

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA

MOLEKULÊRE EN SELBIOLOGIE 111
MOLECULAR AND CELL BIOLOGY 111

EERSTE SEMESTERTOETS : 18 APRIL 2006
FIRST SEMESTER TEST : 18 APRIL 2006

PUNTE TOEGEKEN MARKS AWARDED	
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VAN EN VOORLETTERS
SURNAME AND INITIALS

STUDENT REGISTRASIENOMMER
STUDENT REGISTRATION NUMBER

GRAAD (bv. BSc 1)

DEGREE (e.g. BSc 1)

DATUM VAN TOETS

DATE OF TEST

NAAM VAN TOETSLOKAAL

NAME OF TEST VENUE

VRAAG QUESTION	PUNTE TOEGEKEN MARKS AWARDED	MAKS PUNTE MAX MARKS
1		13
2		8
3		6
4		13
5		2
6		9
7		11
8		6
9		12
10		6
11		8
12		6
TOTAAL TOTAL		100

MOLECULAR AND CELL BIOLOGY 111 (MLB 111)
MOLEKULÊRE EN SELBIOLOGIE 111 (MLB 111)

FIRST SEMESTER TEST / EERSTE SEMESTERTOETS

2006-04-18

MARKS / PUNTE : 100
TIME / TYD : 100 MIN

EXAMINERS / EKSAMINATORE:

Dr A Gaspar Dr Q Kritzing

The test paper consists of 12 questions and 17 pages.
Die toetsvraestel bestaan uit 12 vrae en 17 bladsye.

VERIFY IT !!
KONTROLEER DIT !!

QUESTION / VRAAG 1: [13]

- 1.1. Complete the following sentences by providing the correct words/number:/
Voltooi die volgende sinne deur die korrekte terme/getal te verskaf: (6)

A covalent bond may be or ,
depending on the atoms involved. Covalent bonds between atoms of
different electronegativities are bonds.

Water molecules associate with each other by means of
..... bonds. The latter bonds are the reason why water
dissolves (water "loving") substances.

These substances are either (non-polar/polar) or
..... (charged/uncharged) molecules.

Living organisms are able to live in water because water has a high
..... at 4 ° Celsius. It takes one calorie of heat to raise the
temperature of one gram of water by one degree Celsius. This property is
referred to as the of water.

A pH of 4 is times more (basic/acidic)
than a pH of 7

*'n Kovalente binding is of ,
afhangend van die atome betrokke in die binding.*

Kovalente bindings tussen atome van verskillende elektronegatiwiteite
staan bekend as bindings. Water molekules
assosieer met mekaar deur middel van bindings.

Die laasgenoemde bindings is die rede waarom water in staat is om

..... (water "loving") verbindings op te los.

Hierdie verbindings is of (nie-polêre/ polêre) of

..... (gelaaide/ongelaaide) molekule.

Lewende organisms kan in water leef omdat water 'n hoë

..... het by 4 ° Celsius. Dit neem ongeveer een kalorie van

hitte om die temperatuur van een gram water met een graad Celsius te

verhoog. Hierdie eienskap staan bekend as die

..... van water.

'n pH van 4 is voud meer (basies/suur) as

'n pH van 7.

- 1.2. One of the buffers in human blood is **carbonic acid** (H_2CO_3). /
Een van die buffers in mensbloed is **karboonsuur** (H_2CO_3).

(4)

- 1.2.1. Write the reaction down for the formation of carbonic acid. /
Skryf die reaksie vir die vorming van karboonsuur neer.

.....

- 1.2.2. Give the reaction for the dissociation of carbonic acid. /
Gee die reaksie vir die dissosiasie van karboonsuur.

.....

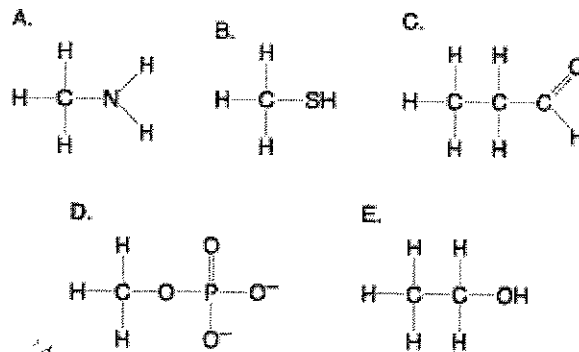
- 1.2.3. Identify the conjugate acid-base pair. /
Identifiseer die gekonjugeerde suur-basis paar.

