WJEC A-LEVEL BIOLOGY

BIOLOGY



EXAM QUESTION PACK

UNIT BY4 OLD SPECIFICATION PAPERS

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Surname	Centre Number	Candidate Number
Other Names		2

GCE A level

1074/01

S16-1074-01

BIOLOGY – BY4

P.M. THURSDAY, 16 June 2016

1 hour 45 minutes

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Question	**Maximum Mark**	**Mark Awarded**
1.	**7**	
2.	**9**	
3.	**5**	
4.	**8**	
5.	**6**	
6.	**12**	
7.	**12**	
8.	**11**	
9.	**10**	
Total	**80**	

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ADDITIONAL MATERIALS

In addition to this examination paper you will need a ruler and a calculator.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.
Write your name, centre number and candidate number in the spaces at the top of this page.
Answer **all** questions.
Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.
You are reminded of the necessity for good English and orderly presentation in your answers.
The quality of written communication will affect the awarding of marks.

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Answer **all** *questions.*

1. *(a)* Gram-positive and Gram-negative bacterial cell walls have different structures. Explain how the structure of Gram-negative bacteria allows them to be resistant to certain antibiotics. [2]

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(b) Microorganisms require certain factors to be supplied in the culture medium to allow them to grow. These are molecules such as amino acids, purines and pyrimidines. State the functions of the following growth factors in microorganisms. [2]

Amino acids

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Purines and pyrimidines

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(c) It is not possible to culture viruses on sterile agar plates. Explain why. [1]

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(d) Describe how bacterial culture plates are safely disposed of. [2]

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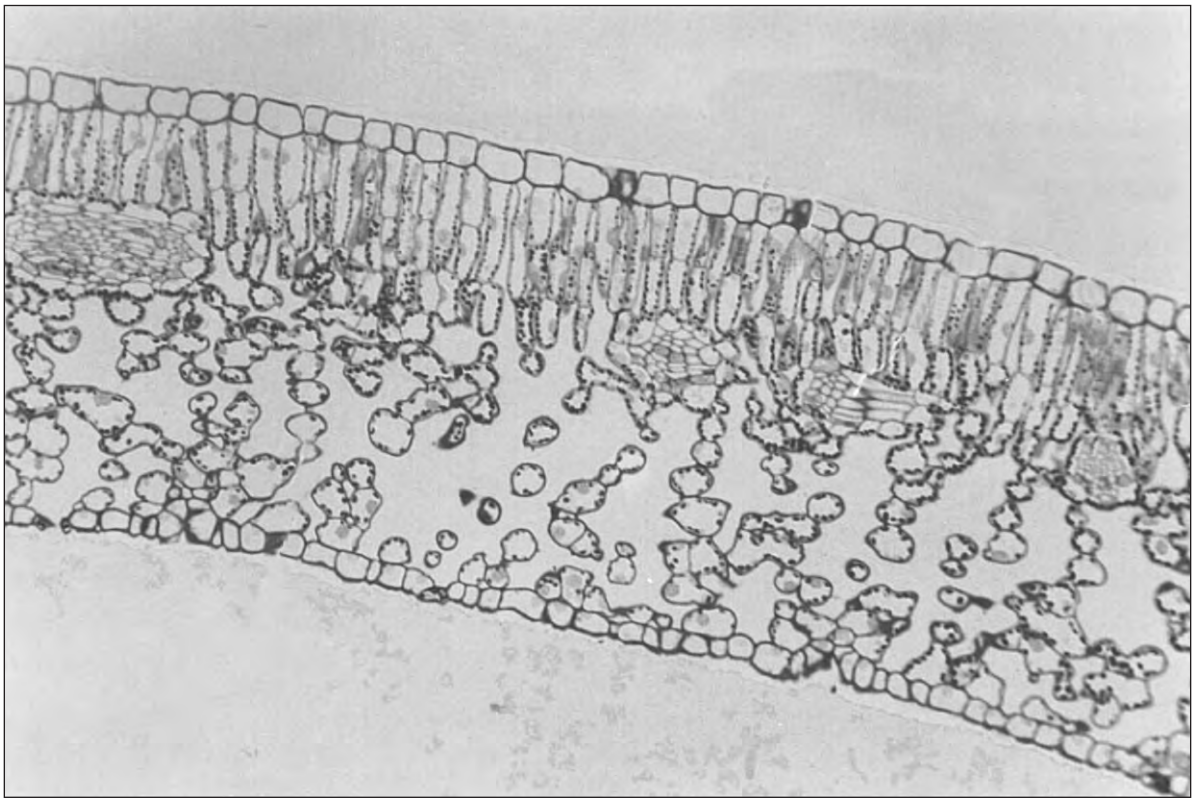
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2. Below is a leaf section as seen with a light microscope.



(a) **Indicate clearly with an arrow** on the photomicrograph above, the main site of photosynthesis. [1]

(b) Distinguish between an absorption spectrum and an action spectrum. [2]

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(c) In part of the Calvin cycle, the carbon in carbon dioxide is incorporated into triose phosphate. Briefly describe **this** sequence of reactions. [4]

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(d) How would you expect the pH of the thylakoid space of the chloroplast to differ from the stroma? Explain your answer. [2]

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3. The following table compares the abilities of kidneys of various mammals to concentrate urine.

Species	Max Urine Concentration / a.u.
beaver	520
pig	1100
kangaroo rat	5500

(a) (i) Describe how the structure of the kidneys in these species would differ, which would explain the trend of data shown. [1]

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(ii) What does this data suggest about the environments in which each of these mammals live? [3]

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The maximum urine concentration for sheep is shown below.

Species	Max Urine Concentration / a.u.
sheep	3500

(b) What does this suggest about the environment in which sheep have evolved? Explain your answer. [1]

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4. *Mycobacterium leprae* is a gram positive, intracellular, aerobic bacillus that causes leprosy (Hansen's disease) and has never been successfully cultured on an artificial cell culture medium. The main reason for this appears to be that it is an obligate parasite that lacks many of the genes necessary for independent survival.

One form of *M. leprae* invades and multiplies in Schwann cells. Loss of sensation develops as a result of invasion of the peripheral sensory nerves.

Use the text above to answer the following questions.

(a) How would these bacteria appear under the light microscope following Grams staining? [2]

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(b) Explain what is meant by the description *'intracellular aerobic'*. [2]

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(c) Explain why *M. leprae* is an *'obligate parasite'*. [1]

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(d) Suggest why there is a loss of sensation in the extremities in cases of leprosy. [3]

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5. Leaf feeding caterpillars may be controlled by *Bacillus thuringiensis* (Bt), a naturally occurring pathogen of insects.

- Bt acts by producing toxic proteins that react with the cells of the gut lining of susceptible insects. These toxic proteins paralyse the digestive system and the infected insect stops feeding within hours.
- Bt must be eaten to be effective and application coverage of the leaves must be thorough.
- If Bt is ingested by other species it is digested without producing toxic proteins.
- Bt persists on foliage for less than a week following application.

Use the text above to answer the following questions.

(a) (i) What type of insect control is described? [1]

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(ii) Explain the advantage of using Bt as described above. [2]

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(iii) Explain **two** disadvantages of using Bt as described above. [2]

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(b) The plum sawfly lays its egg in the embryonic plum fruit at flowering time and its larvae burrow through the young fruit as it develops. Suggest why Bt would be ineffective in this case. [1]

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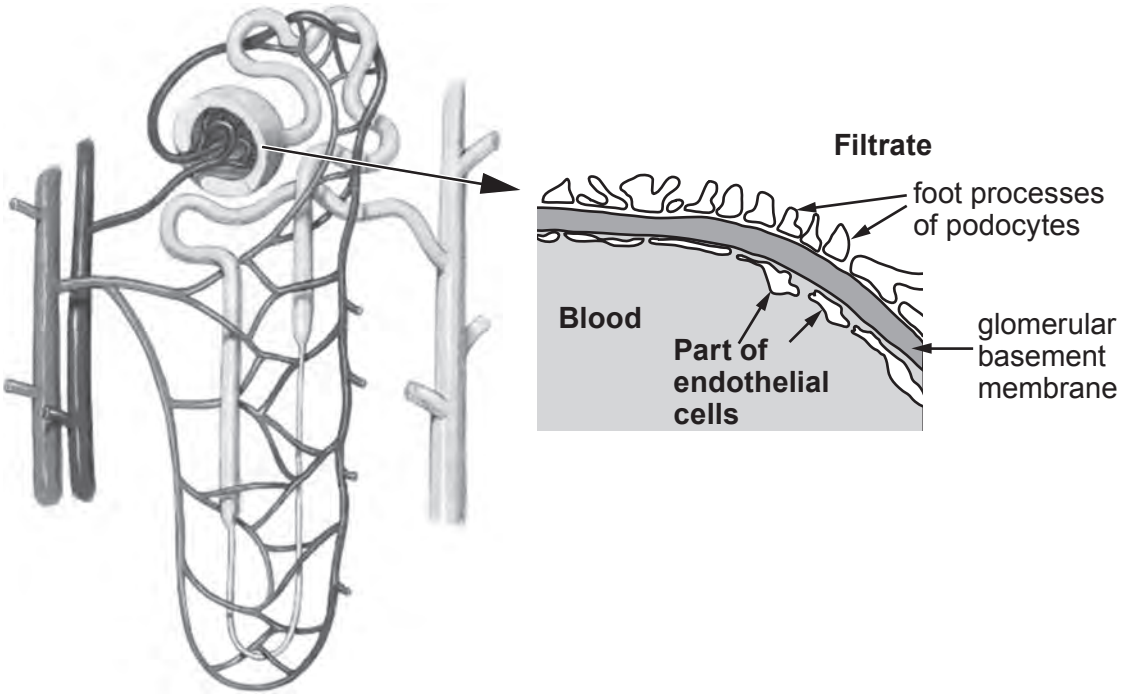
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6. *(a)* Glucose is not present in normal urine. A person with untreated diabetes produces large volumes of urine containing glucose. The diagram below shows a nephron with a section enlarged to show the site of ultrafiltration of the blood.



(i) Explain why large proteins are not usually found in the glomerular filtrate. [2]

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(ii) Glucose is filtered out of the blood, but is not found in urine. Explain why glucose is not present in urine. [2]

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(iii) If the blood glucose level is high, as may occur in a person with diabetes prior to diagnosis and treatment, glucose is present in the urine. Normally, water is reabsorbed from the collecting duct. Explain why a person with diabetes produces a larger volume of urine than a person that does not have diabetes. [3]

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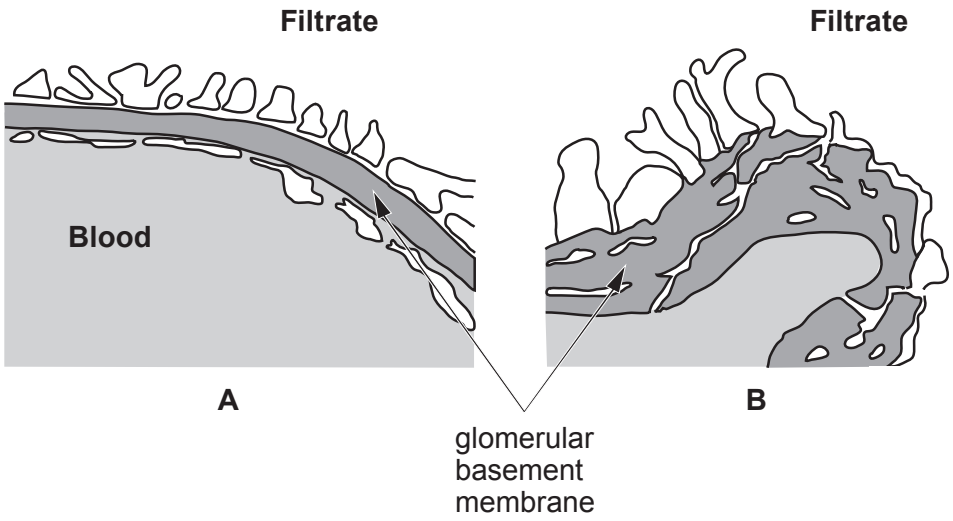
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(b) In Alport syndrome, the glomerular basement membrane is abnormal because it lacks a particular type of collagen. Picture **B** below shows a diagrammatic representation of the condition. Picture **A** shows a normal glomerular basement membrane.
Most people with Alport syndrome develop kidney failure in early adult life. In the early stages of the syndrome, symptoms may include blood and protein in the urine.



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(i) Briefly describe the biochemical structure of collagen. [2]

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(ii) Using your knowledge of ultrafiltration and the diagrams above, suggest how the symptoms of Alport syndrome are caused. [3]

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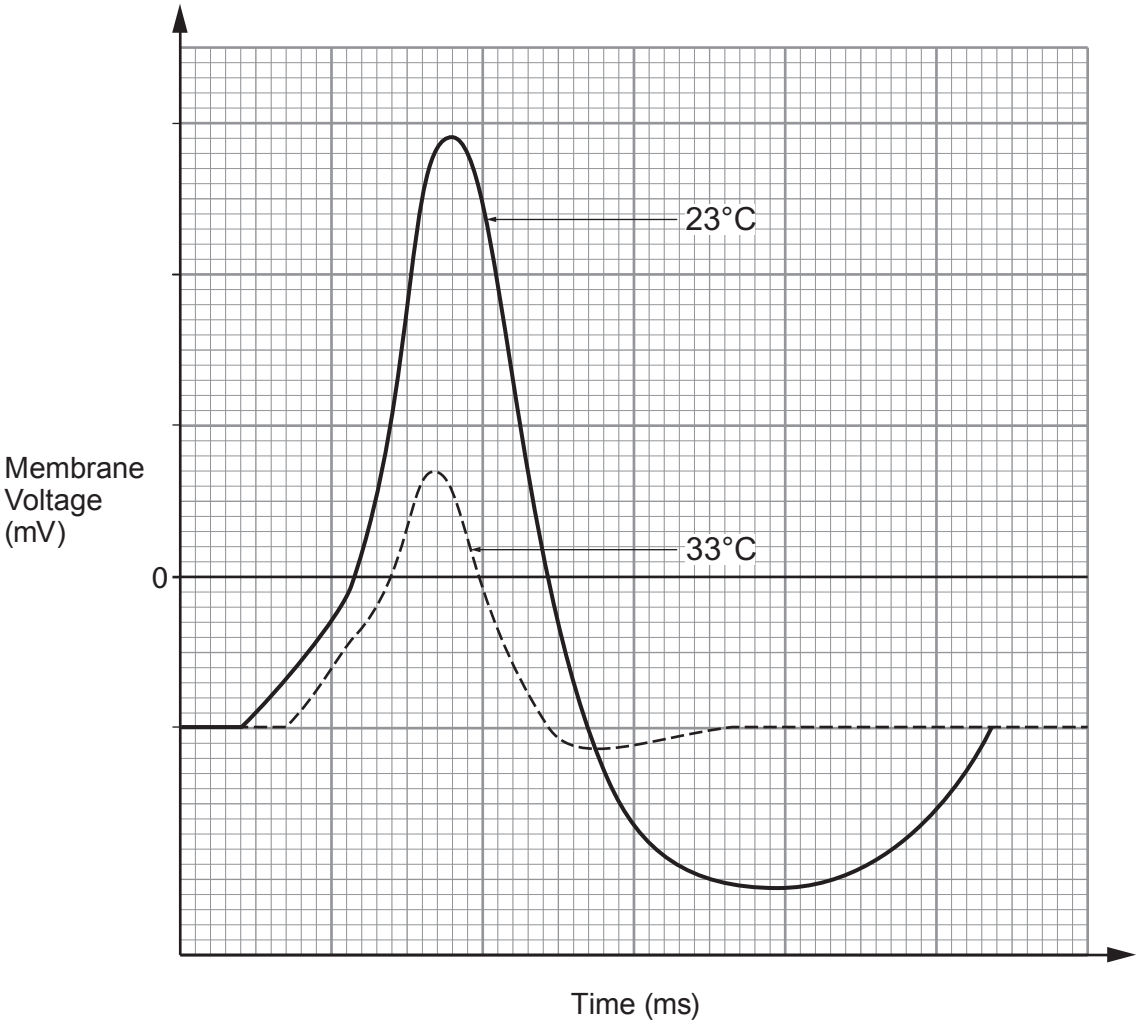
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7. Experiments were carried out to determine the effect of temperature on action potentials in mammalian ear cells. Results are shown below.



(a) Use the graph to describe **three** effects of an increase in temperature on the action potential. [3]

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(b) The scientists concluded that the opening and closing of potassium gated channels was temperature dependent. Suggest an explanation for the differences shown in the traces. [2]

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(c) Research has shown that the brains of people with Alzheimer's disease show a loss of function of nerve cells that use the neurotransmitter acetylcholine. The loss of function of these nerve cells is related to the severity of symptoms that people experience. There are no drug treatments available that can provide a cure for Alzheimer's disease. However, medicines have been developed that can reduce symptoms, or temporarily slow down their progression, in some people.

(i) Briefly describe how the normal functioning of the synapse causes depolarisation of the post synaptic membrane. [2]

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(ii) It has been noted that patients who are given acetylcholinesterase inhibitors have improved synapse function. Describe the action of acetylcholinesterase inhibitors and why they would result in improved synapse function. [2]

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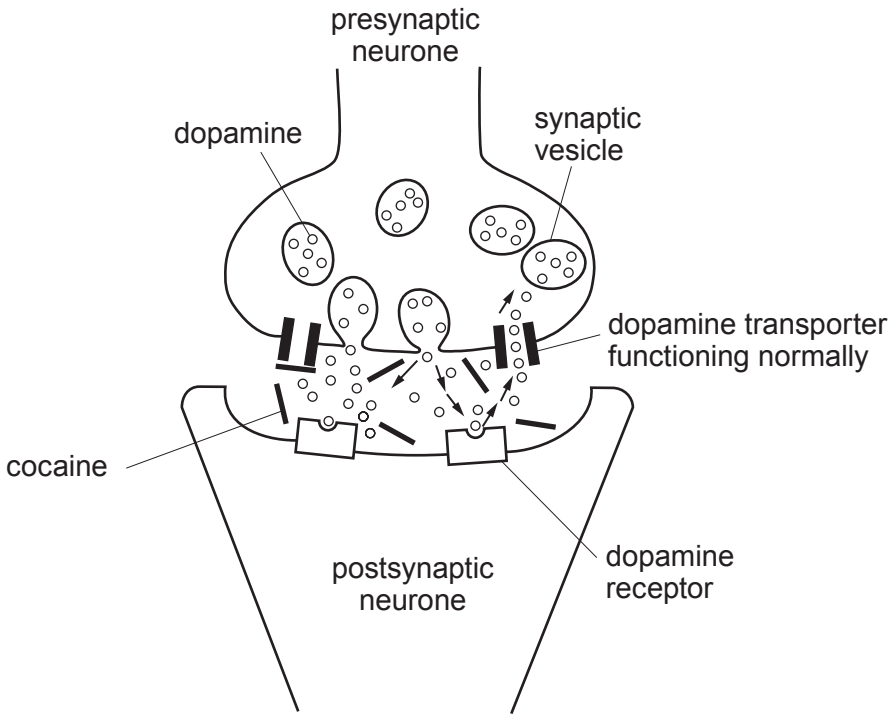
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(d) The diagram below shows the effect of cocaine on synapses where the neurotransmitter is dopamine.



Describe and explain the effect that cocaine has on the synapse. [3]

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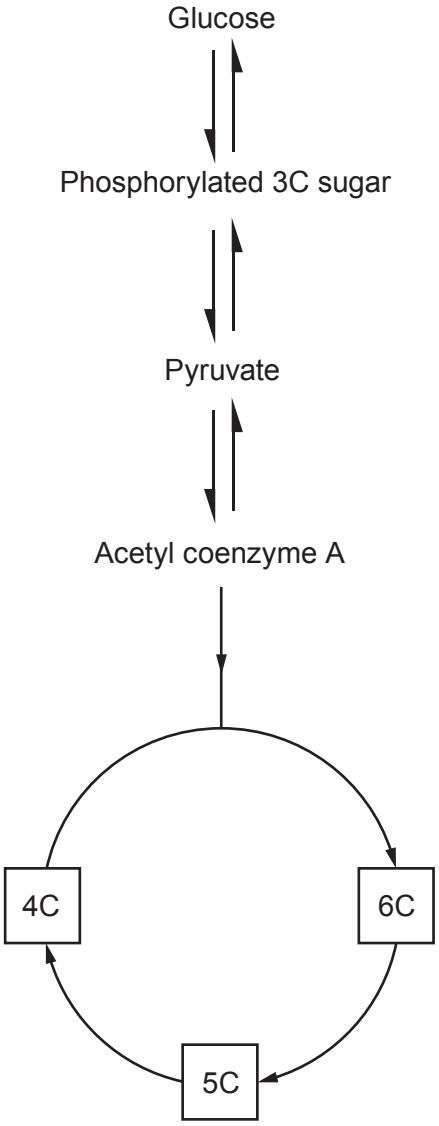
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8. The diagram below shows the stages of glycolysis and the Krebs cycle in respiration.



(a) Using **labelled** arrows indicate clearly where **amino acids** and the **products of the hydrolysis of triglycerides** (lipids) enter the respiratory pathway. [3]

(b) Describe the role of oxygen in aerobic respiration. [2]

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(c) A piece of apparatus called a respirometer can be used to measure the rates of oxygen uptake and carbon dioxide production. Using these results, a respiratory quotient (RQ) can be calculated.
The RQ is defined as the ratio of carbon dioxide produced to oxygen consumed per unit time by an organism.

$$RQ = \frac{\text{volume of } CO_2 \text{ produced}}{\text{volume of } O_2 \text{ consumed}} \text{ per unit time}$$

Table 1

Rate of oxygen consumption (cm^3 O_2 min^{-1})	Rate of carbon dioxide production (cm^3 CO_2 min^{-1})	RQ (Respiratory quotient)	Substrate being respired
2.55	2.21	0.87	
2.63	2.65	1.01	
2.23	1.55		

(i) **Calculate the missing value** in the RQ column **in the table above**. [1]

Different respiratory substrates give different RQ values as can be seen in the table below.

Table 2

Substrate	RQ
Glucose	1.0
Amino acid	0.9
Triglycerides	0.7

(ii) **Complete the substrate column** in **Table 1** using the above information. [1]

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(d) During a sprint an athlete's muscle cells may respire anaerobically to produce ATP.

(i) Name one other metabolic product of anaerobic respiration in muscle cells. [1]

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(ii) Where in a cell does anaerobic respiration occur? [1]

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(iii) Describe the importance of ATP to muscle cells. [1]

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(e) Suggest what would happen to the RQ value if you were investigating anaerobic respiration in yeast and explain your answer. [1]

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9. Answer **one** of the following questions.

Any diagrams included in your answer must be fully annotated.

Either, *(a)* Describe cyclic and non-cyclic photophosphorylation in photosynthesis. [10]

Or, *(b)* Describe the biological processes which occur in the nitrogen cycle and briefly explain how agricultural practices lead to increased soil fertility. [10]

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END OF PAPER

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GCE MARKING SCHEME

SUMMER 2016

BIOLOGY – BY4
1074/01

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Surname	Centre Number	Candidate Number
Other Names		2

GCE A level

1074/01

S15-1074-01

BIOLOGY – BY4

P.M. MONDAY, 8 June 2015

1 hour 45 minutes

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Question	**Maximum Mark**	**Mark Awarded**
1.	**4**	
2.	**8**	
3.	**11**	
4.	**12**	
5.	**12**	
6.	**14**	
7.	**9**	
8.	**10**	
Total	**80**	

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Answer **all** *questions.*

1. Complete the following table indicating whether the statement is true or false by placing a tick (✓) in the correct box. [4]

Statement	True	False
Motor neurones have only a single dendrite.		
Motor neurones have many axons.		
Dendrites receive and integrate impulses.		
Dendrites of motor neurones are rarely myelinated.		

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2. A denitrifying bioreactor is a trench in the ground packed with wood chips. It becomes colonised by soil bacteria that convert nitrate in drainage water to nitrogen gas. Woodchip bioreactors may be a cost-effective, farm-scale practice for nitrate removal from agricultural drainage. When placed strategically, these bioreactors can reduce nitrate levels flowing into streams and help meet environmental demands for the reduction of total nitrogen content in streams and rivers.

Read the passage above and answer the following questions.

(a) (i) What is the correct term for the process where nitrate is washed from the land in the drainage water? [1]

.....

(ii) Name **one** source of the nitrate on the farmland. [1]

.....

(b) Various soil bacteria can change ammonia or ammonium into nitrite, or nitrite into nitrate as part of the nitrogen cycle. Bacteria of the genus **X** are the primary converters of ammonium into nitrite and bacteria of the genus **Y** oxidise the nitrite to form nitrate.

Name the **two** genera **X** and **Y** in the paragraph above and explain why it is important for plants that ammonia is converted to nitrate. [4]

X ..... **Y** .....

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(c) The drainage of land is important for improving crop growth. Explain why farmers want to drain their land. [2]

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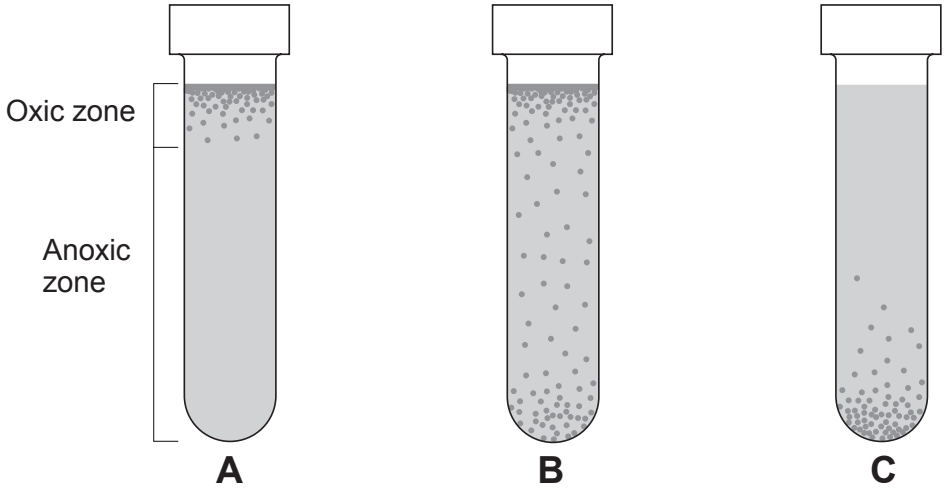
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3. The diagrams below show the results of a number of experiments investigating bacterial growth with different levels of oxygen.
Bacteria were mixed with agar in bacteriology tubes and the agar was allowed to set. The tubes were incubated for 24 hours at 37°C.



Each dot represents an individual bacterial colony within the agar or on its surface. The surface which is directly exposed to atmospheric oxygen contains oxygen (oxic zone). The oxygen content of the agar decreases with depth until it does not contain oxygen (anoxic zone) towards the bottom of the tube.

(a) Using the results above, what terms are given to the types of bacteria which grow in tubes **A**, **B** and **C**? [2]

A .....

B .....

C .....

(b) Some bacteria will not grow at all in the presence of oxygen. These bacteria cannot generate ATP through aerobic respiration. Using your knowledge of respiratory pathways describe how they are able to produce ATP in the absence of oxygen. [4]

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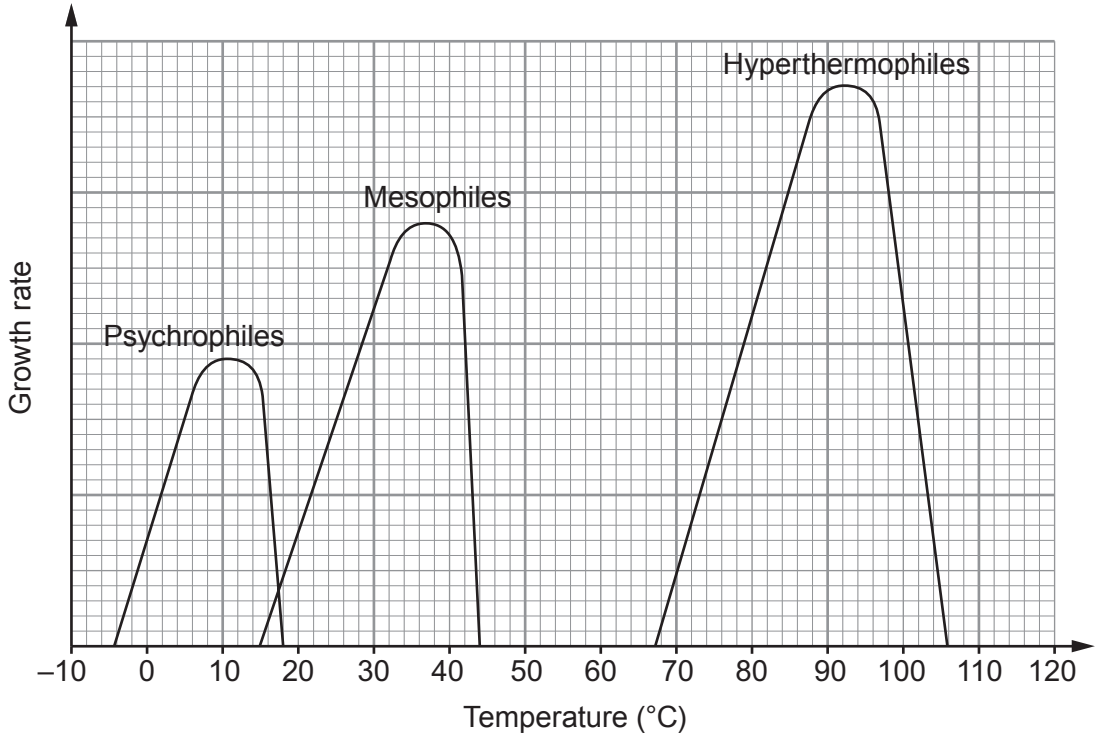
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(c) Microorganisms can be grouped based on the temperatures in which they actively grow, as shown below.



(i) Using the graphs, state the optimum temperature for each group and suggest an environment where they can actively grow. [3]

	Optimum temperature (°C)	Environment
psychrophiles		
mesophiles		
hyperthermophiles		

(ii) Using your knowledge of cell biology, suggest **two** biological problems which psychrophiles must overcome in order to carry out cellular processes. [2]

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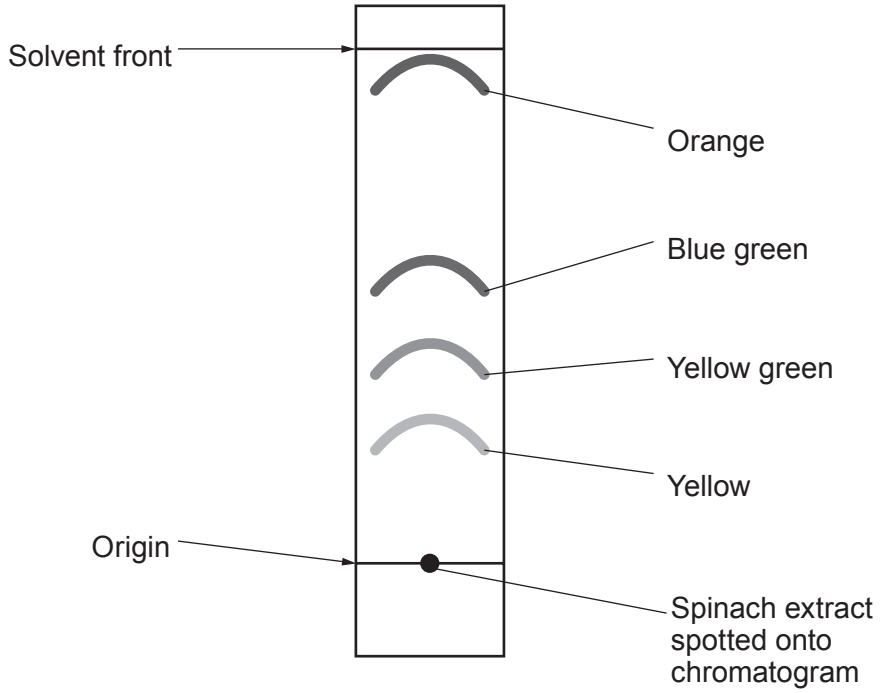
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4. A student carried out a practical to separate the pigments in spinach leaves and the results are shown in the diagram below.



(a) The blue-green pigment is chlorophyll *a*.
State precisely where chlorophyll *a* is found in a photosynthetic cell. [2]

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(b) The Rf value of the pigments can be calculated using the following formula.

$$\textbf{Rf} = \frac{\text{distance moved by pigment from origin}}{\text{distance moved by solvent front from origin}}$$

Calculate the Rf value of the yellow band and use the following table of Rf values to identify it. Show your working. [3]

Rf value = ...

Pigment	Rf value
xanthophyll	0.28
chlorophyll *b*	0.42
chlorophyll *a*	0.59
carotene	0.98

Identity of yellow band .....

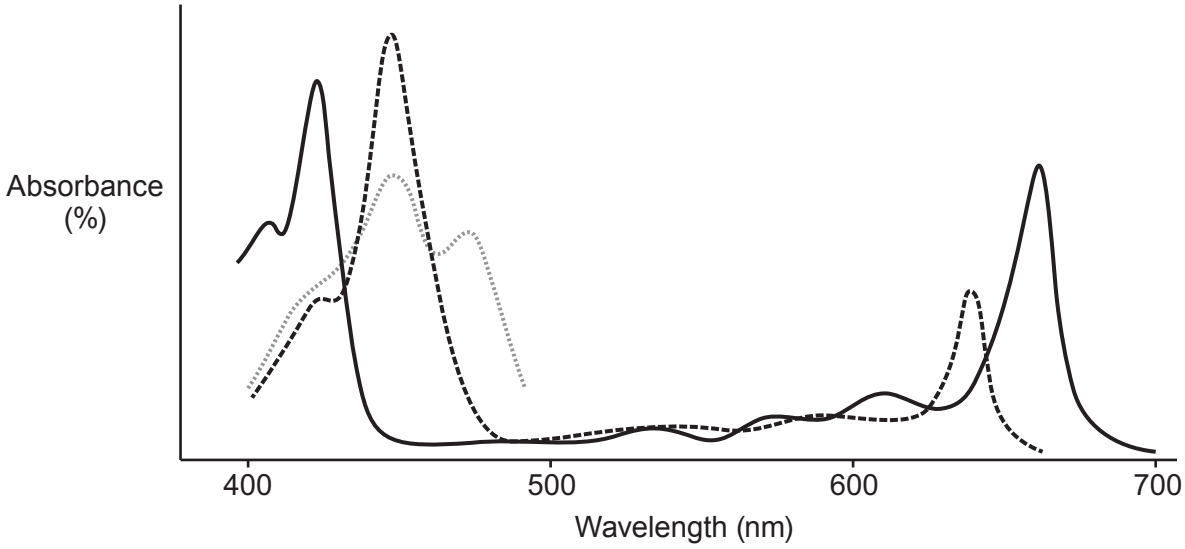
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(c) Some of the pigments were extracted from the chromatogram separately. The percentage of light absorbed at wavelengths from 400 to 700 nm by each of them was measured and a chart produced.



(i) Name this type of chart. [1]

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(ii) Explain the results in the 500 to 600 nm range. [1]

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(iii) Explain the advantage to plants of having more than one pigment in their leaves. [2]

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(d) Use your knowledge of photosynthesis to explain the role of these pigments in the production of ATP. [3]

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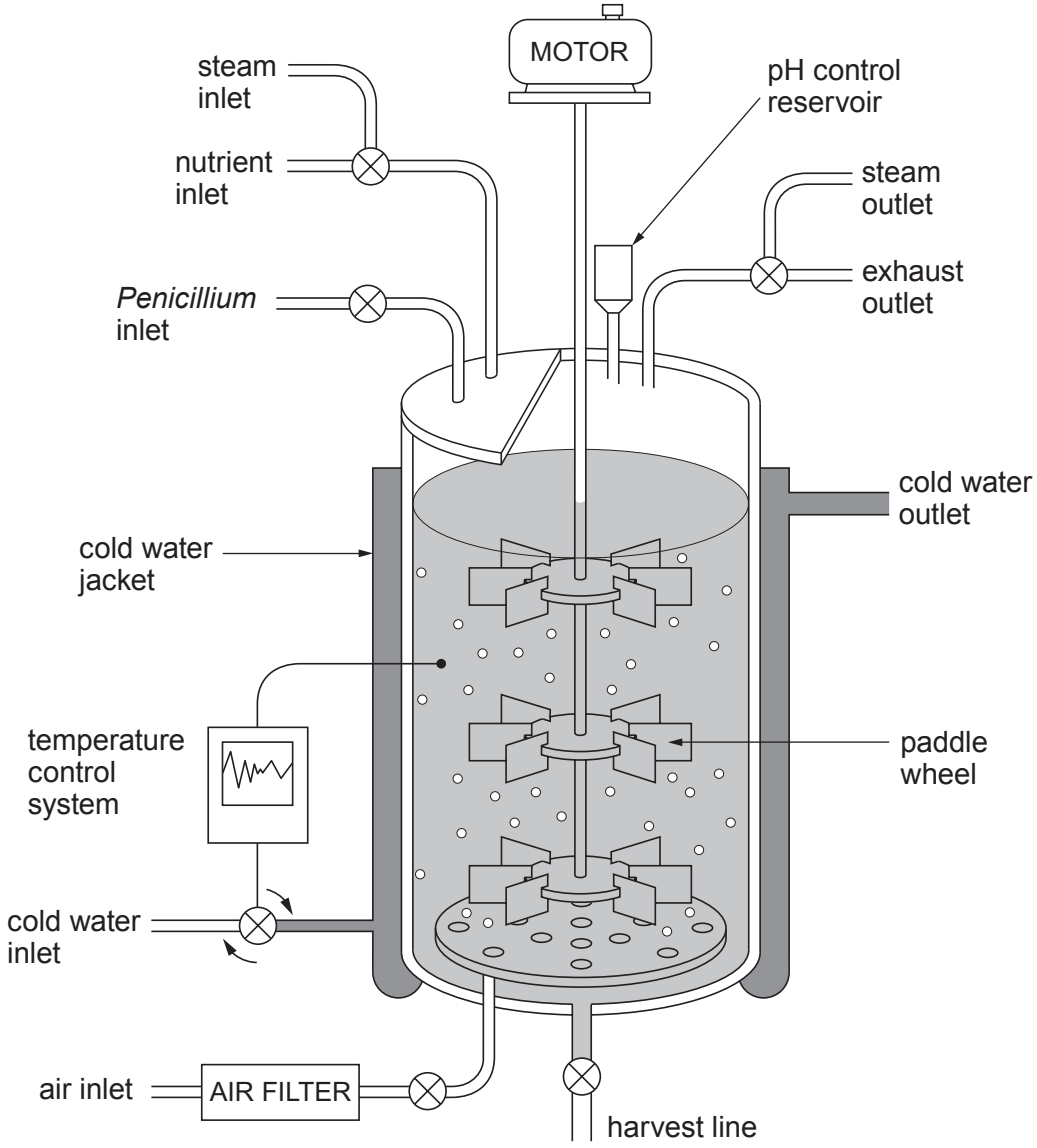
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5. The diagram below shows a type of batch fermenter used to produce penicillin.



(a) (i) Apart from helping with the mixing, explain why sterile air is pumped into the fermenter. [2]

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(ii) The fungus that produces penicillin requires a supply of carbon and nitrogen. In what form might these elements be supplied to the fungus? [2]

Carbon source .....

Nitrogen source .....

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(iii) How would the pH be controlled? [1]

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(iv) What is the purpose of the *temperature control system*? [2]

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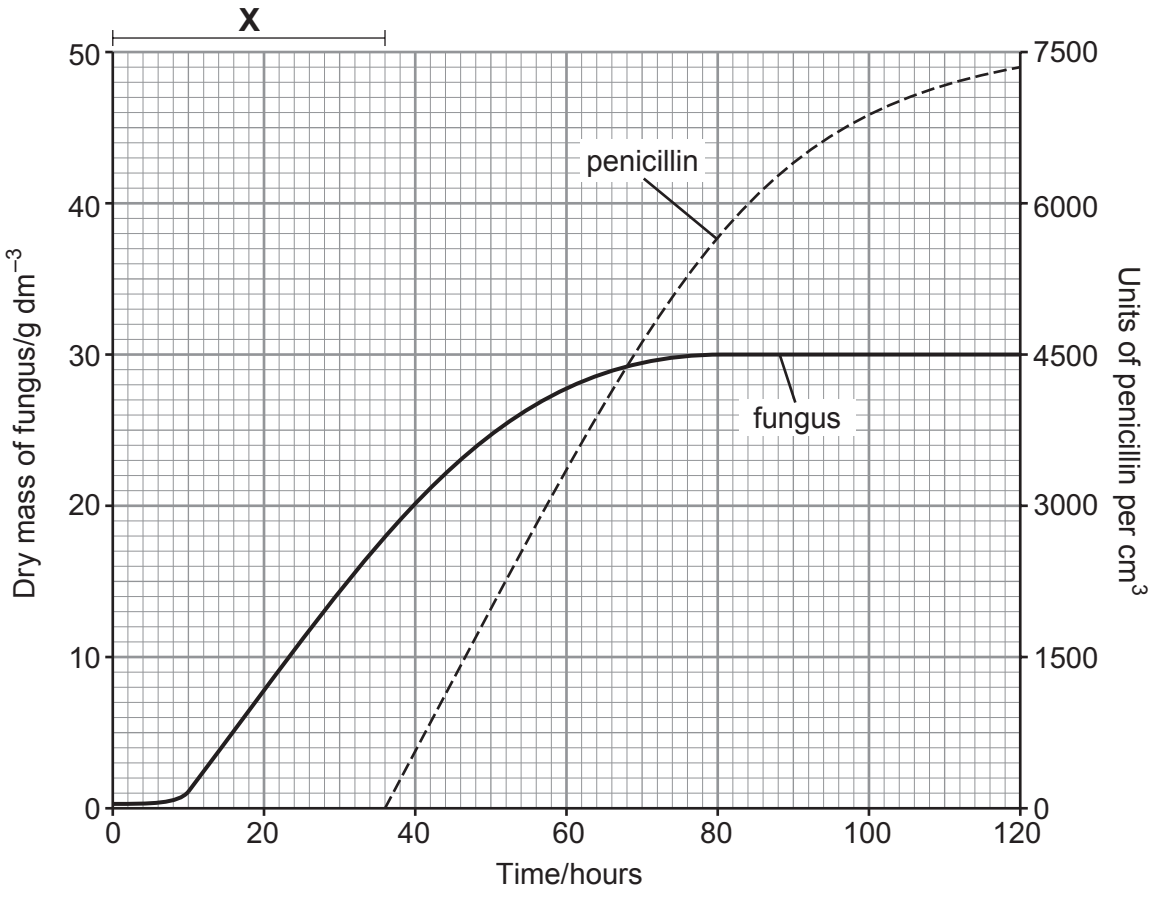
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(b) Below is a graph showing the production of penicillin and the growth of the fungus, *Penicillium*, in the fermenter shown on page 10.



(i) Using the graph, state the time that *Penicillium* enters the stationary phase. [1]

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(ii) Why is there a high level of protein synthesis in the first ten hours of the *Penicillium* culture? [1]

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(iii) Explain why no penicillin is produced during time period **X**. [3]

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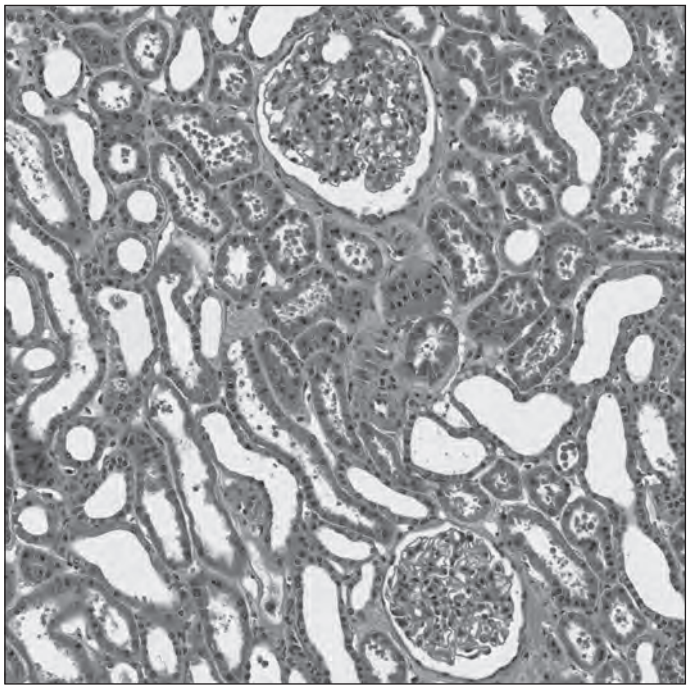
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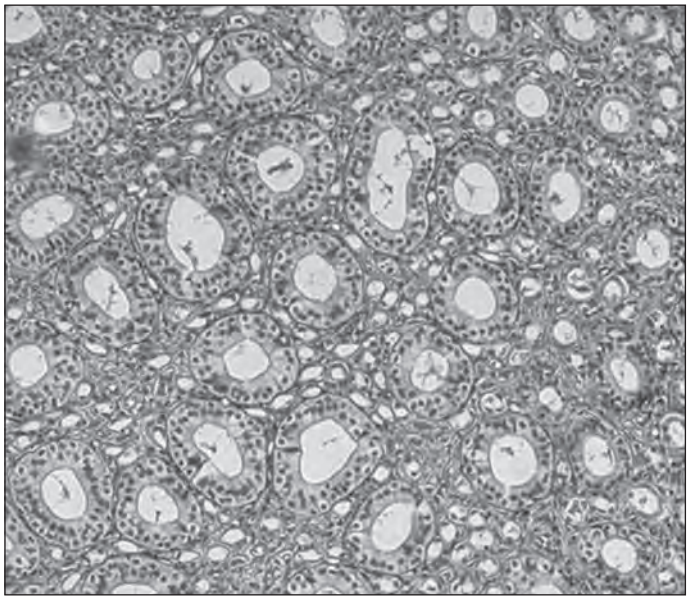
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6. The two sections below were taken from different regions of a kidney.

