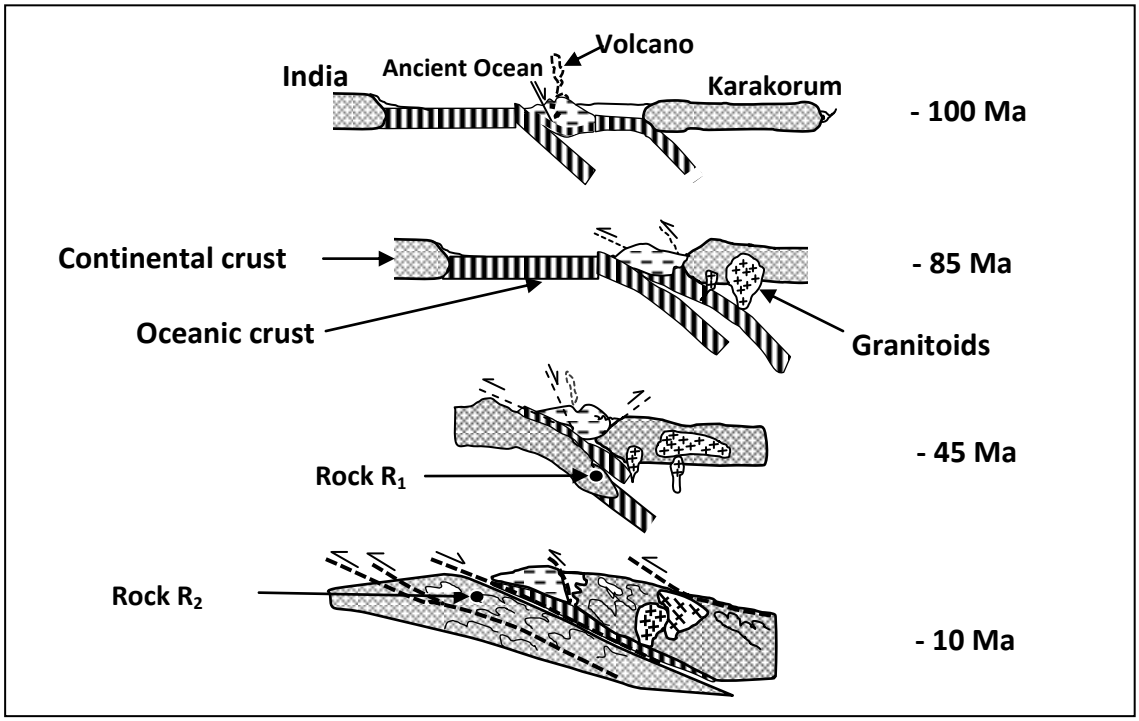


Document 3

2. Based on document 2, **describe** the mineralogical variations observed during metamorphic transformation from paragneiss to gneiss. **(0.75 pts)**

3. Based on document 3, **determine** the conditions of the pressure and temperature allowing the formation of the two rocks R_1 and R_2**, and explain** the mineralogical variations observed during metamorphic transformation from paragneiss to gneiss. **(1.25pts)**

Document 4 shows the stages of formation of Karakorum mountain range according to the model proposed by Y. LEMENNICIER:



Document 4

4- Use the previous data and document 4 to **reconstruct** the geological history of Karakorum mountain and **specify** the relationship between the gneiss formation and the formation of this mountain range (orogeny). **(2 pts)**