.....

- 1.2.4. Indicate the shift in reaction direction (**left or right**) if the pH of blood
drops. /
Dui die skuif in reaksierigting aan (**links of regs**) indien die bloed pH val.

.....

- 1.3. The following questions refer to the following structures: (Answer each question by giving the correct letter/s only) /
 Die volgende vrae verwys na die volgende strukture: (Beantwoord elke vraag deur slegs die korrekte letter/s te gee) (3)



- 1.3.1. Which molecule contains a sulfhydryl (thiol) functional group? /
 Watter molekule bevat 'n sulfhidriel (tiol) funksionele groep?

- 1.3.2. Which molecule contains an amino group, but is not an amino acid? /
 Watter molekule bevat 'n aminogroep, maar is nie 'n aminosuur nie?

- 1.3.3. Which molecule can function to transfer energy between organic molecules? /
 Watter molekule kan funksioneer in energietoedrag tussen organiese molekule?

- 1.3.4. Which molecule can function as a base? /
 Watter molekule kan optree as 'n basis?

- 1.3.5. Which molecule contains a hydroxyl functional group? /
 Watter molekule bevat 'n hidroksiel funksionele groep?

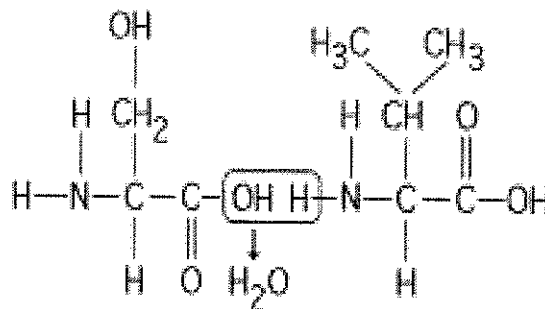
- 1.3.6. Which molecule is a fatty acid? /
 Watter molekule is 'n vetsuur?

QUESTION / VRAAG 2:

[8]

- 2.1. Refer to the figure below to answer the following questions: /
Verwys na die figuur hieronder om die volgende vrae te beantwoord:

(3)



- 2.1.1. What type of bond is formed in the above condensation reaction? /
Watter tipe binding word gevorm in die bogenoemde
kondensasiereaksie?

.....

- 2.1.2. Which two functional groups are reacting to form the above mentioned bond? /
Watter twee funksionele groepe reageer met mekaar om die bogenoemde binding te
vorm?

.....

- 2.1.3. Classify the amino acid as (non-polar/polar/charged) on the N-
and C-terminus of the formed product, respectively. /
Klassifiseer die aminosure as (nie-polêr/ polêr/gelaa) aan die N- en C-
terminaal van die gevormde produk, onderskeidelik.

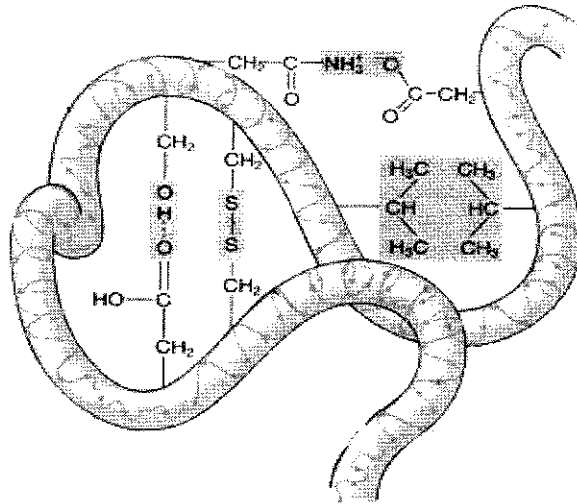
.....

.....

- 2.1.4. The opposite reaction used to disassemble the formed product back into
the individual monomers is called a reaction. /
Die teenoorgestelde reaksie wat gebruik word om die gevormde produk
weer af te breek na die afsonderlike monomere, staan bekend as 'n
..... reaksie.

- 2.2. Consider the following structure to answer the questions below: /
 Beskou die volgende struktuur om die volgende vrae te beantwoord:

(5)



- 2.2.1. Which level of protein structure is represented above? /
 Watter vlak van proteïenstruktuur word hierbo verteenwoordig?

