

الصفحة 1	<b>الامتحان الوطني الموحد للبكالوريا</b> <b>الممالك الدولية</b> <b>الدورة الاستدراكية 2021</b> <b>- الموضوع -</b>		المملكة المغربية وزارة التربية الوطنية والتكوين المهني والتعليم العالي والبحث العلمي المركز الوطني للتقويم والامتحانات
5	SSSSSSSSSSSSSSSSSSSSSS	RS 34E	
3h	مدة الإنجاز	علوم الحياة والأرض	المادة
5	المعامل	شعبة العلوم التجريبية مسلك العلوم الفيزيائية (خيار إنجليزية)	الشعبة أو المسلك

*Candidates may use non-programmable calculators*

**Section I : Knowledge Retrieval (6 pts)**

- I. Define** the following notions: - Eutrophication. - Ozone hole. (1 pt)
- II. Give** two techniques allowing the valorization of household waste and specify their economic importance. (1 pt)
- III. For** each of the following 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- The biological struggle :**

- a. is based on the use of chemical pesticides.
- b. is based on the introduction of organisms which can reduce the number of harmful insects.
- c. causes the pollution of natural environment.
- d. causes total eradication of harmful insects.

**2. The enrichment of the waters of a lake with mineral matter causes:**

- a. a decrease of the biological oxygen demand.
- b. an increase of the rate of dissolved oxygen in water.
- c. the proliferation of green algae.
- d. the proliferation of microscopic fungus.

**3- A radioactive element is characterized by a:**

- a. half-life which corresponds to the time after which this isotope is completely disintegrated;
- b. half-life used for absolute dating of fossils;
- c. gradual disintegration which results in an increase in the number of these nuclei;
- d. disintegration of stable nuclei giving off usable energy.

**4- Tropospheric ozone:**

- a. forms a layer that protects the environment from ultraviolet rays;
- b. comes from the degradation of the stratospheric ozone layer;
- c. is a greenhouse gas resulting from air pollution;
- d. forms a layer whose concentration decreases as a result of air pollution.

- IV. On** your exam sheet **copy down** the number corresponding to each proposition and **write** whether the statement is “true” or “false”. (1 pt)

1. The use of fossil fuels is the main source of atmospheric pollution by nitrogen oxides.
2. Methane is a greenhouse gas that comes from the use of aerosol pumps in agriculture.
3. Marine hydrocarbon pollution causes a decrease in the production of unicellular algae.
4. The determination of the quality of aquatic environments is based on biotic index.

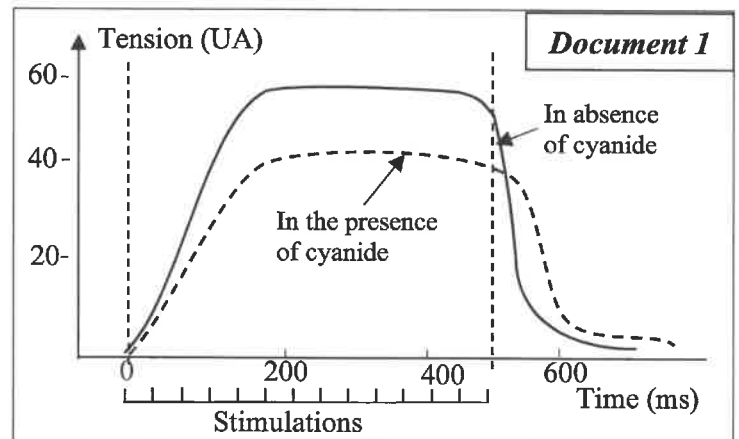
- V. Give** the advantages and the dangers of using radioactive materials in the production of nuclear energy. (1pt)

**Section II : Scientific reasoning and communication in graphic and written modes (14 pts)**

**Exercise 1 (6 pts)**

The almonds contained in the stone of certain fruits contain a natural toxin called cyanogenic glycoside. Apricots, cherries, peaches, plums are all stone fruits. The pulp of the fruit itself is not toxic. However, when we chew the almonds contained in the stone of these fruits, the cyanogenic glycoside is transformed into hydrocyanic acid (cyanide) toxic to humans. To highlight the action of cyanide on respiration and muscle activity, we present the following data.