A



B



(a) Identify the regions from which these two sections were taken, giving a reason for each answer. [2]

	Region of kidney	Reason
A		
B		

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(b) Explain how the nephron and its blood supply is adapted for **ultrafiltration**. [5]

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(c) Patients with severe kidney disease may be told to follow a protein controlled diet with low sodium chloride (salt) intake. Using your knowledge of the role of the kidney, suggest why this diet is recommended. [3]

Protein controlled diet

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Low sodium chloride (salt) intake

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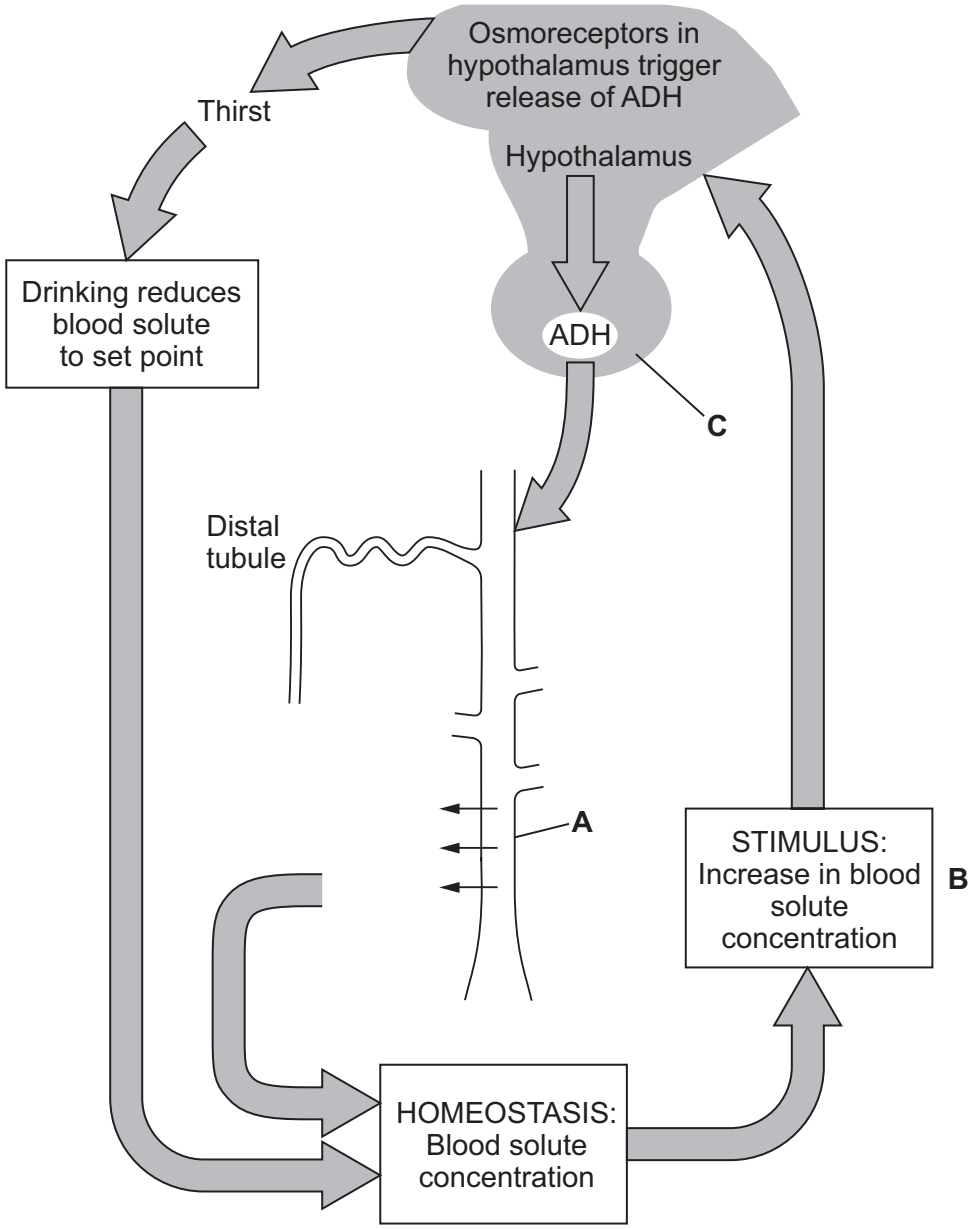
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(d) The following diagram shows the feedback mechanisms involved in controlling blood solute concentration.



(i) Name structures **A** and **C** on the diagram above. [2]

A .....

C .....

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(ii) Give **two** examples of what might cause a rise in blood solute concentration as shown in box **B**. [1]

I .....

II .....

(iii) From your knowledge of the kidney, what would be the result of higher levels of ADH at **A**? [1]

.....

.....

.....

.....

14

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7. Acetyl cholinesterase is one of many enzymes needed for the functioning of the nervous systems of vertebrates and insects. Certain chemical classes of pesticides, such as organophosphates, work against pests by inhibiting cholinesterase. While the effects of cholinesterase-inhibiting products are intended for insect pests, these chemicals can also be toxic to humans.
In severe cases of exposure to organophosphates, symptoms include uncontrollable muscular tremors, breathing difficulty and possible death.

(a) Explain the toxic effects of the organophosphates. [5]

(b) Psychoactive drugs can affect synaptic transmission in a number of different ways. Suggest some different mechanisms by which psychoactive drugs could decrease the rate of synaptic transmission. [4]

9

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8. Answer **one** of the following questions.

Any diagrams included in your answer must be fully annotated.

Either, *(a)* Describe the role of the electron transport chain in the synthesis of ATP. (Details of glycolysis, link reaction and Krebs cycle are not required.)
Explain the importance of ATP in living organisms. [10]

Or, *(b)* Describe the processes of glycolysis and the link reaction. [10]

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GCE MARKING SCHEME

BIOLOGY/HUMAN BIOLOGY
AS/Advanced

SUMMER 2015

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Surname	Centre Number	Candidate Number
Other Names		2

GCE A level

1074/01

BIOLOGY – BY4

P.M. FRIDAY, 13 June 2014

1 hour 45 minutes

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**6**	
2.	**7**	
3.	**14**	
4.	**14**	
5.	**13**	
6.	**16**	
7.	**10**	
Total	**80**	

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INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.
Write your name, centre number and candidate number in the spaces at the top of this page.
Answer **all** questions.
Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.
You are reminded of the necessity for good English and orderly presentation in your answers.
The quality of written communication will affect the awarding of marks.

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Answer **all** *questions.*

1. **Nitrogenases** are enzymes used by some organisms to fix atmospheric nitrogen gas (N_2) into a form of nitrogen available to plants.

The **nif gene** is the gene coding for the synthesis of nitrogenases, found in nitrogen fixing bacteria.

Rhizobium is a mutualistic nitrogen fixing bacteria forming a relationship with legume species. In some species of *Rhizobium*, the nif genes are located on plasmids.

(a) Name the *form* of nitrogen produced by *Rhizobium* that is *'available to plants'*. [1]

.....

(b) Name *another* genus of nitrogen fixing bacteria. [1]

.....

(c) State *precisely* where *Rhizobium* would be found in the legume. [1]

.....

(d) Suggest how the relationship between *Rhizobium* and a legume species is beneficial to **both** organisms. [2]

.....

.....

.....

.....

(e) What are *plasmids*? [1]

.....

6

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2. *(a)* Define the following terms with reference to bacterial growth. [3]

(i) obligate aerobe

.....

.....

(ii) obligate anaerobe

.....

.....

(iii) facultative anaerobe

.....

.....

(b) Describe and explain the appearance of Gram positive and Gram negative bacteria following Gram staining. [3]

.....

.....

.....

.....

(c) Most pathogens in humans are Gram-positive organisms. Six Gram-positive genera are typically pathogenic in humans. Two of these, *Streptococcus* and *Staphylococcus*, are cocci. The remaining organisms are bacilli.

What **three dimensional shape** would the cocci and bacilli be? [1]

cocci .....

bacilli .....

7

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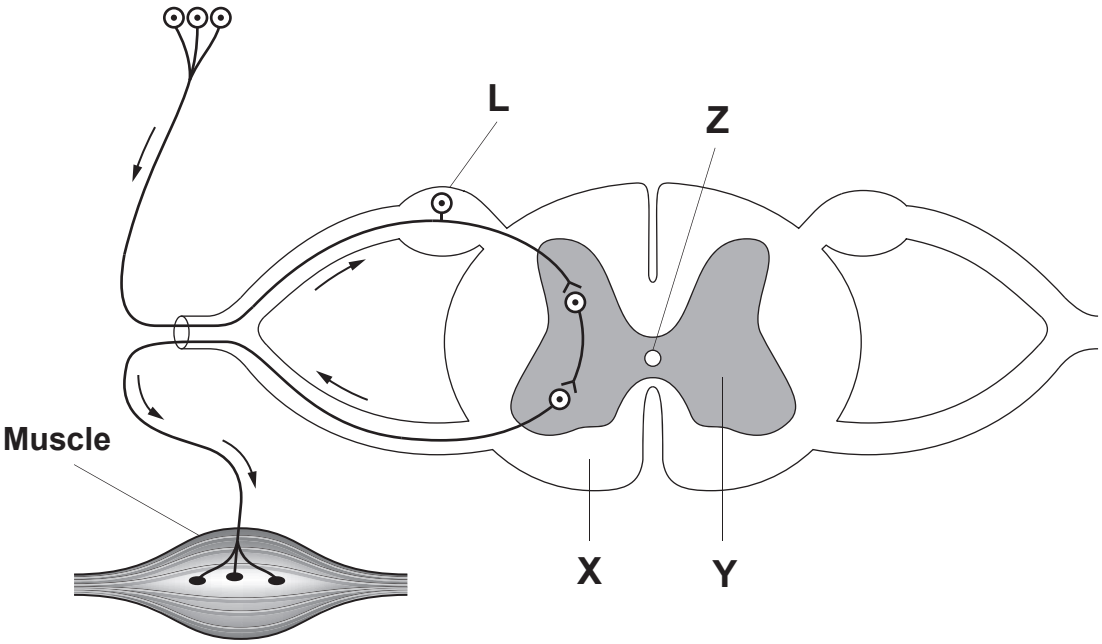
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3. The diagram below shows a transverse section of spinal cord and an associated reflex arc.



(a) (i) Identify **X** and **Y** shown on the diagram above and explain why there is a difference in colour in these two areas. [2]

X .....

Y .....

Explanation

.....

.....

(ii) Identify **L** and **Z** shown on the diagram above. [2]

L .....

Z .....

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(b) (i) What is the name given to: [2]

I the cells which partially cover neurons

.....

II the material which the cells produce to cover the axon

.....

(ii) What is the function of this material in the conduction of an action potential? [2]

.....

.....

.....

.....

(iii) Multiple sclerosis is a progressive, degenerative disease of the nervous system in which the material referred to in *(b)*(i) is destroyed. Symptoms include increasing muscle weakness and loss of vision. Suggest an explanation for these symptoms. [2]

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(iv) Suggest a possible medical treatment for multiple sclerosis. [1]

.....

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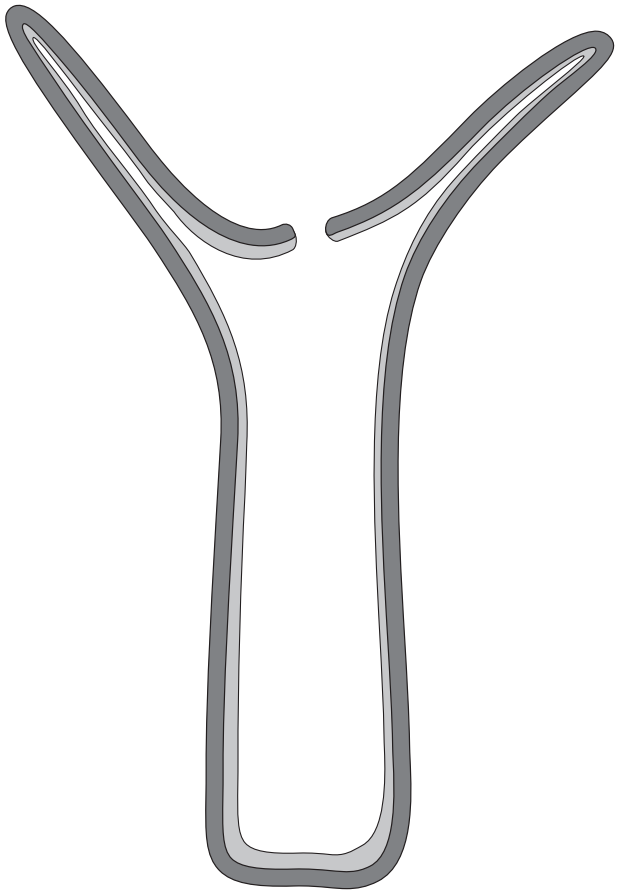
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(c) Nerve nets are common in some animal groups.

(i) Complete the diagram below to show a nerve net as would be seen in *Hydra*. [1]



(ii) Give **two** ways in which the nerve net, as seen in *Hydra*, differs from that of the nervous system of a vertebrate. [2]

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14

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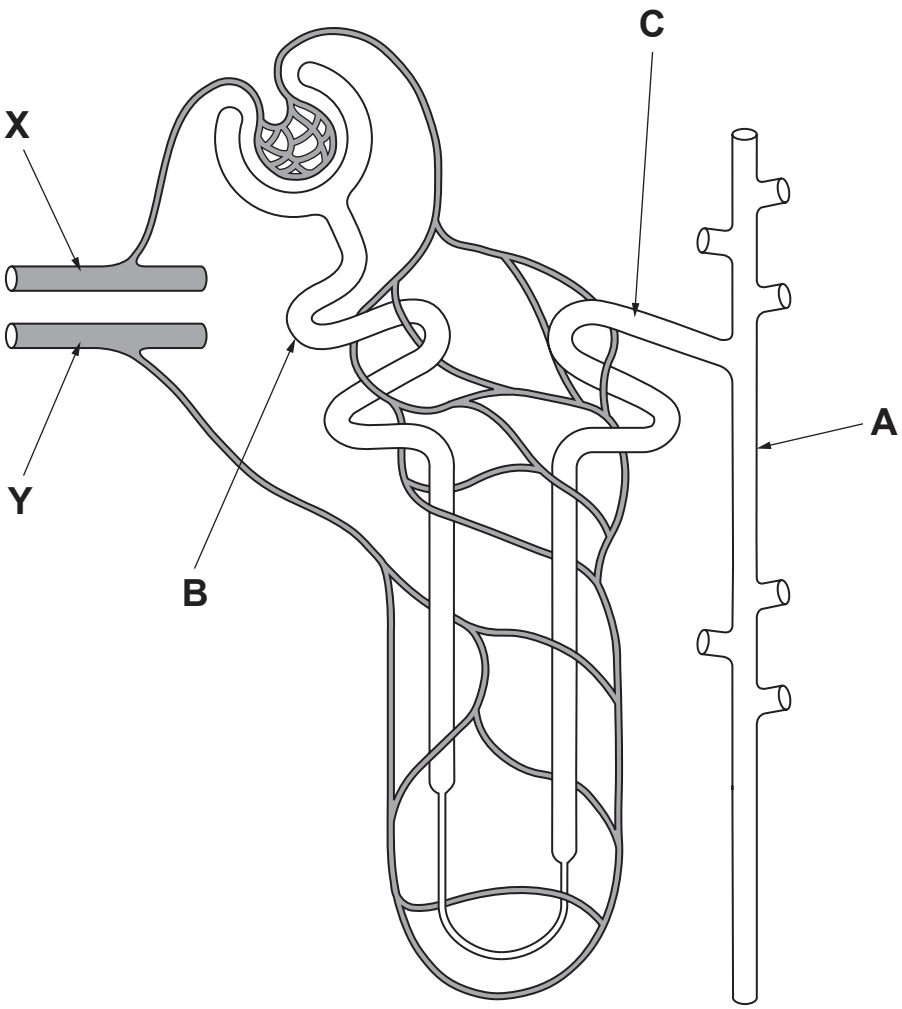
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4. The diagram below shows a single nephron, with its blood supply, from a kidney.



(a) (i) Name **A**, **B** and **C** shown on the diagram above. [3]

A .....

B .....

C .....

(ii) Use **two** arrows, clearly labelled, on the nephron above, to show where the following processes take place: [2]

I ultrafiltration;

II selective reabsorption.

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(b) Name the blood vessels supplying the kidney which would connect at points **X** and **Y** shown on the diagram opposite. [1]

X .....

Y .....

(c) Explain the function of the Loop of Henle in osmoregulation. [4]

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(d) Describe how hormonal control affects the final concentration and volume of urine produced when someone is dehydrated. [4]

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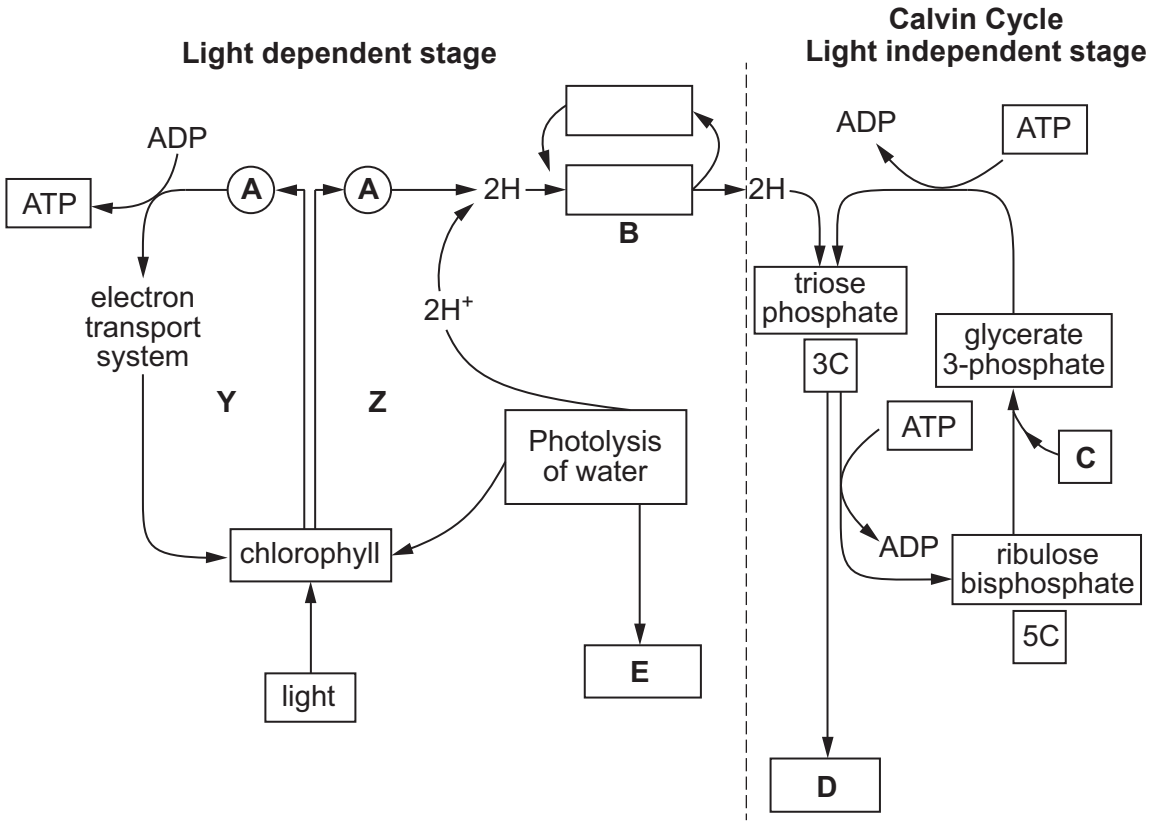
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5. The diagram below shows the events involved in photosynthesis.



(a) (i) Name stages **Y** and **Z** in the light dependent stage. [1]

Y .....

Z .....

(ii) What is represented by circles **A**? [1]

.....

(iii) Complete the boxes above to show the reactions occurring at point **B**. [1]

(iv) What is being produced at **E**? [1]

.....

(v) Name the molecule entering at **C**. [1]

.....

(vi) What compound is produced at **D**? [1]

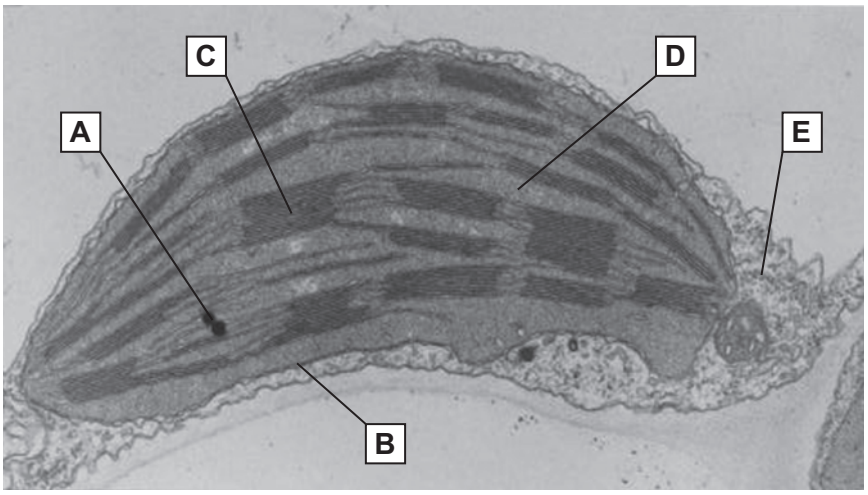
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(b) The photomicrograph below is of a chloroplast.



Using the letters on the photomicrograph, complete the following table. [4]

Area	Letter	Name of region
Where the light dependent stage occurs		
Where the light independent stage occurs		

(c) Plants take up minerals from the soil. These are combined with the products of the light independent stage to produce other molecules needed by the plant.

Give **three** examples of minerals taken up from the soil and state what molecules are produced when each example combines with the products of the light independent stage. [3]

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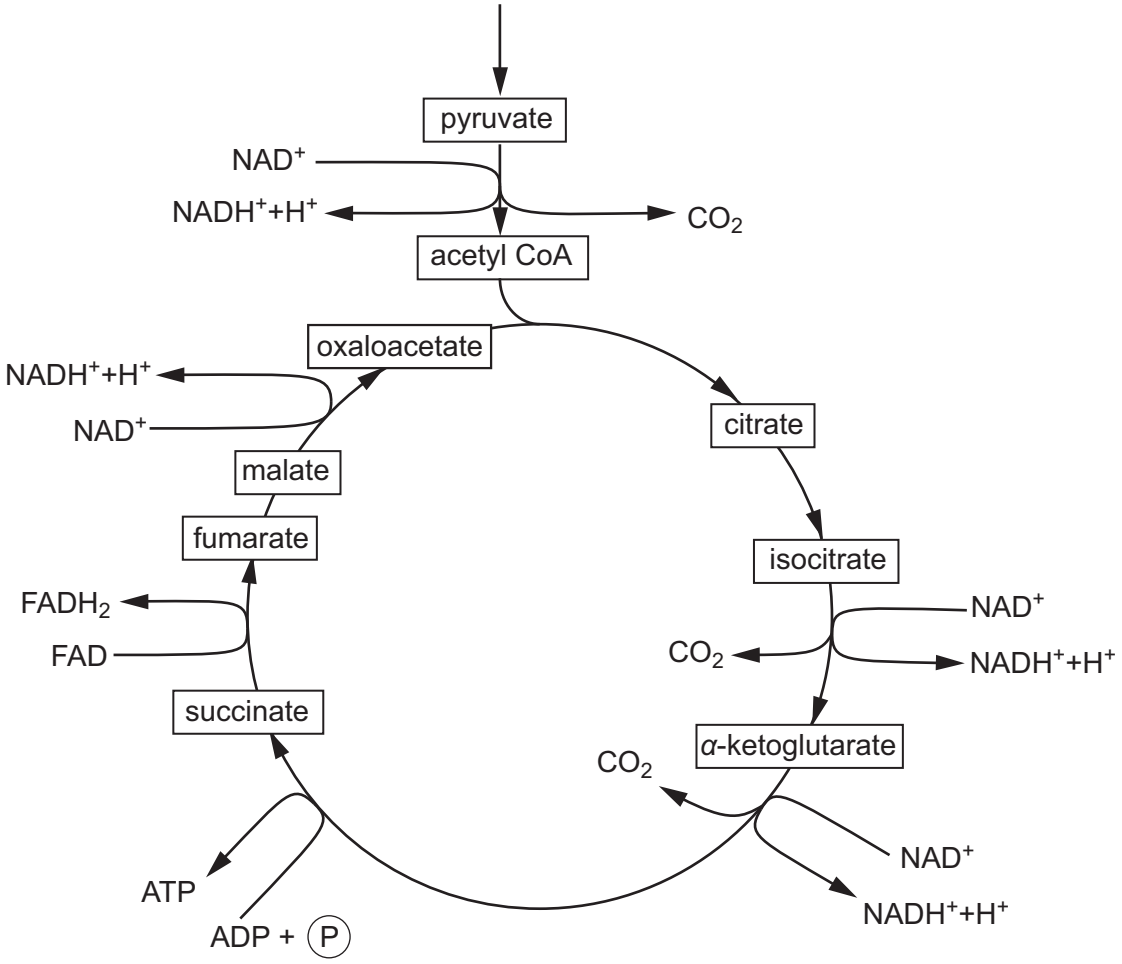
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6. The detailed diagram below shows the link reaction and Krebs cycle. Most of the intermediates involved are named.



(a) (i) Using the diagram above, and your own knowledge, determine how many carbons there are in the following Krebs cycle intermediates. [1]

citrate .....

α-ketoglutarate .....

succinate .....

(ii) Explain precisely how you have arrived at these figures. [2]

.....

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(b) Briefly describe how reduced FAD and reduced NAD are used to create an electrochemical gradient. [4]

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In patients with a suspected mitochondrial disorder a minimally invasive tissue biopsy provides the best opportunity to examine mitochondrial function, freezing the sample immediately after collection.
In addition to activity measurements of individual enzymes, analysis of mitochondrial respiration and ATP production rates are performed. This includes the measurement of mitochondrial oxygen consumption in the presence of different substrates, such as pyruvate and α-ketoglutarate. Analysis may show increased levels of a Krebs cycle intermediate, such as malate and succinate.
Defects in mitochondrial ATP synthesis may lead to high lactate levels in blood.
J Inherit Metab Dis. 2011 April; 34(2): 283–292.

(c) Name the **two** enzyme **types** involved in the conversion of pyruvate to acetyl CoA. [2]

.....

.....

Using the diagram opposite, the text above and your own knowledge, answer the following questions.

(d) Suggest a suitable tissue to examine mitochondrial function and explain why you have chosen this tissue with respect to patient safety. [2]

.....

.....

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(e) What could be deduced if the oxygen consumption was low with the pyruvate as a substrate but high with α-ketoglutarate as a substrate? [2]

.....

.....

.....

.....

(f) What could be deduced if there was a build up of any one of the Krebs cycle intermediates? [1]

.....

.....

(g) Explain why there is a raised blood lactate level in many patients with mitochondrial disease. [2]

.....

.....

16

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7. Answer **one** of the following questions.

Any diagrams included in your answer must be fully annotated.

Either, *(a)* Explain the role of photosynthetic pigments in a green plant and how the use of chromatography allows these pigments to be separated and identified. [10]

Or *(b)* Using **suitable examples throughout**, describe the way in which populations grow and the factors affecting population growth. [10]

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Question		Marking details	Marks Available
1	(a)	{Ammonium/ammonia} **ions/** NH_4^+;	1
	(b)	*Azotobacter;*	1
	(c)	Root nodules;	1
	(d)	1. *(Rhizobium* synthesises) {nitrogen containing compounds/or eg} {which pass to plant/ which plant can use}/ allows legumes to grow in low fertility soil; NOT fixes nitrogen 2. (Plant synthesises) {carbohydrates/organic acids} which pass to the *Rhizobium/ {*Plant/ leghaemoglobin} provides anaerobic conditions for the bacteria; NOT Plant provides protection for the bacteria/ nutrients passing to bacteria	2
	(e)	{Small/additional} rings of DNA (which occur in addition to the chromosomal DNA);	1
		Question 1 total	**[6]**

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Question			Marking details		Marks Available
2	(a)	(i)	Obligate aerobe	{microorganisms/bacteria} that {grow/divide/ metabolise} in the presence of <u>oxygen</u>;	1
		(ii)	Obligate anaerobe	{microorganisms/bacteria} that will only {grow/divide/metabolise} in the absence of <u>oxygen</u>;	1
		(iii)	Facultative anaerobe	{microorganism/bacteria} that can {grow/divide/ metabolise} with or without <u>oxygen</u>;	1
					1
	(b)		Gram +ve PURPLE Gram –ve RED/PINK (**both** colours correct for one mark); Gram positive retain the {(crystal) violet/ purple} stain because of their {thick/peptidoglycan/murein} cell wall; Gram negative do not retain the stain because of their {thinner cell wall/ less peptidoglycan/ less murein/lipopolysaccharide layer}; Gram positive retain crystal violet because they have a thicker cell wall than the gram negative = 2 marks		3
	(c)		**Both for one mark** Cocci sphere/ spherical Bacilli Rod; Accept cylinder		1
				Question 2 Total	**[7]**

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Question			Marking details	Marks Available
3	(a)	(i)	**Both X and Y correct for one mark** X White matter Y Grey matter; Explanation: Grey matter contains the (darkly staining) cell bodies/nuclei of neurones whilst the white matter is mainly {axons/myelin};	**1 for both** 1
		(ii)	L Dorsal Root ganglion; Z Central canal;	2
	(b)	(i)	Schwann cell; Myelin/ phospholipid; NOT lipid	2
		(ii)	Insulates the axon; Allows saltatory conduction/ impulse jumps from node to node; So speeding up the transmission of the action potential/ increase speed of conduction;	Max 2
		(iii)	Impulses cannot jump node to node/ saltatory conduction is stopped/ local circuits {too short/insufficient}/ {Few/no} voltage gated Na+ channels (between Nodes of Ranvier); So action potential cannot be generated/ speed of conduction is reduced/ action potential does not reach destination;	2
		(iv)	Remyelinate the axon/use of stem cells/make the membrane add Na^+ channels in bare areas/prevent further demyelination/ immune {suppressants/ inhibitory} drugs; Accept physiotherapy	1
	(c)	(i)	Nerve net drawn	1
		(ii)	Respond to a limited number of stimuli; Cannot detect source of stimulus/ impulses pass in all directions; Number of effectors is small; No CNS; Accept no brain Action potential can be carried in more than one direction along a neurone; Only one type of cell/ unmyelinated/ facilitation - qualified/ slower response;	Max 2
				Question 3 Total **[14]**

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Question			Marking details		Marks Available
4	(a)	(i)	A	Collecting duct;	3
			B	Proximal Convoluted Tubule;	
			C	Distal Convoluted Tubule;	
		(ii)	Label to Glomerulus capillary/centre of Bowman's capsule;		2
			Label to PCT;		
	(b)		**Both for one mark**		1
			X Renal artery		
			Y Renal vein;		
	(c)		Water leaves descending limb {osmotically/by osmosis}/ Na^+ is retained in descending limb;		Max 4
			At apex Na^+ is very concentrated/ the ascending limb receives a filtrate rich in Na^+/OWTTE;		
			Na^+ {actively transported/pumped out} of the ascending limb;		
			Lowering the water potential in the medulla;		
			Ascending limb {does not allow the escape of water/ impermeable to water};		
			Counter current system = neutral		
	(d)		{High osmotic pressure /low water potential/ low solute potential/ high solute concentration} of <u>blood</u> detected by {**osmoreceptors/hypothalamus}**;		Max 4
			(Secretion of) ADH by pituitary;		
			Reject: anterior pituitary		
			Causes collecting duct (walls) to {become more permeable to water/insertion of aquaporins};		
			Water moves into the medulla by osmosis;		
			(Quickly) removed by the {Vasa Recta/capillaries/ blood};		
			<u>Low volumes</u> of <u>concentrated</u> urine produced;		
				Question 4 Total	**[14]**

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Question			Marking details	Marks Available
5	(a)	(i)	**1 mark for both** Y Cyclic photophosphorylation Z Non cyclic photophosphorylation	1
		(ii)	(High energy) electrons/electron {carriers/acceptors};	1
		(iii)	NADP → $NADPH_{(2)}$/ reduced NADP;	1
		(iv)	Oxygen/ O_2/ ½ O_2;	1
		(v)	Carbon dioxide/ CO_2;	1
		(vi)	Glucose;	1
	(b)			4

Area	Letter	Name of region
Where the light dependent stage occurs	**C;**	Grana/Thylakoid;
Where the light independent stage occurs	**D;**	Stroma;

One mark for each box

	(c)		Synthesis of amino acids/proteins **using {a nitrogen source/ named nitrogen source}**; Synthesis of phospholipids with **phosphate;** Synthesis of chlorophyll with **magnesium**; Synthesis of {nucleotides/named nucleotide} with a **nitrogen source and phosphate source**;	Max 3

Question 5 Total [13]

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Question			Marking details		Marks Available
6	(a)	(i)	**All three correct for one mark**		1
			Citrate	6	
			α-ketoglutarate	5	
			Succinate	4	
		(ii)	4C oxaloacetate plus 2 C acetyl; 1C lost/ CO_2 lost {before α-ketoglutarate/ from isocitrate}/ isocitrate is decarboxylated **and** 1C lost/ CO_2 lost {from α-ketoglutarate/ before succinate} / α-ketoglutarate decarboxylated;		2
	(b)		Reduced NAD and reduced FAD pass electrons to the Electron Transport Chain; The high energy electrons/ electrons provide energy; (Used to power) proton pumps; On the inner mitochondrial membrane/cristae; Which pump H^+ into the inter-membrane space; Reduced NAD powers all 3 pumps/ Reduced FAD passes to 2nd pump/ OWTTE; ATP synthesis = neutral		Max 4
	(c)		Dehydrogenase; decarboxylase;		2
	(d)		(Skeletal) muscle; High numbers of mitochondria and easy to access/ OWTTE;		2

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Question	Marking details	Marks Available
(e)	*Low with pyruvate* {The pathway leading to Acetyl Co A/link reaction} is not working/ {Enzymes/dehydrogenase/decarboxylase} are not active/ There is no reduced NAD for the Electron Transport Chain (so no O_2 needed); *High with α-ketoglutarate* The pathway between α-ketoglutarate and the rest of the cycle is working correctly/ There is enough reduced {NAD/FAD} to drive the ETC (which needs O_2);	2
(f)	Enzymes catalysing the conversion of the molecule to the next in the cycle are not functional/ The {molecule/named example} cannot be converted to the {next intermediate/ named example} / build up of reduced NAD and FAD;	1
(g)	The {Krebs cycle/ link reaction/ Electron Transport Chain} is not working (as well); Pyruvate levels {build up/ increase/ higher}; (Excess) {pyruvate/$NADH_2$} is converted to Lactate;	Max 2
	Question 6 Total	**[16]**

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Question		Marking details	Marks Available
7	(a)	Any 10 from:	
	A	**3 for 1 mark** The main photosynthetic pigments found in plants are chlorophyll **a**, chlorophyll **b**, carotene and xanthophyll;	
	B	The function of these pigments is to **absorb** {light <u>energy/ photons;</u>	
	C	Correct reference to pigments in photosystems/ antenna complexes;	
	D	Correct reference to pigment positions within the thylakoid membrane/grana;	
	E	Of a chloroplast;	
	F	Chlorophyll a molecules in the reaction centre;	
	G	{Reaction centre/ chlorophyll} emitting high energy electrons;	
	H	Ref to range of pigments absorbing more {light energy/ photons}/ over a greater range of wavelengths	
	I	Used to synthesise ATP {to drive/for} the {Calvin cycle/light independent stage};	
	J	Some mention of {spotting plant pigments/ crushing leaf} onto a TLC/chromatography paper;	
	K	Addition of solvent (extraction of pigment or for separation);	
	L	Pigments are carried different distances;	
	M	According to their {solubility (in solvent)/ size};	
	N	Correct reference to {relative solubility/ different spot positions} {i.e. carotene more soluble than chlorophyll a and b/ carotene carried further};	
	O	Identify using Rf values/comparison with known separation of pigments;	
		Question 7a Total	**[10]**

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Question		Marking details	Marks Available
7	(b)		
		Correct term and **explanation** of events in each of A, B, C and D:	
	A	lag phase – enzyme synthesis/ rehydration/ inability to find mates/ time for sexual maturity NOT getting used to environment;	
	B	log/ exponential phase – rate of reproduction exceeds death rate/ {no environmental pressure/ OWTTE};	
	C	stationary phase – environmental pressure/ limiting factors/ rate of reproduction = death rate;	
	D	death phase - death rate exceeds rate of reproduction/ lack of resources/ build up of toxins;	
	E	Graph drawn the correct shape with BOTH axes labeled with Population size/ eq and time (if use units must be appropriate);	
	F	Correctly **explained** carrying capacity (NOT just a labeled line on the graph) as the max numbers of a pop that can be sustained by the environment;	
	G	Correct explanation of inter-specific competition (2 different species competing for a given resource) and e.g.;	
	H	Correct explanation of intra-specific competition (same species competing for a given resource) and e.g.;	
	I	Explanation of how density dependent factor affects population growth (increase numbers in population increases competition for resources);	
	J	One suitable e.g. of dependent factor affecting pop growth;	
	K	Explanation of how density independent factors affects population (Independent of population size);	
	L	One suitable e.g. of density independent factor affecting pop^{n};	
	M	Immigration and emigration definition;	
	N	Description of predator prey relationship; Accept labelled diagram	
	O	Births and immigration = deaths and emigration {at stationary phase / in a stable population};	
		Question 7b Total	**[10]**

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Surname	Centre Number	Candidate Number
Other Names		2

GCE A level

1074/01

BIOLOGY – BY4

P.M. FRIDAY, 10 January 2014

1 hour 45 minutes

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**3**	
2.	**7**	
3.	**9**	
4.	**11**	
5.	**12**	
6.	**12**	
7.	**16**	
8.	**10**	
Total	**80**	

1074
010001

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INFORMATION FOR CANDIDATES

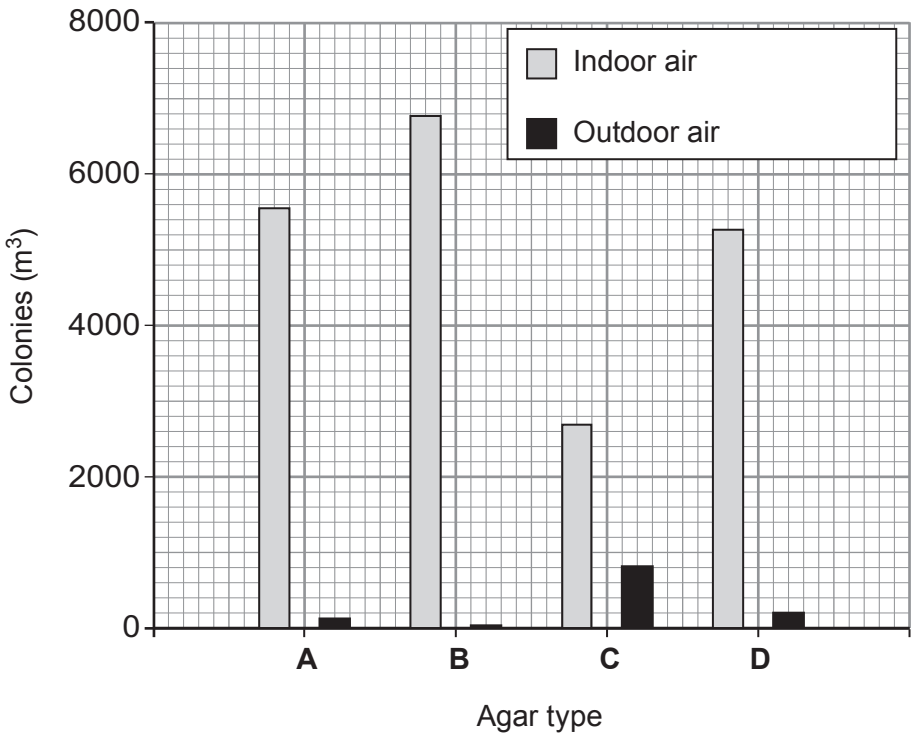
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The quality of written communication will affect the awarding of marks.

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1. 1 m^3 of air was filtered from two different environments.
The microorganisms collected were grown, using aseptic technique, on four different types of agar plates (**A**, **B**, **C** and **D**) at the same temperature and for the same length of time.
The number of colonies grown from each sample is shown.



(a) What conclusion can you draw from the graph above about the numbers of microbes in the **two** air samples? [1]

.....

(b) The four agar types have resulted in different colony numbers because they contain different nutrients.
State **four** ways that the **agar types** could differ in composition. [2]

i. .....

ii. .....

iii. .....

iv. .....

3

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2. The photograph below shows root nodules on a plant.



(a) Name the group of plants which have large numbers of root nodules on their roots. [1]

.....

(b) Explain the advantage to these plants of having root nodules. [3]

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(c) *Nitrosomonas* and *Nitrobacter* are two groups of bacteria which carry out nitrification. Explain this process and why it is so important to soil fertility. [3]

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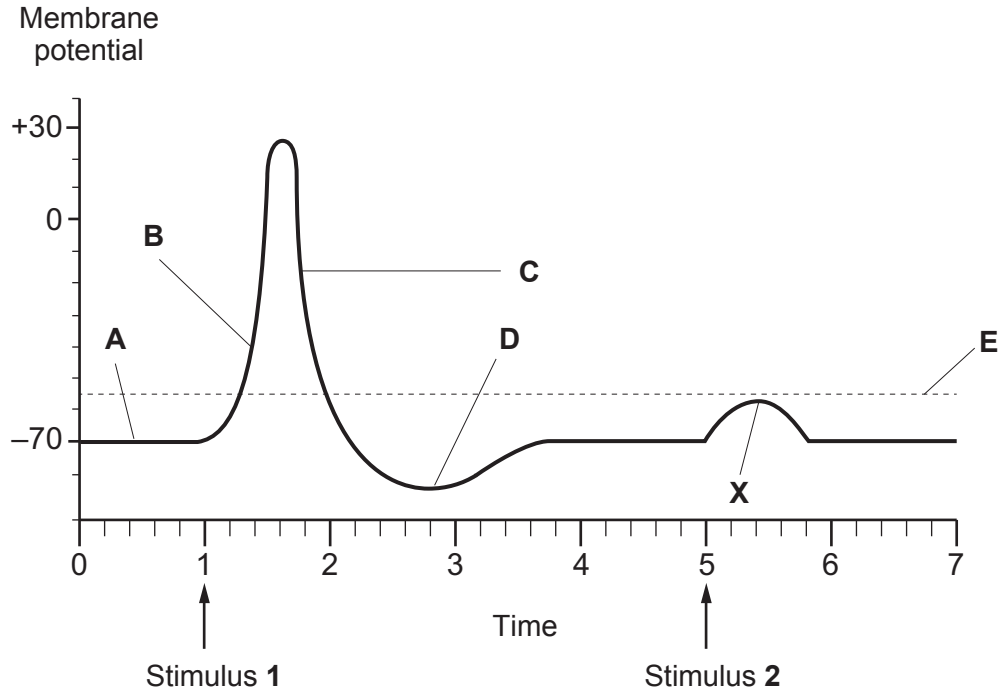
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3. An action potential is illustrated in the following graph.



(a) What units should be used on the two axes of the graph shown above? [2]

Membrane potential .....

Time .....

(b) Identify the stages of the action potential indicated by **A**, **B**, **C** and **D**. [4]

A .....

B .....

C .....

D .....

(c) (i) What is represented by line **E** on the graph above? [1]

.....

(ii) Explain why stimulus **2** failed to initiate an action potential as seen at point **X**. [2]

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4. Roughly 60% of the mass of the body is water and despite wide variation in the quantity of water taken in each day, body water content remains incredibly stable.
One hormone responsible for this homeostatic control is antidiuretic hormone (ADH).

(a) Describe the mechanisms that are triggered in the mammalian body when water intake is reduced. [6]

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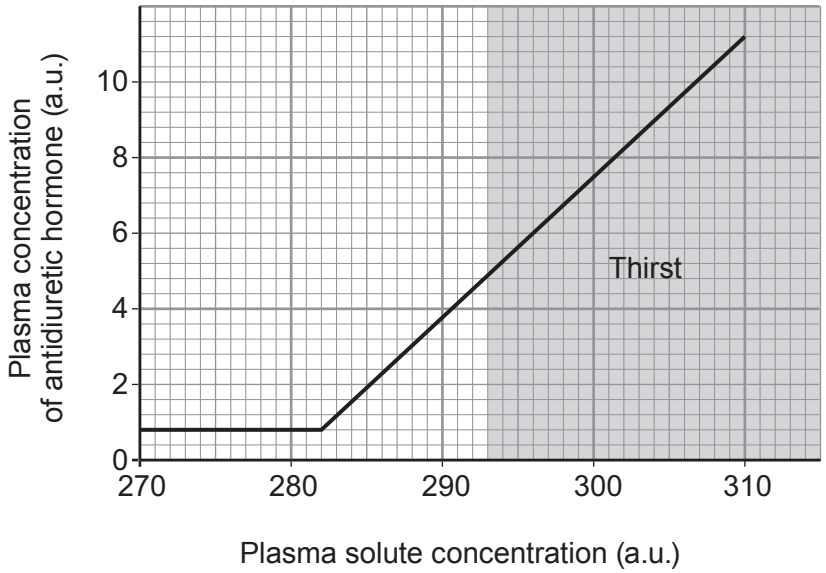
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(b) The graph below shows how the plasma concentration of antidiuretic hormone changes as plasma solute concentration rises.



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(i) Describe the relationship shown in the graph opposite. [2]

.....

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(ii) Suggest why a person only begins to feel thirsty at a plasma solute concentration of 293 AU. [2]

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Secretion of antidiuretic hormone is stimulated by decreases in blood pressure and volume. These are conditions sensed by stretch receptors in the heart and large arteries. Severe diarrhoea is one condition which stimulates ADH secretion.

(c) Suggest another condition which might stimulate ADH secretion. [1]

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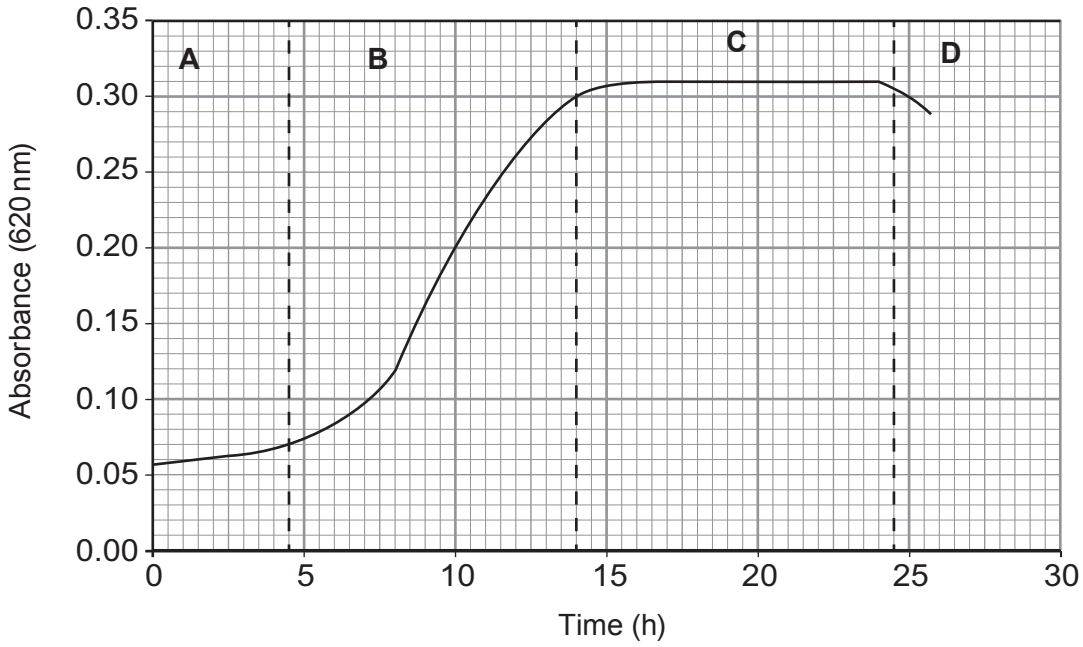
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5. Dried yeast cells were added to sterile culture medium and grown under **anaerobic** conditions. Glucose was present in excess of requirements for 30 hours of culture. The following growth curve was obtained.