- 2.2.2. Indicate the interactions stabilizing the protein structure **on the figure above** as follows:
(use only letter) /
 Dui die interaksies wat die proteïenstruktuur stabiliseer **op die bogenoemde figuur** aan as volg: **(gebruik slegs letter)**
- A:** covalent bond/ kovalente binding
B: ionic interaction/ ioniese interaksie
C: hydrogen bond/ waterstofbinding
D: hydrophobic interaction/ hidrofobiese interaksie
- 2.2.3. Which of the above interactions will be affected by a change in pH? /
 Watter van die bogenoemde interaksies sal beïnvloed word deur die pH te verander?

- 2.2.4. Identify the following molecules: /
 Identifiseer die volgende molekule:

A:

B:

C:

CCCCCCCCCCCC(=O)OCC(C)CCCC(C)C12CCC3C(C1CC=C3)C(C)CC2

3.1. A reaction that has a positive ΔG is an (-gonic) and a (spontaneous/non-spontaneous) reaction. / 'n Reaksie met 'n positiewe ΔG is 'n (-goniese) en 'n (sponane/nie-spontane) reaksie.

.....

6

- 3.4. How does a competitive inhibitor affect the K_m and V_m of an enzyme-catalyzed reaction? /
Hoe beïnvloed 'n kompeterende inhibitor die V_m en K_m van 'n ensiem-gekataliseerde reaksie?
-

QUESTION / VRAAG 4: [13]

The following reactions are involved in the catabolism of glucose. Enzymes are numbered in superscript next to the reaction arrows: /

Die volgende reaksies is betrokke in die katabolisme van glukose. Ensieme is genummer in boskrif naas die reaksiepyltjies:

Glucose \rightarrow ¹ Glucose-6-phosphate \rightarrow ² Fructose-6-phosphate \rightarrow ³
Fructose-1,6-bisphosphate \rightarrow ⁴⁺⁵ Glyceraldehyde-3-phosphate \rightarrow ⁶
1,3-Bisphosphoglycerate \rightarrow ⁷ 3-Phosphoglycerate \rightarrow ⁸
2-Phosphoglycerate \rightarrow ⁹ Phosphoenolpyruvate \rightarrow ¹⁰ Pyruvate \rightarrow ¹¹
Acetyl-CoA \rightarrow etcetera

- 4.1. Write down the numbers of the endergonic reactions that are coupled to ATP hydrolysis. /
Skryf die nommers neer van die endergoniese reaksies wat gekoppel is aan ATP hidrolise. (2)
-

- 4.2. Give the number of the reactions where reduction of NAD^+ to $NADH/H^+$ occurs. /
Gee die nommer van die reaksies waar die reduksie van NAD^+ tot $NADH/H^+$ plaasvind. (2)
-

- 4.3. Where (give reaction number) is the first molecule of CO_2 released? /
Waar (gee reaksienommer) word die eerste CO_2 molekule vrygestel? (1)
-

- 4.4. In which cellular compartments do reactions 1-10 and reaction 11 take place, respectively? /
In watter sellulêre kompartemente vind reaksies 1-10 en 11 onderskeidelik plaas? (2)
-
-

- 4.5. Write down the numbers of the reactions where substrate-level phosphorylation occurs. / *Skryf die nommers neer van die reaksies waar substraat-vlak fosforilasie plaasvind.* (2)

.....

- 4.6. Under anaerobic conditions pyruvate is converted to
..... in muscle cells. During this reaction the oxidizing
reagent required for glycolysis is regenerated. /

Onder anaërobiese kondisies word pirovaat omgeskakel na

..... in spierselle. Tydens hierdie reaksie word die
oksideermiddel wat benodig word vir glikolise hergenereer. (2)

- 4.7. Which metabolite in the scheme above is also an intermediary product of the catabolism of fatty acids?
Watter metabolite in die skema hierbo is ook 'n tussenproduk van vetsuurmetabolisme? (1)

.....

- 4.8. Which molecule is the final electron acceptor when glucose is catabolized completely to CO_2 and H_2O ? /
Watter molekule is die finale elektronontvanger wanneer glukose volledig gekataboliseer word na CO_2 en H_2O ? (1)

.....

QUESTION / VRAAG 5: [2]

- 5.1. What is the critical factor regarding the surface area to volume ratio of a cell? / *Wat is die kritieke faktor aangaande 'n sel se oppervlakte-tot-volume verhouding?* (1)

.....

.....