A series of successive and effective stimuli of the same intensity is applied to an isolated muscle of the thigh of a mouse in the absence and presence of cyanide in very small quantities. Document 1 presents the myograms obtained.



1. Based on document 1:

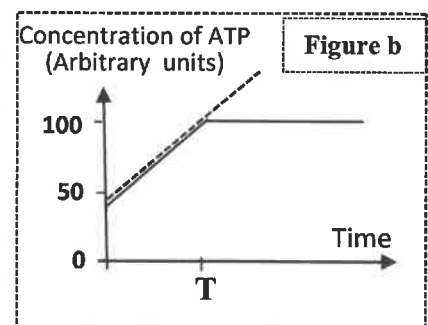
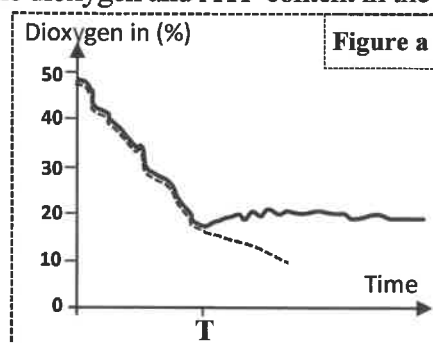
- a- Compare the muscle activity recorded during stimulation in the absence and presence of cyanide. (1 pt)
- b- Propose a hypothesis to explain the effect of cyanide on muscle activity. (0.75 pt)

To show the effect of cyanide on muscle contraction, we propose the experimental data presented in documents 2.

A suspension of mitochondria is placed in two suitable medium 1 and 2 rich in oxygen and containing a sufficient quantity of pyruvic acid, Pi and ADP. At time T, the cyanide is added to medium 2 only. Figures (a) and (b) show the evolution of the dioxygen and ATP content in the two medium.

----- Medium 1  
 ———— Medium 2

Pi : inorganic phosphate

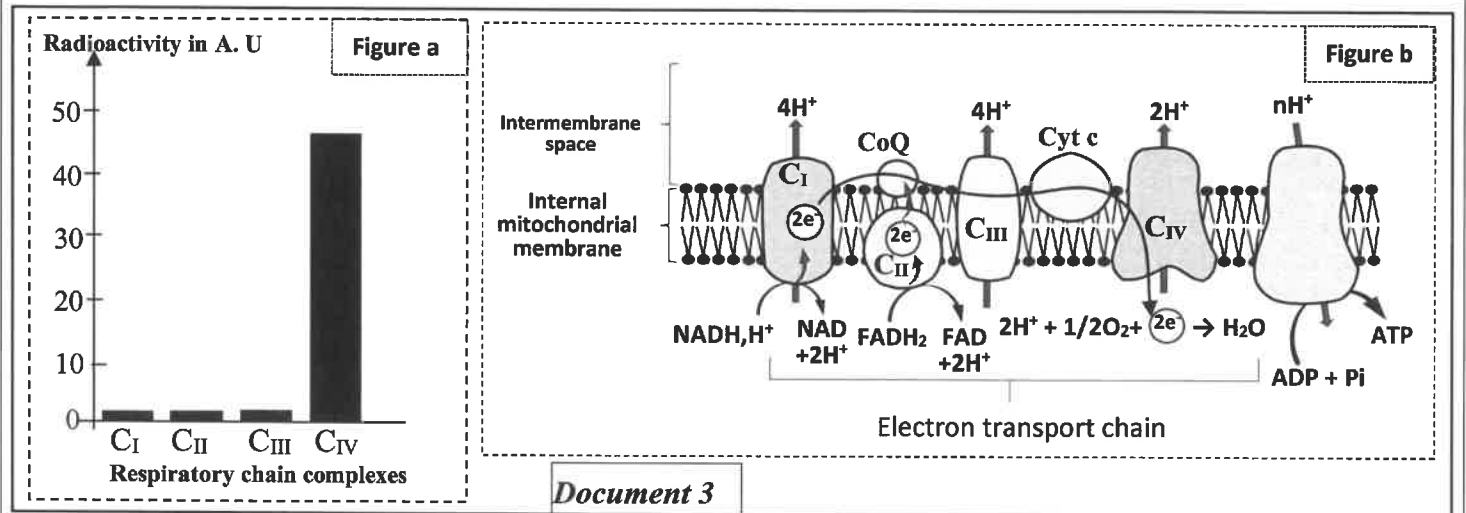


**Document 2**

2. By exploiting document 2:

- a. Describe the evolution of the concentration of oxygen and ATP in the medium. (1,5 pt)
- b. Deduce the action of cyanide on the mitochondria. (0.5 pt)