(a) Name the stages of the growth curve of yeast shown on the graph above and explain **precisely** what is occurring in the culture at **each** of these stages. [8]

	Name of stage	*Explanation*
A		
B		
C		
D		

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(b) Describe the metabolism of pyruvate in the anaerobic respiration of glucose in yeast. [4]

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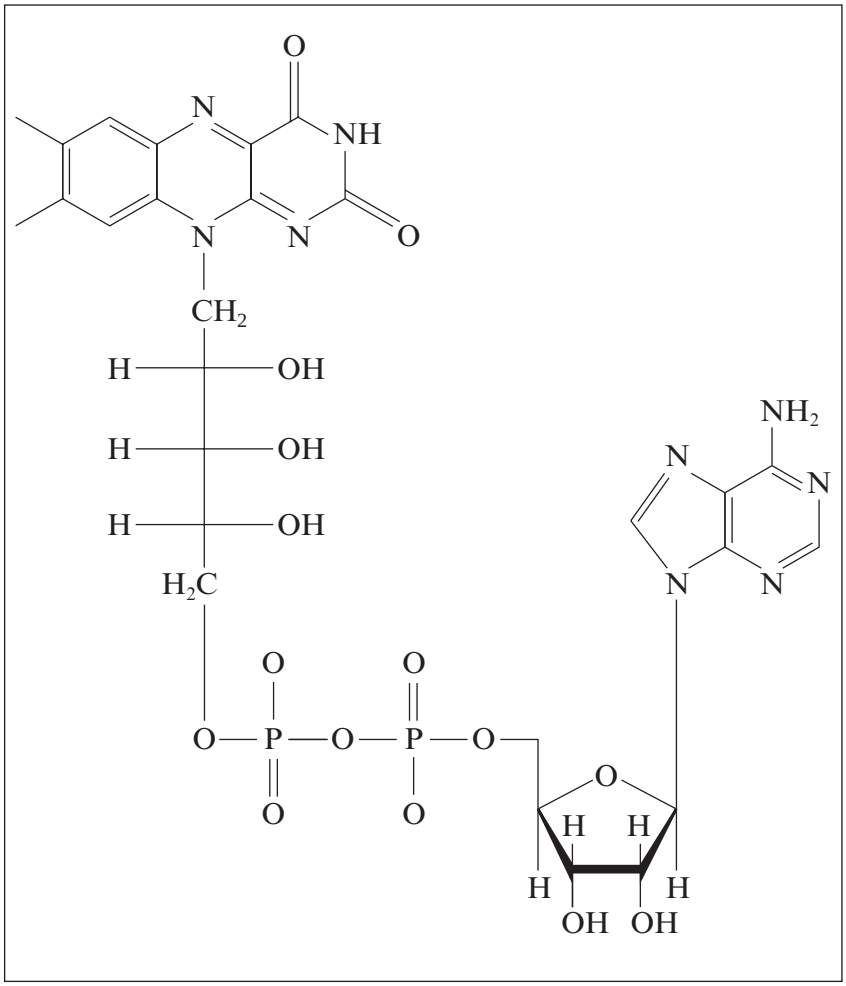
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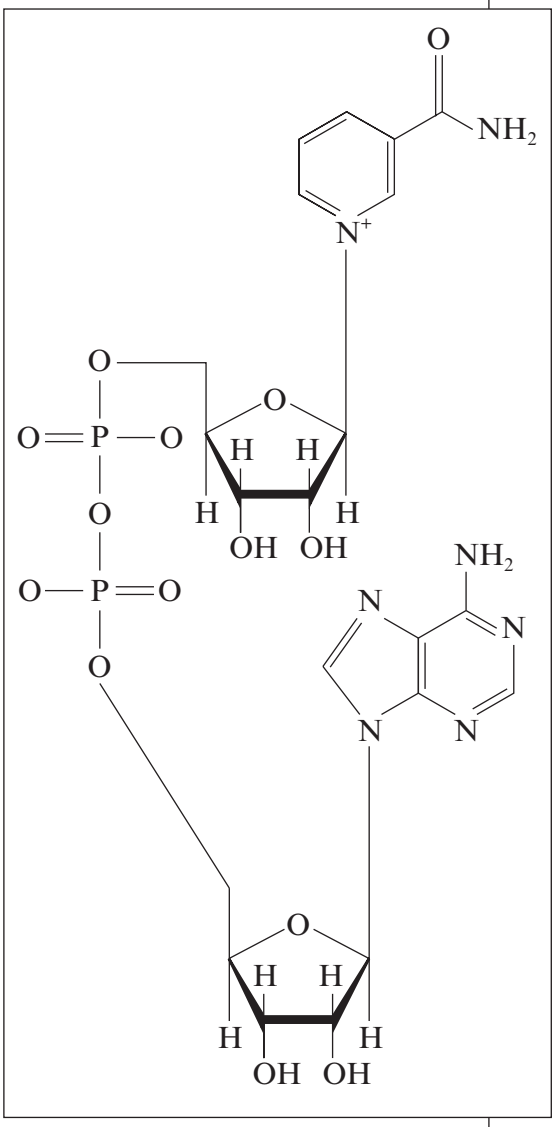
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6. The two diagrams below show nicotinamide adenine dinucleotide (NAD) and flavin adenine dinucleotide (FAD), two nucleotides used in respiration.



FAD



NAD

(a) State **two** chemical features which these two molecules have in common and **one** difference between the two molecules. [3]

Features in common.

(i) .....

(ii) .....

Difference

.....

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(b) Substrate level phosphorylation (SLP) is the simplest, oldest and least-evolved way to make ATP. In substrate level phosphorylation, ATP is made during the conversion of an organic molecule from one form to another. Energy released during the conversion is used to synthesise the high energy bond of ATP.

(i) Describe the position of the 'high energy bond of ATP' referred to in the paragraph above. [1]

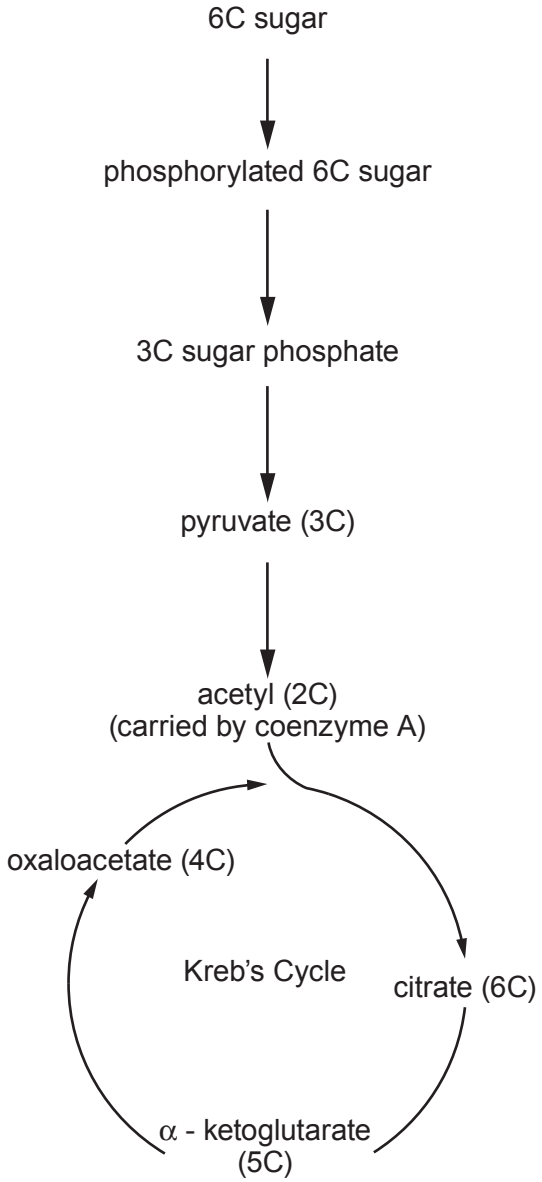
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(ii) Suggest why SLP is referred to as the 'simplest and oldest way to make ATP'. [2]

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.....

The diagram below shows glycolysis, the link reaction and Kreb's cycle.



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(iii) Draw **two** arrows labelled **A** and **B** on the diagram opposite to show the **two** steps where there is conversion of an organic molecule from one form to another and SLP occurs. [2]

(iv) Give the number of ATP molecules made by SLP at **each** of the conversions shown in part (iii) **per glucose molecule** in aerobic respiration. [2]

Arrow	Number of ATP molecules made per glucose molecule in aerobic respiration.
A	
B	

(c) (i) Where does the link reaction occur in cells? [1]

.....

(ii) Name the **two** types of enzyme involved in the link reaction. [1]

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7. Diuron is a weed-killer which is a very specific and sensitive inhibitor of photosynthesis. It blocks the electron carrier binding site on photosystem II. This stops the electron flow from where it is generated, in photosystem II, to the electron carrier. This reduces the ability of the plant to convert light energy into chemical energy.

Diuron only blocks electron flow from photosystem II. It has no effect on photosystem I or other reactions in photosynthesis, such as light absorption or carbon fixation in the Calvin cycle.

(a) Explain the effects of Diuron on non-cyclic photophosphorylation and why cyclic photophosphorylation is not affected. [4]

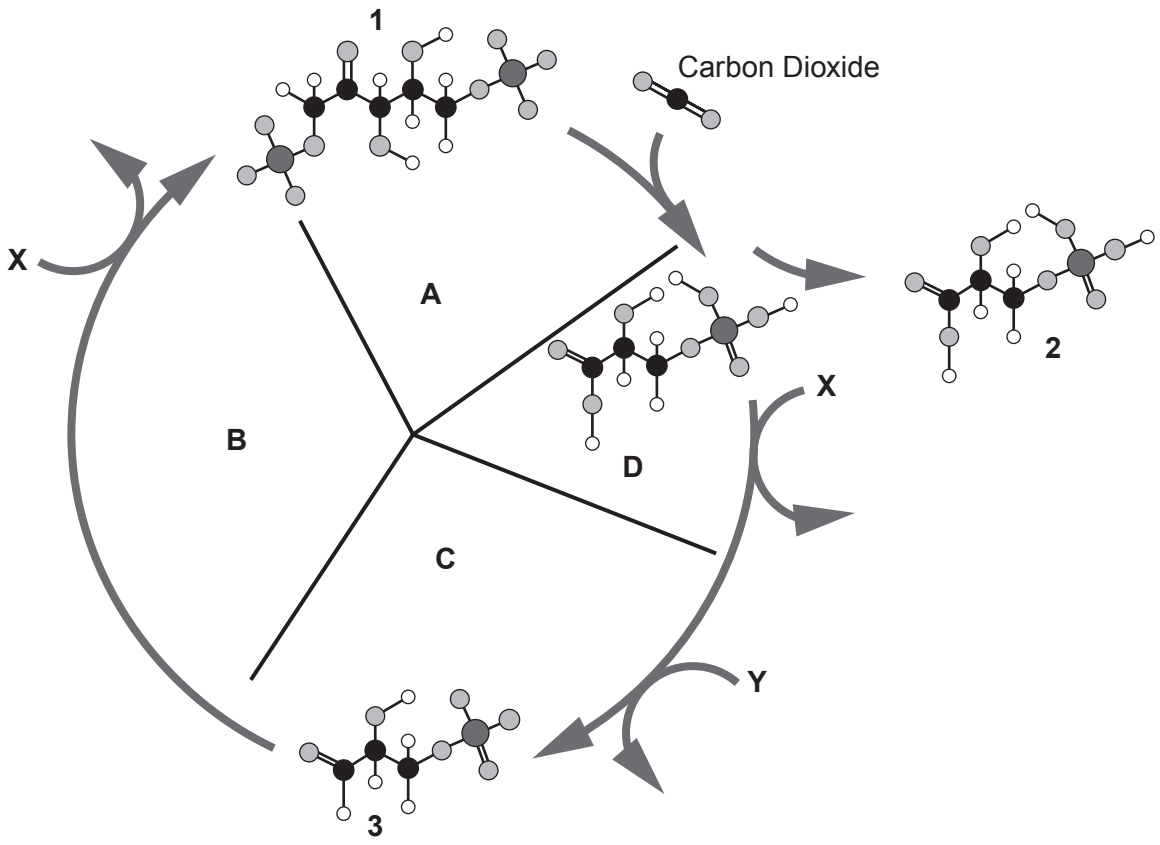
(b) Suggest why a plant would die when the weedkiller Diuron is sprayed onto it. [3]

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(c) The Calvin cycle is shown below with some of the intermediate compounds drawn.

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(i) Name compounds **1**, **2** and **3** shown on the diagram above. [3]

1 .....

2 .....

3 .....

(ii) What is the role of ribulose bisphosphate carboxylase (RuBisCo) in the Calvin cycle? [1]

.....

(iii) Name molecules **X** and **Y** shown on the diagram above. [2]

X .....

Y .....

(iv) Describe simply what is happening at **each** stage of the cycle indicated by **A**, **B** and **C** on the diagram above. [3]

A .....

B .....

C .....

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8. Answer **one** of the following questions.
All diagrams included in your answer must be fully annotated.

Either, *(a)* Explain what is meant by the viable count technique and describe how it is used to monitor population growth of microorganisms. [10]

Or *(b)* Describe the sequence of events involved in synaptic transmission at a synapse. [10]

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END OF PAPER

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Question		Marking details	Marks Available
1	*(a)*	There more {microorganisms/ bacteria/ fungi} in indoor air than outdoor air samples;	1
	(b)	(Different) pH; (Different) C {source/ concentration}; (Different) N {source/ concentration}; (Different) growth factors: {Different/ different concentration} Vitamins/minerals; NOT nutrients Any 4 1 mark per pair	max 2
		Question 1 total	**[3]**

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Question		Marking details	Marks Available
2	*(a)*	Legumes/ leguminous;	1
	(b)	Contain nitrogen fixing bacteria/ OWTTE; (must be correct context, not plant fixing nitrogen) Such as *Rhizobium;* (Some) {nitrogenous compounds/ ammonium ions/ ammonia/ amino acids} pass to the plant; NOT nitrate/ nitrogen Allows the plant to grow in poor soil/ used for {amino acid/ proteinsynthesis};	max 3
	(c)	*Nitrosomonas* converts ammonia to nitrites; *Nitrobacter* converts nitrites to nitrates; *Accept diagram/equation* Which the plant can {absorb/take up} (from the soil); And use for {nucleic acid/eq or protein synthesis};	max 3
		Question 2 total	**[7]**

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Question			Marking details	Marks Available
3	*(a)*		milliVolts/mV; NOT microvolts milliseconds/msec/ ms;	2
	(b)		A Resting potential; B Depolarisation C Repolarisation; D Hyperpolarisation/ refractory ;	4
	(c)	(i)	Threshold (potential);	1
		(ii)	Failed to reach threshold potential; All or nothing response; -55; So (too few) sodium gates opened/not enough depolarisation;	max 2
			Question 3 Total	**[9]**

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Question			Marking details	Marks Available
4	*(a)*		• Low water levels in blood/high osmotic potential/low Ψ; • Detected by <u>osmoreceptors</u>; • In <u>hypothalamus</u>; • (More) <u>ADH</u> secreted from (posterior lobe of) <u>pituitary</u>; • {Into/travels in} blood to; • {collecting duct/distal convoluted tubule}{ becomes more permeable/more aquaporins/ more water channels in membranes}; • Water absorbed; • Because of low Ψ in medulla;	max 6
	(b)	(i)	As plasma solute concentration increases to 282 there is no increase in ADH/ the concentration of ADH remains constant; After 282 there is {a proportional/ rapid} increase in ADH; (increase must be qualified)	2
		(ii)	(Up to 293 au) ADH can achieve sufficient water reabsorption/ OWTTE; After this point {water needs to be taken in/ by drinking} to <u>avoid dehydration</u>;	2
	(c)		Blood loss/vomiting; NOT dehydration/ anaemia	1
			Question 4 Total	**[11]**

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Question	Marking details	Marks Available

5 *(a)* 8

	Name of stage	*Precisely what is happening in the culture*
A	Lag;	Cells are rehydrating/ Yeast is synthesizing enzymes/ gene activation; NOT adapting/ acclimatizing/DNA replication
B	Log/Exponential;	Cells are {dividing/budding/ replicating/ fission} (at maximum rate) eq; NOT rapid growth
C	Stationary;	Cells are dying in equal numbers to those produced by division; NOT births=deaths
D	Decline/death;	There is a build up of ethanol which is killing the cells;

(b) Pyruvate is converted to ethanal/acetaldehyde; 4

With the removal of CO_2/ by decarboxylation;

Ethanal/acetaldehyde is reduced to ethanol;

Using the $NADH_2$/ reduced NAD/ NADH. ;

Or correct diagram for 3max

Accept Pyruvate is converted to ethanol = 1 mark (alternative to MP 1 and 3)

Question 5 Total **[12]**

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Question			Marking details	Marks Available
6	*(a)*		<u>Similarities</u> (Both contain) a 5 carbon sugar; Both have two phosphate groups; Both contain (two) nitrogenous bases/ adenine/ organic base; Dinucleotide; Accept adenosine for 1 mark if MP1 and 3 not awarded	max 2
			<u>Differences</u> FAD only contains one (ring form) sugar **<u>and</u>** NAD contains 2/ One 5C sugar is in its linear form in FAD <u>and</u> both 5C sugars are in ring form in NAD/ NAD contains nicotinamide and FAD contains flavin/ FAD has a three ring base and NAD has one ring base;	1
	(b)	(i)	The bond between the {terminal/last two} phosphate groups on ATP;	1
		(ii)	Does not involve the ETC/complex series of carriers and pumps; Does not need stalked particles/ATP synthetase; Does not need an electrochemical gradient/eq; Does not require oxygen; Accept 'Does not require mitochondria' as alternative to MPs 1, 2,3	Max 2
		(iii)	Arrows showing In the conversion of triose phosphate to pyruvate; After the 5C compound in the Kreb's cycle;	2
		(iv)	4; 2;	2
	(c)	(i)	In the mitochondrial matrix;	1
		(ii)	Dehydrogenase AND decarboxylase;	1
			Question 6 Total	**[12]**

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Question			Marking details	Marks Available
7	*(a)*		It stops electrons from PS II being moved to PS I; So blocking the reduction of $NADP^+$ to NADPH; Cyclic Photo Phosphorylation only involves PSI; is not stopped as the electrons pass from PSI and return to PSI/ eq; And the carrier involved in this is not affected;	4
	(b)		Plant cannot generate {$NADPH_2$/ NADPH/ reduced NADP} {so Calvin cycle cannot work/ description of part of process which is prevented}; {No glucose/ hexose sugar} will be formed; For respiration;	3
	(c)	(i)	1. Ribulose bisphosphate; 2. Glycerate(-3-)phosphate; 3. Glyceraldehyde(-3-)phosphate/triose phosphate;	3
		(ii)	Catalyses {the reaction between RuBP and carbon dioxide/ to fix carbon dioxide} ;	1
		(iii)	X ATP; Y NAD**P**H_2;	2
		(iv)	A CO_2 Fixation/ 6C intermediate/ RuBP binds to CO_2; B Regeneration/resynthesis of RuBP; C Reduction;	3
			Question 7 Total	**[16]**

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Question		Marking details	Marks Available
8	*(a)*	**Viable count mark scheme**	
	A	Viable count is counting living cells;	
	B	As opposed to a direct count which counts both living and dead cells;	
	C	One cell gives rise to one colony/so N^{o} of colonies = N^{o} of viable cells;	
	D	Use of aseptic technique + example; (eg flaming neck of bottle etc)	
	E	Sterilisation of equipment and media + example; (eg autoclave/ oven/ radiation)	
	F	Serial dilution;	
	G	Culture needs diluting by ten-fold steps;	
	H	1cm^{3} of original sample added to;	
	I	9cm^{3} of (sterile) water;	
	J	(Mixed and) process repeated;	
	K	Known volume(or eg such as 1cm^{3}/0.5 cm^{3}) of microorganisms are added to agar plates;	
	L	Incubated at 25°C (up to 37°C) for 24-48 hours; Must state a temperature and time	
	M	Count N^{o} of colonies in {appropriate plate/appropriate number of colonies};	
	N	Multiply by dilution factor to calculate No of cells per cm^{3} in original sample;	
	O	Some comment on unreliability eg reference to clumping of cells;	
		Question 8a Total	**[10]**

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Question			Marking details	Marks Available
8	*(b)*		**Synapse mark scheme**	
		A	A synapse occurs between neurones;	
		B	The impulse across a synapse is chemical (rather than electrical);	
		C	Neurotransmitter;	
		D	Acetylcholine/noradrenaline;	
		E	Is enclosed in synaptic vesicles;	
		F	Arrival of an action potential at the;	
		G	Axon terminal/(pre) synaptic knob;	
		H	Causes Ca^{2+} ions to flow into the axon terminal;	
		I	This causes synaptic vesicle to fuse with the presynaptic membrane;	
		J	Neurotransmitter is released by exocytosis and;	
		K	Diffuses across the synaptic cleft;	
		L	Where it binds with receptors on the post synaptic membrane;	
		M	Which open sodium channels;	
		N	allowing Na^{+} to enter;	
		O	The membrane is depolarised;	
			Question 8b Total	**[10]**

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Surname	Centre Number	Candidate Number
Other Names		2

GCE A level

1074/01

BIOLOGY – BY4

A.M. TUESDAY, 11 June 2013

1¾ hours

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1	**3**	
2	**7**	
3	**10**	
4	**9**	
5	**15**	
6	**12**	
7	**14**	
8	**10**	
Total	**80**	

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INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.
Write your name, centre number and candidate number in the spaces at the top of this page.
Answer **all** questions.
Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.
You are reminded of the necessity for good English and orderly presentation in your answers.
The quality of written communication will affect the awarding of marks.

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1. *(a)* State the general role of muscles and glands in simple reflexes. [1]

.....

(b) The phylum Cnidaria includes animals with a relatively simple body plan such as sea anemones, jellyfish and hydra. They respond to stimuli but these responses are slower than in humans. Suggest a reason for the slower speed of response. [1]

.....

(c) Name the substance that plants use to detect day and night length. [1]

.....

2. The red kite *(Milvus milvus)* was at one time a common bird of prey in Britain, but by the end of the 19th century it had been driven almost to extinction and just three pairs survived in mid-Wales. As a result of conservation efforts, numbers rose during the 20th century. The table below shows numbers of breeding pairs for years when accurate counts or estimates are available.

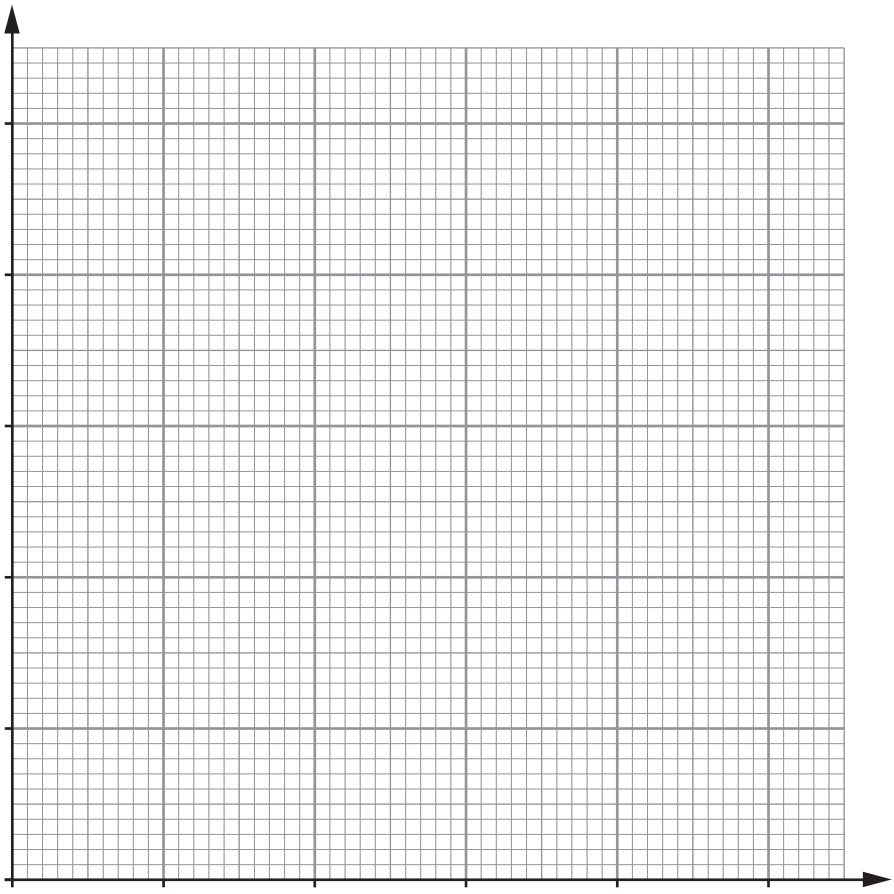
Year	Number of breeding pairs
1933	4
1962	15
1976	34
1986	48
1995	100
2009	1000

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(a) Use the data opposite to draw a graph to show the increase in the number of breeding pairs of red kites in Wales between 1933 and 2009. [3]



(b) Assuming no net migration, state with a reason whether it was the **birth rate** or the **death rate** which was greater between 1976 and 1986. [1]

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(c) (i) Suggest **two** density dependent factors, which might prevent numbers of red kite continuing to rise. [2]

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(ii) Suggest **one** density independent factor that might cause the population of red kite in Wales to crash in the future. [1]

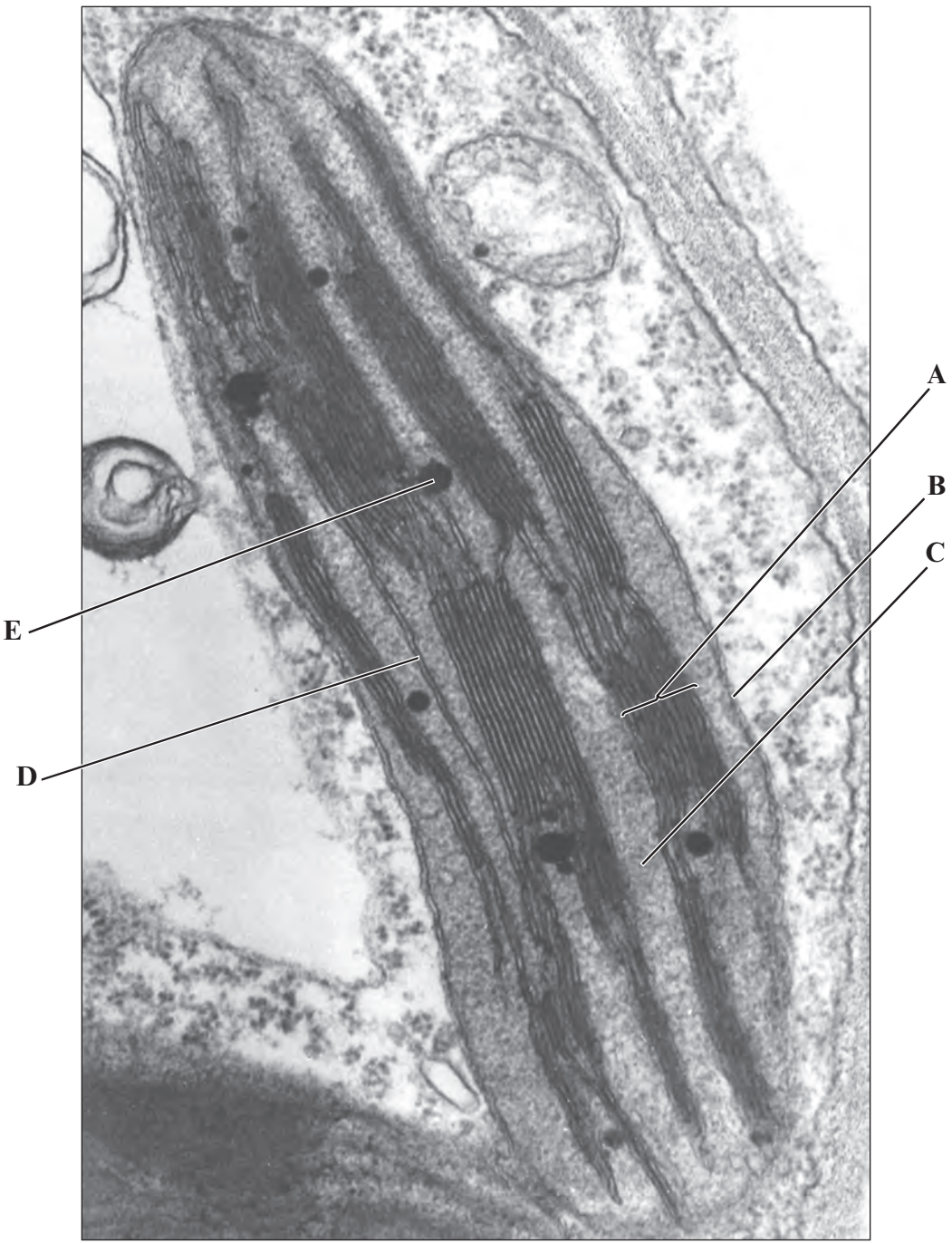
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3. The electron micrograph below shows part of a palisade cell, including one chloroplast.



(a) Choose a letter or letters from the electron micrograph above that indicate [3]

(i) one granum, ...

(ii) parts of the chloroplast where photosynthetic pigments are located, ...

(iii) where reactions of the Calvin cycle occur. .....

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(b) The Calvin cycle involves the conversion of inorganic carbon dioxide into useful organic compounds.

(i) Explain how carbon dioxide is used in the production of glycerate-3-phosphate. [2]

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(ii) Describe how glycerate-3-phosphate is converted to triose phosphate. [3]

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(c) (i) State why only some of the triose phosphate produced by the Calvin cycle can be used to produce hexose phosphate. [1]

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(ii) Suggest how many times the Calvin cycle must occur to produce one molecule of glucose. [1]

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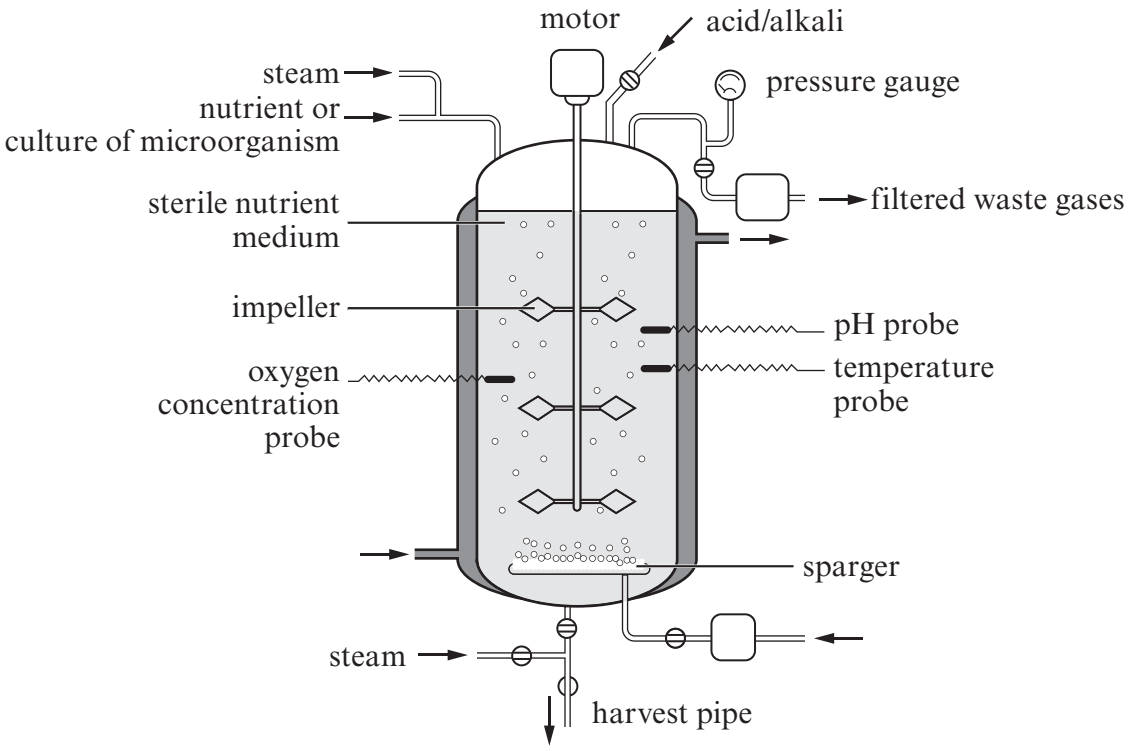
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4. The diagram below shows a fermenter that has been set up to culture a microorganism and harvest a product from it.



(a) Suggest **two** reasons for the use of a sparger in fermenters. [2]

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(b) (i) Using information in the diagram opposite, suggest why the pH probe is needed. [2]

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(ii) If the microorganism in the fermenter is an obligate aerobe, state **one** waste gas that will need to be removed. [1]

.....

(iii) In the early stages of fermentation by batch culture it may be necessary to warm the contents of the fermenter, but cooling is often needed towards the end. Suggest reasons for this difference. [2]

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(c) Suggest reasons for preventing the fermenter becoming contaminated with other microorganisms. [2]

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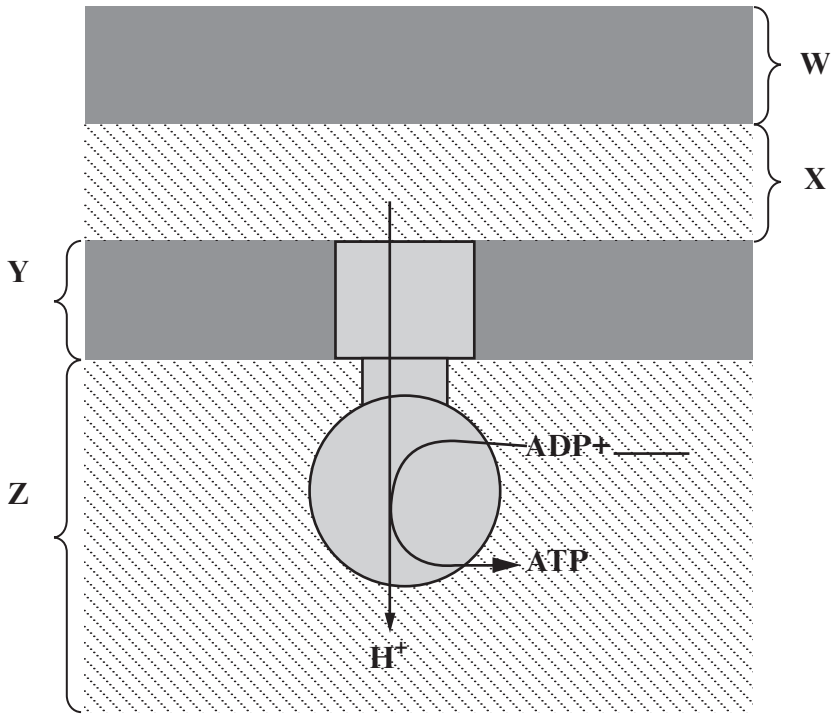
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5. Respiration results in the production of ATP in cells. Production of ATP in the mitochondrion is catalysed by an enzyme and requires energy supplied by a proton gradient. The diagram below represents a model of the ATP synthetase complex.



(a) (i) On the diagram above, complete the equation for the production of ATP. [1]

(ii) Name parts **W** and **Z** shown on the diagram above. [2]

W ..... **Z** .....

(iii) State whether the H^+ concentration is highest in part **W**, **X**, **Y** or **Z**. [1]

.....

(b) The proton gradient can be maintained as long as reduced NAD is available in the mitochondrion. Explain the reasons for reduced NAD being required to maintain a proton gradient. [2]

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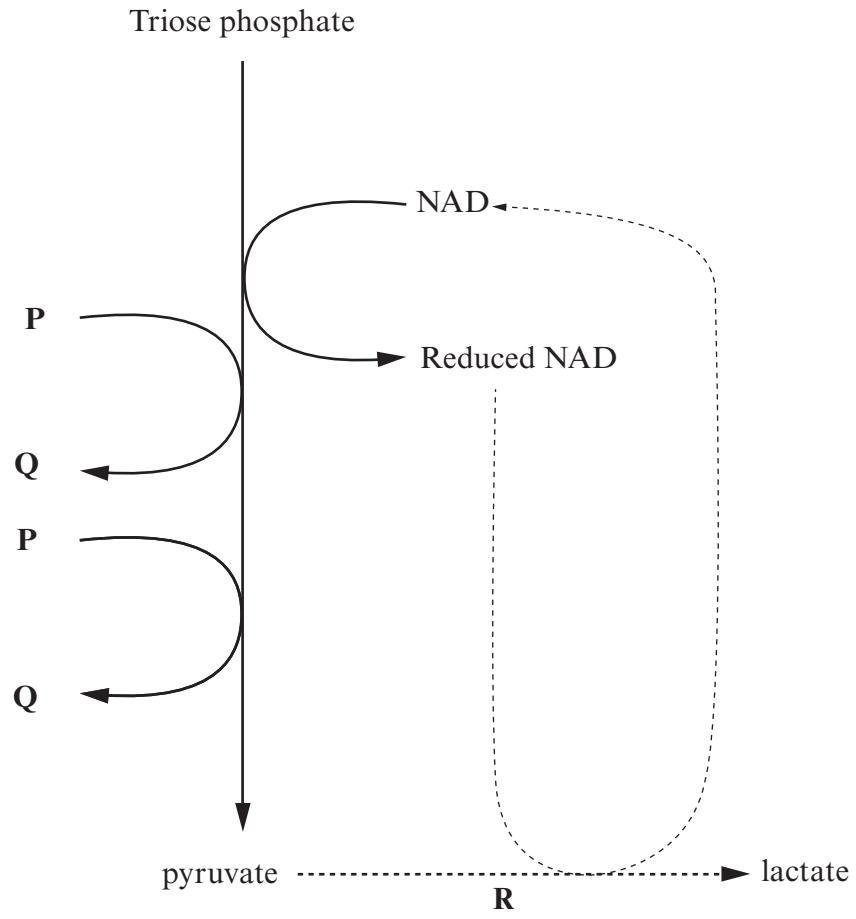
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(c) The diagram below shows one stage of respiration in which reduced NAD is produced.



(i) Name chemicals **P** and **Q**. [1]

P ..... **Q** .....

(ii) Where in the cell do the reactions shown in the diagram above occur? [1]

.....

(iii) Outline the pathway for the production of triose phosphate in glycolysis. [3]

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(d) (i) The reaction labelled **R** on the diagram on the previous page occurs in humans when there are **anaerobic** conditions in a tissue.
Explain the **biochemical** reasons for carrying out the reaction, despite the fact that lactate is toxic in high concentrations. [3]

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(ii) Reaction **R** sometimes occurs in muscle fibres when a short burst of very rapid ATP production is needed. Suggest a reason for this. [1]

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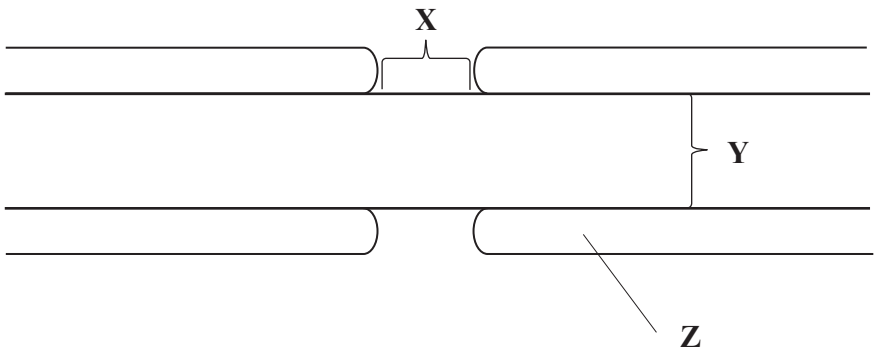
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6. The diagram below represents part of a myelinated neurone.



(a) Name **X** and **Y** shown on the diagram above. [2]

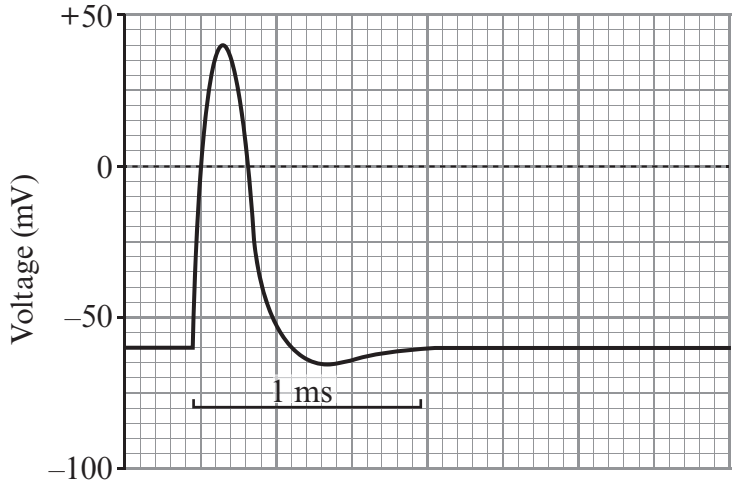
X ..... **Y** .....

(b) Name the cell type that forms layer **Z**. [1]

.....

Trace **A** below is an oscilloscope recording of changes in voltage across the membrane of a myelinated neurone during an action potential.

Trace **A**



(c) Use Trace **A** to estimate the resting potential of **this neurone**. [1]

.....

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(d) (i) Explain, in terms of movement of ions, what causes the rise in membrane potential seen in Trace **A** opposite. [2]

.....

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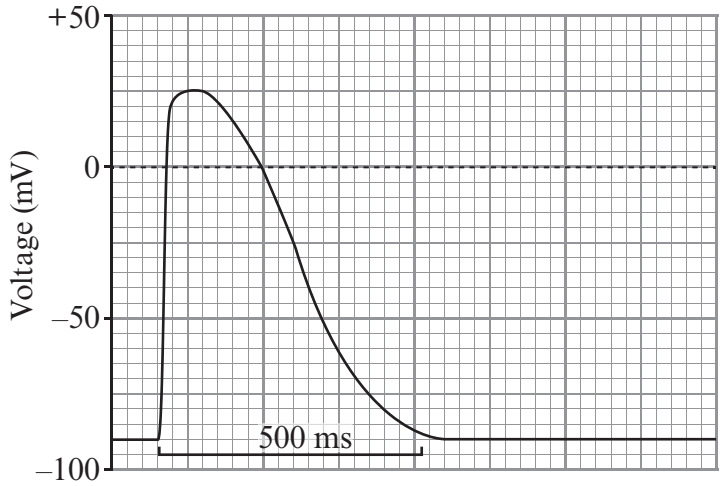
.....

(ii) State the name given to the rapid fall in membrane potential seen in Trace **A**. [1]

.....

Trace **B** is another oscilloscope recording, showing changes in voltage across the membrane of a cardiac muscle fibre.

Trace **B**



(e) Compare Trace **A** and Trace **B** by giving two differences between them. [2]

1. .....

.....

2. .....

.....

(f) Suggest how cardiac muscle fibres would respond when the voltage across the membrane rises. [1]

.....

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(g) The cardiac muscle fibres used to obtain the oscilloscope trace were obtained from a frog's heart. Consider the ethics of killing a frog to obtain cardiac muscle fibres by giving **one** argument in favour and **one** against. [2]

.....

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7. *(a)* Name the vessel that brings blood to the kidney. [1]

.....

(b) Describe **two structural** features of glomeruli that allow ultrafiltration to occur. [2]

1. .....

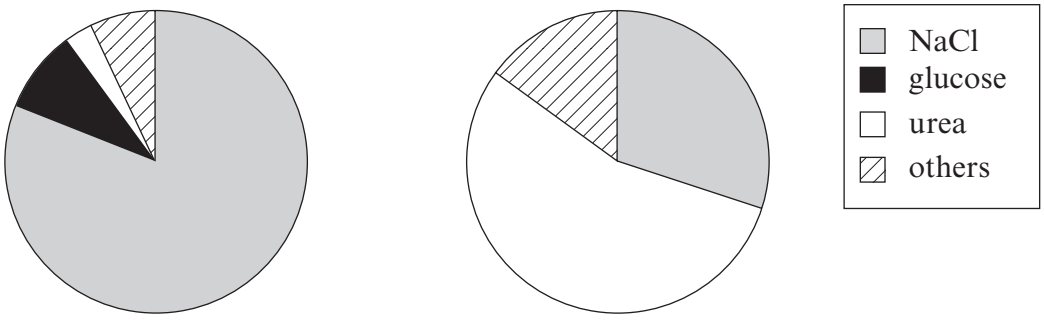
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2. .....

.....

Ultrafiltration in the glomerulus results in the production of glomerular filtrate. The pie charts below show the percentage composition of solutes in human glomerular filtrate and in urine.

Glomerular filtrate **Urine**



(c) Using your knowledge of processes occurring in the nephron, explain the difference in glucose concentration between glomerular filtrate and urine shown in the pie charts. [2]

.....

.....

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(d) (i) The urea concentration of urine is much higher than that of glomerular filtrate. Describe the role of the nephron and collecting duct in achieving this increase in concentration. [5]

(ii) Suggest an advantage to mammals of excreting urine with a high concentration of urea. [2]

(e) The concentration of sodium ions in the urine of a person varies. The concentration is affected by the level of a hormone. Name this hormone and explain how it affects the concentration of ions in urine. [2]

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8. Answer **one** of the following questions.

Any diagrams included in your answers must be fully annotated.