- 5.2. In the fractionation of homogenized cells using centrifugation, what is the primary factor that determines whether a specific cellular component ends up in the supernatant or the pellet? / *Gedurende die fraksionering van gehomogeniseerde selle tydens sentrifugering, wat is die primêre faktor wat sal bepaal of 'n sekere sellulêre komponent in die supernatant of in die pellet beland?* (1)

.....

QUESTION / VRAAG 6:

[9]

- 6.1. For the following question, use the answers (A – D) to match the structure to its proper cell type. Take note: a cell type might not have a corresponding structure. / Vir die volgende vraag, gebruik die antwoorde (A – D) om die strukture by sy regte seltipe te pas. Let wel: 'n seltipe kan dalk geen ooreenstemmende struktuur hê nie.

(4x½ = 2)

- A. plasma membrane / plasmamembraan
- B. tonoplast / tonoplas
- C. nucleoid / nukleêre gebied
- D. mitochondrion / mitochondrion

6.1.1. a feature of all cells / kom voor in alle selle

6.1.2. found in prokaryotic cells only / kom net in prokariotiese selle voor

6.1.3. found in eukaryotic cells only / kom net in eukariotiese selle voor

6.1.4. found in plant cells only / kom net in plantselle voor

6.1.5. found in animal cells only / kom net in dierselle voor

- 6.2. Match each organelle with its most suitable function or description. Write the letter of the function next to the correct organelle in the column B. / Pas elke organel met sy mees toepaslike funksie of beskrywing. Skryf die letter van die funksie langs die korrekte organel in die kolom B.

(6x½ = 3)

A	B	C
6.2.1. nucleus / nukleus		a. synthesis of oils and phospholipids / sintese van olies en fosfolipiede
6.2.2. vacuole / vakuool		b. directs protein synthesis / beheer proteïensintese
6.2.3. ribosome / ribosoom		c. contains enzymes that transfer hydrogen from various substrates to oxygen / bevat ensieme wat waterstof vanaf verskeie substrate na suurstof oordra
6.2.4. smooth ER / gladde ER		d. sort and modify proteins / sorteer en modifiseer proteïene
6.2.5. peroxisome / peroksisome		e. a plant compartment that can hold reserves of organic compounds or inorganic ions / 'n plant kompartement wat reserwes van organiese verbindings of anorganiese ione kan huisves
6.2.6. Golgi Apparatus / Golgi Apparaat		f. non-membranous organelle / organel wat nie membraan-geslote is nie

- 6.3 Give an example of how components of the endomembrane system are directly related to each other by physical continuity. / Gee 'n voorbeeld van hoe komponente van die endomembraansisteem direk aanmekaar deur fisiese kontinuiteit verbind is. (1)

- 6.4. Describe the role of a lysosome during phagocytosis. / *Beskryf die rol van 'n lisosoom tydens fagositose.* (3)

.....

.....

.....

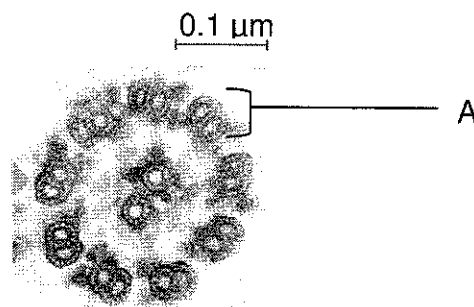
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QUESTION / VRAAG 7: [11]

- 7.1. Answer the following questions with regard to the cross-section of a flagellum below. / *Beantwoord die volgende vrae oor die onderstaande deursnee van 'n flagellum.*



- 7.1.1. Name the type of microscope used to produce the image. / *Noem die tipe mikroskoop wat gebruik was om hierdie beeld te verkry.* (1)

.....

- 7.1.2. Identify structure A. / *Identifiseer struktuur A.* (1)

.....

- 7.1.3. Name the motor protein that plays a role in the movement of flagella. / *Noem die motor proteïen wat 'n rol speel in die beweging van flagellums.* (1)

.....

- 7.1.5. Briefly explain how this motor protein causes a flagellum to bend. / *Verduidelik kortliks hoe hierdie motor proteïen die buiging van 'n flagellum veroorsaak.* (3)

.....

.....

.....