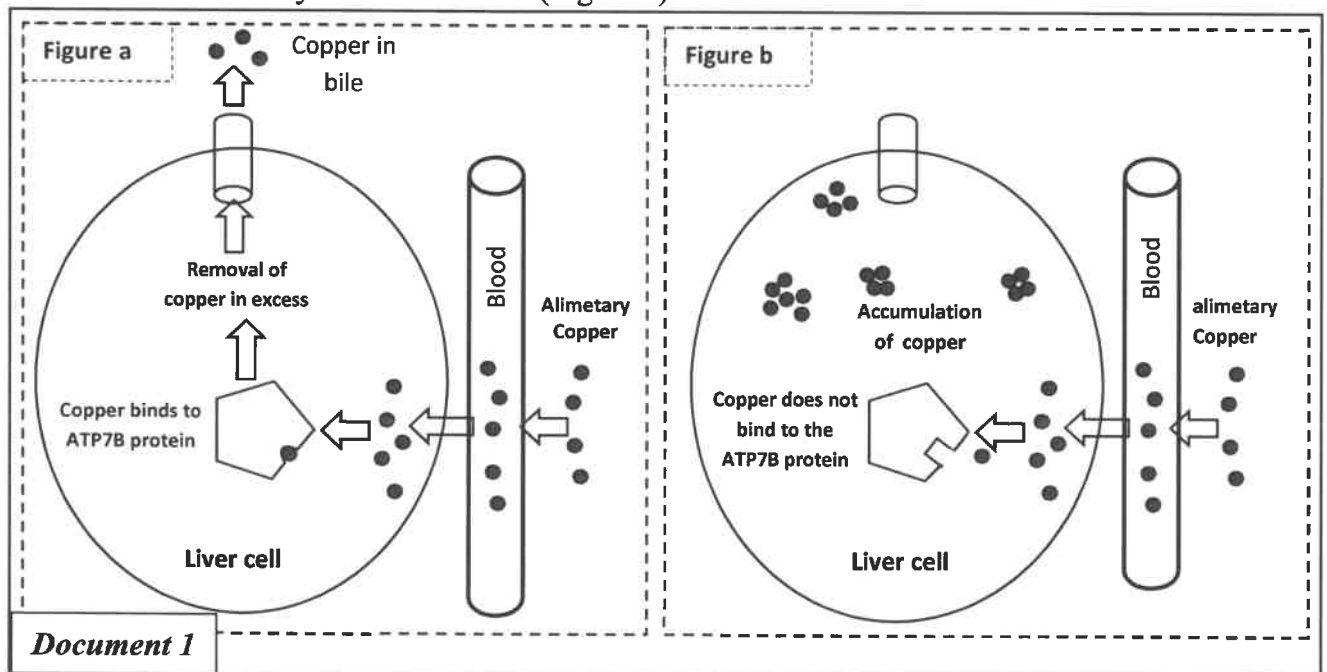
In order to determine the site of action of cyanide in the mitochondria, a small quantity of radioactive cyanide is added to a mitochondrial suspension and the distribution of radioactivity in the respiratory chain complexes is monitored. Document 3 presents the results obtained (figure a) and a diagram of the respiratory chain (figure b).



3. Using Document 3, determine the site of action of cyanide and its impact on mitochondrial activity. (1,25 pt)
4. Based on the above, verify the hypothesis proposed in answer to question (1.b), justify your answer.(1pt)

**Exercice 2 : (3,5 pts)**

People with Wilson's disease suffer from fatigue, weight loss, digestive disturbances, jaundice, and liver problems related to the regulation of copper stock in the body, this regulation involves a protein called ATP7B. In order to highlight the genetic origin of this disease, we propose the following data: Document 1 shows the pathways of excess copper through the body in the healthy individual (Figure a) and in the individual affected by Wilson's disease (Figure b)



1. Based on document1, compare the copper pathway in the normal liver cell, in the liver cell of the individual affected by Wilson's disease, and deduce the cause of Wilson's disease. (1. 5 pt)

The synthesis of the ATP7B protein is controlled by the ATP7B gene located on chromosome 13. Document 2 shows the nucleotide sequence of a fragment of the non-transcribed strand of the ATP7B gene in a healthy individual (normal allele) and in an individual affected by Wilson's disease (mutated allele) and document 3 presents the table of the genetic code.