Either, *(a)* Describe the light dependent reactions of photosynthesis. [10]

Or *(b)* Describe how the nitrogen cycle allows nitrogen in one plant to become available to another plant and the various roles of nitrogen in plant metabolism. [10]

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END OF PAPER

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Question			Marking details	Marks Available
1	*(a)*		effectors /{carry out/ bring about} the response/ react to a stimulus;	*1*
	(b)		only have a nerve net /no CNS / (nerve fibres) non-myelinated/ branching neurons/ narrower axons; NOT shorter neurons/ no reflex arc	1
	(c)		phytochrome;	1
			Question 1 total	**[3]**

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Question			Marking details	Marks Available
2	*(a)*		axes correctly assigned with correct labels; appropriate linear scales; all points correctly plotted and joined with a curve or ruled straight lines; (tolerance ½ small square)	3
	(b)		birth rate must be greater because {population rose/ sensible explanation};	1
	(c)	(i)	Any two from nesting / roosting sites (in oakwoods)/ space in habitat; NOT habitat destruction/ shelter source of food/ number of prey; mates; parasites / disease ;	2
		(ii)	Extreme climate/ severe weather / harsh winter /drought/ wind farms/fires/shooting/poisoning/pesticides/egg collecting/ habitat destruction/ deforestation/ flooding/ new top predator;	1
			Question 2 total	**[7]**

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Question			Marking details	Marks Available
3	*(a)*	(i)	A;	1
		(ii)	A and D;	1
		(iii)	C;	1
	(b)	(i)	{RuBP/ 5C compound} and carbon dioxide linked together / carbon dioxide is fixed with RuBP; RuBP carboxylase / RUBISCO {is the enzyme / catalyses the reaction}; unstable 6C {substance/compound} {initially formed/ splits into two 3C};	2 max
		(ii)	Glycerate 3 phosphate reduced; using reduced NADP; ATP also required (to supply energy) / Glycerate 3 phosphate is phosphorylated; {reduced NADP / ATP} from the light dependent reactions;	3 max
	(c)	(i)	some (triose phosphate) needed to {regenerate/ make more} RuBP;	1
		(ii)	six times;	1
			Question 3 Total	**[10]**

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Question			Marking details	Marks Available
4	*(a)*		(improves) aeration / ensures all parts of the culture receive oxygen; helps to mix the contents / prevent {sedimentation/ clumping}; improves contact with nutrients;	2
	(b)	(i)	Monitor pH; used to determine whether acid or alkali must be added; to maintain optimal pH/ pH required for growth;	2
		(ii)	carbon dioxide;	1
		(iii)	heat needed at the start to speed up {enzyme reactions/ growth/ metabolic rate}; removal of heat produced by respiration/ more microbes at the end so more respiration/heat ;	2
	(c)		competition for nutrients/ oxygen; NOT food lower yield; toxic products; contamination of <u>product</u>;	2
			Question 4 Total	**[9]**

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Question			Marking details	Marks Available
5	*(a)*	(i)	phosphate / Pi / inorganic phosphate/ iP/ PO_4^{3-};	1
		(ii)	W is outer (mitochondrial) membrane; Z is the (mitochondrial) matrix;	2
		(iii)	most concentrated in part X;	1
	(b)		(reduced NAD) supplies protons; and brings (high energy) electrons; electrons {supply energy for proton pumping/ fuels proton pumps};	2
	(c)	(i)	P = ADP/ ADP + Pi Q = ATP	1
		(ii)	cytoplasm/ cytosol;	1
		(iii)	glucose is phosphorylated by ATP; two phosphorylations / production of hexose/fructose (bi)phosphate; hexose (bi)phosphate is split (from 6C to two 3C);	3
	(d)	(i)	allows reduced NAD to be converted back to NAD/ regenerate reduced NAD/ without oxygen reduced NAD not converted to NAD by {electron transport chain/ krebs/ link reaction}; allowing ATP production/ without oxygen no ATP production by oxidative phosphorylation; allows {glycolysis/ substrate level phosphorylation} to continue/ ORA; No O_2 to act as the final {hydrogen/ electron} acceptor/ NADH {must find an alternative hydrogen acceptor/ must use pyruvate};	3
		(ii)	Only glycolysis required/ shorter metabolic pathways; oxygen supply too slow/ no need for oxygen {supply/diffusion}; no need to carry out Krebs cycle/ electron transport / oxidative phosphorylation; no need to build up a proton gradient; no need to transport pyruvate into the mitochondrion;	Max 1
			Question 5 Total	**[15]**

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Question			Marking details	Marks Available
6	*(a)*		X is the node of Ranvier; Y is axon /axoplasm;	2
	(b)		Schwann (cell);	1
	(c)		-60mV;	1
	(d)	(i)	(voltage-gated) sodium channels open/ increase in sodium ion permeability; {sodium ions / Na^+} {diffuse/ flood/ rush/ sudden influx} in;	2
		(ii)	repolarisation;	1
	(e)		resting potential is lower / more negative in {B/ the cardiac muscle fibre}/ ORA; slower repolarisation / time taken to get back to resting potential is longer in {B/ the cardiac muscle fibre}/ ORA; higher peak of depolarisation /more positive potential reached in {A/ neurone}/ ORA; {no hyperpolarisation/ refractory period/ undershoot} in Trace B;	2 max
	(f)		contraction; NOT contract faster	1
	(g)		Frog has right to life / {suffering/ pain/ distress/ harm} of frog / frogs scarce in the wild; NOT cruel benefits to medicine/ health of heart research;	2
			Question 6 Total	**[12]**

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Question			Marking details	Marks Available
7	*(a)*		renal artery;	1
	(b)		many {pores/ gaps} in the {capillary wall/endothelium / fenestrated wall}; basement membrane with {pores / molecular sieve} (through which large molecules cannot pass); efferent arteriole has {smaller <u>diameter</u>/ narrower <u>lumen</u>} than afferent;	2 max
	(c)		(all) glucose (selectively) reabsorbed; (reabsorption)in the proximal convoluted tubule; (reabsorption) by active transport;	2 max
	(d)	(i)	A. water {reabsorbed from filtrate/removed from filtrate}; B. less urea reabsorbed / urea not reabsorbed; C. {sodium / mineral ions} reabsorbed in proximal convoluted tubule; D. therefore water reabsorbed by osmosis in proximal convoluted tubule; E. {active transport/ pumping} of Na^+ ions in the ascending limb of the loop of Henle; F. water reabsorbed from filtrate in the descending limb of loop of Henle/ descending limb is permeable to water/ ascending limb impermeable; G. hypertonic conditions /high solute concentrations in the medulla/ lowering water potential of medulla/ correct description of concentration gradient towards apex of loop; H. therefore water reabsorbed in the collecting duct/distal convoluted tubule;	5 max
		(ii)	less water lost (in urine)/ conserves water; reduces risk of dehydration; useful in dry habitats/ adaptation to terrestrial life;	2 max
	(e)		ADH /anti diuretic hormone; {increases reabsorption of water/ increases permeability of collecting duct to water / opens more aquaporins} <u>so increases ion concentration</u>;	2
			Question 7 Total	**[14]**

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Question			Marking details	Marks Available
8	*(a)*		A absorption of light {in photosystems/by pigments}; B energy transferred to reaction centre of photosystem /antenna complex; C (a molecule of) chlorophyll a is the reaction centre; D electrons excited / electrons {raised to higher energy level / emitted}/ high energy electrons produced; E {high energy / excited} electrons passed to electron acceptor/ first carrier in chain}; F electrons (from Photosystem II) pass along {a chain of electron carriers/ electron transport chain}; G energy from electrons used to pump protons; H higher concentration of protons <u>inside thylakoid</u> (than in the stroma)/ concentration gradient of protons from thylakoid to stroma; I used to produce ATP; J Photosystem I receives electrons from{ the chain of carriers / from Photosystem II}; K Electrons {used to reduce NADP /to produce reduced NADP}; L photolysis of water provides electrons to replace those lost by Photosystem II; M oxygen produced {by photolysis /by splitting of water}; N cyclic photophosphorylation only involves Photosystem I/ non cyclic involves both photosystems; O light dependent reactions take place {in thylakoid (membranes)/ in (membranes of) grana}; [Marks can be awarded for points made using an annotated diagram]	

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Question			Marking details	Marks Available
		(b)	*Nitrogen cycle* A death of plant / shedding of {leaf/other part of plant}; B consumers feed on plant material then {die / excrete /defecate/ egest}; C putrefaction due to bacteria/ decomposition due to{ fungi/ bacteria}; D digestion of protein to amino acids; E deamination of amino acids/ ammonification; F nitrification is conversion of {ammonia/ ammonium} to nitrate; G *Nitrosomonas* convert {ammonia/ ammonium} to nitrite; H *Nitrobacter* convert nitrite to nitrate; I plants absorb nitrate from the soil; *Roles of nitrogen in metabolism* J in amine/ amino group; K needed to make amino acids / proteins; L part of (organic) bases ; M needed to make DNA / RNA / nucleic acids/ nucleotides; N part of chlorophyll; O part of NADP/ ATP; **Question 8 Total**	**[10]**

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Surname	Centre Number	Candidate Number
Other Names		2

GCE A level

1074/01

BIOLOGY – BY4

P.M. FRIDAY, 11 January 2013

1¾ hours

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1	**6**	
2	**14**	
3	**10**	
4	**13**	
5	**17**	
6	**10**	
7	**10**	
Total	**80**	

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INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.
Write your name, centre number and candidate number in the spaces at the top of this page.
Answer **all** questions.
Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.
You are reminded of the necessity for good English and orderly presentation in your answers.
The quality of written communication will affect the awarding of marks.

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1. *(a)* Flowering in some plants is affected by the relative periods of dark and light that they are exposed to.

Identify the following:

(i) the name given to this process; [1]

.....

(ii) the chemical that acts as a photoreceptor in plants; [1]

.....

(iii) the part of a plant that detects changes in day length. [1]

.....

(b) Nitrogen is required for healthy plant growth.

Identify the following:

(i) **two** forms in which nitrogen can be absorbed by plant roots; [1]

.....

(ii) the stage in the nitrogen cycle that would be slowed down by ploughing and drainage of soils; [1]

.....

(iii) free-living bacteria involved in the fixation of atmospheric nitrogen. [1]

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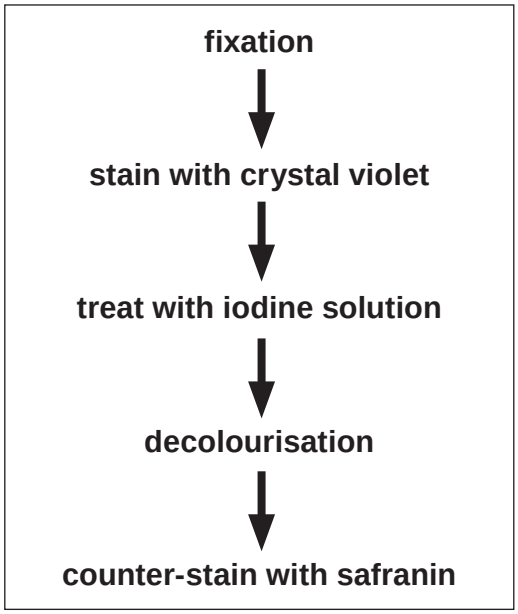
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2. The diagram below shows the process of Gram staining to identify Gram positive (+) and Gram negative (-) bacteria.



(a) State the colour of the bacteria following the application of the counter stain: [1]

Gram positive; .....

Gram negative. .....

(b) Use your knowledge of the structure of the bacterial cell wall to explain the differences in the appearance of the two types of bacteria when stained with the Gram staining technique. [3]

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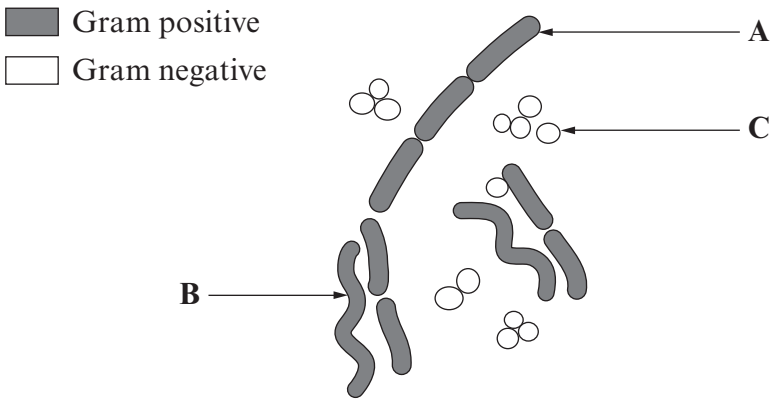
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(c) Following an outbreak of food poisoning in a school, samples were taken from infected patients. The Gram staining technique was used, in conjunction with the shape of bacterial cells, to identify potentially pathogenic bacteria in the samples.

The diagram below shows part of a bacterial smear stained using the Gram staining technique.



(i) State the name given to the shapes of the bacteria labelled **A**, **B** and **C**. [3]

A .....

B .....

C .....

(ii) Suggest why the bacteria labelled **C** in the diagram might be the possible cause of the food poisoning. [1]

.....

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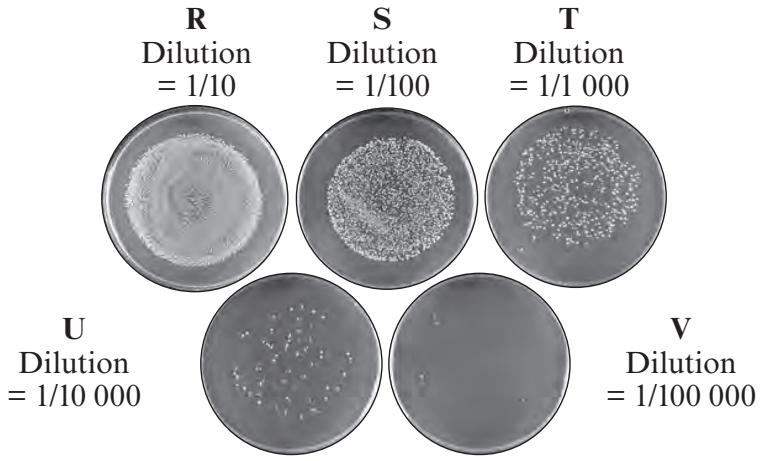
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(d) Using the viable count method Environmental Health Officers made an estimate of the number of bacteria in various foods in the school canteen. Dilutions of 1/10, 1/100, 1/1 000, 1/10 000 and 1/100 000 were prepared and 0.5 cm^3 of each dilution were spread evenly over the surface of agar plates. The plates were incubated at 35°C for 24 hours. A photograph of the results for one of the samples is shown below.



They decided to use Plate **U** to estimate the number of bacteria in the food sample.

(i) With reference to the plates shown above explain why they decided to use Plate **U** and **not** any of the other plates. [2]

.....

.....

.....

.....

(ii) On plate **U** 69 bacterial colonies were counted. Estimate the number of bacteria present in 1 cm^3 of the original food sample. Show your working. [2]

Estimated number of bacteria = ... per cm^3

(iii) Suggest why this number is likely to be an underestimate of the actual number of bacteria present. [1]

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(iv) Suggest why the bacteria were cultured at 35°C and not at 25°C. [1]

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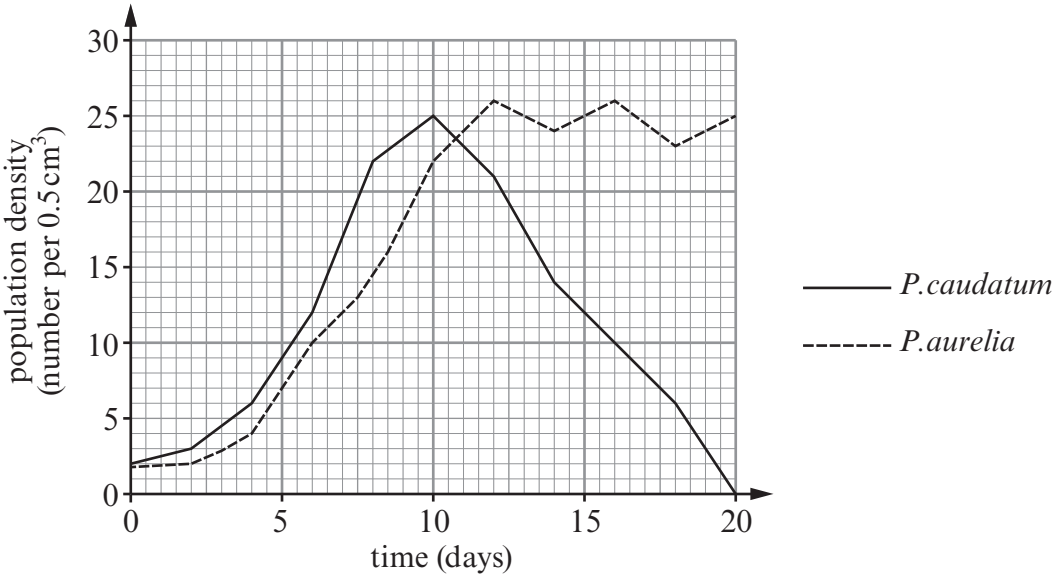
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3. In the 1930s G.F.Gause investigated the population dynamics of different species of a protoctistan of the genus *Paramecium*. These single-celled organisms live in ponds and feed mainly on yeast. Two species, *P.aurelia* and *P.caudatum* swim freely and feed in all parts of a pond while another species, *P.bursaria* feeds mostly at the bottom of the habitat.

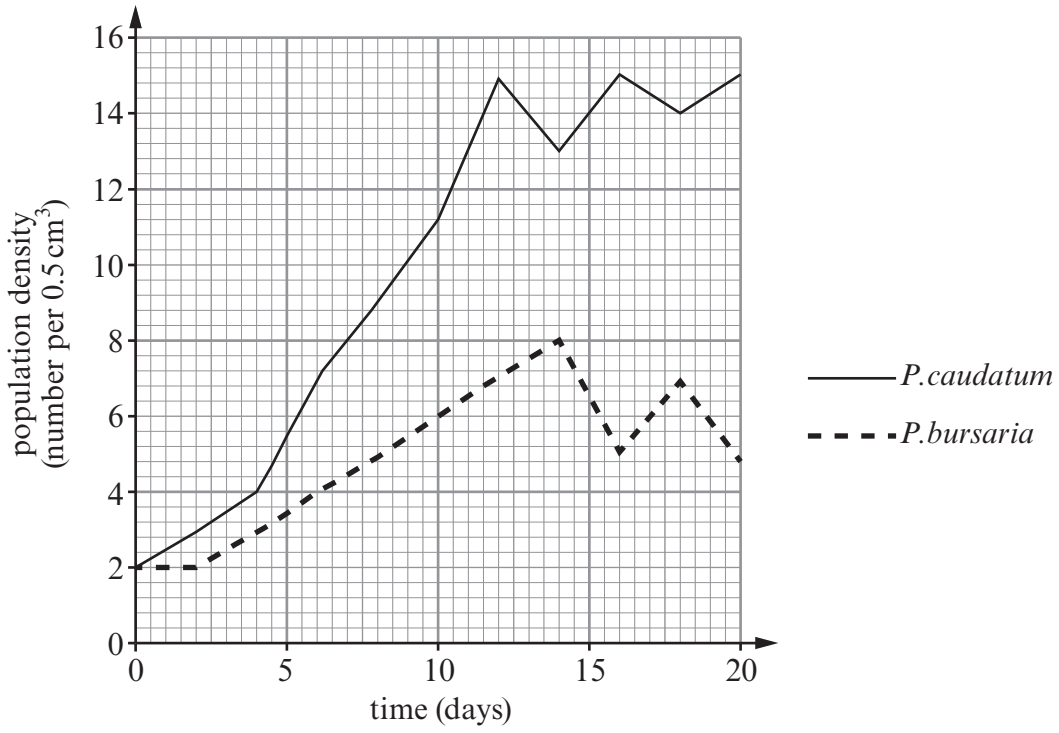
In a series of experiments Gause grew different species of *Paramecium* together in the same container, under the same conditions, to investigate interspecific competition.

The graphs below show results from two of his experiments.

Graph 1 shows the change in population densities of *P.caudatum* and *P.aurelia* when grown together.



Graph 2 shows the change in population densities of *P.caudatum* and *P.bursaria* when grown together.



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(a) (i) Explain what is meant by the term **carrying capacity**. [2]

.....

.....

.....

(ii) From **Graph 1** opposite estimate the carrying capacity for *P.aurelia* in this experiment. [1]

.....

(iii) Describe **TWO** density dependent factors and **ONE** density independent factor that could have prevented the population of *P.aurelia* from exceeding its carrying capacity.

I. <u>Density Dependent</u> [2]

.....

.....

.....

.....

II. <u>Density Independent</u> [1]

.....

.....

(b) (i) Explain how interspecific competition caused the decrease in the population of *P.caudatum* shown in **Graph 1**. [2]

.....

.....

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(ii) Suggest why *P.caudatum* and *P.bursaria* could co-exist when grown in the same container but *P.caudatum* became extinct when grown with *P.aurelia*. [2]

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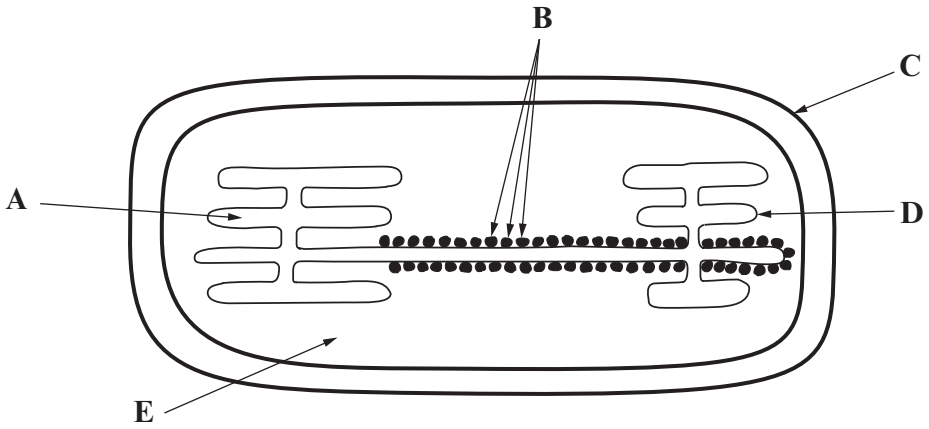
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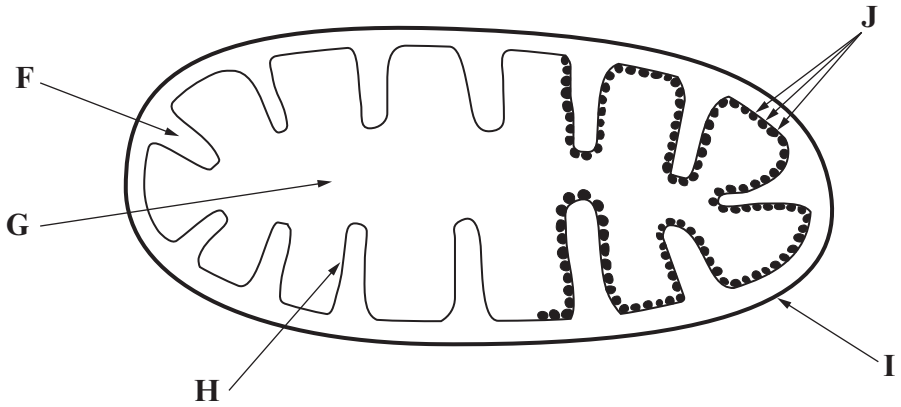
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4. The diagrams below show the main structures in mitochondria and chloroplasts that are involved in the production of ATP.





(a) Use a letter from **each** diagram to identify where the following stages of ATP production take place in chloroplasts and mitochondria. [8]

Stage in ATP Production	Chloroplasts	Mitochondria
Protons are pumped across a membrane by proton pumps fuelled by electron energy		
A high concentration of hydrogen ions builds up		
Protons flow down a concentration gradient and provide the energy for ATP synthesis		
Free electrons are taken up by a final electron acceptor		

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(b) (i) Explain the importance of ATP in cells. [3]

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(ii) Explain why ATP is sometimes called the ***universal energy currency***. [2]

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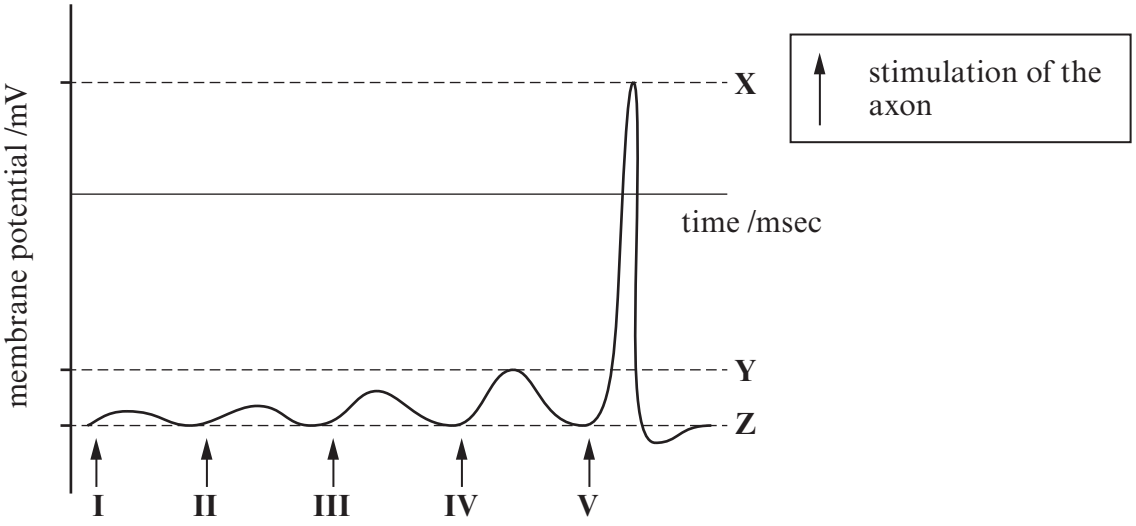
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5. *(a)* The axon of a motor neurone was stimulated using an intracellular electrode. The strength of each stimulus was increased by the same amount each time and the potential difference across the cell membrane was monitored using an oscilloscope.

The results of the experiment are shown in the graph below.



(i) Suggest values for the membrane potential at: [1]

X ..... mV and Z ..... mV

(ii) Generation of an action potential involves ion-channels.

Explain how opening and closing of ion channels results in the depolarisation and repolarisation of the axon membrane shown at point **V** on the graph.

I. Depolarisation; [2]

.....

.....

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II. Repolarisation. [2]

.....

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(iii) Explain why an action potential was not generated by stimuli **I** to **IV**. [2]

.....

.....

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.....

(b) At rest the sodium-potassium pump helps to maintain a constant membrane potential. A model of this protein is shown in the diagram below.



(i) The sodium-potassium pump has a quaternary structure.

Explain what is meant by the term **quaternary structure**. [2]

.....

.....

.....

(ii) On the diagram above use a letter **H** to label a region of the sodium-potassium pump that would have hydrophobic properties. [1]

(iii) Explain why this region would be hydrophobic. [1]

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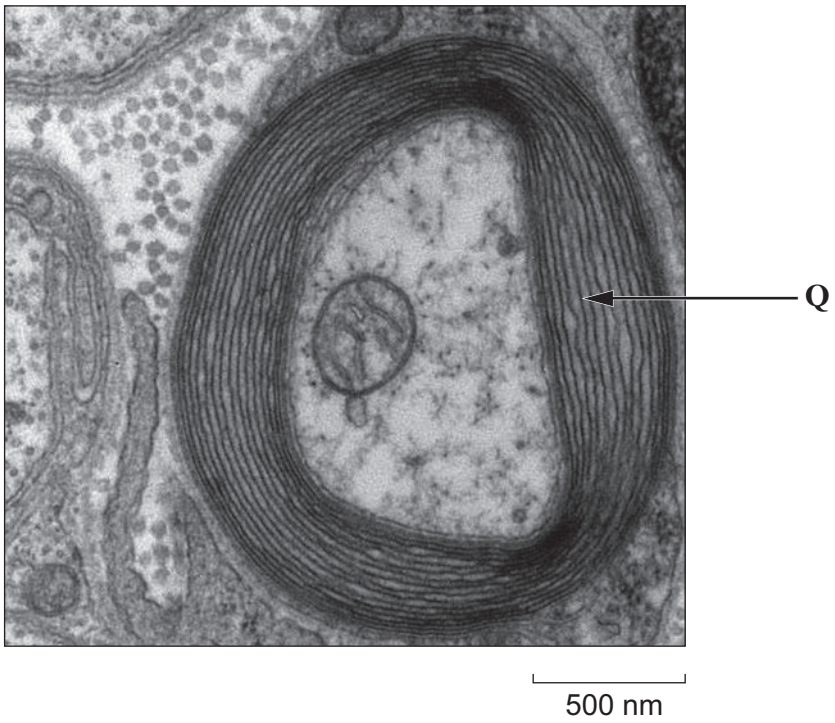
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(c) The transmission electron micrograph below shows a cross section of the axon of a motor neurone.



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(i) Name the substance you would expect to find at **Q** shown on the diagram above. [1]

.....

(ii) Name the cell that produces this substance. [1]

.....

(iii) Explain how the substance secreted by these cells and their arrangement along the neurone affect the speed of transmission of a nerve impulse. [4]

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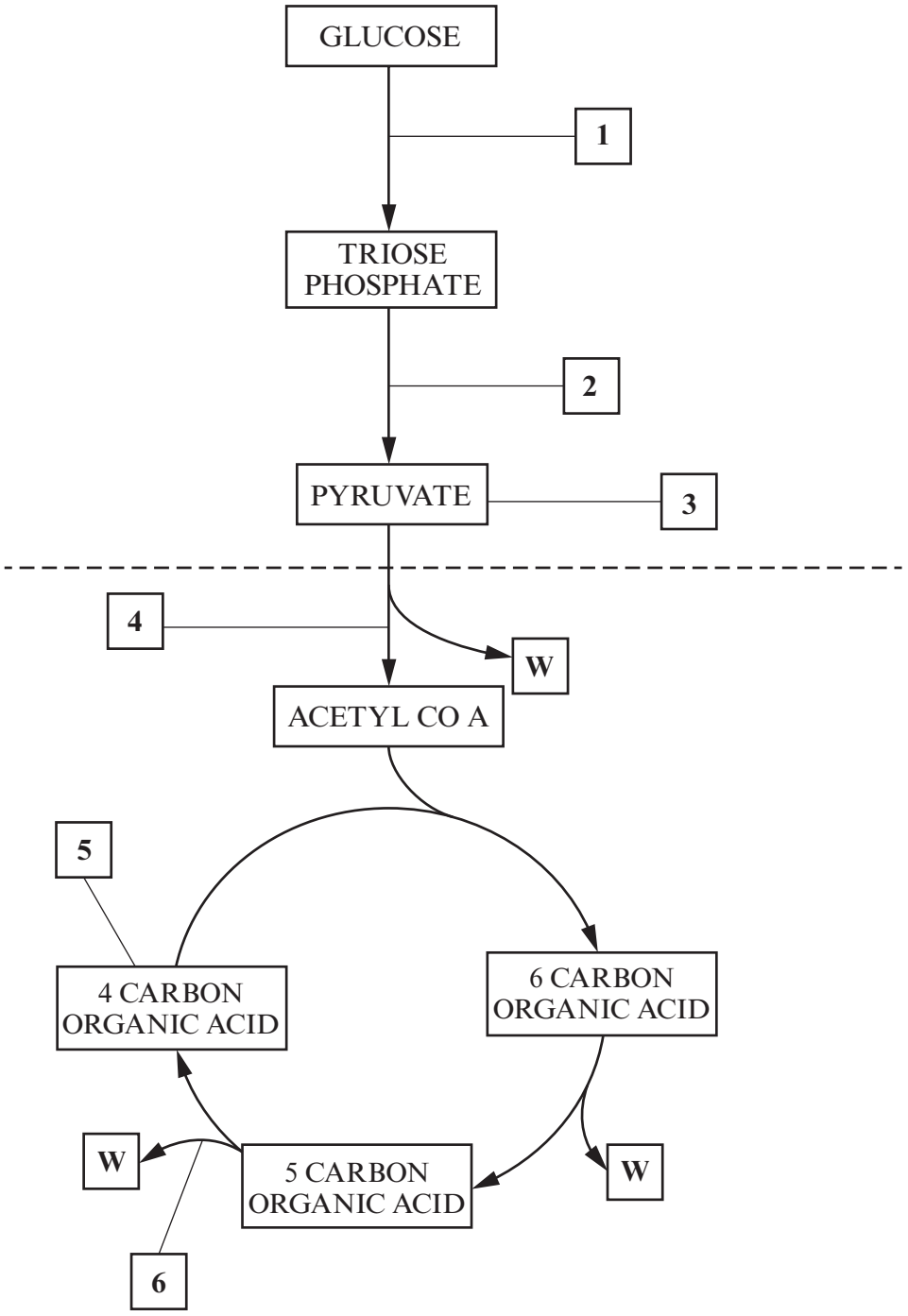
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6. The diagram shows an outline of three stages of aerobic respiration.



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(a) (i) Name the three stages of respiration shown in the diagram opposite and state where in the cell they occur. [3]

Name of stage of respiration	*Where it occurs in the cell*

(ii) Which of these stages will operate in the absence of oxygen? [1]

.....

(b) (i) Identify substance **W** shown on the diagram opposite. [1]

.....

(ii) Name the enzyme responsible for its production. [1]

.....

(c) Use the numbers **1** to **6** from the diagram opposite to identify where the following events take place during respiration. The numbers can be used once, more than once, or not at all.

[4]

Event	**Point(s) on Diagram**
Substrate-level phosphorylation occurs	
Glycerol can be converted to a 3C sugar which enters respiration at this point	
ATP is used in phosphorylation	

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7. Answer **one** of the following questions.

Any diagrams included in your answers must be fully annotated.

Either, *(a)* Explain how **the light-independent** stage of photosynthesis (Calvin cycle) leads to the production of triose phosphate. [7]

Indicate the origin of the raw materials required for this stage of photosynthesis and the possible uses of the triose phosphate produced. [3]

Or *(b)* Explain how the kidney is involved in osmoregulation in mammals. [10]

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END OF PAPER

10

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Question			Marking details	Marks Available
1	*(a)*	(i)	Photoperiod(ism)	1
		(ii)	Phytochrome NOT PR/ PFR	1
		(iii)	Leaves	1
	(b)	(i)	Ammonium/ NH_4^+ + nitrate (ions)/ NO_3^- [both needed for 1 mark] NOT ammonia	1
		(ii)	Denitrification	1
		(iii)	*Azotobacter*	1
			Question 1 total	**6**

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Question			Marking details	Marks Available
2	*(a)*		Gram positive: purple/ violet NOT crystal violet Gram negative: red / pink [both needed for 1 mark];	1
	(b)		Gram +ve: (thick) {murein / peptidoglycan} cell wall (only)/ no lipopolysaccharide layer; {retains/ binds/ absorbs} crystal violet stain / purple colour; Gram –ve: {lipoprotein / lipopolysaccharide}{ layer / wall} (external to murein cell wall); Does not retain {crystal violet stain / purple colour}; Stains {red/pink} with {counter stain / safranin / carbol fuchsin};	3 max 2 if only discuss one type of bacteria
	(c)	(i)	Ignore references to Gram +ve / Gram –ve.	
			A bacillus/ bacilli; NOT rod	1
			B spirillum/ spirilli; NOT spiral	1
			C coccus/ cocci; NOT round / staphylococcus	1
		(ii)	(lipoprotein / lipopolysaccharide layer) protects against (some) {antibiotics) / penicillin / antibodies} / makes them less susceptible to attack by lysozyme/ (lipid component) acts as an (endo)toxin;	1

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Question		Marking details		Marks Available
(d)	(i)	*Plate U*	*- enough colonies for reliable results/* *- colonies easily countable;* *NOT the right number/ we can see them*	*max 2*
		Plate R/S	*- cannot distinguish individual colonies;*	
		Plate T	*- too many colonies to count reliably;*	
		Plate V	*- not enough colonies for reliable estimate*	
	(ii)	69 colonies x 10 000 (dilution factor) x 2 (or 1/0.5); 1 380 000/ 1.38 x 10^6 colonies per cm^3;		2
	(iii)	does not include {dead / non-viable bacteria}/ cannot be sure that {each colony has grown from a single bacterium/ colonies are not clumped}/ ORA;		1
	(iv)	need to count pathogenic bacteria / pathogenic bacteria more likely to grow at temperature close to body temperature/ want bacteria to grow quickly to identify to treat infection as quickly as possible; NOT want to grow them as quickly as possible without qualification		1
		Question 2 total		**[14]**

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Question			Marking details	Marks Available
3	*(a)*	(i)	{maximum number / density/ size} of a population; Sustained/ maintained (indefinitely) by a particular environment/ OWTTE;	2
		(ii)	24 to 26;	1
		(iii)	**I. Density Dependent** nutrient / food / yeast levels; oxygen level / concentration; disease/ infection/ contamination; toxins / waste products; accept pH NOT mates	max 2
			II. Density Independent temperature; size of container; accept pH if not awarded in **I**	max 1
	(b)	(i)	competition for (same) food source/ niche; reject nutrients *P.aurelia* {more successful than/ outcompetes} *P.caudatum;*	2
		(ii)	Live in different locations in same habitat/ *P. caudatum* swims freely while *P. bursaria* lives at bottom of ponds/ *P. caudatum* feeds (on yeast suspended) in water while *P. bursaria* feeds (on yeast that have settled) at the bottom; Less interspecific competition;	2
			Question 3 Total	**[10]**

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Question			Marking details	Marks Available
4	*(a)*			

Chloroplasts	Mitochondria
D;	H;
A;	F;
B;	J;
E;	G;

8

(b) (i) Reference to a suitable function of ATP e.g. protein synthesis/ active transport/ muscle contraction etc NOT movement

Different types of energy can be transferred into a common form;

Only 1 molecule needed to transfer energy to chemical reactions;

Energy can be supplied in {small amounts/ packages/ approx 30.6kJ} /less {energy/ heat} wasted;

Easily transported (across membranes);

{Single enzyme/ only ATPase} needed to release energy from ATP;

{Single bond needed to be broken/ one step reaction} to release energy;

max 3

(ii) used by all organisms/ species; NOT cells

To provide {energy/ fuel} for (nearly all biochemical) reactions;

NOT provide energy unqualified

2

Question 4 Total **[13]**

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Question			Marking details	Marks Available
5	*(a)*	(i)	**A** + 40mV **C** - 70mV [both needed for 1 mark] (accept suitable alternatives eg., -60 / + 30)	1
		(ii)	**depolarisation** Sodium / Na^+ (ion) channels open; Na^+ {flood / diffuse rapidly} into axon; (pd) inside axon becomes {positive/ +40}; **repolarisation** Na^+ (ion) channels close and K^+(ion) channels open; K^+ {flood / diffuse rapidly} out of axon ; Must infer sudden movement out (pd) inside axon becomes {negative/ returns to-70};	max 2 max 2
		(iii)	threshold potential not reached / all sub-threshold stimuli; stimulus / depolarisation not enough to open Na^+ (ion) channels; ref. to action potential being 'All or Nothing';	max 2
	(b)	(i)	{2 or more/ a number of/ several} polypeptide chains; NOT group {bonded/ joined} together; NOT held Reject if used 'wrong' bond – i.e. hydrogen (alone)/ glycosidic/ ester/ peptide to form functional protein/ OWTTE;	max 2
		(ii)	H 	1
		(iii)	middle of cell membrane is composed of {lipid / fatty acid side chains / tails}/ non polar;	1

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Question		Marking details	Marks Available
(c)	(i)	Myelin; Accept phosphopilid	1
	(ii)	Schwann cell;	1
	(iii)	Accept annotation on diagram myelin inhibits{loss of charge/ movement of ions} (from axon) / insulates (axon)/ prevemts depolarisation; {gaps/ spaces} (between Schwann cells) called nodes of Ranvier; no myelin present in {nodes/ gaps/ spaces}; depolarisation only possible at Nodes of Ranvier / action potential can only form {at the nodes/ where there is no myelin}/ channels can only {open/close} in the nodes; action potential jumps from one node to the next / saltatory conduction/ lengthens local circuits/ OWTTE; nerve impulse transmission faster;	max 4
		Question 5 Total	**[17]**

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Question			Marking details			Marks Available
6	*(a)*	(i)	Glycolysis	cytoplasm;		3
			Link reaction	matrix (of mitochondria);		
			Krebs Cycle	matrix (of mitochondria);		
			[1 mark each row]			
		(ii)	Glycolysis;			1
	(b)	(i)	Carbon dioxide/ CO_2;			1
		(ii)	Decarboxylase;			1
	(c)		Substrate- level phosphorylation		2; and 6;	4
			Glycerol can be converted to a 3C sugar which enters respiration at this point		3;	
			ATP is used in phosphorylation		1;	
			Question 6 Total			**[10]**

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Question		Marking details	Marks Available
7	*(a)*	Describe how **the light-independent** stage of photosynthesis (Calvin cycle) leads to the production of triose phosphate. [7] Indicate the origin of the raw materials required for this stage of photosynthesis and the possible uses of the triose phosphate produced. [3]	
	A	In stroma (of chloroplast);	
	B	5 carbon compound;	
	C	ribulose bisphosphate / RuBP;	
	D	carbon dioxide <u>fixed/ fixation</u>;	
	E	By enzyme RuBisco;	
	F	To form hexose bisphosphate / 6C compound;	
	G	(breaks down into 2 × 3C) glycerate 3 phosphate/PGA/GP;	
	H	(converted into 2 × 3C) triose phosphate/TP/GALP;	
	I	NADPH H^+/reduced NADP / $NADPH_2$;	
	J	supplies hydrogen/used for reduction;	
	K	ATP broken down into ADP and Pi supplies energy. [Max 7] (not ATP supplies energy).	
	L	ATP + $NADPH_2$ from <u>light dependent stage</u>,	
	M	CO_2 from {environment/respiration}	
	N	RuBP regenerated from TP.	
	O	Phosphate from ATP needed for this.	
	P	TP starting point for synthesis of: glucose, lipids, amino acids, chlorophyll, cellulose, starch etc. Any **2** products. [max 3]	
		Question 7(a) Total	**[10]**

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Question		Marking details	Marks Available
7	*(b)*	Give an account of how the kidney is involved in osmoregulation in mammals. [10]	
	A	Antidiuretic hormone; NOT abbreviated	
	B	(ADH) Is {secreted/ released} by the (posterior lobe of the) pituitary;	
	C	(ADH) is carried in the bloodstream to the (distal convoluted tubule and) collecting duct;	
	D	When the blood is more concentrated / low Ψ/ more negative/ low blood volume;	
	E	Detected by (osmo) receptors in hypothalamus;	
	F	(more) ADH released;	
	G	ADH levels increases the permeability of the (cells lining the) DCT/CD to water /explanation of water channels opening / aquaporins inserted into DCT membrane.;	
	H	Water moves out of the DCT/CD by osmosis;	
	I	Into the {interstitial / tissue} fluid where it is rapidly removed by the capillary network/ vasa recta;	
	J	This occurs because the {medulla of the kidney/ tissue fluid} has a high {solute/ salt/ ion} concentration/low Ψ;	
	K	Due to the countercurrent multiplier system operating in the Loop of Henle/ correct reference of how counter current produced;	
	L	This (conserves water and) produces {small volumes/ concentrated urine};	
	M	Most water absorbed in the PCT;	
	N	Length of loop of Henle effects the volume of urine produced	
	O	Short loop of Hemle results in less water reabsorbed/ ORA	
	P	Correct ref to adaptation to their environment	
			[max 10]
		Question 7b Total	**[10]**

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Surname	Centre Number	Candidate Number
Other Names		2

GCE A level

1074/01

BIOLOGY – BY4

A.M. FRIDAY, 15 June 2012

1¾ hours

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1	**14**	
2	**10**	
3	**14**	
4	**7**	
5	**13**	
6	**12**	
7	**10**	
Total	**80**	

1074
010001

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.

You are reminded of the necessity for good English and orderly presentation in your answers.

The quality of written communication will affect the awarding of marks.

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1. A student introduced a pure culture of anaerobic bacteria into a nutrient medium and recorded the numbers of bacteria per cm^3. The results are shown in the table.

Time / hours	*Numbers of bacteria / millions per cm^3*
0	1.0
1	1.0
2	1.0
3	1.2
4	1.8
5	3.5
6	6.9
7	13.8
8	28.0
9	57.0
10	113.8
11	225.0
12	375.0
13	440.0
14	460.0
15	482.0
16	484.0
17	486.0
18	488.0
19	488.0
20	488.0

(a) (i) Calculate the percentage increase in population size between 7 and 8 hours after introduction of the bacteria into the nutrient. Show your working. [2]

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(ii) How do you account for the low rate of population growth in the first three hours of the experiment? [2]

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(iii) The stage of rapid growth in population size is described as being exponential. What is meant by the term exponential growth? [1]

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(iv) Give **two** reasons which could lead to a decline in population growth in this culture. [2]

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(b) What conditions would be needed for the growth of the bacteria in the experiment? [3]

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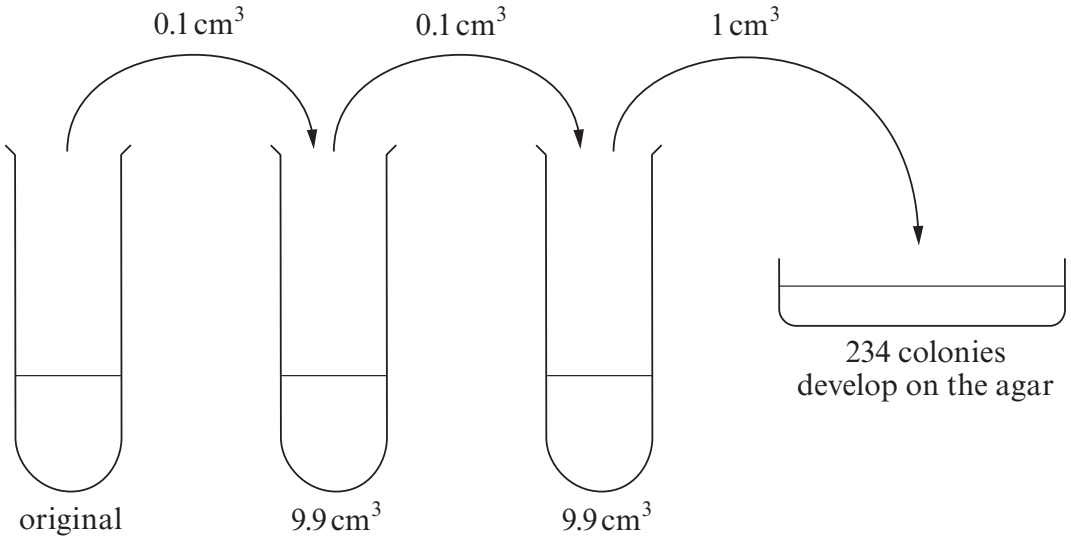
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(c) The numbers of bacteria in sea water are commonly monitored. Small samples of the water are taken, diluted and plated onto nutrient agar. The diagram represents the stages of serial dilution to assess the numbers of bacteria in an original sample.



Calculate the number of bacteria per cm^3 in the original sample. Show your working. [2]

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(d) Describe **two** precautions which should be carried out to ensure aseptic conditions in **this** experiment. [2]

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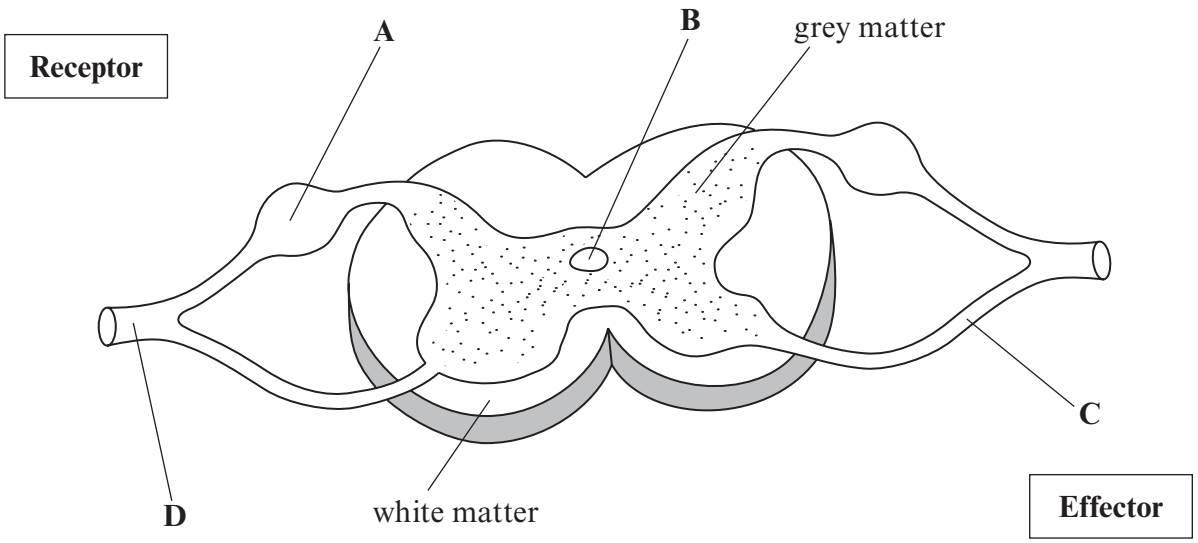
(Total 14 marks)

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2. A diagram of a section of the spinal cord is shown.



(a) (i) Identify structures **A-D**. [4]

A .....

B .....

C .....

D .....

(ii) Explain why the white matter is white and the grey matter is grey. [2]

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(b) (i) On the diagram above, draw a **sensory neurone**, a **relay neurone** and a **motor neurone**. The sensory neurone should enter at one side of the spinal cord and the motor neurone should exit on the other side. The neurones should link the **receptor** to the **effector**. **Label** each neurone. [3]

(ii) What is the difference in **function** between an axon and a dendrite? [1]

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(Total 10 marks)

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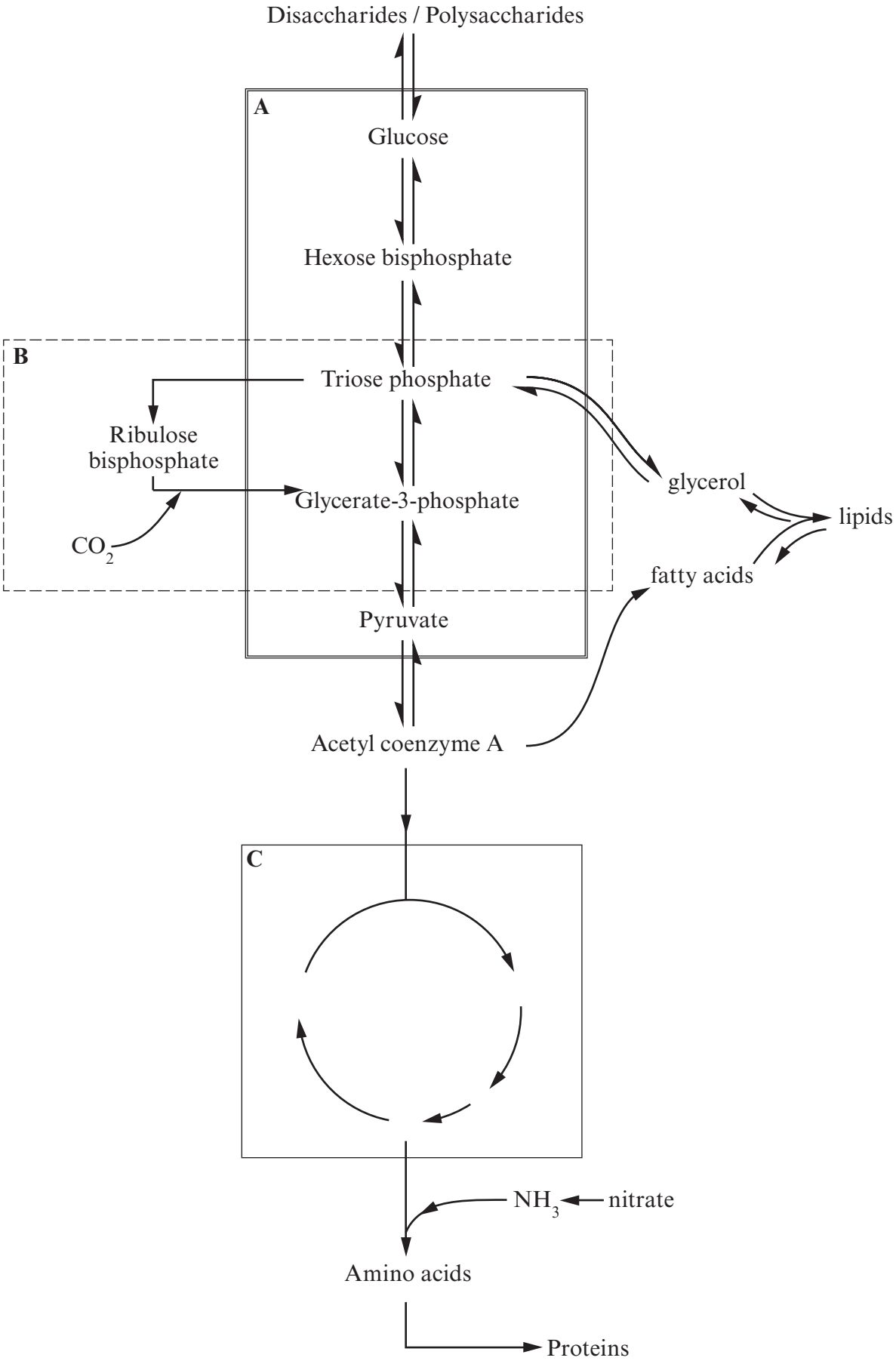
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3. Some of the metabolic pathways which take place in plant cells are shown in the following diagram.