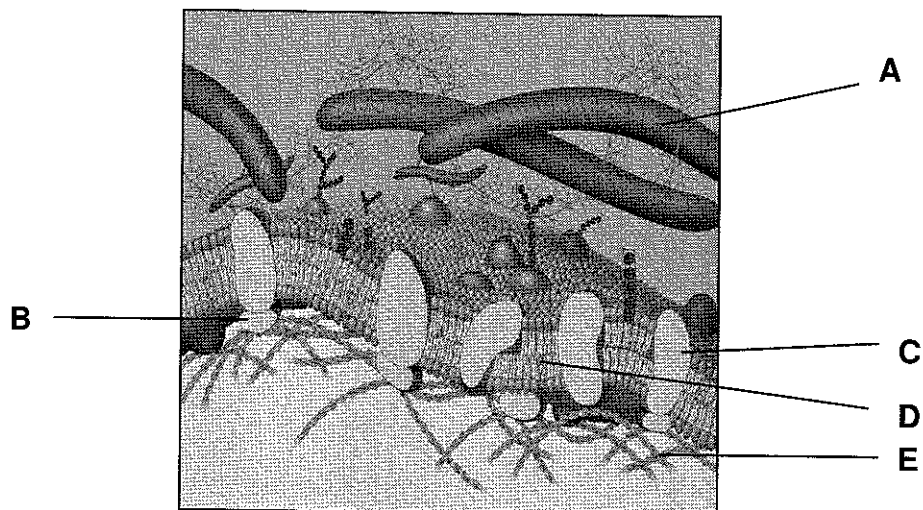
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7.1.4. How does the arrangement of the structures, as represented by A, differ in a centriole? /
Hoe verskil die rangskikking van die strukture, soos voorgestel deur A, in 'n sentriool?
 (2)

7.1.5. In which cellular process in animal cells do centrioles play an important role? / *In watter
 sellulêre proses in dierselle speel die sentriole 'n belangrike rol?*
 (1)

7.2. Why is the following description of intermediate filaments incorrect? (two reasons).
 Intermediate filaments consist of only tubulin proteins, are 8-12 nm in size, and play an
 active role in muscle contraction. /
Hoekom is die volgende beskrywing van intermediêre filamente foutief? (twee redes)
Intermediêre filamente bestaan net uit tubulien proteïene, is 8-12 nm groot, en speel 'n
aktiewe rol in spiersametrekking.
 (2)

QUESTION / VRAAG 8: [6]



- 8.1. Provide labels for each of the structures in the above illustration. / *Verskaf byskrifte vir elk van die strukture in die illustrasie hierbo.* (5)

A: D.

B: E.

C:

- 8.2. The carbohydrates attached to some of the proteins and lipids of the plasma membrane are added as the membrane is made and refined in the ER and Golgi Apparatus. The new membrane then forms transport vesicles that travel to the cell surface. On which side of the vesicle membrane are the carbohydrates? /

Die koolhidrate wat aan sommige proteïene en lipiede van die plasmamembraan vasgeheg is, word bygevoeg soos wat die membraan in die ER en Golgi Apparaat vervaardig en verfyn word. Die nuwe membraan vorm transport vesikels en beweeg na die seloppervlakte toe. Op watter kant van die vesikel membraan is die koolhidrate?

(1)

.....

QUESTION / VRAAG 9: [12]

- 9.1. A patient has had a serious accident and lost a lot of blood. In an attempt to replenish body fluids, distilled water equal to the volume of blood lost, is transferred directly into one of his veins. What will the most probable result of this transfusion on the red blood cells be? Explain your answer. /

'n Pasiënt was in 'n ernstige ongeluk en het baie bloed verloor. In 'n poging om sy liggaamsvloeistof aan te vul, is gedistilleerde water, gelyk aan die volume bloed verloor, direk in een van sy are oorgetap. Wat sal die mees waarskynlike uitwerking op die rooi bloedselle wees a.g.v. die oortapping? Verduidelik jou antwoord. (3)

.....

.....

.....

.....

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.....

.....

.....

.....

9.2. Indicate which statements are TRUE or FALSE and provide an explanation. / *Dui aan watter stellings REG of VERKEERD is en motiveer u antwoord.* (6)

9.2.1. In a phospholipid bilayer the fatty acid tails are hydrophilic. / *In 'n fosfolipied dubbellaag is die vetsuur sterte hidrofilies.*

.....

.....

9.2.2. Cholesterol enters the cell via pinocytosis. / *Cholesterol dring die sel binne via pinositose.*

.....

.....