Number of nucleotide triplets :                    776    777    778    779    780  
Part of the normal ATP7B allele:                .. CTG GGC CGG TGG CTG..  
Part of the mutated ATP7B allele:             .. CTG GGC CTG TGG CTG..

**Document 2**

➔ Reading direction

1st letter \ 2nd letter	U	C	A	G	3rd letter	
U	UUU	Phe	UCU	Tyr	UGU	U
	UUC		UCC		UGC	C
	UUA	Leu	UCA	STOP	UGA	A
	UUG		UCG		UGG	G
C	CUU	Leu	CCU	His	CGU	U
	CUC		CCC		CGC	C
	CUA		CCA	CGA	A	
	CUG		CCG	CGG	G	
A	AUU	Ile	ACU	Asn	AGU	U
	AUC		ACC		AGC	C
	AUA	Met	ACA	Lys	AGA	A
	AUG		ACG		AGG	G
G	GUU	Val	GCU	Ac.asp	GGU	U
	GUC		GCC		GGC	C
	GUA		GCA	GGA	A	
	GUG		GCG	GAG	G	

**Document 3**

- Based on documents 2 and 3, **determine** the amino acid sequence of the ATP7B protein corresponding to the normal allele and that corresponding to the mutated allele. (1 pt)
- Based on your previous answers, **explain** the genetic origin of Wilson's disease. (1 pt)

**Exercise 3 (4.5 pts)**

In order to study the mode of transmission of the two hereditary characteristics (traits) in pigs: the thumb shape and the fur shape, we suggest the exploitation of the results of the two following crosses:  
- **First cross** between two pure lineages of pigs: one lineage has a returned thumb "pollex" and the rough fur, and the other has a normal thumb and normal fur.

The first generation obtained (F<sub>1</sub>) is composed of individuals with a turned thumb and rough fur.

- **Second cross** between females of F<sub>1</sub> and males with a normal thumb and normal fur.

This cross has given a generation F<sub>2</sub> composed of:

- 122 pigs with a normal thumb and normal fur
- 118 pigs with a returned thumb and rough fur;
- 70 pigs with a normal thumb and rough fur;
- 66 pigs with a returned thumb and normal fur.

الصفحة			
5	RS 34E	الامتحان الوطني الموحد للبكالوريا - الدورة الاستدراكية 2021 - الموضوع	
5		- مادة: علوم الحياة والأرض - شعبة العلوم التجريبية مسلك العلوم الفيزيائية (خيار إنجليزية)	

1. **Based on** the results of the two crosses, **determine** the mode of transmission of the two hereditary traits studied. (1 pt)

2. Use Punnett square to **Interpret** and **explain** the results obtained in the second cross. (1.5 pt)

*NB. Use the symbols  $P$  and  $p$  for 'thumb shape' trait and the symbols  $R$  and  $r$  for 'fur shape' trait.*

3. **Determine** the phenomenon responsible for the appearance of pigs with a normal thumb and the rough fur and pigs with a returned thumb and normal fur in generation F<sub>2</sub>. **Explain** this phenomenon by drawing a scheme. (1.25 pt)

4. **Establish** the gene map. (0.75 pt)