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(a) (i) State the names of the processes in the boxes labelled **A**, **B** and **C**. [3]

A .....

B .....

C .....

(ii) Explain how it is possible for the three metabolic pathways (**A**, **B** and **C**) to take place independently of each other in the same cell. [3]

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(iii) A series of reactions which are essential for process **B** to continue are not shown. Complete the following sentences describing this series of reactions: [4]

A series of reactions which are light ..... take place in the ..... of the chloroplasts. These reactions produce ..... and ..... which are needed for process **B** to continue.

(b) Explain why photosynthesis is essential for the survival of animals on this planet. [2]

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(c) (i) Plant cells also need nitrate ions to synthesise amino acids State **one** *other* use of nitrates in plants. [1]

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(ii) Why is magnesium required by plant cells? [1]

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(Total 14 marks)

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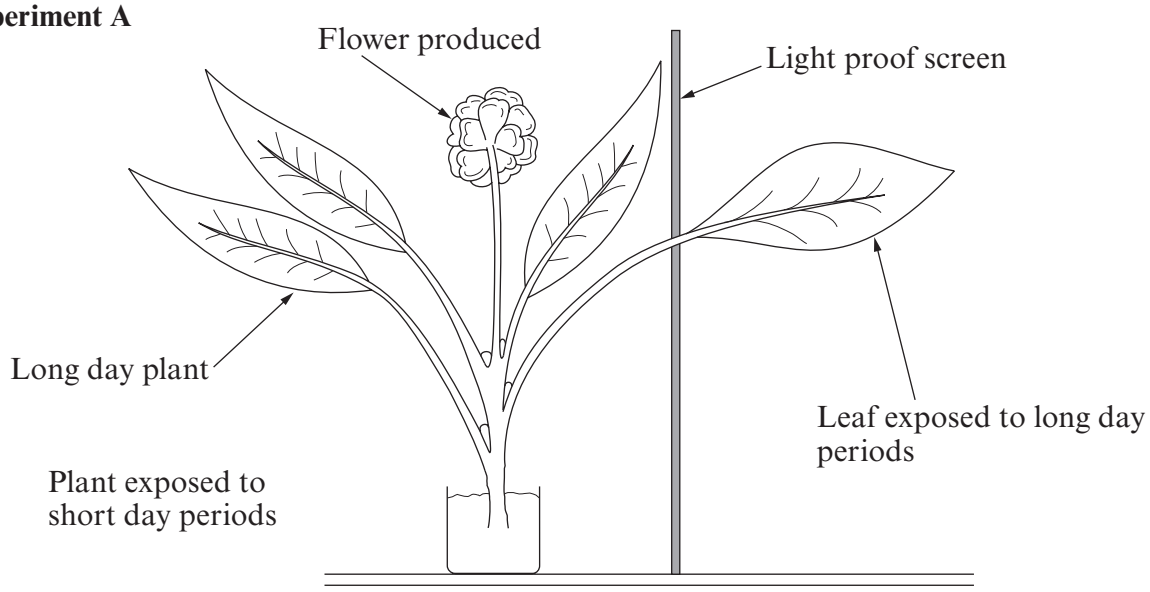
4. *(a)* Define what is meant by the term *photoperiodism*. [1]

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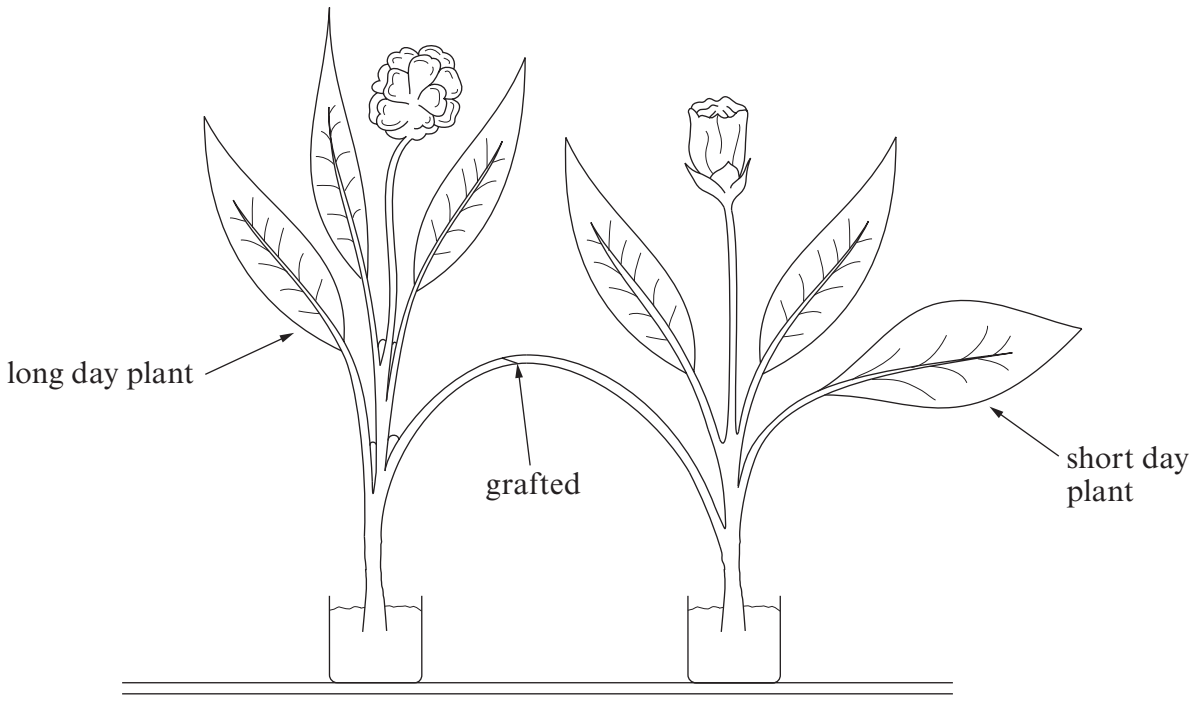
(b) The diagrams show two experiments to study photoperiodism in plants and the effect it has on flowering.
Long day plants only flower if the daylength exceeds a critical value.
Short day plants flower only if daylength is less than a critical value.

Experiment A



Experiment B

Both plants exposed to long days. Flowering in both species takes place but ONLY if vascular bundles are successfully connected in the graft.



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(i) What conclusions can be made from the results of experiment **A**? [2]

.....

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(ii) Suggest a suitable control for this experiment. [1]

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(c) What conclusions can be made from experiment **B**? [3]

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(Total 7 marks)

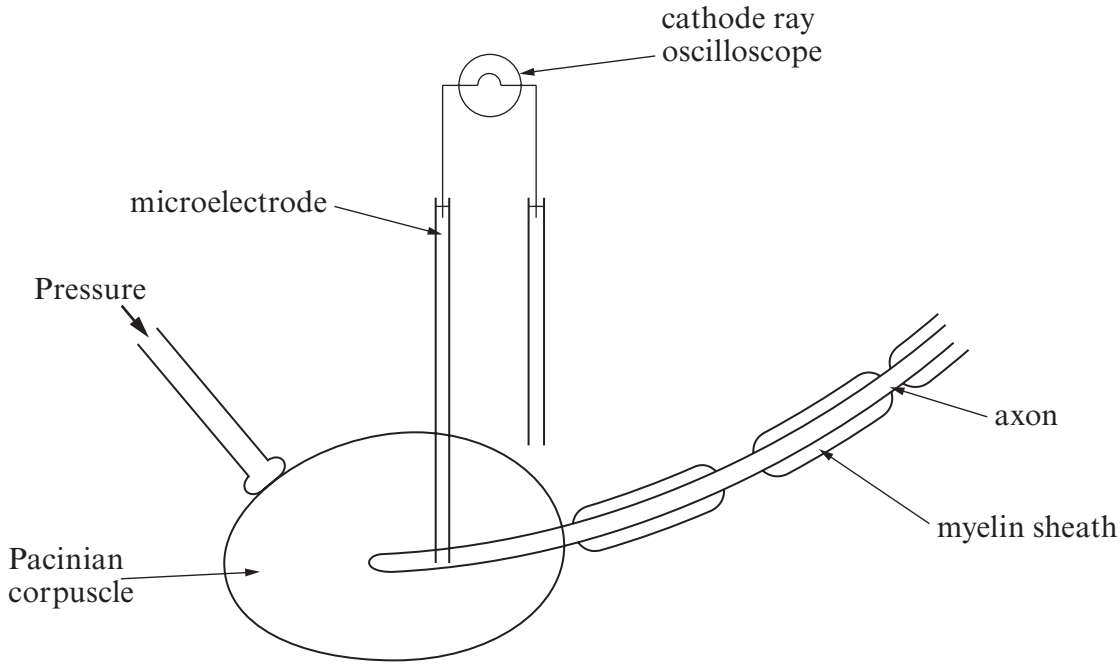
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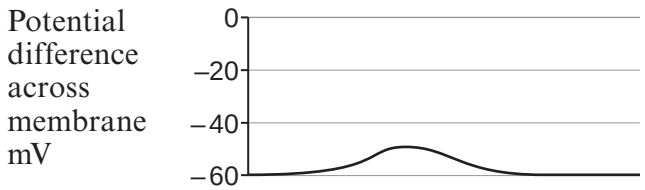
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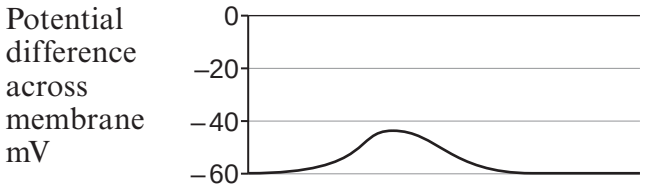
5. Pacinian corpuscles are receptors found in the skin and consist of a **single sensory neurone** surrounded by connective tissue. They respond to changes in pressure.
The Pacinian corpuscle was stimulated and the electrical activity across the membrane of the sensory neurone was recorded using a microelectrode as shown.



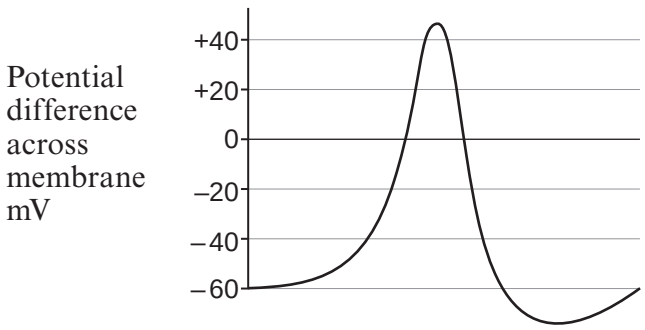
Oscilloscope readings



Light pressure



Medium pressure



Heavy pressure

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(a) (i) Explain the change in potential difference shown by the microelectrode after light pressure was applied. [3]

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(ii) Explain the change in potential difference across the membrane shown by the microelectrode when heavy pressure was applied. [6]

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(b) Many chemical substances affect the transmission of the nerve impulse across the synapse.
Suggest **two** ways by which excitatory drugs could change activity at the synapse and **two** ways by which chemicals could inhibit activity at the synapse. [4]

Possible mode of activity of excitatory drugs:

1 .....

.....

2 .....

.....

Possible mode of activity of inhibitory chemicals.

1 .....

.....

2 .....

.....

(Total 13 marks)

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6. Complete the following using appropriate scientific terms.

The general name given to glands which produce hormones are ..... glands. Hormones are involved in the maintenance of a constant internal environment, this is referred to as ..... . If there is a move away from the norm or set point a corrective procedure takes place which returns it to the norm and this is referred to as ..... .

Osmoreceptors in the ..... of the brain constantly monitor the ..... of the blood.

ADH is a hormone that is produced in specialised nerve cells and it is then stored in the ..... .

If there is a need for the body to conserve water a nerve impulse causes the release of ADH into the ..... which transports it to the target organ.

ADH acts on the cells of the ..... where it attaches to ..... on the membrane of these cells. This causes protein channels to open and water passes through these channels by ..... into the ..... of the medulla and then into the blood. A small volume of concentrated ..... is produced.

(Total 12 marks)

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7. Answer **one** of the following questions.

Any diagrams included in your answers must be fully annotated.

Either, *(a)* Describe how the structure of the different regions of the nephron and associated blood supply are adapted to their function. [10]

Or *(b)* Write an account outlining the similarities and differences in the ways that mitochondria and chloroplasts generate a proton gradient and synthesise ATP. (Diagrams alone are insufficient). [10]

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(Total 10 marks)

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Questions	Marking details	Marks Available
1. (a) (i)	28.0 - 13.8/13.8 OR 14.2/13.8; 102.9 / 103%; (2 marks for correct answer) (1 mark for calculation if answer incorrect)	2
(ii)	Any 2 from: Genes switched on; Synthesis of enzymes / protein synthesis; Replication DNA; Cells increase in size / storage of nutrients; Digestion / absorption; Getting used to new medium / OWTTE; NOT reference to small number	2
(iii)	Population grows at an increasing <u>rate</u> / <u>doubles in unit time</u> / is growing logarithmically; NOT birth rate.	1
(iv)	{Competition for / Lack of} nutrient; build-up of waste products; oxygen supplied; Accept ref to competition with other species / predation (qualified); Accept carrying capacity has been <u>exceeded.</u>	2

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Questions	Marking details	Marks Available
(b)	**Any 3** from Suitable / optimum / stated / best / temperature; Suitable optimum / stated / best / pH; Source of carbon / named carbohydrate / sugar / lipids / glycerol; Source of nitrogen / amino acids / nitrates / ammonium; Or nutrients (1 mark alternative if above not named); Mineral ions; Absence of Oxygen / anaerobic conditions; If state oxygen <u>needed</u> = Max 2 marks.	3
(c)	234 x 10 000; 2.34 million / 2 340 000; (2 marks for correct answer / 1 for calculation if answer incorrect)	2
(d)	Sterile equipment / autoclave equipment; Flame loop; Disinfectant bench; Flame neck of tube; Work next to flame / updraft; Ref to lid of petri dish; NOT wash hands / wear lab coat / shut windows	2
	Question total	**14**

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Questions			Marking details	Marks Available
2.	(a)	(i)	A Dorsal root ganglion; B Central canal / spinal canal / (accept Cerebro Spinal fluid); C Ventral root; D Spinal nerve/ nerve (fibres) / collection of neurones;	4
		(ii)	White matter made of myelin (sheath) / Schwann cells / lipid / phospholipid; NOT fat. Grey matter made of cell bodies / nuclei;	2
	(b)	(i)	1 mark for each neurone correctly labelled and in correct position, including position of cell bodies. Sensory neurone – labelled, connecting receptor to grey matter, passing through dorsal root, with correct cell body; Relay nerve – labelled, connecting sensory and motor, inside grey matter; Motor nerve – labelled, connecting relay to effector, through ventral root on opposite side; Reject continuous line.	3
		(ii)	Dendrite conducts {impulse / electrical signal / action potential} towards {cell body / nucleus}, axon conducts away from {cell body / nucleus}; NOT message / information.	1
			Question total	**10**

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Questions			Marking details	Marks Available
3.	(a)	(i)	A Glycolysis; B Calvin cycle / light independent reactions; C Krebs cycle / citric acid cycle / tricarboxylic acid cycle (Accept TCA cycle);	3
		(ii)	Different places within cell; NOT different places in the chloroplast; Different enzymes; A Cytoplasm / glycolysis takes place in cytoplasm; B Chloroplast / calvin cycle takes place in chloroplast; C Mitochondria / krebs cycle takes place in mitochondria; Reference membrane separation / compartmentalisation;	3
		(iii)	Dependent; Grana / thylakoid (membranes); $NADPH_2$ / reduced NADP / NADPH; } can be either way round ATP; }	4
	(b)		Oxygen; Organic materials / compounds / named organic material / fixing carbon; NOT nutrients / food / ref to CO_2.	2
	(c)	(i)	DNA; Nucleic acids; RNA; chlorophyll; ATP; NAD; FAD;	1
		(ii)	Chlorophyll; NOT chloroplast.	1
			Question total	**14**

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Questions			Marking details	Marks Available
4.	(a)		Response controlled by relative length of the light and dark periods; Accept Response controlled by relative length of the {light / day} / {dark / night} periods;	1
	(b)	(i)	{Photoperiod / duration of light / day length} detected by <u>leaf</u> OR only one leaf needs to be exposed to light for flowering to occur; Makes {Hormone / plant growth substance / chemical / floragen}; High PFR / P730;	2
		(ii)	Expose whole plant / leaf to short day periods;	1
	(c)		Hormone same in all species / both plants; Transported from long day to short day plant; In phloem;	3
			Question total	**7**

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Questions			Marking details	Marks Available
5.	(a)	(i)	(Stimulation) causes sodium ions to {move in / diffuse};	3
			NOT active transport.	
			Inside becomes less negative / <u>some</u> depolarisation;	
			Threshold not reached / Ref to 'all or nothing' law;	
			Sodium voltage gated channels remain closed / no action potential;	
		(ii)	Sodium ions in; NOT pumped / active transport;	6
			Threshold reached;	
			Sodium (voltage gated) channels open;	
			Depolarisation;	
			Inside becomes +ve / (from -60 to) +40mV;	
			Action potential;	
			Sodium (gated) channels close <u>and</u> Potassium channels open;	
			K^+ move (down concentration gradient) / diffuse out;	
			Repolarised;	
			Ref hyperpolarisation / refractory period;	
			sodium potassium pump restores resting potential;	
	(b)		<u>Excitatory</u>	2
			Mimic normal transmitter;	
			Inhibit breakdown of transmitter / cholinesterase;	
			Blocks uptake back into presynaptic knob;	
			Increases number of receptors on post synaptic membrane;	
			<u>Inhibitory</u>	2
			Prevent exocytosis / stop release of transmitter substance;	
			Bind with receptors on post synaptic membrane and block it;	
			Prevents Ca^{2+} entry into presynaptic knob;	
			Question total	**13**

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Questions	Marking details	Marks Available
6.	Endocrine;	12
	Homeostasis;	
	Negative feedback;	
	Hypothalamus;	
	{Water / solute} potential;	
	Posterior pituitary;	
	Blood;	
	Collecting duct / distal convoluted tubule; NOT DCT;	
	Receptors / glycoproteins;	
	Osmosis;	
	Tissue fluid;	
	Urine;	
	Question total	**12**

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Questions	Marking details		Marks Available
7. (a)	A	Afferent vessel wider than efferent; NOT bigger.	
	B	Increase in blood pressure;	
	C	Gaps / pores between / in endothelial cells;	
	D	Gaps / pores in basement membrane;	
	E	Podocytes feet / filtration slits;	
	F	Ultra filtration {into Bowman's capsule / from glomerulus};	
	G	Example of substance which can pass through and one which cannot;	
	H	Proximal convoluted tubule cells have microvilli to give large surface area / Folded base membrane / basal channels;	
	I	Large numbers mitochondria for active transport / ATP synthesis;	
	J	Selective re-absorption in proximal convoluted tubule;	
	K	Ascending limb loop of Henle pump Na^+ / out;	
	L	But impermeable to water;	
	M	Decreases water potential in medulla;	
	N	Descending limb permeable to water / water moves out by osmosis;	
	O	Collecting duct walls receptors for ADH;	
	P	Collecting duct / distal convoluted tubule walls variable permeability / OWTTE;	
		Question total	**10**

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Questions	Marking details	Marks Available

(b) **Similarities**

A Both involve transport of electrons;

B {ETC / cytochrome chain / carriers} in membrane;

C Energy released used to pump;

D Protons;

E Creates Proton gradient / pH gradient across the membrane;

F Protons diffuse down concentration gradient;

G Stalked particles / ATP synthetase;

H ref to Chemiosmosis in correct context;

Differences

	RESPIRATION	**PHOTOSYNTHESIS**
I	Substrate level phosphorylation /	No Substrate level phosphorylation;
J	Electrons from hydrogens produced in respiration / reduced carriers /	Electrons come from chlorophyll / water;
K	Hydrogen from glucose / fats / amino acids /	OR Production of $NADPH^+$ increases the proton gradient;
L	Electrons combine / reduce H^+ and O to form water / oxygen is final electron acceptor;	
M		Cyclic phosphorylation - electrons back to chlorophyll/ {Non cyclic to NADP / final electron acceptor is NADP};
N	Chemiosmosis occurs - Mitochondria, inner membrane /	on the thylakoid membranes (of the chloroplasts);
O	Low pH / H^+ mitochondria inter membrane space /	Chloroplasts thylakoid cavity;
P	3 (types of) proton pump in mitochondria /	1 (type of) proton pump in chloroplasts;

Question total **10**

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Surname	Centre Number	Candidate Number
Other Names		2

GCE A level

1074/01

BIOLOGY – BY4

A.M. WEDNESDAY, 25 January 2012

1¾ hours

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1	**14**	
2	**13**	
3	**14**	
4	**14**	
5	**7**	
6	**8**	
7	**10**	
Total	**80**	

1074
010001

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.

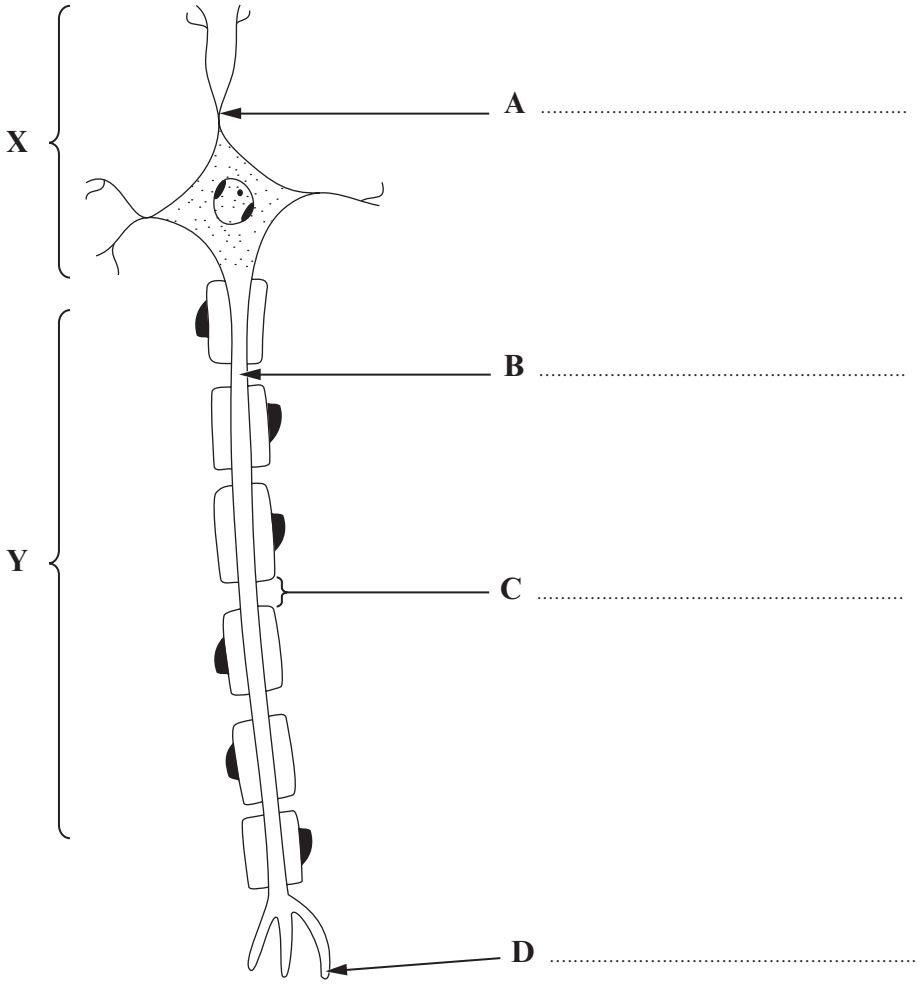
You are reminded of the necessity for good English and orderly presentation in your answers.

The quality of written communication will affect the awarding of marks.

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1. *(a)* (i) Label structures **A-D** on the diagram of the motor neurone below. [4]



(ii) Give the names of **two different types** of effectors. [2]

.....

.....

(iii) Where in the spinal cord would you find structure **X**? [1]

.....

.....

(iv) In which spinal cord root would you find structure **Y**? [1]

.....

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(b) (i) Complete the following which describes how the myelin sheath is formed. [3]

During embryonic development ..... cells become associated with axons and dendrons. These cells ..... around the axon forming a layer called the myelin sheath. This layer is formed of many layers of ..... .

(ii) What are the functions of the myelin sheath? [3]

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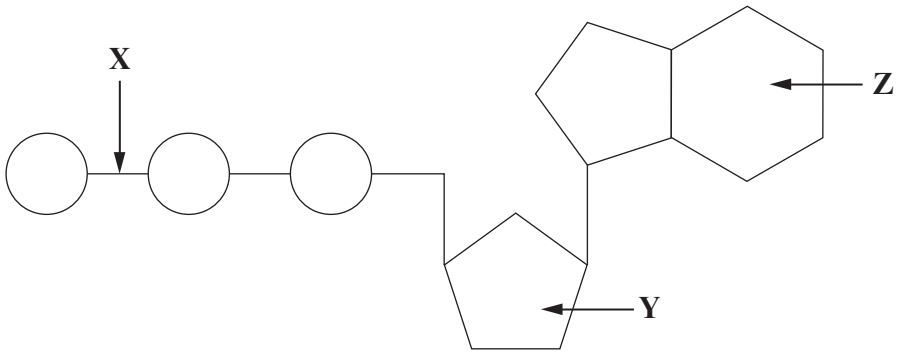
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(Total 14 marks)

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2. *(a)* The diagram represents a molecule of ATP.



(i) Give the name of the reaction which has resulted in the bond **X**. [1]

.....

(ii) Name the pentose sugar **Y**. [1]

.....

(iii) Name the organic base **Z**. [1]

.....

(b) Describe how energy is released from ATP. [3]

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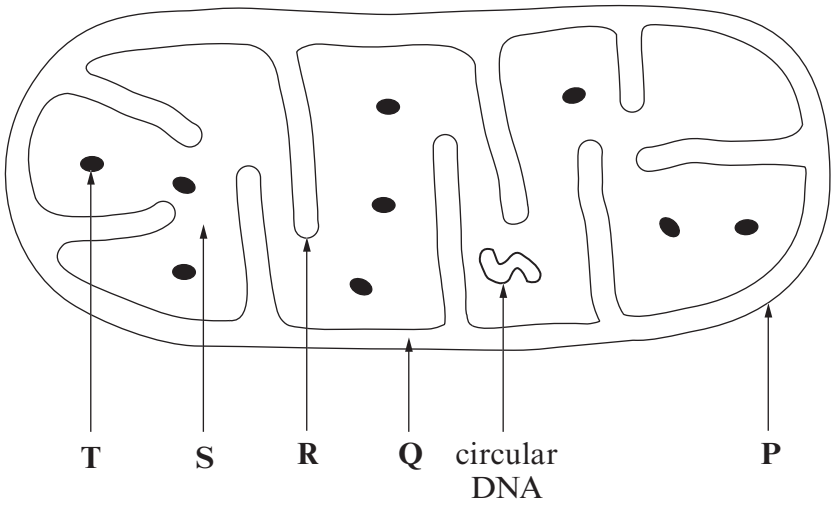
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(c) (i) The diagram shows the structure of a mitochondrion as seen using an electron microscope.



Using the letters on the diagram identify the site of each of the following: [3]

I. Krebs cycle; .....

II. oxidative phosphorylation; .....

III. decarboxylation. .....

(ii) What is the function of the circular DNA? [1]

.....

.....

(iii) Explain how the pH in region **Q** becomes acidic. [3]

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(Total 13 marks)

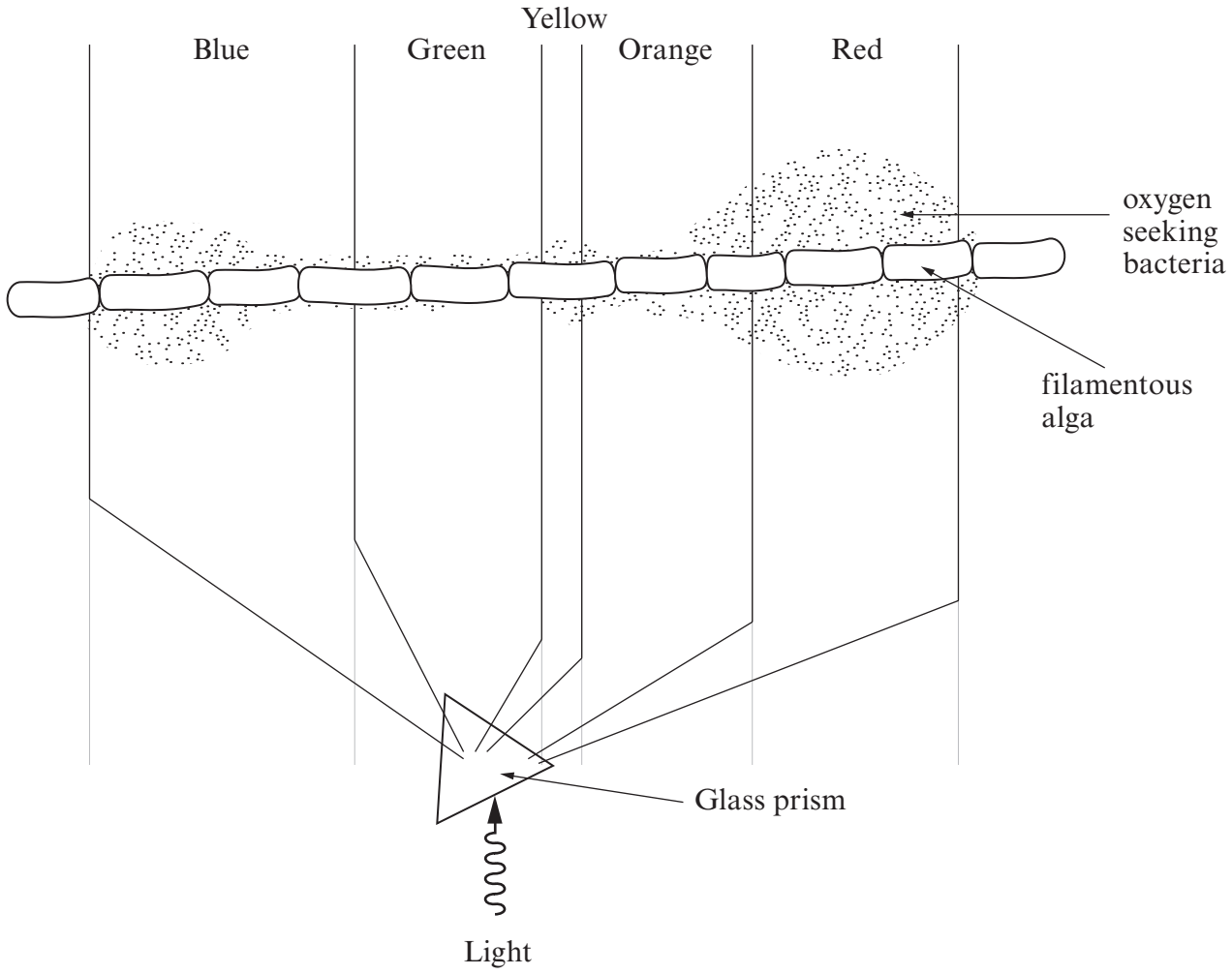
1074 010005

Turn over.

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3. A scientist called Engelmann set up an experiment using a filamentous alga (a single strand of photosynthetic cells joined end to end). The filamentous alga received light which had been passed through a glass prism which split the light into the different wavelengths. He used motile oxygen seeking bacteria to show which regions of the filamentous alga produced most oxygen.



(a) (i) Describe and explain the distribution of the bacteria. [3]

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(ii) Describe the process by which the alga produces oxygen. [5]

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.....

(b) A suitable control would be to repeat the experiment without the prism. Suggest how the bacteria would then be distributed. [1]

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.....

(c) (i) Give the name of the pigment found at the reaction centre. [1]

.....

(ii) Give the names of **two** *other* light absorbing pigments found in chloroplasts. [2]

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(iii) What is the advantage to a plant of having several different light absorbing pigments? [2]

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(Total 14 marks)

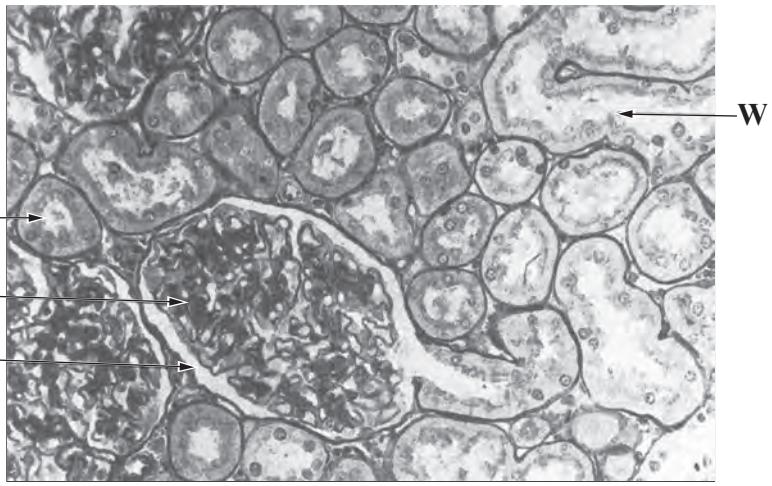
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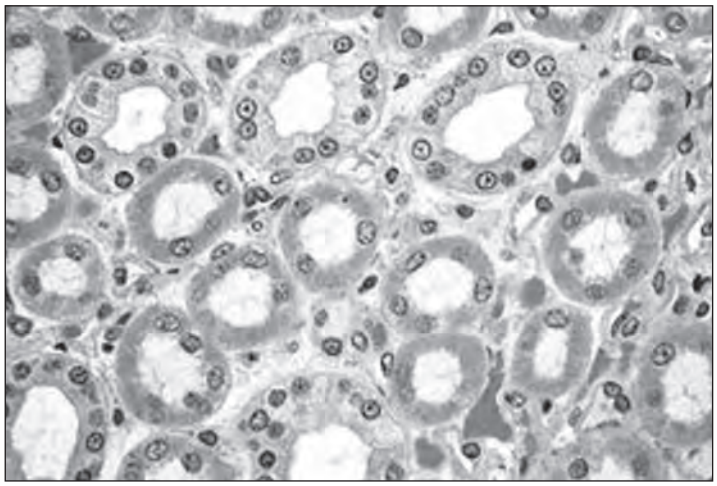
Examiner only

4. The micrographs are of kidney as seen using a light microscope.

Micrograph **A**



Micrograph **B**



(a) (i) Name the area of the kidney from which micrograph **A** is taken. [1]

.....

(ii) In micrograph **A** identify structures **X**, **Y** and **Z**. [3]

X .....

Y .....

Z .....

(iii) **X** and **W** are the same structure. How do you account for their different appearance under the microscope? [1]

.....

.....

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(iv) Micrograph **B** shows structures in the medulla. Which parts of the nephron can be seen? [3]

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(b) Describe the process of ultrafiltration. [6]

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(Total 14 marks)

Turn over.

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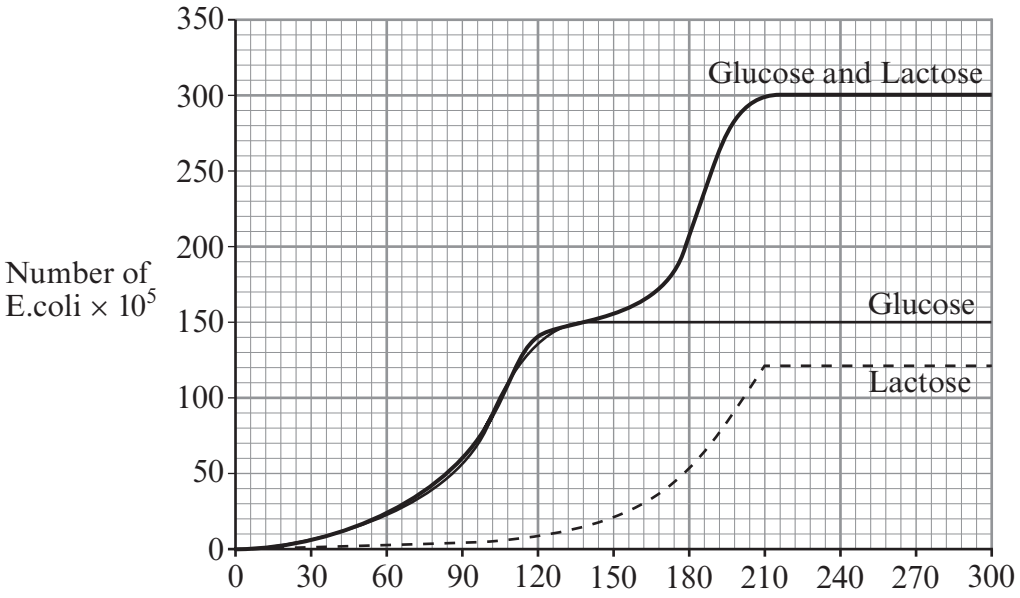
5. Fill in the missing blanks with appropriate scientific terms. [7]

Proteins in dead organisms are decayed by ..... into ..... . The bacterium called ..... converts these into ..... and finally the bacterium ..... converts the waste products of these bacteria into nitrate ions. Bacteria called ..... which live in the root nodules of legumes can fix atmospheric nitrogen.

The bacterium ..... is a free living bacterium in the soil which can also fix nitrogen. It does this by adding atmospheric nitrogen to a carbon source from sugars.

(Total 7 marks)

6. Three fermenters were set up in order to study the population growth of *E. Coli* in different sugar solutions, 0.001 M glucose, 0.001 M lactose and a mixture of glucose and lactose both at 0.001 M. Samples were removed from the fermenter at timed intervals. The population size in each fermenter was estimated. The results are shown in the graph below.



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(a) Explain why there is a difference in population growth between the glucose and lactose. [3]

(b) Describe and explain the shape of the curve when the bacteria are grown in lactose and glucose together. [5]

(Total 8 marks)

Turn over.

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7. Answer **one** of the following questions.

Any diagrams included in your answers must be fully annotated.

Either, *(a)* Describe the function of enzymes and coenzymes (carriers) in the process of respiration. [10]

Or *(b)* Describe the role of the **cell membrane** in

(i) the generation of a nerve impulse; [7]

(ii) the passage of a nerve impulse between two neurones. [3]

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(Total 10 marks)

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Question	Answer	Mark
1. (a) (i)	A = Dendrite(s), accept dendron; B = Axon/ axoplasm; C = Node(s) of Ranvier; D = Synaptic knob/motor end plate/ axon ending/ axon terminal/ synaptic bulb; NOT synpase/ dendrite/ nerve ending/ neuromuscular junction	4
(ii)	Muscle;	1
	Gland; (name = neutral)	1
(iii)	Grey matter	1
(iv)	Ventral (root) (ref to ganglion = neutral).	1
(b) (i)	Schwann cell; coils/ wraps/ folds/ spreads/ grows/ surrounds; NOT fuses/ binds/ accumulates (cell) membrane / (phospho)lipids	3
(ii)	<u>Electrical</u> insulation; Increase distance of local circuits or currents/ saltatory conduction (or description of); Speed up transmission/ impulses travel faster; Protection of axon / Dendron; NOT protection alone/ protection of nerve Reference to preventing ion exchange/ depolarisation/ action potential	*Max 3*

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Question			Answer	Mark
2.	(a)	(i)	Condensation / phosphorylation;	1
		(ii)	Ribose;	1
		(iii)	Adenine;	1
	(b)		Hydrolysis/hydrolyse; Enzyme / ATPase; NOT Synthetase (ATP)to ADP and iP/ Pi/ phosphate; Ref. 30.6 KJ; Accept answer in range 30 – 30.9	Max 3
	(c)	(i)	S; R; S;	3
		(ii)	Codes (of primary structure) of protein or enzyme or polypeptide/ allows mitochondria to replicate/ self replication	1
		(iii)	Chemiosmosis; Protons/ H^+/ hydrogen ions; Not hydrogen or atoms or molecules Pumped (from matrix) into inter membrane space; Using energy from passage of electrons along the ETC; Accumulation of hydrogen ions;	Max 3

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Question			Answer	Mark
3.	(a) (i)		Photosynthesis produces oxygen/ photolysis produces oxygen/ light dependent stage produces oxygen; Aerobic bacteria/ bacteria need oxygen for respiration; Most bacteria {move/ attracted} to (blue and) red regions; Most {photosynthesis/ photolysis occurs/ more oxygen is released} in the (blue and) red regions / at these wavelengths/ frequencies (650-700nm);	Max 3
	(ii)	A	Light Dependent stage;	
		B	(Absorbed) energy passed to reaction centre or primary pigment or chlorophyll a;	
		C	Excites electron or electron lost/ emitted;	
		D	Reference to PS II;	
		E	Photolysis;	
		F	Use of photolysis equation/ or description of;	
		G	Replace electrons lost (from PS II) ;	
		H	Oxygen released	
	(b)		Evenly/ equally (along strand)	Max 5
	(c) (i)		Chlorophyll a; NOT A	1
	(ii)		Carotenoids; xanthophylls; chlorophyll b; chlorophyll c; carotene Accept phytochromes	Max 2
	(iii)		Increases range of wavelengths/ frequencies (of light) used/ Absorb different wavelengths (of light); More photosythesis/ increased rate of photosynthesis; More sugar/ carbohydrates/ glucose made;	Max 2

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Question			Answer	Mark
4.	(a)	(i)	A = Cortex; (nephron = neutral)	1
		(ii)	X = (proximal) convoluted tubule / (distal) convoluted tubule; Y = Glomerulus / Malpighian body/ glomerular capillaries Z = Bowmans capsule;	3
		(iii)	X transverse section, W = LS./ cut at different angles/ planes/ axes/ OWTTE	1
		(iv)	loop of Henle; ascending or descending; collecting duct;	3
	(b)		Increased/ high, blood/ hydrostatic pressure in glomerulus;	1
	(c)		Afferent arteriole/ Blood vessel wider than efferent/ (or description of process)/ ORA; Pores/ gaps/ fenestrations in endothelium / capillary wall; Pass through pores, in basement membrane; Ref size/ charge allowing only certain substances through/ molecular sieve; 2 examples of substances which pass through; 2 examples of substances which do not; Filtration between (feet) of podocytes; Ref. Hydrostatic pressure having to overcome the water potential of blood;	Max 6

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Question	Answer	Mark
5.	Bacteria / fungi / decomposers; Accept putrefication/ decomposition Ammonium ions; Nitrosomonas; Nitrites/ NO_2^-, Nitrobacter; Rhizobium; Azotobacter;	7

Question		Answer	Mark
6.	(a)	Glucose is a monosaccharide;	
		(and so) can be used instantly/ OWTTE for respiration / directly into glycolysis/ primary metabolite;	
		Glucose more easily absorbed/ ORA;	
		Lactose is a disaccharide/ made of glucose and galactose;	
		And so needs hydrolysis/ broken down/ digested (into monosaccharides) ; REJECT converted unqualified	
		Enzyme/ Lactase needs to be synthesised or made/ ORA	Max 3
	(b)	A Slow start/ lag phase;	
		B Adjusting to surroundings/ synthesis of enzymes/ DNA replication/ small population size;	
		C rapid increase in population/ log/ exponential phase;	
		D No limiting factors/ excess glucose; NOT plenty of food	
		E Levels off / second lag phase;	
		F when glucose runs out	
		G Synthesis of enzymes / lactase (to hydrolyse lactose);	
		H To glucose and galactose;	
		I Rapid rise (when lactose is hydrolysed);	
		J Then levels off / stationary phase/ carrying capacity reached;	
		K Reason for stationary phase/ lactose used up/ toxic waste produced/ oxygen running short;	
		L Use of correct figures;	Max 5

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Question	Answer	Mark
7. (a)	A <u>Decarboxylase</u>; B which removes CO_2; } Only award B and/ or C if an C in Link reaction / Krebs; enzyme is mentioned D Dehydrogenase; E which removes hydrogen; } Only award E and/ or F if F in Glycolysis / link / Krebs; an enzyme is mentioned G ATP synth(et)ase; reject ATPase H which produces ATP from ADP and iP; I NAD acts as hydrogen carrier/ is reduced J in Glycolysis / link /Krebs K FAD acts as hydrogen carrier/ is reduced L in Krebs; M Reduced NAD/ FAD carry protons/ electrons to ETC; N Coenzyme A; O Joins with/ carries an acetyl/ acetate group; P electron carriers in ETC.; ACCEPT mark points on a clearly annotated diagram	Max 10

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Question	Answer	Mark
7. (b)	A Sodium potassium pump;	
	B 3 Na^+ out, 2K^+ in (must refer to ions)/ Membrane more permeable to potassium ;	
	C creates a potential difference across membrane/ membrane polarised/ inside negative compared to outside/ inside -60 / -70 mV; ;	
	D resting potential;	
	E threshold reached ;	
	F sodium (voltage gated) channels/ gates open/ more permeable to sodium;	
	G sodium diffuses/ (accept floods) in;	
	H Ref to depolarisation/ +40mV;	
	I Potassium (voltage gated) channels/ gates open;	
	J sodium channels close;	
	K Ref to repolarisation;	
	L Synaptic knob/ presynaptic membrane + Ca^{2+} channels open/ membrane becomes more permeable;	
	M Synaptic vesicles fuse with <u>presynaptic membrane</u>; NOT bind	
	N Exocytosis/ Description of neurotransmitter secretion; NOT synaptic vesicles	
	O Receptors on <u>post synaptic membrane</u>;	Max 7 A - K
	P Sodium channels open on <u>post synaptic membrane</u>	Max 3 L - P

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Surname	Centre Number	Candidate Number
Other Names		2

GCE A level

1074/01

BIOLOGY – BY4

P.M. MONDAY, 13 June 2011

1¾ hours

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1	**10**	
2	**10**	
3	**12**	
4	**14**	
5	**9**	
6	**15**	
7	**10**	
Total	**80**	

1074
010001

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.