9.2.3. Fluidity of a membrane increases as the percentage of unsaturated fatty acids in the phospholipids goes up. / *Vloeibaarheid van membrane neem toe soos wat die persentasie onversadigde vetsure in die fosfolipiede styg.*

.....

.....

9.2.4. Active transport moves substances down their concentration gradient and requires cellular energy. / *Aktiewe transport (vervoer) beweeg stowwe by hul konsentrasie gradiënt af en benodig sellulêre energie.*

.....

.....

9.2.5. A characteristic of the sodium-potassium pump is that 2 potassium ions are pumped into a cell against their gradient. / *'n Kenmerk van die natrium-kalium pomp is dat 2 kalium ione teen hul gradiënt tot binne die sel gepomp word.*

.....

.....

9.2.6. Plasmodesmata facilitate movement of certain substances between animal cells. / *Plasmodesmata fasiliteer beweging van sekere stowwe tussen dierselle.*

.....

.....

9.3. Complete the following: / *Voltooi die volgende:*

(3)

Aquaporins are examples of that greatly facilitate the movement of molecules through a membrane. This is an example of transport.

Akwaporiene is voorbeelde van wat die beweging van molekules deur 'n membraan grootliks fasiliteer. Hierdie is 'n voorbeeld van transport (vervoer).

QUESTION / VRAAG 10: [6]

10.1. Answer the following questions about the Calvin Cycle in photosynthesis. / *Beantwoord die volgende vrae oor die Calvinsiklus van fotosintese.* (6)

10.1.1. Name the acceptor molecule of CO₂. / *Gee die naam van die ontvanger molekule van CO₂.*

.....

10.1.2. Give the name of the enzyme that catalyses this reaction (12.1.1.). / *Gee die naam van die ensiem wat hierdie reaksie kataliseer (12.1.1.)*

.....

10.1.3. Where do these reactions take place specifically in a plant cell? Be very specific! / *Waar vind hierdie reaksies in die plantsel plaas? Wees baie spesifiek!*

.....

10.1.4. Give the name of the net product of the Calvin Cycle. / *Gee die naam van die netto produk van die Calvinsiklus.*

.....

10.1.5. Name the products of the light phase that are required by the Calvin Cycle. / *Noem die produkte vanaf die ligfase wat die Calvinsiklus benodig.*

.....

10.1.6. How many CO₂ molecules are required to produce one molecule of glucose during this cycle? / *Hoeveel CO₂ molekules word benodig om een molekule glukose tydens die siklus te vorm?*

.....

QUESTION / VRAAG 11:

[8]

- 11.1. Give the correct term for each of the following descriptions: / *Gee die korrekte term vir elk van die volgende beskrywings:* (5)

Description / <i>Beskrywing</i>	Term
11.1.1. A yellow to orange plant pigment that can be utilised during photosynthesis. / <i>'n Geel tot oranje pigment in plante wat tydens fotosintese gebruik kan word.</i>	
11.1.2. The colours of visible light that chlorophyll absorbs. / <i>Die kleure van sigbare lig wat deur chlorofil absorbeer word.</i>	
11.1.3. The formation of ATP that uses light as a source of energy. / <i>Die vorming van ATP wat lig gebruik as 'n bron van energie.</i>	
11.1.4. The location where the ATP synthase complexes are found. / <i>Die plek waar die ATP sintase komplekse gevind word.</i>	
11.1.5. The product of cyclic electron flow. / <i>Die produk van sikliese elektronvloei.</i>	

- 11.2. Photosystem I and II are utilized during photosynthesis. / *Fotosisteem I en II word tydens fotosintese gebruik.*

- 11.2.1. What is the function of the light-harvesting complex in each Photosystem? / *Wat is die funksie van die lig-insamelingskompleks in elke Fotosisteem?* (1)

.....

.....

- 11.2.2. How are the electrons that are lost from the reaction centre of Photosystem II replaced? / *Hoe word die elektrone wat deur die reaksiesentrum van Fotosisteem II verloor is, vervang?* (1)

.....

.....