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### Key and Marking Scale

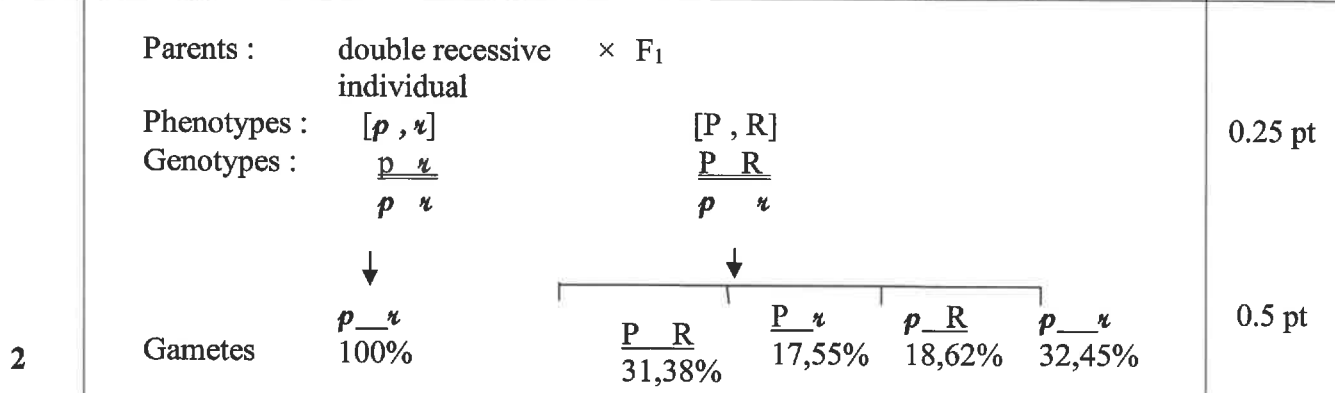
Question	The elements of answer	Scores
<b>Section I : Knowledge Retrieval (6pts)</b>		
I	<b>Accept any appropriate answers.</b>	
	- <b>Eutrophication:</b> Eutrophication is an enrichment of water by nutrient salts that causes structural changes to the ecosystem such as: increased production of algae and aquatic plants and deterioration of water quality.....	0.5 pt
	- <b>The ozone hole:</b> Is a thinning of the ozone layer resulting from air pollution .....	0.5 pt
II	<b>Two techniques for household waste valorization by specifying their economic interest among the following proposition: .....</b> (2x0.5 pt)	
	- Composting: obtaining a humus-like complex that can be used in agriculture as fertilizer for plants.	
	- Biogas production: obtaining a significant amount of methane used in energy production.	1 pt
	- Incineration: Energy production	
	- Recycling: Is the process of converting waste materials (paper, plastic and glass) into new materials and objects.	
III	(1 ; b) ; (2 ; c) ; (3 ; b) ; (4 ; c) .....(4x0.5)	2 pts
IV	1 → true; 2 → false; 3 → true; 4 → true ..... (4x0.25pt)	1 pt
V	<b>Advantages of using radioactive materials :</b> Two advantages such as	0.5 pt
	- Low cost of production - Non release of greenhouse gases	
	<b>Dangers of using radioactive materials :</b> Two advantages such as	0.5 pt
	- Nuclear pollution resulting from explosion	
<b>Section II : Scientific reasoning and communication in graphic and written modes (14 pts)</b>		
<b>Exercise 1 (6 pts)</b>		
1.a	In the presence and absence of cyanide, a perfect tetanus is obtained . .....	0.5 pt
	In the presence of cyanide, the amplitude of tetanus is lower than that obtained in the absence of cyanide .....	0.5 pt
1.b	<b>Accept any logical hypothesis in relation to the proposed data such as :</b>	
	- Cyanide has an inhibitory action on the energy production pathways in muscle (respiration and lactic fermentation). - Binding of cyanide to myosin prevents the formation of the actomyosin complex.	0.75 pt
	<b>Concerning the oxygen level :</b> Before time T, the oxygen level decreases in the two media, going from 45% to 20%... From time T, the level of dioxygen remains stable at around 20% in medium 2	0.25 pt