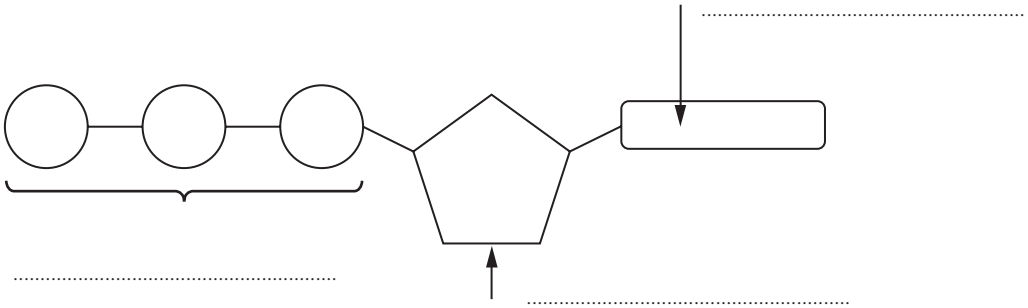
You are reminded of the necessity for good English and orderly presentation in your answers.

The quality of written communication will affect the awarding of marks.

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Examiner only

1. The diagram below shows a molecule of ATP.

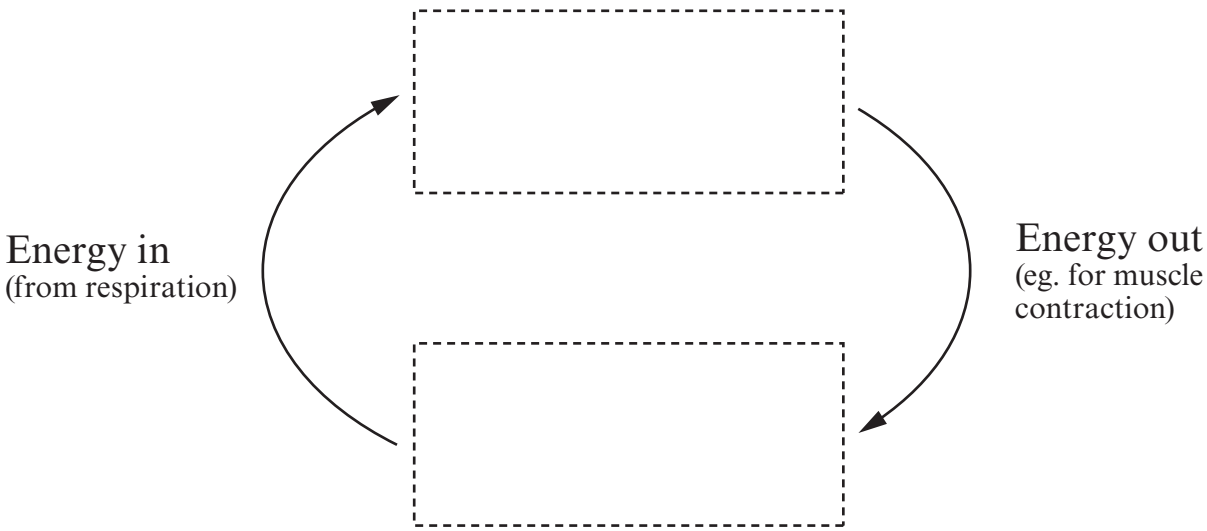


(a) (i) Label the component parts of the molecule. [2]

(ii) Give the full name of the molecule. [1]

.....

(b) (i) In the spaces indicated below, use drawings similar to the one above to show the changes that this molecule undergoes in cells. [1]



(ii) Apart from muscle contraction, name **one** *other* process in cells which requires energy. [1]

.....

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(c) There are four main stages in the production of ATP by **aerobic** respiration.

(i) Complete the table below to show where the listed stages take place and how many molecules of ATP and reduced cofactor are produced from one molecule of glucose. [2]

Stage	Precise location in cell	Number of molecules of ATP	Number of molecules of $NADH_2$	Number of molecules of $FADH_2$
Glycolysis	cytoplasm	2 (net)	2	0
Link reaction				
Krebs cycle				

(ii) Name the fourth stage and give its precise location in the cell. [1]

Name of stage .....

Precise location in the cell .....

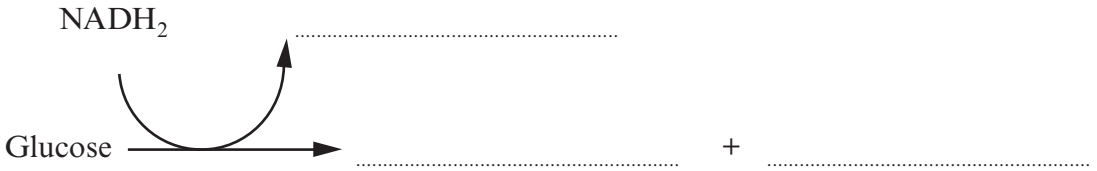
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(iii) State the number of ATP molecules this stage produces for one molecule of each type of reduced cofactor. [1]

$NADH_2$ .....

$FADH_2$ .....

(d) Complete the word equation below to show the products of **anaerobic** respiration in yeast cells. [1]



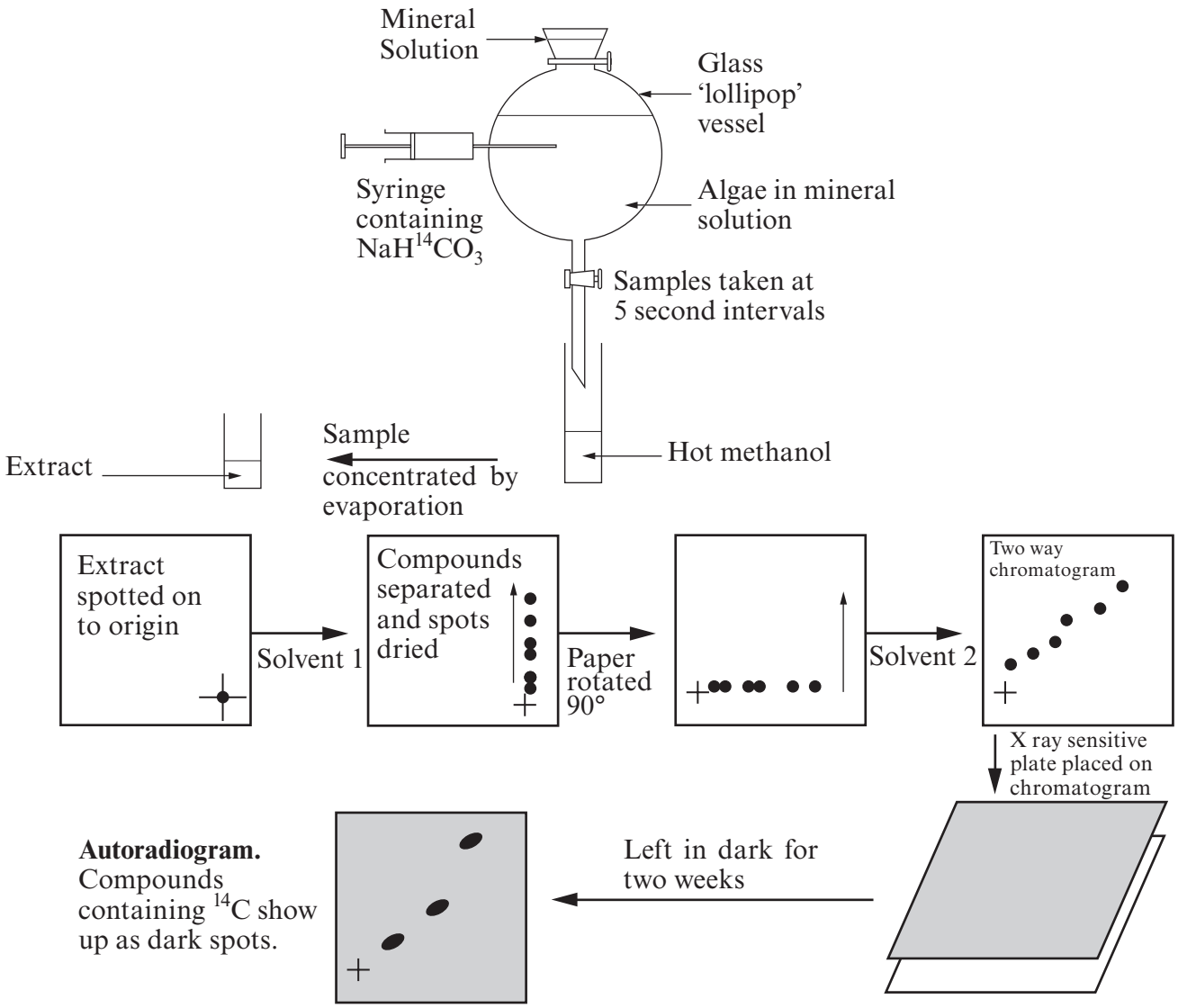
(Total 10 marks)

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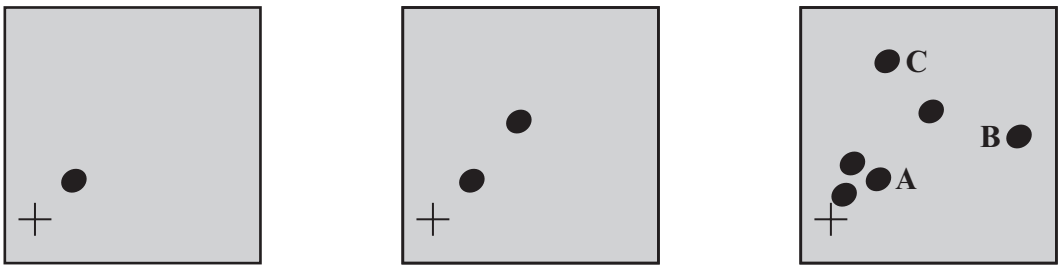
Turn over.

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2. Calvin did experiments on a series of reactions which is now called the light independent stage of photosynthesis. The diagram shows one such experiment. The apparatus was set up as shown and brightly illuminated. The clock was started on the introduction of radioactive hydrogen carbonate ions.



Autoradiograms from one such experiment are shown below:



After 5 seconds | After 10 seconds | After 30 seconds

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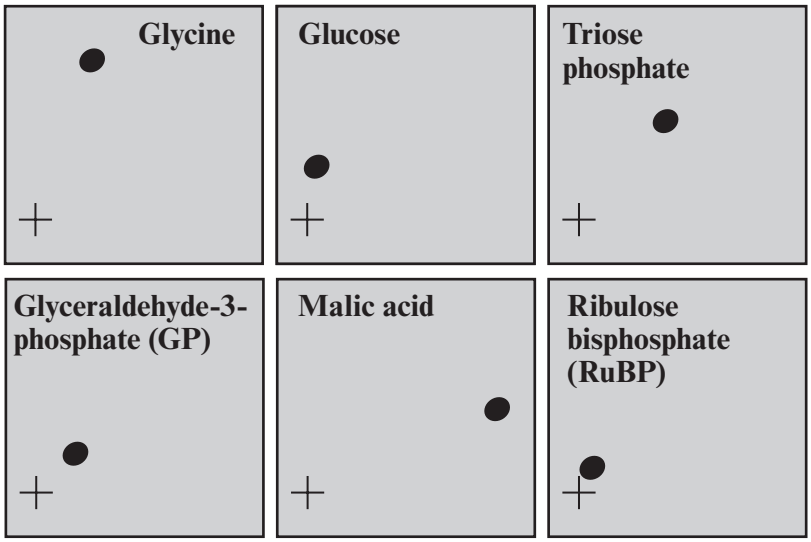
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(a) What is the main difference between these three autoradiograms? [1]

.....

.....

(b) To identify the substances represented by the dark spots, Calvin made autoradiograms of known substances. He then compared their positions with those of the dark spots. The results of some of these are shown below.



Use these autoradiograms and the ones shown in part *(a)* to identify compounds represented by spots **A-C**. [1]

Spot	Name of compound
A	
B	
C	

(c) Use the autoradiograms to determine which were the first and second substances formed. [2]

First .....

Second .....

(d) Glycine is an amino acid. Which chemical element would have been needed in the mineral solution in order for the algae to have made this compound? [1]

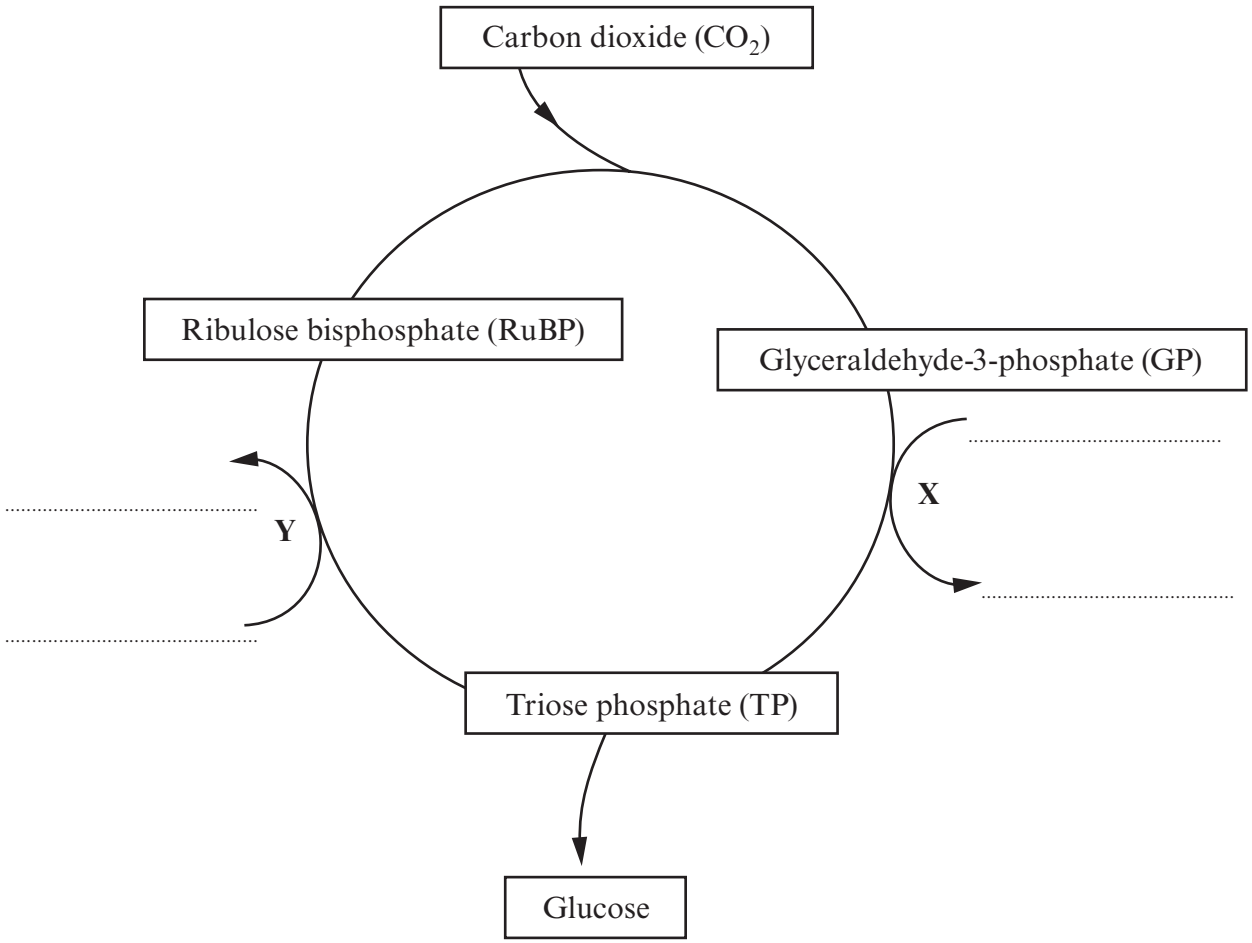
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(e) Calvin worked out that the ribulose bisphosphate is regenerated so that the reactions are in the form of a cycle, which is summarised below:



Compound **X** is a hydrogen carrier and compound **Y** is the universal energy currency in cells.

(i) Complete the diagram to show how compounds **X** and **Y** change during the cycle. [2]

(ii) Which series of reactions provides the compounds **X** and **Y** in chloroplasts? [1]

.....

(iii) State precisely where the production of **X** occurs in chloroplasts. [1]

.....

(f) How many molecules of triose phosphate would be needed to synthesise three molecules of glucose? [1]

.....

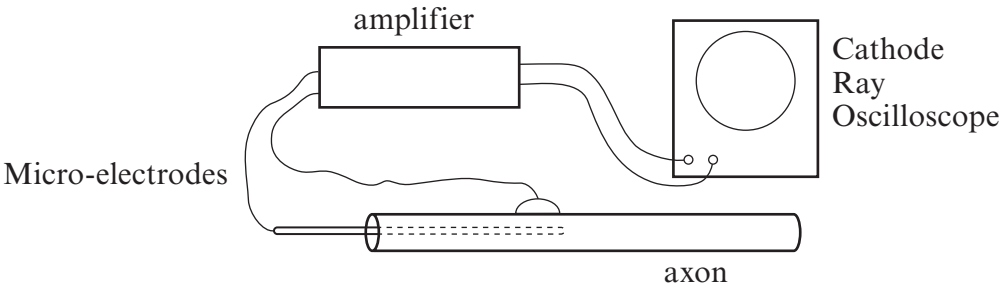
(Total 10 marks)

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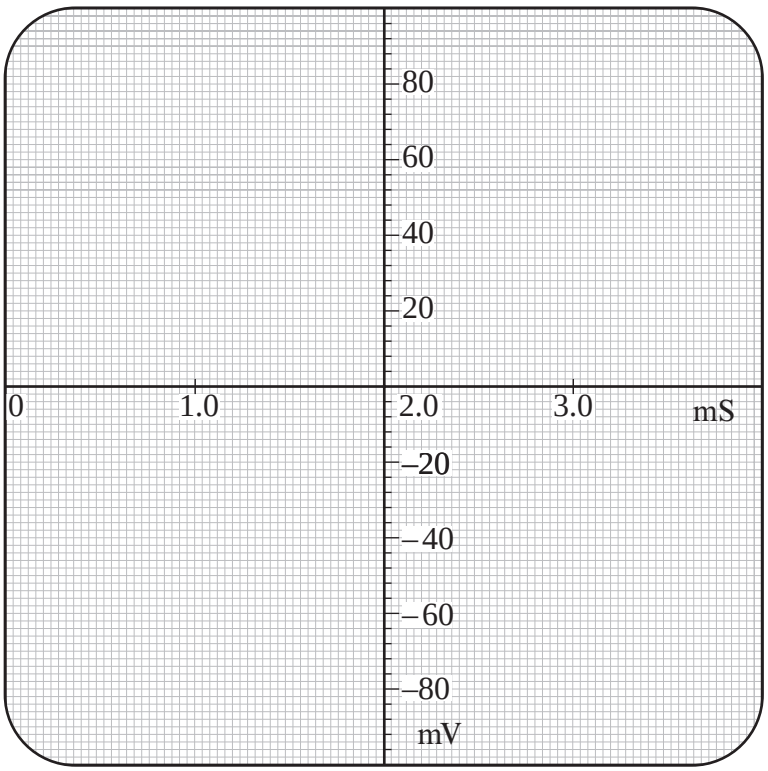
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3. *(a)* The equipment shown in the diagram below is used to measure electrical potential across the membrane of squid giant axons.



(i) Use the grid below to draw a typical action as it would appear on the screen of the cathode ray oscilloscope. [2]

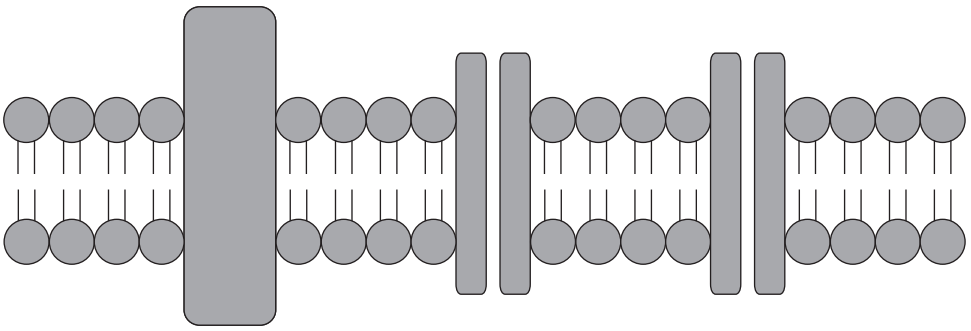


(ii) Label your Action Potential to show, depolarisation and repolarisation. [1]

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(b) The diagram below shows the structural components of the axon membrane that are responsible for the potentials measured in part *(a)*.



Na^+/K^+ pump Na^+channel K^+channel

(i) From which type of biological molecules are the following made?

pumps and channels ..... [1]

the bilayer ..... [1]

(ii) With reference to the diagram, describe how the following events are brought about. [4]

Resting Potential .....

.....

.....

Depolarisation .....

.....

.....

(c) Explain how impulses are transmitted across a synapse. [3]

.....

.....

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.....

.....

(Total 12 marks)

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Turn over.

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4. Following the Haiti earthquake in 2010 there was an outbreak of cholera. A web site describes the cause as follows:

'**Cholera** is caused by the bacterium *Vibrio cholerae* – a curved bacillus each with one flagellum. The genus *Vibrio* is a member of the family Vibrionaceae, which include Gram-negative, motile, facultative anaerobes that utilize glucose as a source of energy.
The bacteria are typically spread by contaminated drinking water.'

(a) Describe what is meant by the following terms used in the article:

(i) Bacillus, [1]

.....

(ii) Gram-negative, [2]

.....

.....

(iii) Facultative anaerobes. [2]

.....

.....

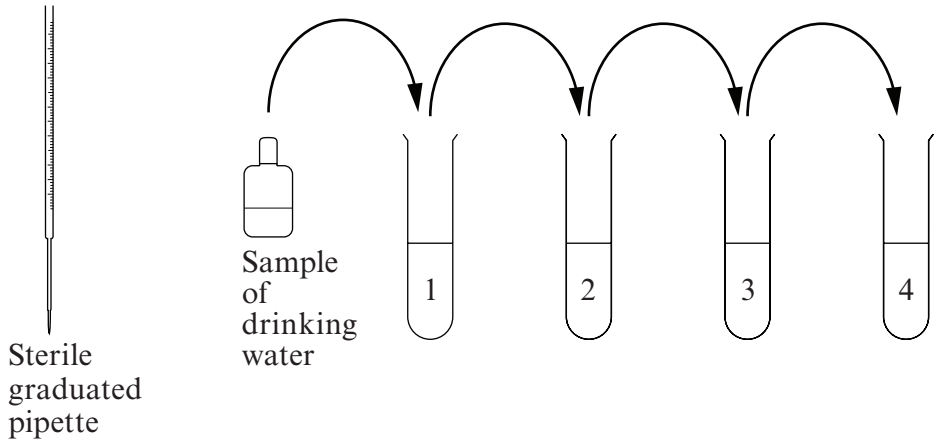
(b) Scientists might be able to determine the extent of contamination by counting the number of bacterial cells in water samples.

(i) What is the difference between a total count and a viable count? [1]

.....

.....

(ii) Both techniques involve serial dilution.
Annotate the diagram below to explain how you would obtain a series of ten fold dilutions of the drinking water sample. [3]



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(iii) If 1 cm^3 of the drinking water sample contained 80 000 living bacterial cells, how many bacterial cells would there be in 0.5 cm^3 of the liquid in tube 4, after this technique had been completed? [1]

.....

(iv) How would you use the dilutions produced to carry out a viable count? [4]

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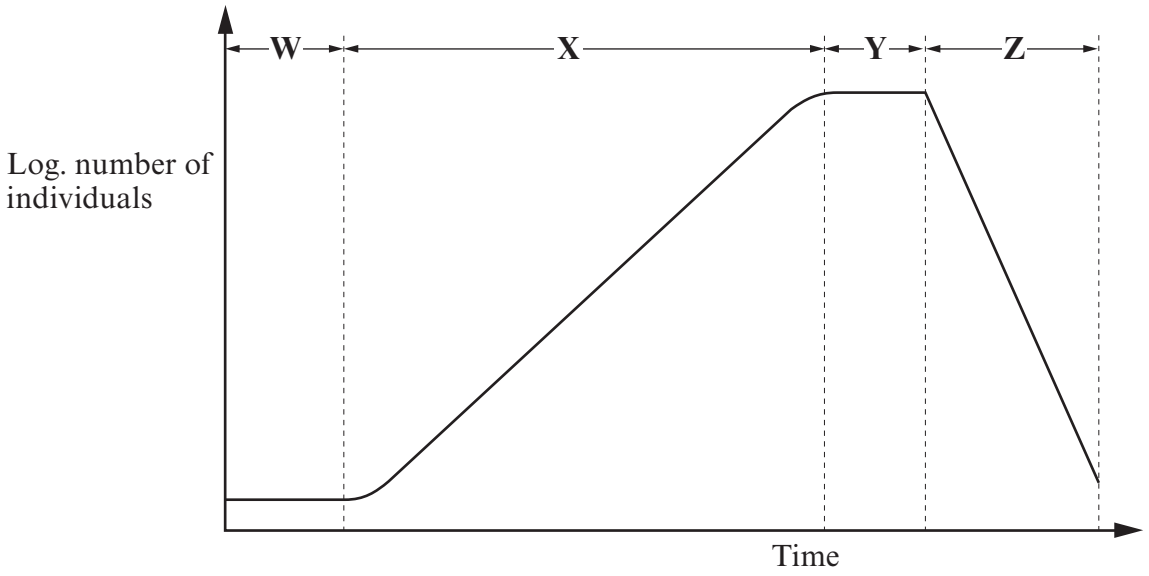
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(Total 14 marks)

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5. The diagram below shows the growth curve for a population of a simple organism such as yeast.



(a) Name the phases of growth **W**-**Z**. [2]

W .....

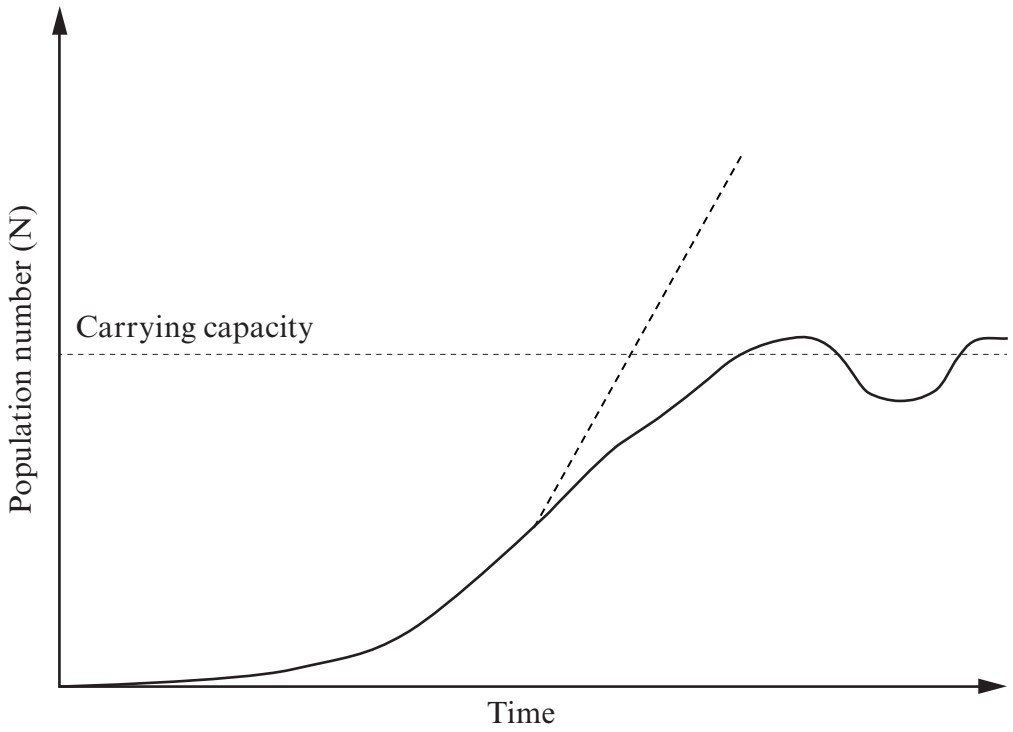
X .....

Y .....

Z .....

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(b) The growth for more complex organisms may be given by the formula;
Population growth = (Births + Immigrations) – (Deaths + Emigrations)
A growth curve for such a population is shown with a solid line below.



(i) Draw an arrow labelled D on the solid line to show **one** phase where (Deaths + Emigrations) exceeds (Births + Immigrations). [1]

(ii) Explain the term *carrying capacity*. [2]

.....

.....

.....

(iii) State **two** examples of **density dependent** factors that can affect the carrying capacity of an ecosystem. [2]

.....

.....

(iv) State **one** example of a density independent factor. [1]

.....

(v) On the graph, extend the dashed line to show what is likely to happen to a population whose size substantially exceeds the carrying capacity. [1]

(Total 9 marks)

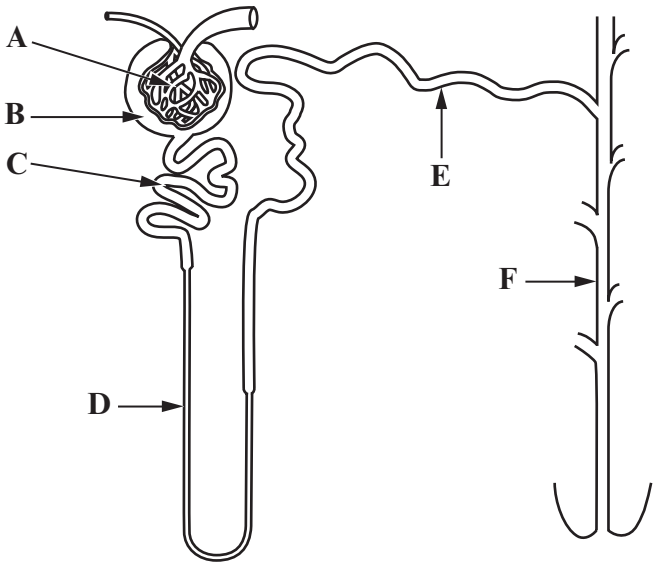
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6. *(a)* Name the functional unit of the mammalian kidney shown in the diagram. [1]

.....



(b) (i) Name the parts labelled **A**-**F**. [3]

A .....

B .....

C .....

D .....

E .....

F .....

(ii) State the function of part **D**. [1]

.....

(iii) How is part **D** adapted in the kidneys of desert mammals such as the kangaroo rat? [1]

.....

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(c) Parts **E** and **F** have restricted permeability which is subject to hormonal control.

(i) Which hormone controls the permeability of parts **E** and **F**? [1]

.....

(ii) Which part of the mammal's body releases this hormone into the blood? [1]

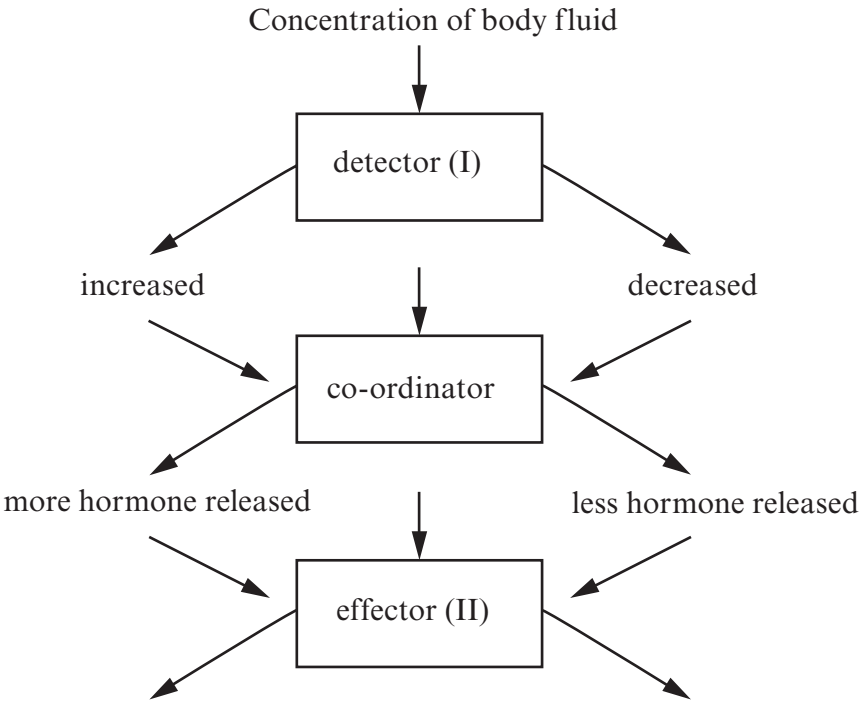
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(iii) Use your answer to parts (i) and (ii) to identify, on the diagram of the Osmoregulatory Feedback Loop below [1]

(I) the detector; .....

(II) the effector. .....

(iv) Complete the diagram below, of an Osmoregulatory Feedback Loop, to explain the mechanism for adjusting urine during osmoregulation. [3]



..... How hormone changes the effector .....

..... How concentration of urine changes .....

..... How volume of urine changes .....

Concentration of body fluid returns to normal

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(d) (i) The environment in which an animal lives plays a part in excretion of nitrogenous waste. Mammals release it as urea. In what form is it released in the following? [2]

(I) Freshwater fish .....

(I) Insects .....

(ii) Suggest **one** advantage to insects of excreting nitrogenous waste in this form. [1]

.....

.....

(Total 15 marks)

7. Answer **one** of the following questions.

Any diagrams included in your answers must be fully annotated.

Either, *(a)* Describe the nitrogen cycle, include the form that nitrogen takes in each part and the roles of bacteria (giving names wherever possible). [10]

Or *(b)* Describe how the principles of a batch culture fermenter are applied in the industrial production of penicillin. [10]

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(Total 10 marks)

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No.			Answer	Mark
1.	(a)	(i)	phosphate; pentose/ribose; adenine (all correct for 2; 1 error = 1) (not: adenosine/nitrogenous base)	**2**
		(ii)	adenosine triphosphate (not: triose phosphate/ATP)	**1**
	(b)	(i)	ATP <u>drawn</u> as in part a in upper box; ADP two Ps attached <u>+ 1P</u> not attached in lower box.	**1**
		(ii)	protein synthesis/biosynthesis/active transport/nerve conduction/cell division/avp (not: metabolism/growth/movement)	**1**
	(c)	(i)		**2**

Stage	Precise location in cell	Number of molecules of ATP	Number of molecules of $NADH_2$	Number of molecules of $FADH_2$
Glycolysis	**cytoplasm**	**2 (net)**	**2**	**0**
Link reaction	**matrix of mitochondrion**	**0**	**2**	**0**
Krebs cycle	**matrix of mitochondrion**	**2**	**6**	**2**

(1 mark for each correct row) (if only 'matrix' penalise once only)

		(ii)	name of stage - electron transfer/transport chain/oxidative phosphorylation + location-inner membrane/cristae of mitochondrion (not: ETC)	**1**
		(iii)	$NADH_2$ -3 $FADH_2$ -2	**1**
	(d)		NAD, ethanol + carbon dioxide in correct places (not: alcohol)	**1**

Total 10 marks

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2.	**(a)**		they have increasing numbers of spots (not: the number of spots)	**1**
	(b)		A - GP, B-malic acid, C-glycine (all 3 for 1 mark)	**1**
	(c)		First - GP; second-Triose phosphate	**2**
	(d)		Nitrogen (not: nitrate)	**1**
	(e)	**(i)**	Y - ATP to ADP (+P); X-$NADPH_2$ to NADP	**1** **1**
		(ii)	light dependent reactions/(non cyclic) photophosphorylation; (not: Z scheme/cyclic photophosphorylation)	**1**
		(iii)	grana/thylakoids	**1**
	(f)		6	**1**
				Total 10 marks

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3.	**(a)**	**(i)**	general shape of spike including overshoot dip. accurate values -70 to +40 or +50 mV (width c.3ms) (allow: 68-80 + 30-60)	**2**
		(ii)	correct labelling of depolarisation on upward and repolarisation on downward side of graph	**1**
	(b)	**(i)**	I proteins	**1**
			II phospholipids	**1**
		(ii)	Ref. to pumps e.g. resting potential – Na^+/K^+ pump pumps Na^+ out and K^+ in;	**1**
			Ref. why difference between two sides e.g. organic anions inside create pd/K^+ channels open; less permeable to Na^+ (not: ref. concentration gradient)	**1**
			depolarisation - impulse opens Na^+ channel/voltage gated channel;	**1**
			Na ions rush in/sudden increase in permeability to Na^+	**1**
	(c)		transmitter substances synthesised in synaptic knob; impulse causes secretory vesicle to migrate to (presynaptic) membrane/Ca ions to rush in; vesicle fuses with membrane discharges transmitter substance/exocytosis; diffusion of transmitter substance across cleft; transmitter binds to post-synaptic membrane/stimulates depolarisation/reference to receptors. (Any 3 in correct sequence; no mention of transmitter substance=2 max)	**3**
				Total 12 marks

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4. (a) (i) rod shaped; **1**

(ii) retains (red) counter stain/stains red/pink in Gram test/do not retain crystal violet; **1**
because of complex nature of cell wall/reference to lipopolysaccharide/does not contain as much merein/peptidoglycan. **1**

(iii) grow best with oxygen; (not: prefer/like oxygen) **1**
but can grow with or without oxygen **1**
(not: ref. aerobic/anaerobic)

(b) (i) viable only counts living cells/cells which are reproducing/total count includes living and dead cells **1**

(ii) 9 cm^3 of sterile distilled water in each tube; (not: tap water)
1 cm^3 of sample transferred to tube 1;
mixed well or ref. 1 cm^3 transferred next tube in sequence;
any reference to aseptic technique. (Any 3) **3**
(labelled diagram=2max e.g. 9cm^3 sterile distilled water + 1 cm^3 sample)

(iii) 4 **1**

(iv) take/prepare 4 sterile nutrient agar plates; (idea of each dilution on a different plate needed)
transfer 0.5 cm^3 /other specified volume of each to a separate plate; (allow: 0.1-1 cm^3)
spread with sterile spreader;
incubate plates at suitable temp./25°C; (allow: 25-40^oC)
count colonies;
1 colony=1 cell.
(any 4 in correct sequence) **4**

Total 14 marks

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5.	**(a)**		W - lag, X-exponential/log, Y-stationary, Z-death (allow: decline) (all correct for 2, 1 error = 1)	**2**
	(b)	**(i)**	(arrow labelled D) pointing to or drawn on the down slope.	**1**
		(ii)	the maximum size of population; (not: optimum size) that can be maintained/supported indefinitely/can be sustained (owtte)	**2**
		(iii)	availability of/competition for food/living space/mates/light; predation; disease/parasitism; accumulation of toxins. (any 2; 1 only from competition; not: competition unqual.)	**2**
		(iv)	temperature/weather (extremes)/flood/fire/natural disasters e.g. tsunami avp	**1**
		(v)	dashed line continued in steep downward gradient (down to at least halfway between line and axis, no lag, no upward turn, down before dip in plotted line i.e. second cross over dotted line)	**1**
				Total 9 marks
6.	**(a)**		nephron	**1**
	(b)	**(i)**	A-glomerulus, B-bowman's capsule, C-proximal convoluted tubule, D-loop of Henle, E-distal convoluted tubule, F-collecting duct. (all correct for 3, 1 error 2, 2 errors 1) (not: letters/ref. first and second convoluted tubule)	**3**
		(ii)	create concentration gradient/low water potential in medulla owtte. (not: reabsorption of water)	**1**
		(iii)	longer	**1**
	(c)	**(i)**	ADH/antidiuretic hormone	**1**
		(ii)	pituitary	**1**
		(iii)	**I detector** - hypothalamus **Effector** wall of collecting duct	**1**

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(iv)	Effector: left dotted line- makes more permeable right dotted line- makes less permeable		**1**
	Concentration: left dotted line- increase/ hypertonic right dotted line- decrease/ hypotonic		**1**
	volume : left dotted line- decrease right dotted line- increase		**1**
(d) (i)	(I) freshwater fish release ammonia; (II) insects release uric acid.		**1** **1**
(ii)	requires less water for its disposal to allow them to survive in dry places. /avp e.g. less toxic/less mass to allow flight		**1**

Total 15 marks

7. (a)	A	Nitrogen gas in air/atmosphere	**1**
	B	amino acids/protein in plants and or animals	**1**
	C	urea in urine/ammonia/nitrite/nitrate in soil	**1**
	D	Decomposition/putrefaction qualified	**1**
	E	Nitrifying bacteria/nitrification qual – produces nitrates in context	**1**
	F	*Nitrobacte*r and *Nitrosomonas*, correctly linked to process	**1**
	G	ammonium compounds to nitrites	**1**
	H	nitrites to nitrates (G+H not: just arrows on diagram)	**1**
	I	denitrifying by *Pseudomonas*	**1**
	J	in anaerobic conditions	**1**
	K	Nitrogen fixing bacteria/nitrogen fixation	**1**
	L	convert nitrogen gas into soluble/organic nitrogen containing compounds. e.g. amino acids	**1**
	M	*Azotobacter* are free living	**1**
	N	*Rhizobium* in root nodules (of legumes)/symbiotic	**1**
	O	Decay bacteria release nitrogen compounds /ammonia from dead bodies faeces and urine	**1**
		(any 10 from 15)	**Total 10 marks (max)**

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7. (b)	A	all materials are present at start/not added during the process	**1**
	B	sterile apparatus;	**1**
	C	pure (culture) of *Penicillium (notatum)*;(not: if ref. bacteria)	**1**
	D	sterile nutrient medium;	**1**
	E	aeration method/oxygen for respiration;	**1**
	F	pH adjustment/buffer;	**1**
	G	filters for introducing sterile air/oxygen;	**1**
	H	method of mixing qualified e.g. to stop sedimentation/clumping;	**1**
	I	water jacket to control temperature/qualified	**1**
	J	allow growth phase to take place/glucose is depleted during growth phase;	**1**
	K	penicillin is secondary metabolite;	**1**
	L	penicillin is produced/harvested <u>after</u> growth phase/during stationary phase/after nutrient depletion;	**1**
	M	filter culture fluid/separate fungus;	**1**
	N	concentrate or extract penicillin/chemically modify antibiotic;	**1**
	O	AVP e.g. penicillin production in nature possibly to reduce competition/comparison with continuous culture;	**1**
		(any 10 from 15)	**Total 10 marks (max)**

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Candidate Name	Centre Number	Candidate Number
		2

GCE A level

1074/01

BIOLOGY – BY4

P.M. MONDAY, 24 January 2011

1¾ hours

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1	**5**	
2	**10**	
3	**12**	
4	**11**	
5	**6**	
6	**12**	
7	**14**	
8	**10**	
Total	**80**	

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010001

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.

You are reminded of the necessity for good English and orderly presentation in your answers.

The quality of written communication will affect the awarding of marks.

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1. State the name of the term used to describe each of the following.

(a) The use of biological control agents, together with the minimal, well-targeted application of highly selective pesticides. [1]

.....

(b) Microorganisms that grow best in the presence of oxygen, but can also survive in its absence. [1]

.....

(c) Receptors responsible for detecting changes in the solute concentration of the blood, as it flows through the hypothalamus of the brain. [1]

.....

(d) Simple nerve cells, found in hydra, with short extensions joined to each other and branching in a number of different directions. [1]

.....

(e) The influence of relative periods of light and darkness on flowering. [1]

.....

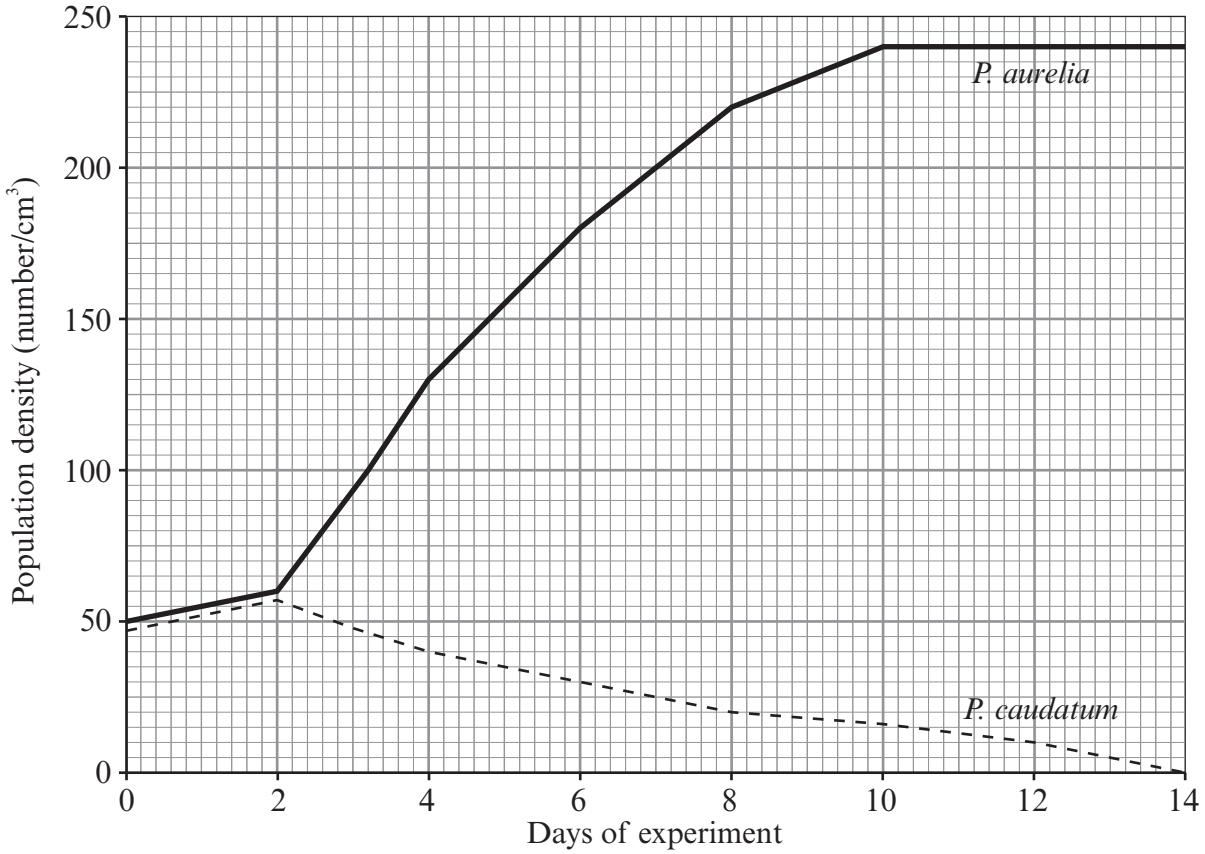
(Total 5 marks)

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2. *(a)* Two species of a single celled organism called *Paramecium*, *P. aurelia* and *P. caudatum* were grown together in a single culture of the bacterium *Bacillus pyocyaneus*, on which they both feed. Their population densities were measured every two days and the results are shown in the graph below.



(i) For *P. aurelia* on which day of the experiment did the population growth enter the stationary phase? [1]

day .....

(ii) On which days of the experiment is the population growth of *P. caudatum* in the death phase? [1]

days ..... to .....

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(b) The experiment shows both interspecific and intraspecific competition.

(i) Which type of competition is most likely to have caused the population of *P. caudatum* to decrease after day 2? [1]

.....

(ii) What was the carrying capacity for *P. aurelia* in this experiment? [1]

.....

(iii) How might the carrying capacity have been increased in this experiment? [1]

.....

(iv) Suggest, with an explanation, what would happen to the numbers of *P. caudatum* if *P. aurelia* became infected with a parasitic microorganism at day eight. [2]

Suggestion .....

Explanation .....

.....

(c) (i) Distinguish between the terms *density dependent* and *density independent* factors. [2]

.....

.....

.....

(ii) Name **one** density independent factor that could have changed in the experiment. [1]

.....

(Total 10 marks)

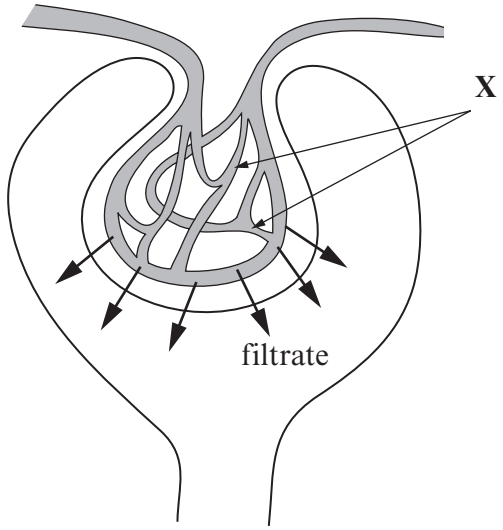
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3. The diagram shows part of a kidney tubule or nephron.