- 11.2.3. Which photosystem(s) is/are used during non-cyclic electron flow? / *Watter fotosisteem(e) word tydens nie-sikliese elektronvloei gebruik?* (1)

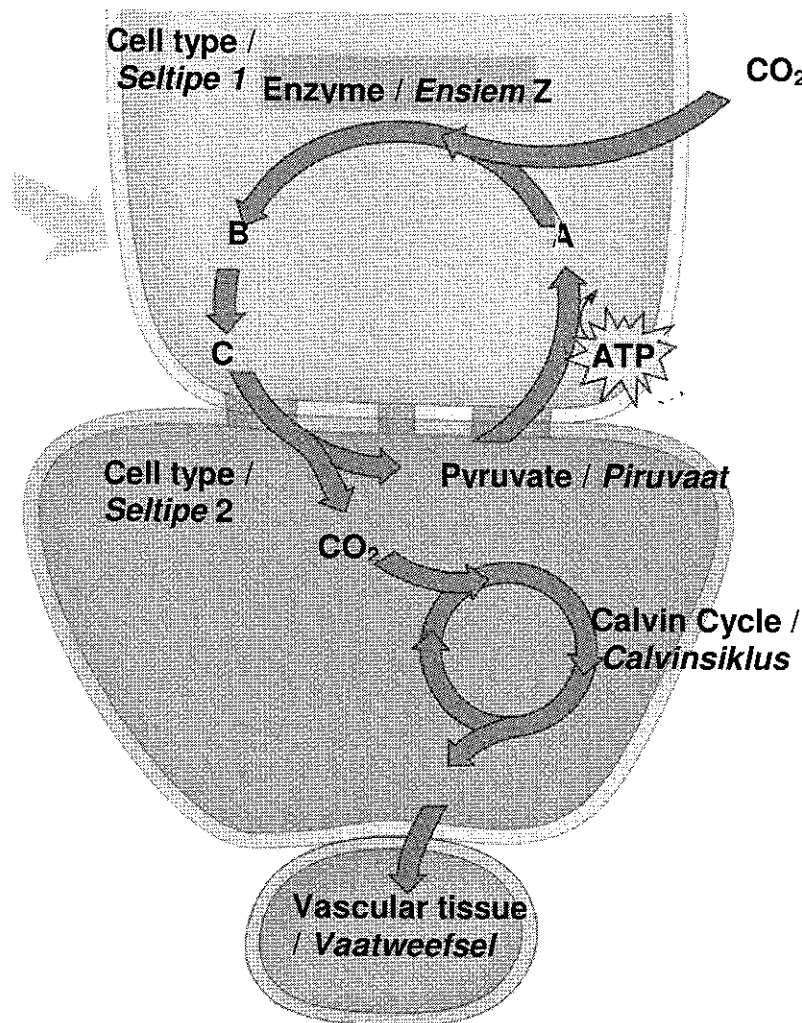
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QUESTION / VRAAG 12:

[6]

12.1. Answer the following questions about C_4 photosynthesis, as represented in the illustration below: / Beantwoord die volgende vrae oor C_4 fotosintese, soos in die onderstaande illustrasie voorgestel:



12.1.1. Give the name of enzyme Z. / Gee die naam van ensiem Z.

($\frac{1}{2}$)

.....

12.1.2. Give the name of the molecule that undergoes decarboxylation. / Gee die naam van die verbinding wat gedekarboksileer word.

($\frac{1}{2}$)

.....

12.1.3. How is the CO_2 concentration kept high in cell type 2? Your answer must refer to the special feature of these cells. / Hoe word die CO_2 konsentrasie hoog gehou in seltipe 2? Jou antwoord moet verwys na die spesiale eienskap van dié selle.

(1)

.....

.....

.....

- 12.2. CAM plants also utilize this alternative pathway of carbon fixation (in 12.1). What is the major difference between C_4 and CAM photosynthesis? / *CSM plante gebruik ook hierdie alternatiewe padweg van koolstof fiksering (in 12.1). Wat is die vernaamste verskil tussen C_4 en CSM fotosintese?* (1)

.....

.....

.....

.....

- 12.3. This alternative pathway of carbon fixation allows C_4 and CAM plants to survive in arid (dry) environments. / *Hierdie alternatiewe padweg van koolstof fiksering help C_4 en CAM plante om in droë omgewings te oorleef.*

- 12.3.1. Name the metabolic pathway that will usually occur in C_3 plants under these conditions. / *Noem die metaboliese padweg wat gewoonlik in C_3 plante sal plaasvind onder hierdie omstandighede.* (1)

.....

- 12.3.2. Why does this pathway reduce the efficiency of photosynthesis? / *Waarom word die effektiwiteit van fotosintese verlaag deur hierdie padweg?* (2)

.....

.....

.....

.....

.....

.....