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2			
3			
2.a	(presence of cyanide) while this rate continues to decrease in medium 1 (absence of cyanide).....	0.5 pt	
	<b>Concerning ATP :</b> Before time T, there is an increase in ATP concentration in both media to reach 100UA.....	0.25 pt	
	From time T, the concentration of ATP in medium 2 (presence of cyanide) stabilizes while it continues to increase in medium 1 (in the absence of cyanide).....	0.5 pt	
2.b	Cyanide blocks oxygen consumption and ATP production in the mitochondria.....	0.5 pt	
3	The intensity of radioactivity is high at complex IV and low at the other complexes of the respiratory chain..... Cyanide binds to complex IV and inhibits its activity which causes the flow of electrons and protons through the respiratory chain to be stopped and prevents the formation of the H <sup>+</sup> gradient, thus blocking the reduction of oxygen and the production of ATP.....	0.5 pt 0.75 pt	
4	<b>Verification of the proposed hypothesis by justifying the answer :</b> The hypothesis is accepted (or rejected)..... The cyanide binds to the IV complex and blocks the functioning of the respiratory chain which pushes muscle cells to produce ATP through lactic fermentation Pathway with low energy yield hence obtaining the contractions with low amplitude in presence of cyanide.....	0.25 pt 0.75pt	
<b>Exercise 2 (3.5 pts)</b>			
1	<b>Comparison of copper paths in the two cells :</b> - In the hepatocyte of a healthy person, copper is bound to the ATP7B protein, which allows its elimination through the bile. .... - In the hepatocyte of a person with Wilson's disease, copper does not bind to the ATP7B protein, which prevents its elimination through the bile, hence the accumulation of copper in liver cells..... <b>Deduction of the cause of the disease:</b> The disease is caused by the malfunction of the ATP7B protein which prevents the elimination of copper through the bile which leads to accumulation of copper in the hepatocytes. ....	0.5 pt 0.5 pt 0.5 pt	
2	<b>The mRNA and the corresponding amino acid sequence :</b> - <b>The normal ATP7B allele :</b> ..... mRNA: CUG GGC CGG UGG CUG amino acid sequence : Leu - Gly - Arg - Trp - Leu - <b>The ATP7B mutated allele :</b> ..... mRNA : CUG GGC CUG UGG CUG amino acid sequence : Leu - Gly - Leu - Trp - Leu	0.5 pt 0.5pt	
3	<b>Explanation of the origin of Wilson's disease :</b> ..... A mutation by substitution of nucleotide G by T at triplet 778 of the non-transcribed strand of the gene encoding ATP7B synthesis (or substitution of C by A at the transcribed strand) → substitution of Arg by Leu at the amino acid sequence of ATP7B protein → Non-functional ATP7B protein unable to bind copper →	1 pt	

Accumulation of copper in tissues and excess of the circulating copper → appearance of Wilson disease.

**Exercise 3 : (4.5 points)**

- \* First cross :**
- F1 is homogeneous, Mendel's first law is verified → non-sex related heredity ..... 0.25 pt
  - The F1 individuals have a parental phenotype ( returned thumb and rough fur), therefore : 0.25 pt
  - The allele responsible for the returned thumb is dominant (**P**) and the allele responsible for the normal thumb is recessive (**p**) ;..... 0.25 pt
  - The allele responsible for the rough fur is dominant (**R**) and the allele responsible for the normal fur is recessive (**r**)..... 0.25 pt
- \* Second cross :**
- This is a back-cross, F'2 is composed of four phenotypes with different percentages: 63.83% of the parental phenotypes and 36.17% of the recombinant phenotypes → The two studied genes are linked..... 0.25 pt



**Chromosomal interpretation of the second cross:**

Punnett square :

	σF1	$\frac{P}{31,38\%} \frac{R}{17,55\%}$	$\frac{P}{18,62\%} \frac{r}{32,45\%}$	
σ P		$\frac{P}{31,38\%} \frac{R}{17,55\%}$	$\frac{P}{18,62\%} \frac{r}{32,45\%}$	
	$\frac{p}{100\%} \frac{r}{100\%}$	$\frac{p}{31,38\%} \frac{R}{17,55\%}$ [P, R]	$\frac{p}{18,62\%} \frac{r}{32,45\%}$ [p, R]	$\frac{p}{32,45\%} \frac{R}{17,55\%}$ [p, r]

Theoretical results are consistent with experimental results. 0.25 pt

- 3**
- The presence in the F'2 generation of pigs with normal thumbs and the rough fur and pigs with returned thumb and normal fur is due to Intrachromosomal recombination (crossing-over) 0.5 pt
  - Diagram of the Crossing over with the use of the symbols **P** and **p** for 'thumb shape' trait and the symbols **R** and **r** for 'fur shape' trait. 0.75 pt

**4** Establishing a correct gene map using a suitable scale and symbols. 0.75 pt