(a) (i) Name the network of capillaries labelled **X**. [1]

.....

(ii) Apart from water and glucose, name **two** substances which will be present in the filtrate. [1]

.....

(iii) Name the process that separates these molecules from the blood plasma. [1]

.....

(iv) The filtration rate is the total volume of filtrate formed per minute.
Explain the effect of a large loss of blood from the body on the filtration rate. [2]

.....

.....

.....

(b) Much of the water in the kidney filtrate is reabsorbed from the collecting duct.

(i) Name the part of the nephron which provides the osmotic gradient for reabsorption. [1]

.....

(ii) Suggest **one** way in which this part of the nephron might be modified in desert animals. [1]

.....

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(c) The environment in which an animal lives plays a part in the type of nitrogenous waste produced.

(i) For the animals listed in the table below name the excretory products and place the products in the appropriate boxes. [3]

Animal	*Main excretory product*	*Toxicity*	*Solubility*
Freshwater fish		high	high
Bird		low	low
Mammal		medium	medium

(ii) Which excretory product requires the least volume of water for its excretion? [1]

.....

(iii) Explain **one** *further* advantage of the excretory product you have named in *(c)* (ii) [1]

.....

.....

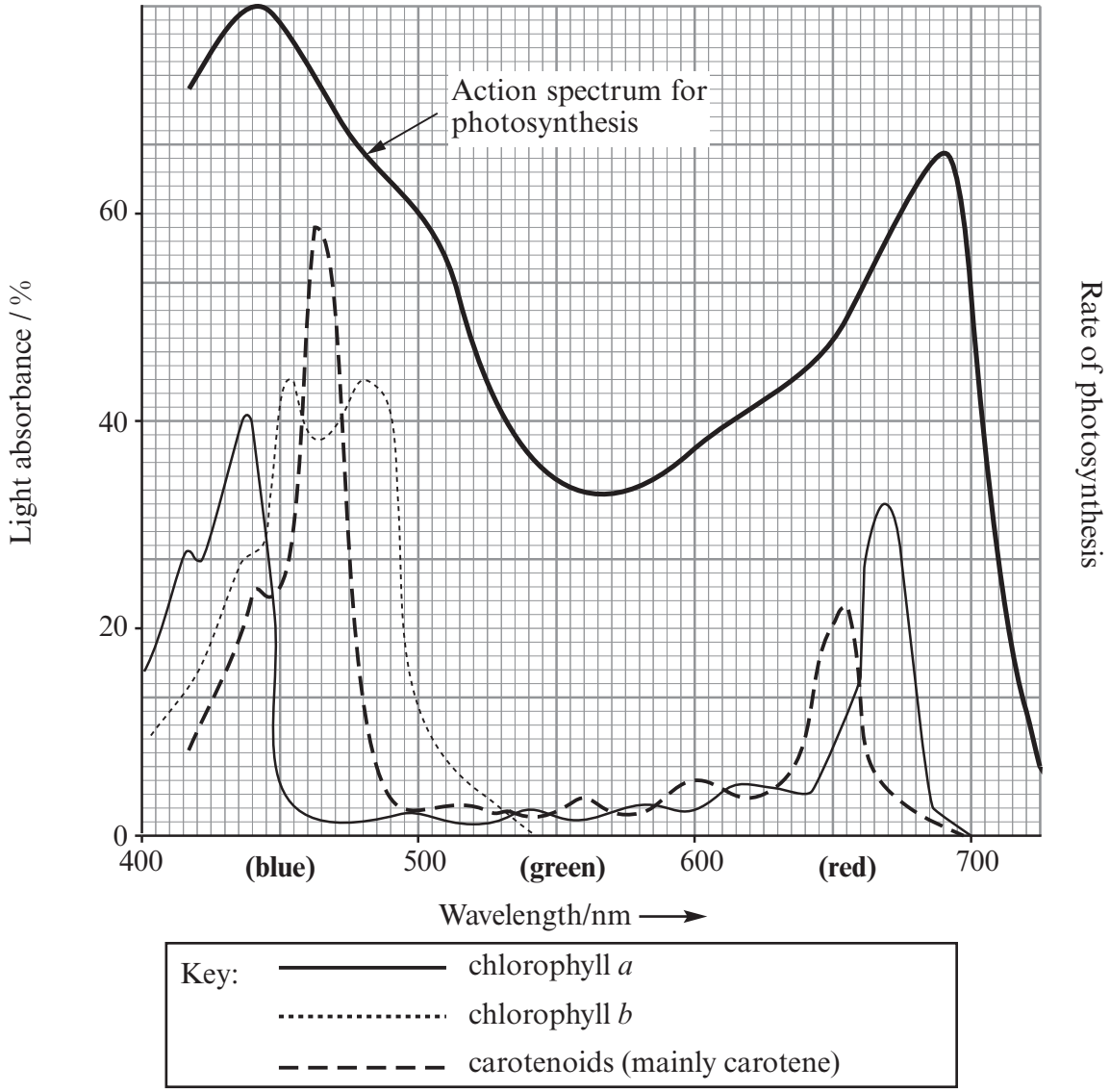
(Total 12 marks)

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4. The important pigments in most chloroplasts are chlorophyll *a*, chlorophyll *b*, and carotene. The graph below shows the absorbtion spectrum of these pigments along with the action spectrum for photosynthesis.



(a) Describe the function of chlorophyll *a*. [1]

.....

.....

(b) (i) State the wavelength which is most effectively absorbed by chlorophyll *a*. [1]

.....

(ii) Use the information in the graph to explain why it is an advantage for a leaf to contain more than one pigment. [2]

.....

.....

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(c) Why do most leaves characteristically have a green colour? [1]

.....

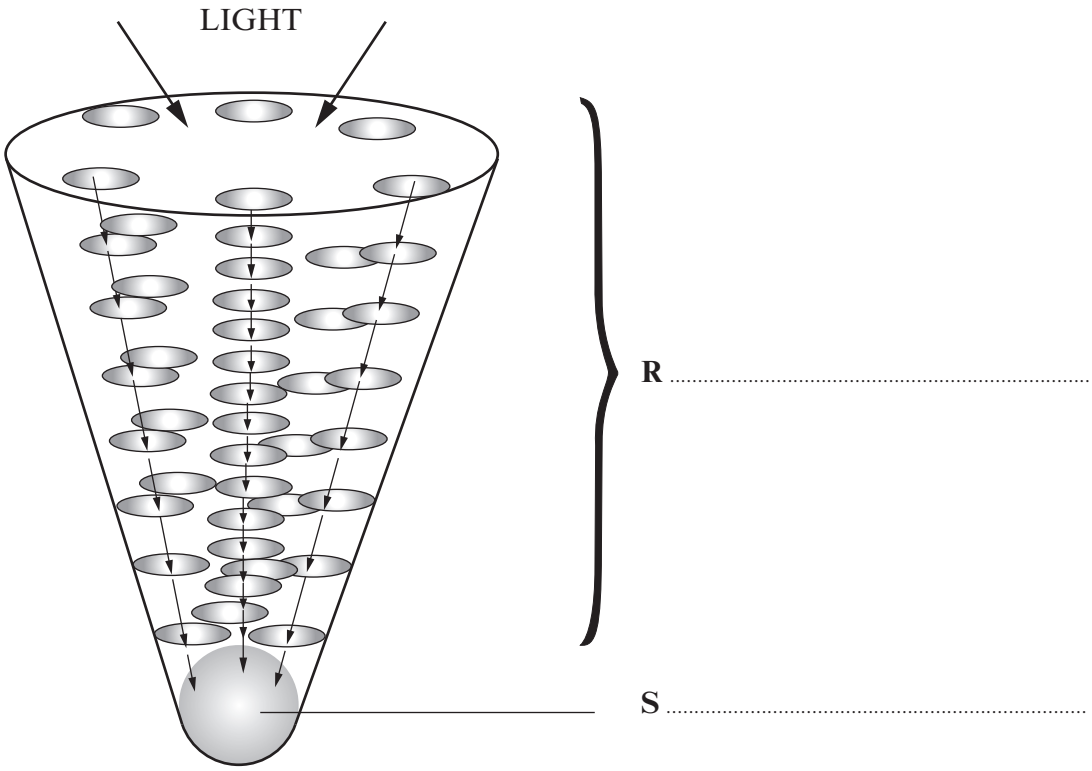
(d) The graph also shows the *action spectrum* for photosynthesis.
Describe the relationship between the absorption spectrum and the action spectrum and explain what this relationship tells us about light absorption and photosynthesis. [2]

.....

.....

.....

(e) The following diagram is of a photosystem.



(i) Identify regions **R** and **S** shown on the diagram. [2]

(ii) Indicate, with a cross (×) on the diagram, where you would expect to find chlorophyll *a*. [1]

(iii) State exactly where in the chloroplast you would expect to find photosystems. [1]

.....

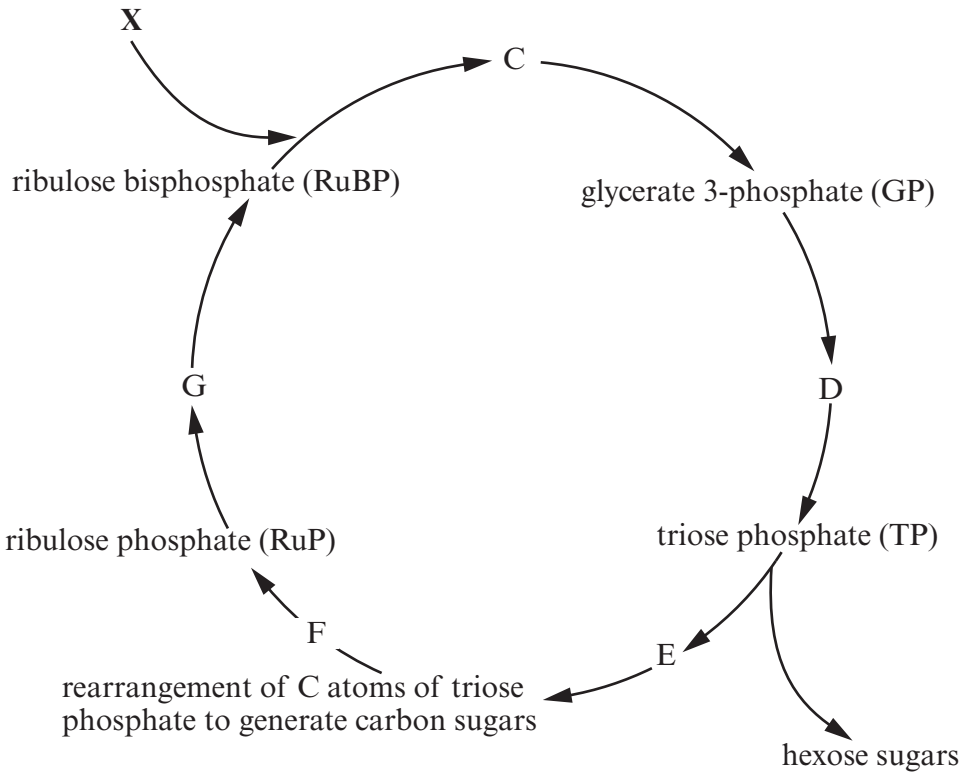
(Total 11 marks)

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5. The diagram summarises the light independent reactions of photosynthesis (Calvin cycle).



(a) Name the molecule which enters the cycle at point **X**. [1]

.....

(b) State the **two** products of the light dependent stage of photosynthesis that are required in the Calvin cycle. [2]

.....

.....

(c) Using the above diagram give the letters of the **two** steps where the chemicals named in *(b)* are required. [2]

.....

(d) State **one** possible fate of the hexose sugars produced. [1]

.....

(Total 6 marks)

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6. *(a)* Describe the reactions that link glycolysis to the Krebs cycle. [3]

.....

.....

.....

.....

.....

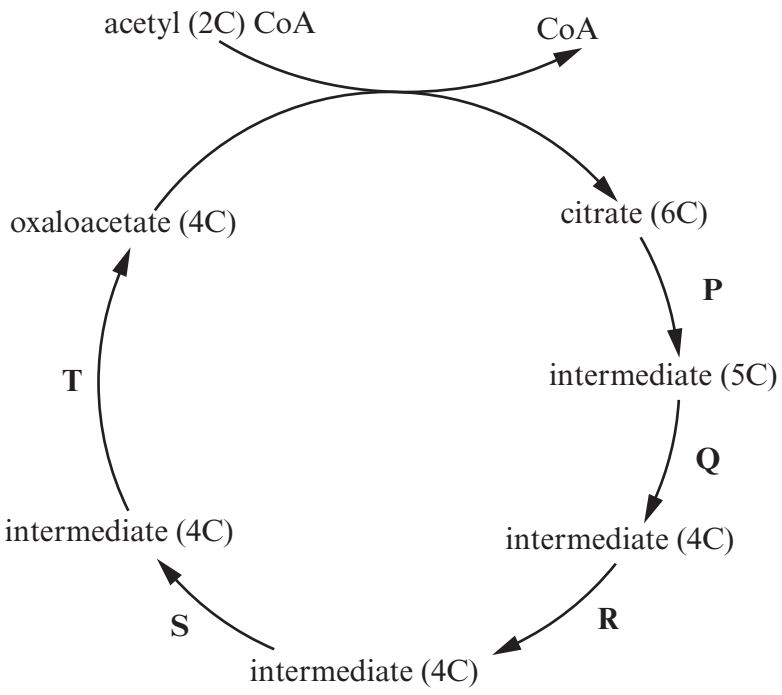
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(b) Where precisely in the cell does each of the following occur? [2]

(i) Glycolysis .....

(ii) Krebs cycle .....

(c) The diagram shows an outline of the Krebs cycle.



A two carbon acetyl group enters the cycle by combining with a molecule of oxaloacetate (4C) with the formation of a molecule of citrate (6C). This is then decarboxylated and dehydrogenated to regenerate the oxaloacetate.

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(i) Explain the following terms. [2]

I Decarboxylation

.....

II Dehydrogenation

.....

(ii) State the **letters** showing the individual steps in the cycle where decarboxylation is taking place. [1]

.....

(d) ATP is made directly by substrate level phosphorylation in the Krebs cycle.

(i) State the number of ATP molecules that are made directly **per 'turn'** of the cycle. [1]

.....

(ii) Complete the table to show the number of ATP molecules that are made in the electron transport chain **per 'turn'** of the cycle. [2]

	In the link reaction using NADH	*In the Krebs Cycle using NADH*	*In the Krebs Cycle using FADH*
Number of molecules of ATP formed			

(iii) Explain why the two hydrogen acceptors NAD and FAD lead to the production of different numbers of ATP molecules. [1]

.....

.....

(Total 12 marks)

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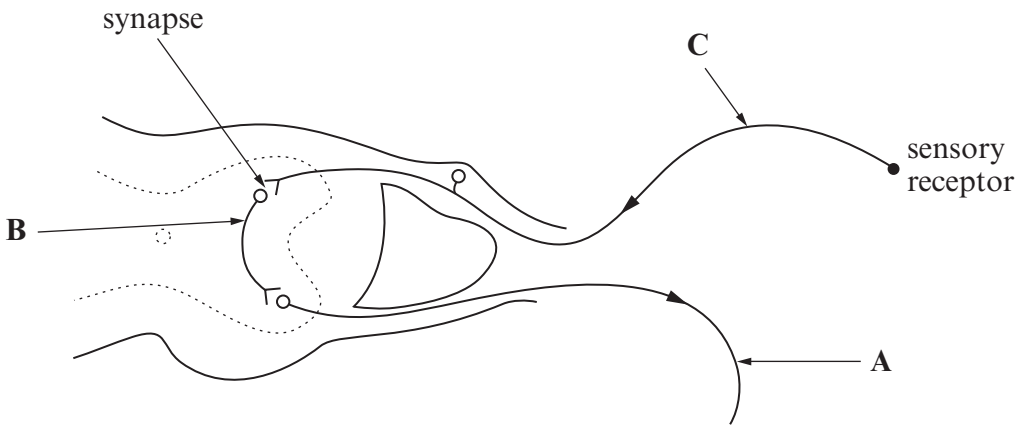
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7. *(a)* What is a reflex action? [2]

.....

.....

(b) The diagram shows the neurones in a reflex arc.



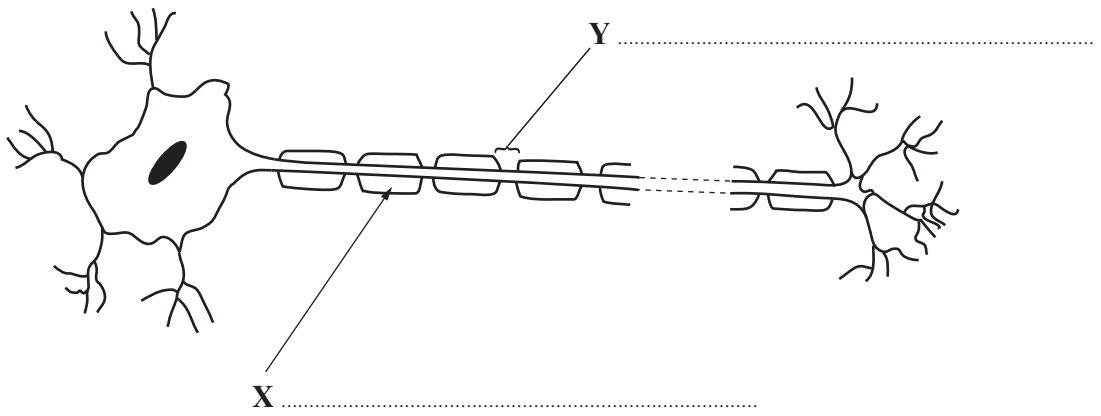
Name the types of neurone labelled **A, B** and **C**. [1]

A .....

B .....

C .....

(c) The diagram below represents a neurone.
On the diagram, label the structures **X** and **Y**. [2]



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(d) (i) Describe how a resting potential is maintained in a neurone. [2]

.....

.....

.....

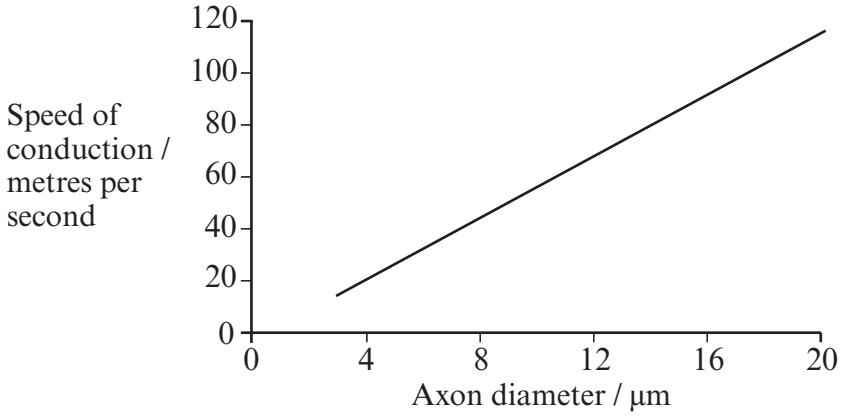
(ii) Describe how the potential across the membrane is reversed when an action potential is produced. [2]

.....

.....

.....

(e) The graph shows the relationship between the diameter of the axon and the speed of conduction of nerve impulses in myelinated axons of a cat.



(i) Describe the relationship between the diameter of the axon and the speed of conduction. [1]

.....

.....

(ii) Suggest an explanation for this increase in speed of conduction. [2]

.....

.....

(iii) Explain why a myelinated axon uses less ATP to transmit a nerve impulse than a non-myelinated axon of the same diameter. [2]

.....

.....

.....

(Total 14 marks)

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8. Answer **one** of the following questions.
Any diagrams included in your answer must be fully annotated.

Either, *(a)* Give an account of anaerobic respiration in organisms. [10]

Or *(b)* Describe how the principles of using a batch culture fermenter are applied to the industrial production of penicillin. [10]

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(Total 10 marks)

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Q.1 Integrated control / integrated pest management **[1]**

(b) facultative anaerobes **[1]**

(c) osmoreceptors (not: osmoregulators) (not: if ref to pituitary) **[1]**

(d) nerve net **[1]**

(e) photoperiodism **[1]**

[Total 5 marks]

Q.2 (a) (i) day 10 **[1]**

(ii) day 2 to day 14 **[1]**

(b) (i) interspecific **[1]**

(ii) 240 (unit needed) **[1]**

(iii) adding more nutrients /food / *B. pyocyaneus* / more food for *B. pyocyaneus* / remove waste / adding bacteria
increasing amount of culture
(not: more space) **[1]**

(iv) increase; **[1]**
Less competition for food / more food available **[1]**

(c) (i) dependent – effect on population depends on population size
independent – effect on population is the same whatever the size of the population **[2]**
[not: population affecting factors)

(ii) temperature / pH (not: O_2 concenntration) (not: fire / flood) **[1]**

[Total 10 marks]

Q.3 (a) (i) glomerulus **[1]**

(ii) urea or amino acids, fatty acids / glycerol / small proteins / inorganic ions or Na + or minerals or salts (not: vitamins / salt)
(name two for 1 mark) **[1]**

(iii) ultrafiltration **[1]**

(iv) Hydrostatic/ blood pressure decreased; **[1]**
less filtrate formed / less rate of filtration **[1]**

(b) (i) loop of Henle (not: ascending limb) **[1]**

(ii) increased length / longer
(not: larger) **[1]**

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(c) (i) fish – ammonia
bird – uric acid
mammal – urea **[3]**

(ii) uric acid (allow: e.c.f) **[1]**

(iii) little mass (for storage) / reduces body mass / light for flight / less storage space for eggs (not: less toxic/ less water unqual) **[1]**

[Total 12 marks]

Q.4 (a) absorbs light energy / of specific wavelength / wavelengths of light / light at red and blue end of spectrum /photons **[1]**

(b) (i) 440 nm (435 – 440) **[1]**

(ii) any pigment / chlorophyll absorbs or uses a limited part of the spectrum / light wavelength;
additional pigments increase range of wavelengths;
from which energy can be obtained / or increase efficiency of photosynthesis (any two) **[2]**

(c) all wavelengths except green are absorbed / green wavelength is reflected or transmitted. (not: ref to light; allow: ref to spectrum / frequency) **[1]**

(d) since they follow a similar trend / pattern / shape / close correlation / peaks correspond (not: similar unqual) **[1]**
it suggests that the pigments / wavelengths responsible are used in light absorption are then used in photosynthesis. **[1]**

(e) (i) R – light harvesting unit / complex / centre / antenna complex **[1]**
S – reaction centre **[1]**

(ii) cross in circle of reaction centre **[1]**

(iii) thylakoid membrane / granal membrane / intergranal membrane **[1]**

[Total 11 marks]

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Q.5 (a) carbon dioxide / CO_2 **[1]**

(b) ATP;
Reduced NADP / NADPH / $NADPH_2$ **[2]**

(c) D;
G (any order) **[2]**

(d) energy source / cellulose / lipids / food store / starch / amino acids / proteins / pentose sugar / disaccharide / release energy in respiration (accept: named sugars; not: carbohydrates / respiration unqual) **[1]**

[Total 6 marks]

Q.6 (a) pyruvic acid / pyruvate is converted to (two carbon) acetyl / acetate;
(two molecules) of reduced NAD formed (by dehydrogenation)
(allow: NADH etc)
loss of (two molecules) of carbon dioxide / decarboxylated
acetate combines with coenzyme A (to form acetyl coenzyme A) **[3]**
(pyruvate converted to acetyl Co A = 0)

(b) (i) cytoplasm;

(ii) matrix of mitochondrion **[2]**

(c) (i) (Decarboxylation) is the removal of carbon dioxide / carboxyl group;
(Dehydrogenation) is the removal of hydrogen **[2]**

(ii) P and Q **[1]**

(d) (i) one **[1]**

(ii)

	In the link reaction using NADH	In the Krebs Cycle using NADH	In the Krebs Cycle using FADH
Number of Molecules of ATP Formed	3	9	2

All 3 = 2 marks any 2 = 1 mark. 1=0 **[2]**

(iii) carrier system involving NAD has three pumps FAD has two pumps.**[1]**
(not: ref carriers)

[Total 12 marks]

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Q.7 (a) (rapid) reaction/ response to a stimulus; **[1]**
automatic / involuntary / not under conscious control /
brain not involved (not: cannot be controlled / automated without thinking) **[1]**

(b) A – motor;
B – relay / intermediate / connector;
C – sensory
(all three) **[1]**

(c) (i) X – myelin sheath / Schwann cell

Y – node of Ranvier **[2]**

(d) (i) Na+ or sodium ions are actively removed / pumped out /
faster than K^+ ions are moved in; **[1]**

K^+ or potassium ions diffuse out more rapidly than Na^+ /
membrane has a higher permeability to K^+ than Na^+. **[1]**

or Na / K pumps $3Na^+$ out and $2K^+$ in = 2 marks
(Ref. to ions needed at least once;1 mark if no number)

(ii) Sudden change /increase in the permeability of the membrane to Na^+/
sodium gates / channels open;
sodium ions diffuse in or ref. concentration gradient
(not: move in) **[2]**

(e) (i) As the axon diameter increases the speed of conduction increases
(ref. linear/proportional needs direction allow: positive correlation) **[1]**

(ii) Speed of transmission (of the action potential) depends on **[1]**
resistance (of axoplasm)
(This resistance is related to the diameter of the axon). The greater /
larger the diameter of the axon the less the resistance. **[1]**

Or increased diameter means increased surface area (of axon)
over which exchange of ions can take place.

(iii) ATP is required for active transport / ref Na/ K pumps;
Na^+ ions (actively) moved out only at nodes in myelinated;
Na^+ ions (actively) moved out along whole length of
axon in non-myelinated. (Any 2) **[2]**

[Total 14 marks]

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Q.8 (a)

A. Glucose is phosphorylated / ATP is added. **[1]**

B. to form hexose (di) phosphate. **[1]**

C. this is split into (two) 3C triose phosphate molecules. (not: abbreviations) **[1]**

D. which are converted to pyruvate. **[1]**

E. and (2) reduced NAD or eq e.g. NADH **[1]**

F. takes place in the cytoplasm / glycolysis **[1]**

G. in the absence of oxygen, (the Krebs cycle and) ETC cannot occur / no oxygen to act as the final electron acceptor at the end of the ETC. **[1]**

H. Pyruvate is converted to lactate / lactic acid in animal cells / humans. **[1]**

I. using the reduced NAD to reduce the pyruvate / transferring the hydrogen to pyruvate (in the process) **[1]**

J. in plants / fungi there is a loss of carbon dioxide / decarboxylation **[1]**

K. ethanal / acetaldehyde is produced **[1]**

L. ethanal is reduced by NADH to ethanol **[1]**

M. anaerobic respiration yields a total of 2 ATP **[1]**

N. (because) a lot of energy is still tied up / contained in the lactate / ethanol (i.e. ethanol high in calories) **[1]**

[Total 10 marks]

(b)

A. All materials are added at start / not during the process **[1]**

B. Sterile apparatus. **[1]**

C. (Pure (culture) of) ref *Penicillium (notatum)*. **[1]**

D. Sterile nutrient medium. **[1]**

E. Aeration method as oxygen is required for respiration / for aerobic conditions **[1]**

F. pH adjustment / buffer. **[1]**

G. introduction of sterile air / oxygen. to prevent contamination (by airborne organisms) **[1]**

H. Method of mixing (qualified). (eg paddle) to mix nutrients (and culture / oxygen) **[1]**

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I . Water jacket to prevent overheating to remove excess heat produced during respiration / metabolism or maintain optimum temperature qual / prevent enzyme denaturation **[1]**

J. nutrients / glucose is depleted during growth phase. **[1]**

K. Penicillin is secondary metabolite. **[1]**

L. Penicillin is produced / harvest after growth phase / during stationary phase / after nutrient depletion. **[1]**

M. Filter / purify culture fluid / separate fungus. **[1]**

N. AVP e.g. penicillin production in nature possibly to reduce competition / comparison with continuous culture. **[1]**

[Total 10 marks]

Candidate Name	Centre Number	Candidate Number
		2

WJEC CBAC

GCE A level

1074/01

BIOLOGY – BY4

A.M. WEDNESDAY, 16 June 2010

1¾ hours

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1	**11**	
2	**9**	
3	**7**	
4	**13**	
5	**11**	
6	**5**	
7	**14**	
8	**10**	
Total	**80**	

1074 01 01

INSTRUCTIONS TO CANDIDATES

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES

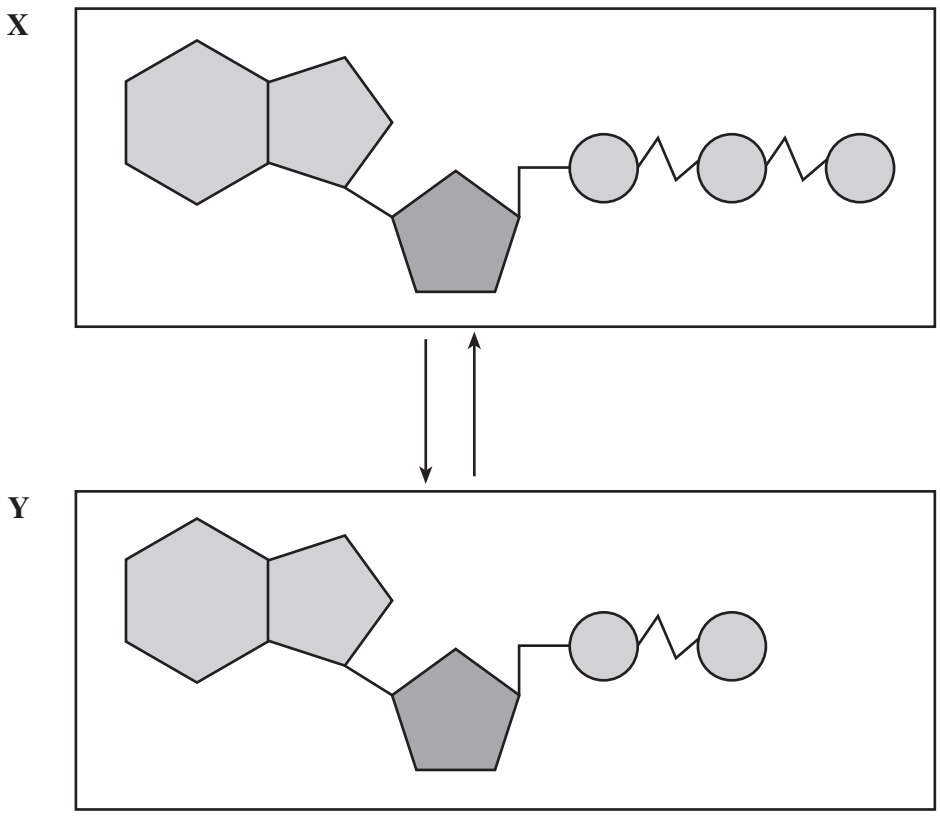
The number of marks is given in brackets at the end of each question or part-question.

You are reminded of the necessity for good English and orderly presentation in your answers.

The quality of written communication will affect the awarding of marks.

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1. The diagram below shows the inter-conversion of two molecules.



(a) (i) Identify molecules **X** and **Y** [1]

X .....

Y .....

(ii) Give **two** examples of cellular activities where **X** would be converted to **Y**. [2]

.....

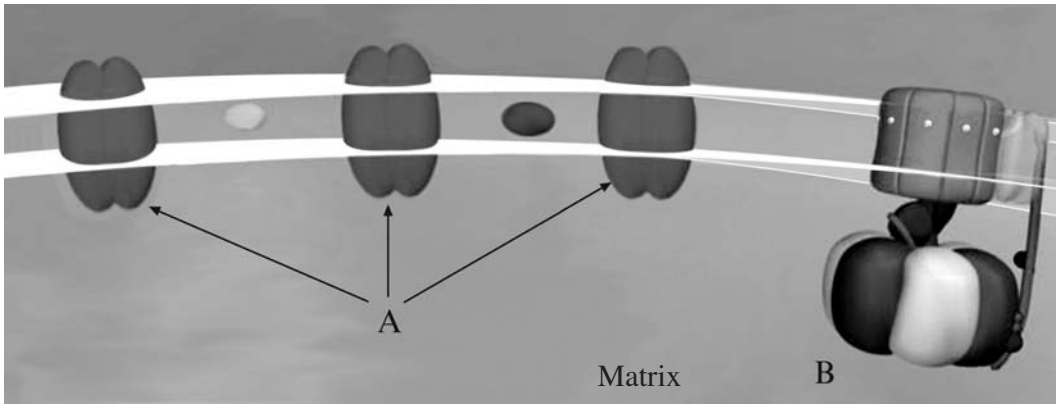
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(iii) Name the enzyme required to convert **Y** to **X**. [1]

.....

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(b) The diagram below shows the components involved in a sequence of events on the inner mitochondrial membrane.



(i) Name this sequence of events. [1]

.....

(ii) Identify structures **A** and **B**. [2]

A .....

B .....

(iii) As electrons are transferred along this membrane energy is made available. Using the information in the diagram above, explain how this energy is used to produce molecule **X** shown in the diagram opposite. [4]

.....

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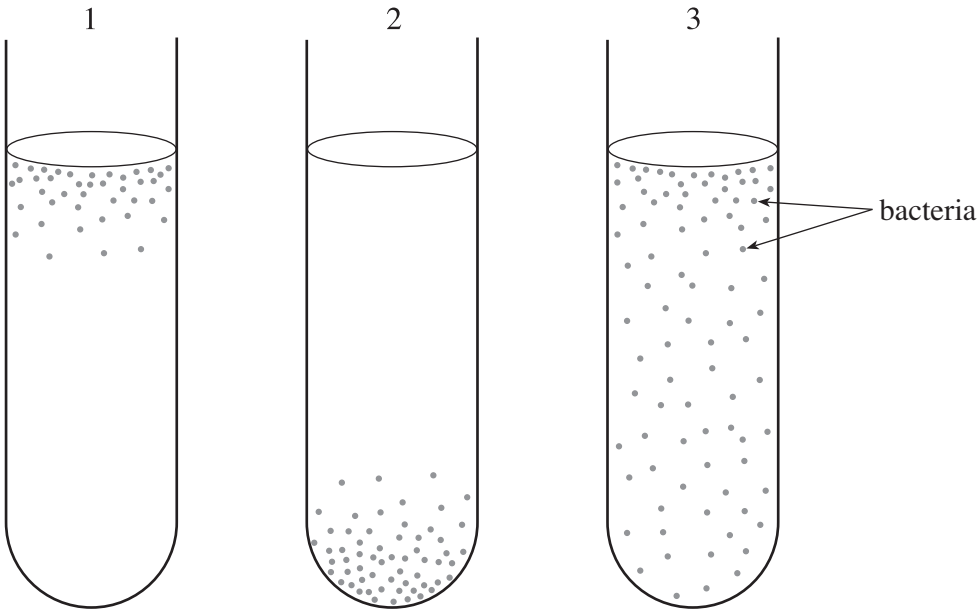
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(Total 11 marks)

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2. *(a)* Many bacteria have precise metabolic requirements for oxygen. Aerobic and anaerobic bacteria can be identified by growing them in liquid culture. The results of one such experiment are shown below. The growth media was the same in all tubes.



Give the correct biological term for each of these types of bacteria from their position in the growth tubes and give a reason for each answer. [6]

Tube 1 .....

.....

Tube 2 .....

.....

Tube 3 .....

.....

(b) Some anaerobic bacteria, such as *Clostridium perfringens* (gas gangrene), produce toxins which are highly dangerous to organisms including humans if a wound becomes infected. Hyperbaric oxygen therapy is one method used in the treatment of such infections. This involves 2 to 4 daily sessions with the whole body exposed to oxygen in a chamber for 150 minutes at 3.0 atmospheres (three times normal atmospheric pressure).
Suggest how such treatment is successful for treating these infections. [2]

.....

.....

.....

(c) Apart from oxygen requirements list **three** *other* requirements for microbial growth. [1]

.....

.....

.....

(Total 9 marks)

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3. Muscle cells were broken up and separated into fractions.
Samples of each fraction were incubated with (i) glucose and (ii) pyruvate (pyruvic acid).
Tests were carried out for the production of carbon dioxide and lactate (lactic acid) in each sample.
The results are given in the table below.

Cell fraction	*Incubated with glucose*		*Incubated with pyruvate*	
	Carbon dioxide	*Lactate*	*Carbon dioxide*	*Lactate*
Ribosomes	absent	absent	absent	absent
Mitochondria	absent	absent	produced	absent
Cytoplasmic residue	absent	produced	absent	absent

(a) Using your knowledge of respiration explain the results obtained with each cell fraction.

Ribosomes [1]

.....

Mitochondria [2]

.....

.....

Cytoplasmic residue [2]

.....

.....

(b) Explain why no carbon dioxide is evolved when cyanide is added to the mitochondrial fraction prior to incubation. [2]

.....

.....

.....

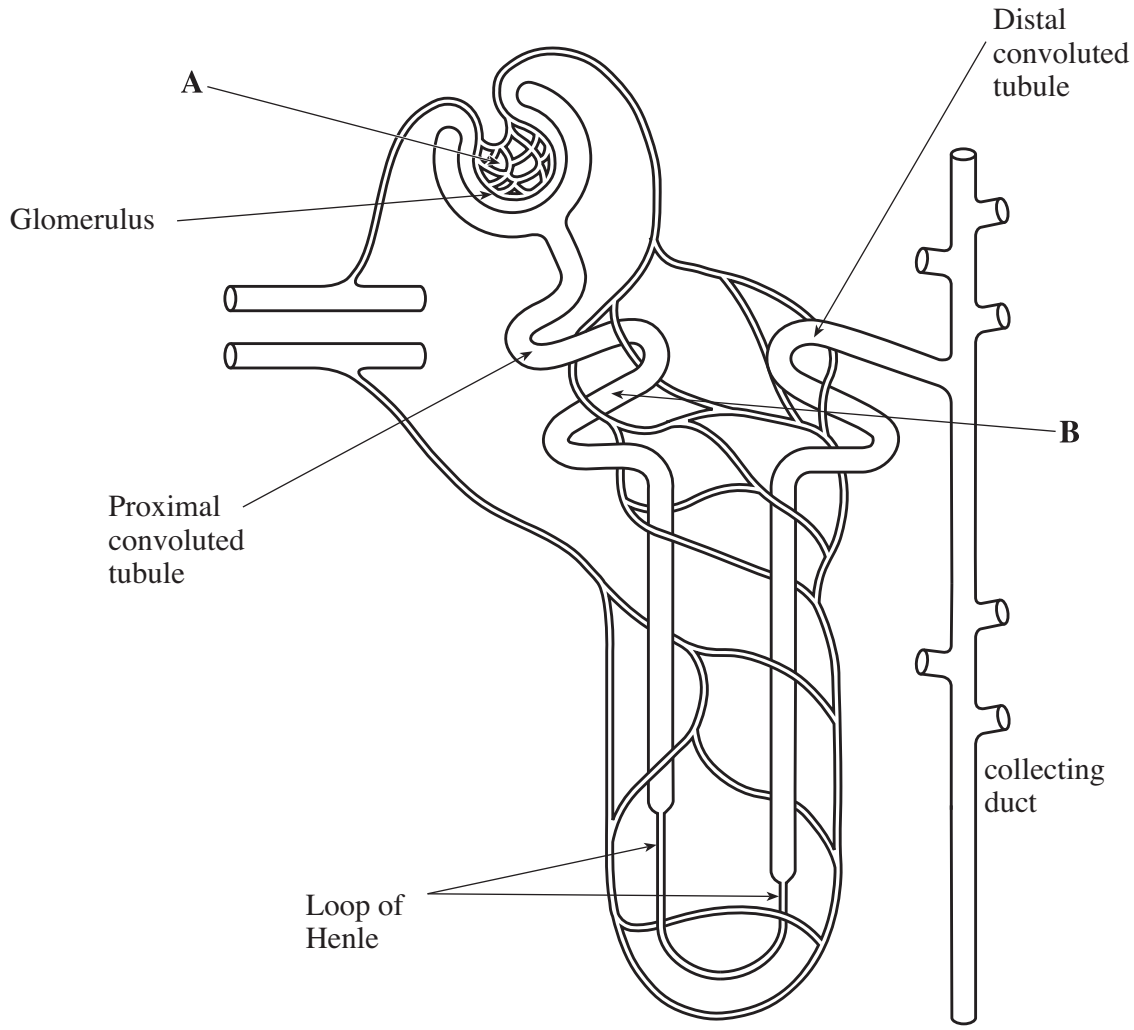
(Total 7 marks)

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4. The diagram below shows a diagram of a kidney tubule or nephron.



(a) Describe briefly the process being carried out at **A**. [3]

.....

.....

.....

.....

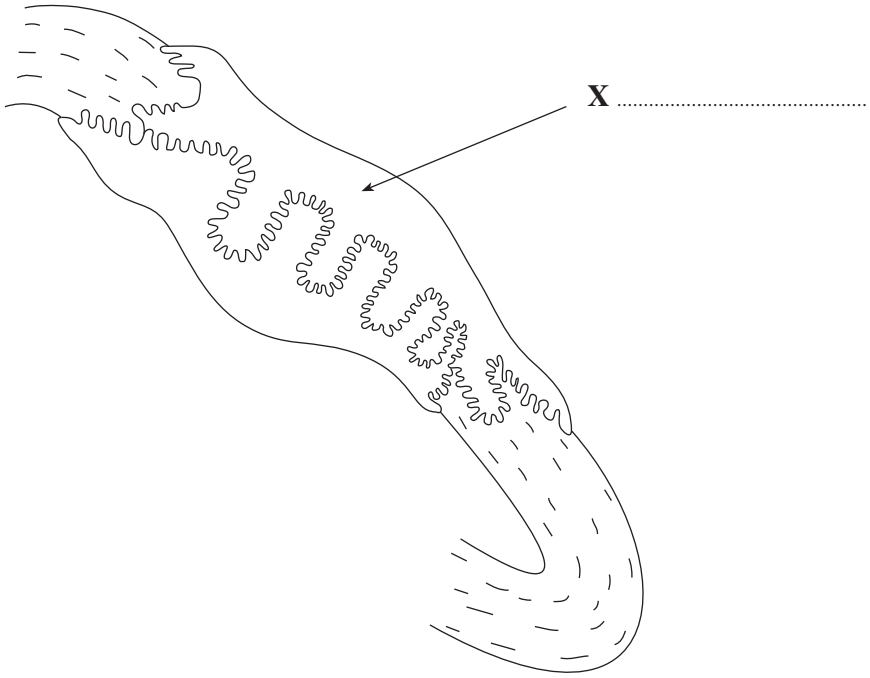
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(b) The diagram below shows a section of capillary from region **A** of the nephron.



(i) Label **X** on the diagram. [1]

(ii) What important feature is shown by the capillary? [1]

.....

(c) (i) Name the process being carried out at **B** of the nephron. [1]

.....

(ii) Tick the correct boxes below to show how each molecule moves into the bloodstream at **B**. [3]

	Transport mechanism		
Molecule	*Facilitated Diffusion*	*Active Transport*	*Osmosis*
Glucose			
Amino Acids			
Water			
Sodium ions			

1074 01 07

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(d) The Loop of Henle is important in producing a medulla with a low water potential. This allows the movement of water from the collecting duct under hormonal control. For the mammals listed below, explain the difference in length of this structure. [3]

Otter .....

.....

Human .....

.....

Camel .....

.....

(e) There is a medical condition (diabetes insipidus) where the body produces large quantities of dilute urine containing no glucose. With reference to hormonal control, suggest why this occurs. [1]

.....

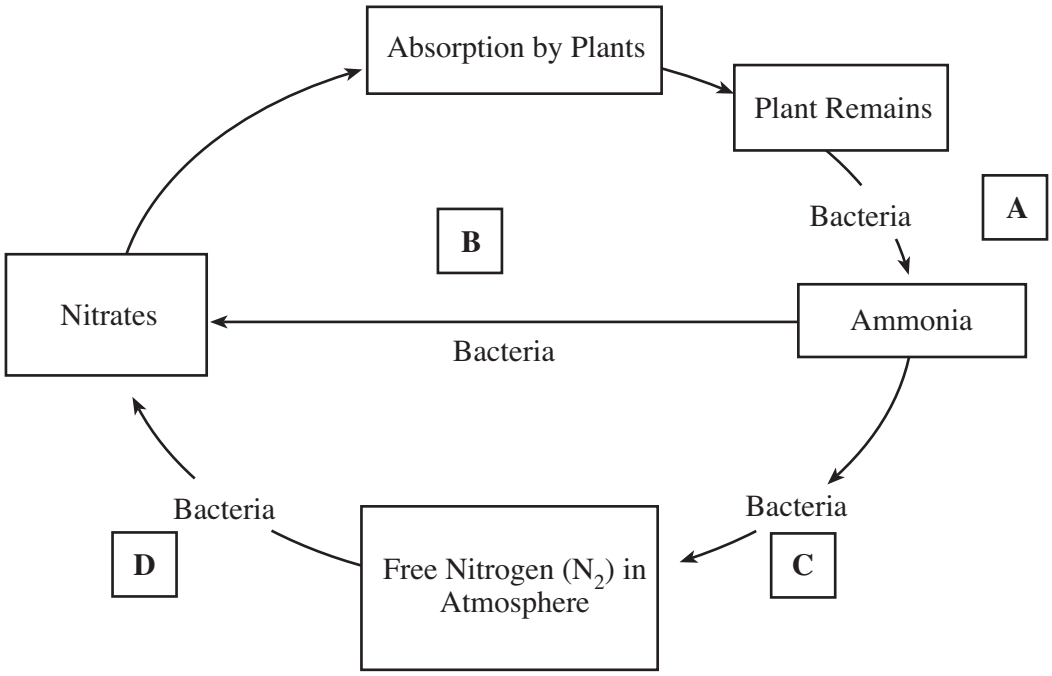
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(Total 13 marks)

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5. The following diagram shows a simplified diagram of the nitrogen cycle.



(a) Name the process at **A**. [1]

.....

(b) Name **two** bacteria involved in process **B**. [2]

.....

.....

(c) Name process **C** and state the condition in which this process is most likely to occur. [2]

.....

.....

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(d) Most nitrogen-fixing bacteria form symbiotic associations with leguminous plants, where they are provided with nutrients by the plant and protected from oxygen. Oxygen inhibits the enzyme (nitrogenase) required for **nitrogen fixation**.
Azotobacter are free-living in soil and have the ability to fix atmospheric nitrogen by converting it to ammonia. Like other nitrogenases, *Azotobacter* nitrogenase is oxygen-sensitive, but it is believed that the extremely high respiration rate of *Azotobacter* protects the nitrogenase.

(i) Name the bacteria which form the symbiotic relationship with leguminous plants. [1]

.....

(ii) A type of haemoglobin is present in root nodules. How does this limit the exposure of bacteria in the root nodule to oxygen? [1]

.....

(e) Using your knowledge of respiration, suggest how the high metabolic rate of *Azotobacter* would protect nitrogenase from oxygen. [2]

.....

.....

.....

(f) *Drosera* (Sundew) is a genus of plants which lives in some waterlogged soils. The plant is able to trap and digest insects on its sticky leaves. Suggest why this is vital to the survival of the plants. [2]

.....

.....

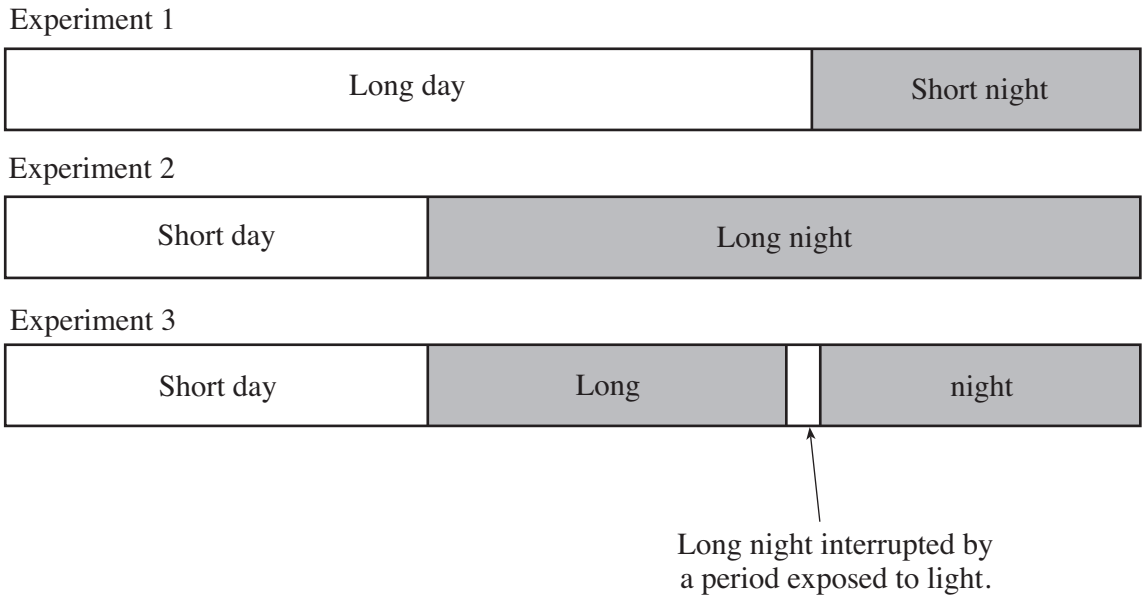
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(Total 11 marks)

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6. An experiment was carried out to determine the environmental factor which triggers flowering in a species of plant. The plant was exposed to a number of different periods of this factor whether it flowered or not was recorded.



Results

Experiment 1	No flowering
Experiment 2	Plant flowered
Experiment 3	No flowering

(a) Explain these results using your knowledge of phytochromes. [3]

.....

.....

.....

(b) Using the results above, what category of plant is this? [1]

.....

(c) Suggest why horticulturalists need to know what conditions plants require to flower. [1]

.....

.....

(Total 5 marks)

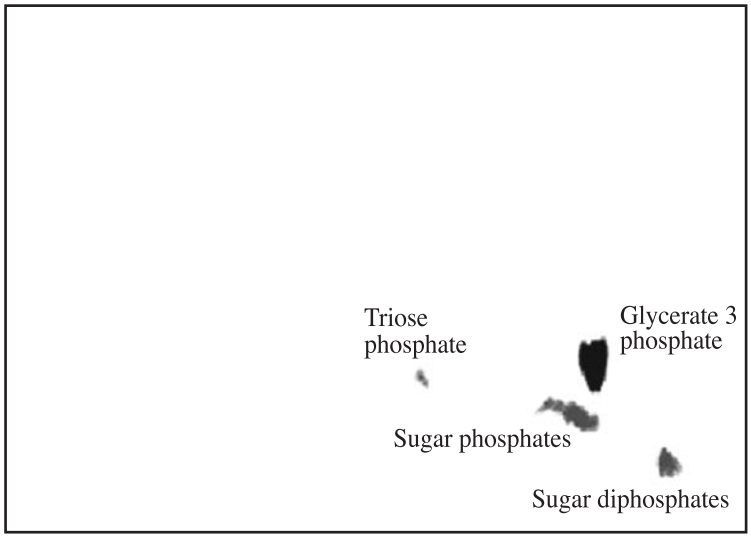
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7. To investigate the sequence of events in the Calvin cycle, the following experiment was carried out.

1. The alga *Chlorella* was exposed to $^{14}CO_2$.
2. After time intervals of 5 seconds and 30 seconds a sample of algae was added to hot ethanol to stop enzyme reactions in the cells.
3. The radioactive compounds were separated by paper chromatography. Autoradiographs of the results are shown below.

The darker, more intense the spots, the more of that compound is present.

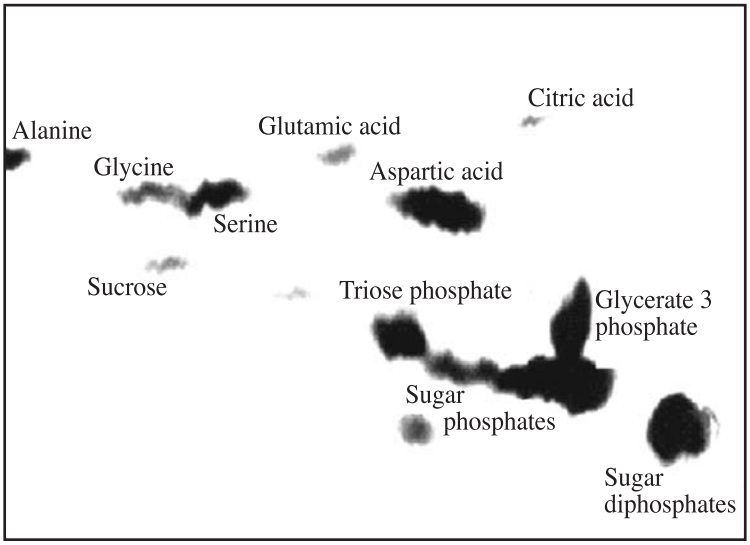


Chromatography paper showing radioactively labelled compounds extracted from *Chlorella* after 5 seconds photosynthesis with radioactive CO_2.

(a) Using your knowledge of the Calvin cycle explain the quantitative results of the autoradiograph after 5 seconds. [2]

.....

.....



Chromatography paper showing radioactively labelled compounds extracted from *Chlorella* after 30 seconds photosynthesis with radioactive CO_2.

From Basham TA (1965) "Photosynthesis: The path of carbon." In Plant Biochemistry, 2nd ed., J Bonner & E Varner, eds. Academic Press NY pp. 875-902

Alanine, glycine, glutamic acid, serine and aspartic acid are all amino acids.

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(b) What further information can be determined from the autoradiograph after 30 seconds? [3]

.....

.....

.....

.....

(c) What further compounds would you expect to see after 300 seconds? [2]

.....

.....

(d) The Calvin cycle depends on products of the light dependent stage of photosynthesis. Name these two products. [1]

.....

.....

(e) The light dependent stage involves both cyclic and non-cyclic photophosphorylation. Explain what is meant by

(i) Cyclic photophosphorylation [2]

.....

.....

.....

(ii) Non-cyclic photophosphorylation [4]

.....

.....

.....

.....

.....

(Total 14 marks)

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8. Answer **one** of the following questions.
Any diagrams included in your answer must be fully annotated.

Either, *(a)* Describe the advantages and disadvantages of chemical and biological control. [10]

Or *(b)* Using a labelled diagram of a synapse, explain how impulses are transmitted across a synapse. [10]

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(Total 10 marks)

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1 (a) (i) X ATP

Y ADP *1 mark for both* (1)

(ii) Active transport; Nerve impulse;

Muscle contraction; Light independent stage of p/s;

Glycolysis;

Protein synthesis / cell division; (Any 2)

(iii) ATP synthetase / ATPase (1)

(b) (i) Electron transport (chain) (1)

(ii) A Proton pumps (1)

B stalked particle / ATP synthetase / ATP ase (1)

(iii) High energy electrons/eq;

Fuel (eq) the proton pumps;

Which pumps protons into the inter-membrane space;

This creates an electrochemical gradient/eq;

Which causes H^+ to flow through a stalked particle;

Synthesising ATP;

Correct reference to chemiosmosis;

Any 4 but in THE CORRECT SEQUENCE (4)

Total: 11 MARKS

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2 (a) 1 Obligate aerobes; (1)

at the top of the test tube in order to absorb maximal oxygen/eq; (1)

2 Obligate anaerobes; (1)

gather at the bottom to avoid oxygen/eq. (1)

3 Facultative anaerobes; (1)

gather mostly at the top, since aerobic respiration is the most beneficial/but as lack of oxygen does not inhibit them, they can be found all along the test tubes. (1)

(b) *C. perfringens* is an obligate anaerobe;

More/high pressure oxygen (is forced) into the wound;

C. perfringens/bacteria cannot metabolise / is inhibited in the presence of O_2; (not: respire)

Bacteria stop dividing / producing toxin;

Allows antibiotics/immune system time to destroy bacteria. (Any 2)

(c) Suitable temperature (not heat);

Suitable pH;

Carbon source/glucose*;

Nitrogen source/eq*;

Vitamins*;

Mineral salts*; (1)

[or nutrients instead of *]

Water; *Any 3 for 1 mark*

Total: 9 MARKS

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3 (a) Ribosomes are not involved in respiration/eq; (1)

Mitochondria cannot metabolise glucose/have no enzymes for glucose breakdown / have no carrier for glucose in the membrane;

Pyruvate is broken down in the/Link reaction/Krebs cycle producing CO_2;

No lactate with either substrate as mitochondria are not involved in anaerobic respiration; (Any 2)

CR breaks down glucose anaerobically to lactate;

Enzymes for pyruvate breakdown are in mitochondria/Link or Krebs occurs in mitochondrial matrix;

Cytoplamic residue cannot metabolise pyruvate (Any 2)

(No source of reduced NAD)

(b) Cyanide must stop Krebs cycle/Link reaction (since no CO_2 is produced);

Non competitive inhibitor;

Of the ETC/(last) proton pump;

Cyanide is a respiratory inhibitor / inhibits respiration; (Any 2)

Total: 7 MARKS

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4 (a) Ultrafiltration;
High hydrostatic pressure/high pressure in glomerular capillary/glomerulus;
Forces small molecules through the capillary (walls) into capsule;
through basement /dialysing membrane; (Any 3)

(b) (i) podocytes, (1)

(ii) Capillary shows pores/fenestrations/small gaps; (1)

(c) (i) Selective reabsorption (1)

(ii)

Transport mechanism

Molecule	Facilitated Diffusion	Active Transport	Osmosis
Glucose	✓	(✓)	
Amino Acids	✓	(✓)	
Water			✓
Sodium Ions		✓	

One mark per column (3)

(d) Short length (in fresh water mammals)
Because water is readily available so low Ψ not needed; (1)
Medium length (in terrestrial mammals)
Water reasonably available; (1)
Long length (in desert mammals)
Water needs to be conserved so medulla with low Ψ required; (1)

(e) ADH is not being secreted;
Collecting duct cells are not responsive to ADH;

So reduced water uptake into the medulla; (Any 1)
Collecting duct cells less permeable.

Total: 13 MARKS

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5 (a) Decay/putrefaction/decomposition/ammonification; (1)

(b) *Nitrosomonas/nitrococcus* (1)

Nitrobacter (1)

(c) Denitrification (1)

Anaerobic/eq (1)

(d) (i) *Rhizobium* (1)

(ii) Hb absorbs/has an affinity for O_2 (1)

(e) Respiration would demand high use of O_2;

O_2 is the final electron acceptor in the ETC;

(And so rapidly) converts O_2 to water (Any 2)

(f) Waterlogged soil/bogs are anaerobic;

Have low nitrate content/denitrification occurring;

Insect's protein is digested;

Releasing *amino acids*/*ammonium* ions;

Which can be used for plant protein/nucleic acid synthesis; (Any 2)

(not: nitrates or growth)

Total: 11 MARKS

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6 (a) Sunlight/Red light is absorbed during daylight;

Pr/ P660 is converted to Pfr/ P730;

Pfr is active and inhibits flowering (in short day plants);

In Exp1 lots of light/high Pfr so no flowering (inhibited);

In Exp2 not enough Pfr/low Pfr (no inhibition) so flowering;

In Exp3 the Pr is (rapidly) converted back to Pfr; so inhibition of flowering; (Any 3)
(allow: converse points)

(b) Short day plant (1)

(c) Allows plant breeders to cross pollinate flowers which would not usually flower at the same time
Preparation of flowering plants for known dates – Christmas/Easter/ Mothers' Day/eq (1)

Total: 5 MARKS

7 (a) Large/intense/dark spot of G3P indicating a lot has been synthesised;

First product after $^{14}CO_2$ added is G3P;

Smaller quantity of sugar phosphates produced later; (Any 2)

(b) More sugar phosphates produced;

More triose phosphate produced;

Presence of amino acids indicate other compounds being synthesised;

Presence of citric acid;

Any comment on Krebs cycle intermediates being used to synthesise amino acids; (Any 3)

Sucrose present.

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(c) Presence of nucleic acids/ATP/ADP/eq.;

Starch;

Proteins;

Lipids/glycerol/fatty acids; (Any 2)

Cellulose.

(not: RUBP/ glucose/fructose/ethanol)

(d) Reduced NADP/NADPH/NADPH$_2$

ATP *1 mark for both* (1)

(e) *Cyclic*

Light absorbed/harvested by PS 1/P700;

High energy electrons used to fuel proton pump;

Creating EC gradient/eq.;

Allowing ATP synthesis/ATP as a product;

Electrons return to PS1/P700/same PS (I); (Any 2)

Non Cyclic

Light harvested/absorbed by both PS;

High energy electrons passed to carriers;

Replaced in PS2/P680 by photolysis of water/eq.;

Electrons replaced in PS1/P700 from PS2/P680;

Electrons from PS 1/P700 passed to NADP;

Products are reduced NADP and ATP (Any 4)

Total: 14 MARKS

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8 (a) Chemical control

Advantages

A. Very effective/quick/cheap means of control

B. Chemicals can be applied on a small area (e.g. Market gardening) / Application does not require a high level of skill/knowledge

Disadvantages

C. Chemicals are not specific/may eradicate useful insects

D. Resistance may occur (not: immunity)

E. Killing of fish/birds/mammals/bioaccumulation;

F. Risk to human health/contamination of rivers.

Biological control

Advantages

G. Highly specific to one pest

H. Long term control if predator: prey balance / Use in glasshouses

I. May be inexpensive in long term

J. No environmental contamination

Disadvantages

K. Slow build up/have to accept some damage to crop/'not perfect'/pest not totally eradicated;

L. Few successful examples

M. Skill and research is expensive/detailed life cycle knowledge is needed

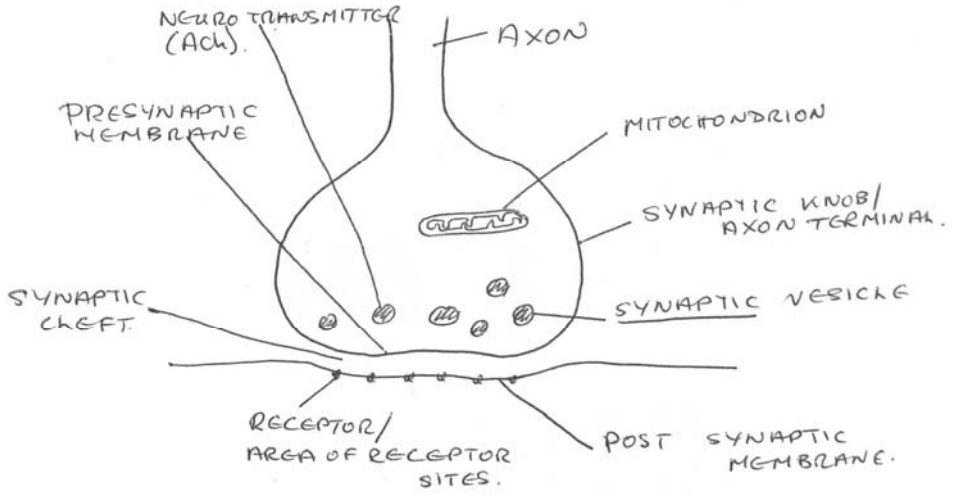
N. Frequent input of predator needed / may only be of use in closed systems (greenhouses)

O. Predator may become a pest itself/suitable e.g. (cane toads/hedgehogs on Uist)

Any 10 from the 15 marks available

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(b) A. Decent drawing of a synapse.



/Na channels

B.C.D. With 6 labels (2 correct labels per mark)

E. When action potential arrives at axon terminal Ca^{2+} moves into synaptic knob

F. Synaptic vesicles fuse with presynaptic membrane

G. Neurotransmitter/Ach/eq released by <u>exocytosis</u>

H. <u>Diffuses</u> over synaptic cleft

I. ACh binds to receptors on post synaptic membrane

J. Causing the protein channels to open/Na gates open

K. Na^+ flows in through channels

L. So depolarising the post synaptic membrane

M. With sufficient depolarisation, an impulse/action potential is generated in the post synaptic neurone

N. Some comment on the breakdown of ACh by (A)Ch-esterase

O. Diffusion back into axon terminal through presynaptic membrane/Use of ATP for <u>re-synthesis and packaging</u>

Any 10 from the 15 marks available

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Candidate Name	Centre Number	Candidate Number
		2

WJEC CBAC

GCE AS/A level

1074/01 **New A2**

BIOLOGY/HUMAN BIOLOGY - BY4

P.M. MONDAY, 25 January 2010

1¾ hours

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1	**16**	
2	**12**	
3	**16**	
4	**12**	
5	**14**	
6	**10**	
Total	**80**	

W10 1074 01 1

INSTRUCTIONS TO CANDIDATES

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.

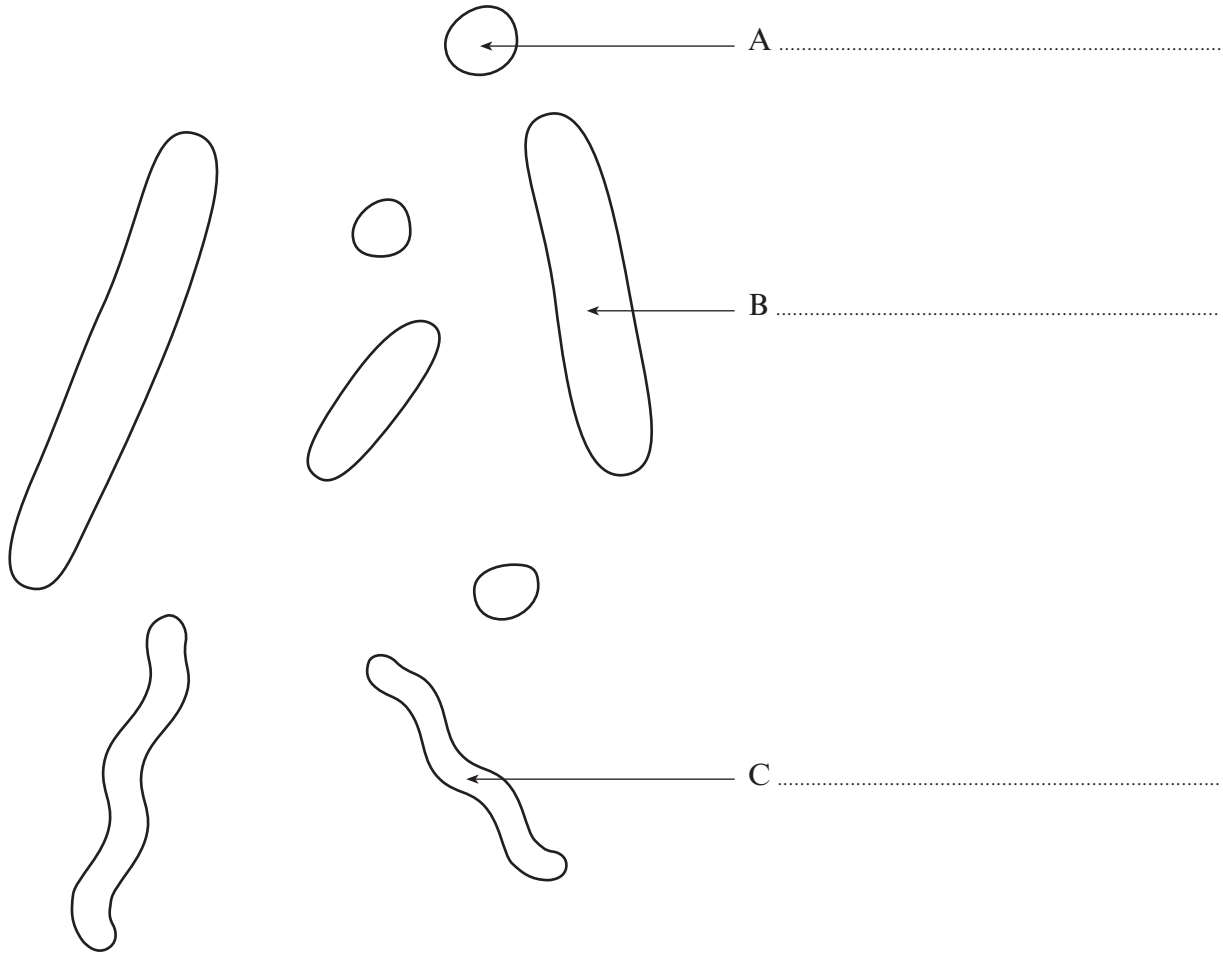
You are reminded of the necessity for good English and orderly presentation in your answers.

The quality of written communication will affect the awarding of marks.

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Examiner only

1. *(a)* Bacteria can be classified according to their shape. The diagram below shows some of the types of bacteria found in the mouth.



On the diagram give the **names** of the types of bacteria labelled A - C. [3]

(b) Before staining all bacteria are colourless. Complete the table to show the final colours expected when using the Gram staining technique on Gram negative and Gram positive bacteria. [2]

Type of bacterium	*Colour after Gram staining*
Gram positive	
Gram negative	

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(c) Some bacteria are described as facultative anaerobes and some as obligate anaerobes. State the difference between these two types of bacteria. [2]

.....

.....

.....

.....

(d) (i) Correct handling techniques have to be used when culturing bacteria on sterile agar plates to prevent contamination of the plates and the environment. Complete the bullet points below to give **four** *other* methods which you would use to prevent contamination when plates were being inoculated. [4]

- Disinfect the bench.
- Wash hands.
- .....
- .....
- .....
- .....

(ii) The plates are secured with adhesive tape and incubated at 25°C. Explain why the plates should **not** be:

I sealed completely from the air; [1]

.....

.....

II incubated at 37°C. [1]

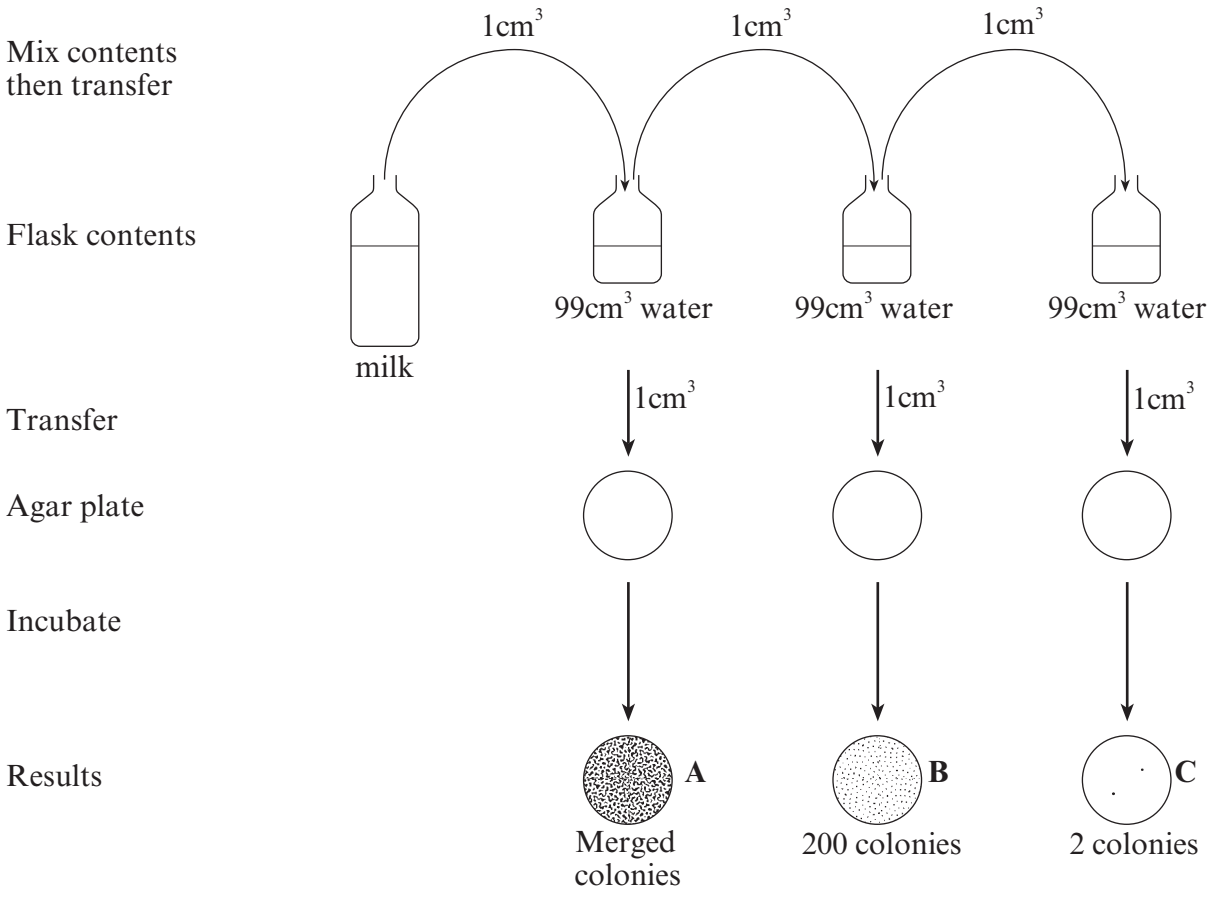
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Examiner only

(e) The following method was used to calculate the number of bacteria in milk.



(i) Explain why plate **B** is used to calculate the number of bacteria per cm^3 of milk. [1]

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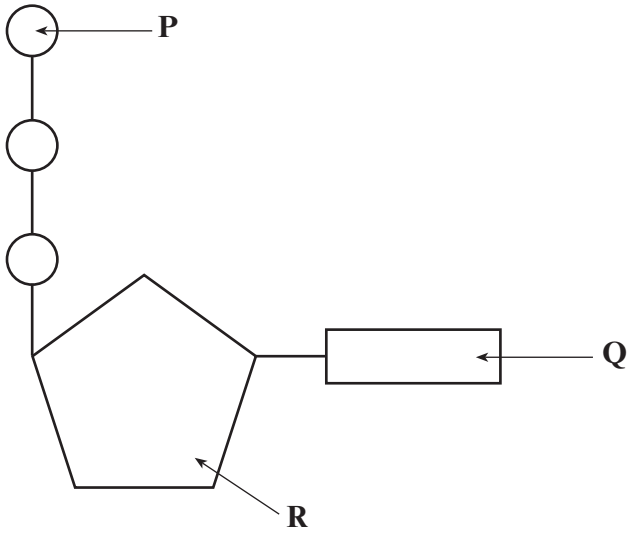
(ii) Using the figures shown in the diagram, calculate the number of bacteria per cm^3 in milk. [2]

Answer .....

(Total 16 marks)

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2. The diagram below represents the structure of ATP.



(a) Name the parts of the molecule **P**, **Q** and **R**. [3]

P .....

Q .....

R .....

(b) (i) ATP is often described as the 'universal energy currency'. Explain why it is described in this way. [2]

.....

.....

.....

.....

(ii) Give **three** advantages of ATP for its function as a source of energy. [3]

1 .....

.....

2 .....

.....

3 .....

.....

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(c) Describe and explain how a parasite, such as the pork tapeworm, which lives in **anaerobic** conditions in the human gut can produce ATP. [4]

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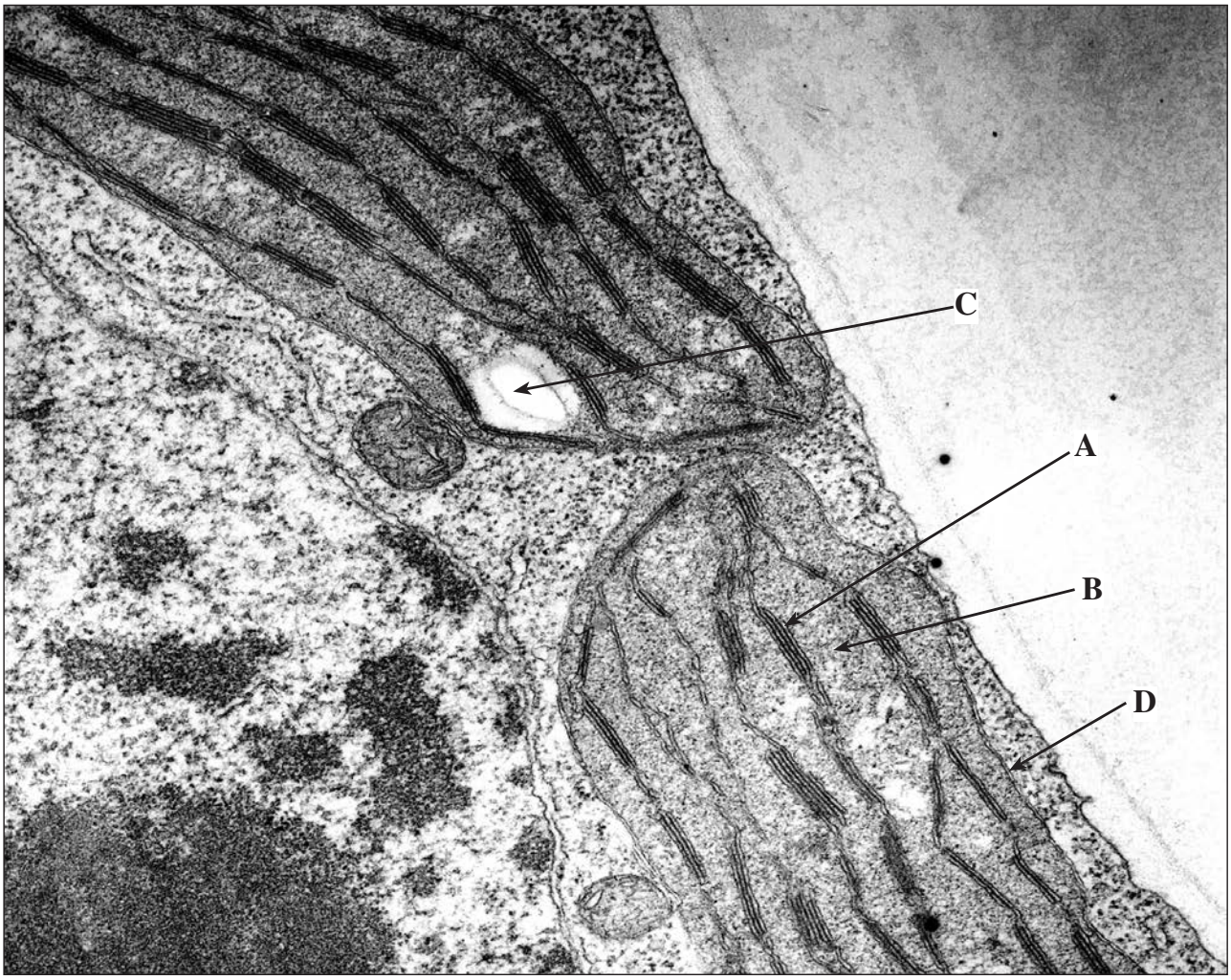
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(Total 12 marks)

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3. *(a)* The electron micrograph shows a section through two chloroplasts.



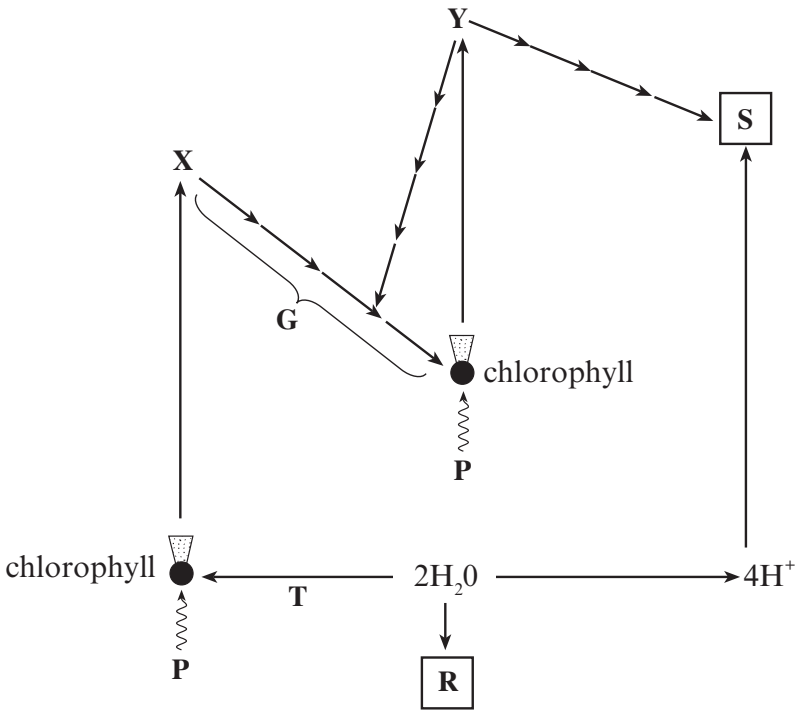
Using the letters on the electron micrograph, complete the following table. You may use the same letter once, more than once or not at all. [5]

Area	*Letter*
where chlorophyll is found.	
where carbon dioxide is reduced to a hexose sugar.	
where oxygen is produced from water.	
where there is a high concentration of ribulose 1-5 bisphosphate Carboxylase (RuBisCo).	
containing the polysaccharides amylose and amylopectin.	

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(b) A representation of the light stage of photosynthesis is shown below.



(i) What is represented by the arrows labelled **P**? [1]

.....

(ii) What is the general name given to the structures **X** and **Y**? [1]

.....

(iii) Briefly explain what is happening in the process labelled **G**. [1]

.....

.....

.....

(iv) What is represented by **R**? [1]

.....

(v) What is represented by **S**? [1]

.....

(vi) What process is represented by the arrow labelled **T**? [1]

.....

.....

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(c) Atrazine is a commonly used weedkiller. It prevents non-cyclic photophosphorylation from taking place. Using your knowledge of the light independent stage of photosynthesis, explain why its use leads to the death of a plant. [5]

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(Total 16 marks)

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4. *(a)* Synapses are found in both the nervous system of vertebrates and in the nerve nets of invertebrates.
State **three** functions of a synapse. [3]

1 .....

2 .....

3 .....

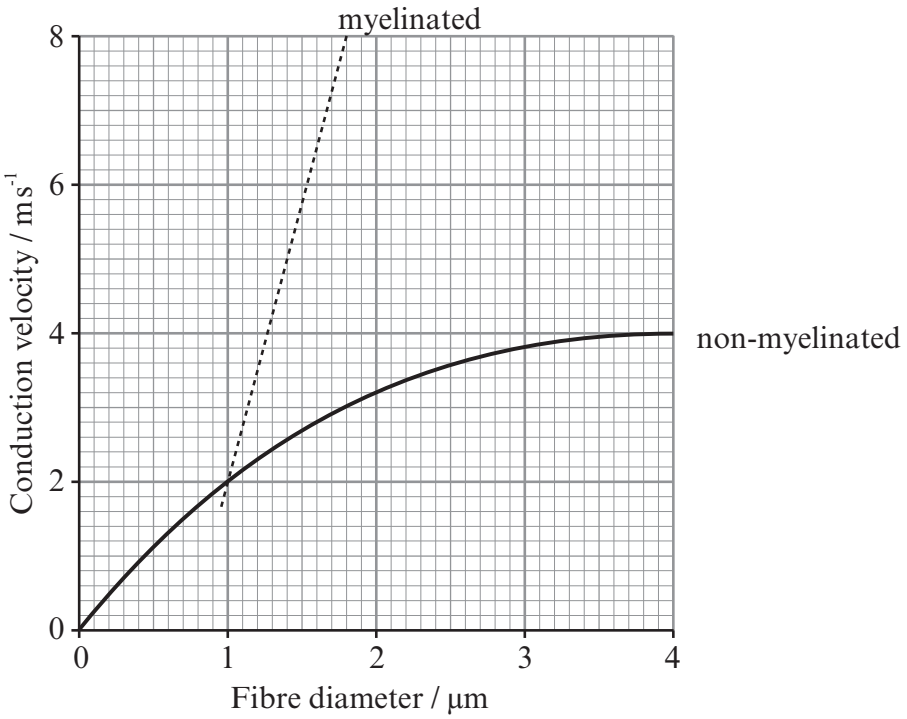
(b) Complete the table to show **two** differences between the structure or functioning of the neurones in a vertebrate and in the nerve net found in organisms such as jellyfish (Cnidarians). [2]

Neurones in a vertebrate	*Neurones in the jellyfish nerve net*

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(c) The graph shows the relationship between fibre diameter and the conduction velocity in myelinated and non-myelinated neurones in the cat.



(i) Using the information on the graph, describe the relationship between fibre diameter and speed of conduction in myelinated and non-myelinated neurones. [3]

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(ii) Suggest why myelinated fibres are never less than 1.0 μm in diameter. [1]

.....

.....

(iii) Suggest **three** ways in which organisms have been able to speed up the rate of conduction of the nerve impulse. [3]

1 .....

2 .....

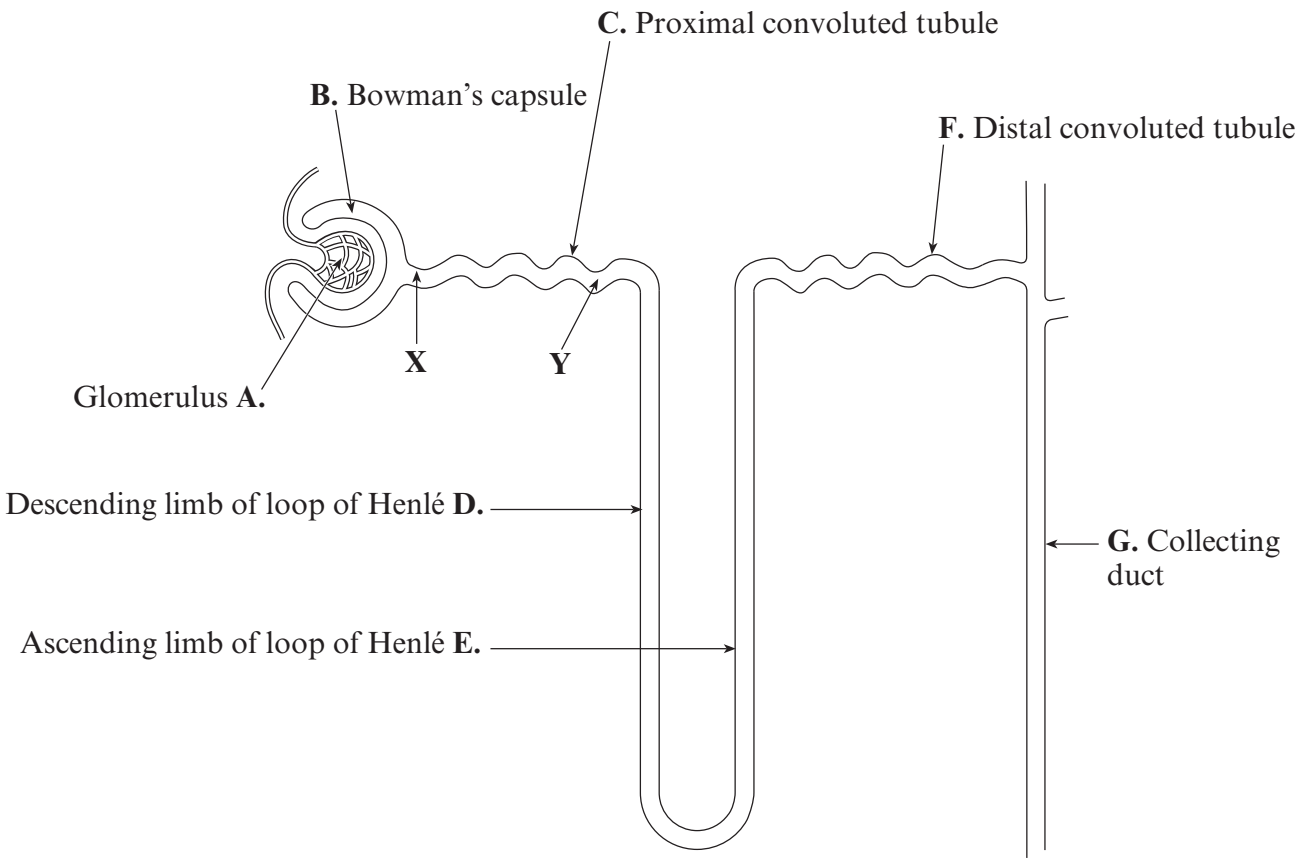
3 .....

(Total 12 marks)

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5. *(a)* The diagram below is of a kidney nephron.



(i) In which region of the kidneys is the Bowman's capsule found? [1]

.....

(ii) Explain why the urea concentration is higher in the region labelled **Y** than it is in the region labelled **X**. [1]

.....

.....

(iii) Match any of the letters **A-G** from the diagram with the statements shown in the following table. [4]

Statement	*Letter(s)*
Main site of selective reabsorption	
Areas involved in ultrafiltration	
Sodium ions actively pumped from this region	
Anti diuretic hormone acts on this region	

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(iv) The water potential of the blood changes as it passes through the glomerulus and the water potential of the filtrate changes as it passes along the nephron. Using a tick (✓), complete the table below to show if the water potential increases or decreases as it passes along each of the regions labelled in the diagram. [4]

flowing along region	*water potential increasing*	*water potential decreasing*
A		
C		
D		
E		

(b) The Kangaroo rat, *Dipodomys spectabilis*, is found in desert regions of North America. It does not drink water and feeds on dry seeds and other dry plant material. It produces very little urine.

(i) Explain how the kidney of this mammal is adapted to reduce the volume of urine produced. [2]

.....

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(ii) Suggest how desert animals are able to obtain water from dry seeds. [2]

.....

.....

.....

.....

(Total 14 marks)

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Examiner only

6. Answer **one** of the following questions.
Any diagrams included in your answer must be fully annotated.

Either, *(a)* Describe and explain the shape of the population growth curve of bacteria cultured in a batch fermenter. [10]

Or, *(b)* The maintenance of soil fertility is mainly determined by bacteria.

(i) Describe the importance of bacteria in the maintenance of soil fertility. [8]

(ii) Suggest how farming practices can encourage the activity of these bacteria. [2]

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(Total 10 marks)

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1. (a) A = Coccus

B = Bacillus

C = Spirillum [3]

(b) Gram +ve violet/purple (not:blue)

Gram –ve red [1]

(c) Facultative anaerobes, grow better in presence of <u>oxygen</u> but can survive without it; [1]

Obligate anaerobes, cannot survive in presence of oxygen. [1]

(d) (i) do not put culture bottle cap onto bench;

flame mouth of tube;

flame (inoculating) loop;

lift Petri dish lid at an angle;
(not: in context of pouring plate)
use a pressure cabinet / sterile cabinet / near Bunsen for updraft;
(not: use sterilised Petri dishes/autoclave/equipment)

[Max 4]

(ii) Sealed: anaerobic conditions encourage pathogenic bacteria; [1]

Body temperature: encourages (human) pathogenic bacteria. [1]

(e) (i) B, clear distinct colonies which can be counted / A too many colonies / merged, to count accurately, C not enough; [1]

(ii) Plate B 200 bacteria per cm^3,

B was diluted by hundredfold twice dilution factor of <u>10000</u>;

200 x 100 = 2 million/ $2x10^6$;

1 mark for method look for 200 and 10000,

Give 2 marks for 2 million [2]

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2. (a) P = phosphate (not: phosphoric acid)

Q = nitrogenous base / organic base / adenine;

R = Ribose / pentose (sugar). [3]

(b) (i) Supplies energy; <u>all</u> reactions; in <u>all</u> cells; [Max 2]
(not: produces)

(ii) Soluble; easily transported across membranes; easily hydrolysed; energy released in useable amounts; several methods of regeneration; link between energy production and energy use; only one enzyme needed [Max 3]

(c) Glycolysis; glucose to pyruvic acid/ pyruvate; (ATP produced) substrate level phosphorylation; pyruvic acid converted into lactic acid (accept ethanol); from reduced NAD; so that NAD regenerated; allows glycolysis to continue.
(not: NADP/glucose to lactic acid/ref. number ATP produced) [Max 4]

3. (a) A = Grana / thylakoid membranes;

B = Stroma;

A = Grana / thylakoid membranes;

B = Stroma;

C = Starch grain, clear area in chloroplasts; [5]

(b) (i) P = light energy / photons of light;

(ii) Electron acceptors/carriers;

(iii) Electrons flowing along an electron transport chain / cytochromes;
(not: chemiosmosis)

(iv) Oxygen

(v) NADP / $NADPH^+$ / reduced NADP / NADPH2;

(vi) Electrons from photolysis replacing electrons in chlorophyll of PS II [6]

(c) a. Light dependent reactions do not take place – in correct context;

b. ATP;

c. reduced NADP not produced;

d. Calvin cycle stops; (not: dark reactions)

e. GP not converted into TP/GALP;

f. no hexose sugar made;

g. no respiratory substrate / respiration stops [Max 5]

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4. (a) Transmit impulses between neurones / from neurone to muscle;
(not: signal)
One direction only / polarity;

Filter out low level stimuli/background;

Protect from over stimulation;

(Act as junctions) / additive effect of stimuli from different neurones/ Spatial summation;

Accept reference to inhibitory synapses;

Temporal summation; [Max 3]

(b) Nerve net, neurones shorter; branched; can transmit in both directions; facilitation; slower transmission; Stimuli pass in all directions from point of stimulation; non-myelinated; one type of cell. Converse vertebrate. Matched points [Max 2]

(c) (i) As fibre diameter increases speed of conduction increases;

Much more rapid response in myelinated;

Below a certain diameter (1.1 um) non myelinated faster;
(not: Below a certain diameter no conduction)
Myelinated linear, non-myelinated rapid at start then plateau; [Max 3]

(ii) Conduct slower than non myelinated. [1]

(iii) Increase diameter; myelination, higher (body) temperature; longer distance between nodes / fewer nodes.
Saltatory conduction [3]

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5. (a) (i) cortex [1]

(ii) Water has been absorbed / less volume of water; [1]

(iii) C

B, A

E acc C

F or G [4]

(iv) A = decrease

C = decrease

D = decrease

E = increase [4]

(b) (i) Loop of Henle longer;

Counter current multiplier; (not: description)

Creates region of (very) low water potential around loop;

More water reabsorbed from collecting duct;

Reference to low filtration rate; [Max 2]

(ii) Metabolic water / water from metabolism;

Respiration;

Fats / oils. [2]

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6. (a)

A. Lag phase, Log phase / exponential- term in correct context;

B. Induction DNA / gene switching / DNA unzipping;

C. Enzyme production/protein synthesis;

D. Substrate breakdown / getting used to growth medium;

E. Slow population growth;

F. Rapid cell division;

G. Abundance of nutrients / oxygen / low levels of waste products / no environmental resistance;

H. Cell production exceeds cell death;
(not: ref. birth/immigration/emigration)

I. Population doubles per unit time;

J. Population increases then begins to slow;

K. Lack of nutrients / accumulation waste products / environmental resistance; (not: ref space)

L. Stationary phase;

M. Cell production = cell death; (not: ref birth, penalise once only)

N carrying capacity;

O. lack of nutrients / accumulation of waste products if not given as K;

P Death phase;

Q Cell death exceeds cell production;

(b)

A. Decomposition / putrefaction;

B. Recycling nutrients;

C. Breakdown of organic materials into inorganic / suitable e.g.;

D. Nitrifying bacteria;

E. Nitrosomonas, Nitrobacter;

F. ammonium compounds to nitrites;

G. nitrites to nitrates;

H. ammonium compounds to nitrates if no F/G;

I. Nitrogen fixing bacteria;

J. atmospheric nitrogen converted into organic nitrogen / e.g.;

K. free living azotobacter;

L. rhizobium;

M. root nodules of (legumes);

N denitrification [Max 8]

O. encourage aerobic conditions (to stop denitrifyers) / ploughing;

P drainage for aerobic conditions to stop denitrifyers;

Q grow leguminous crops / add organic waste products / manure / urea etc;

[Max 2]

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