



RIVER VALLEY HIGH SCHOOL

YEAR 6

PRELIMINARY EXAMINATION

CANDIDATE
NAME

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CENTRE
NUMBER

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CLASS

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INDEX
NUMBER

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H2 BIOLOGY

9744/02

Paper 2 Structured Questions

10 Sep 2018

2 hours

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, index number and name in the spaces at the top of this page.

Write in dark blue or black pen.

You may use an HB pencil for any diagrams or graphs.

Do not use staples, paper clips, glue or correction fluid.

DO NOT WRITE IN ANY BARCODES.

Answer **all** questions in the spaces provided on the Question Paper.

The use of an approved scientific calculator is expected, where appropriate.

You may lose marks if you do not show your working or if you do not use appropriate units.

At the end of the examination, fasten all your work together.

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

For Examiner's Use	
1	/ 6
2	/ 11
3	/ 12
4	/ 8
5	/ 12
6	/ 10
7	/ 10
8	/ 11
9	/ 10
10	/ 5
11	/ 5
Total	/ 100

This document consists of **24** printed pages.

Answer **all** questions.

- 1 Fig.1.1 shows a cell undergoing telophase and process **X** simultaneously.

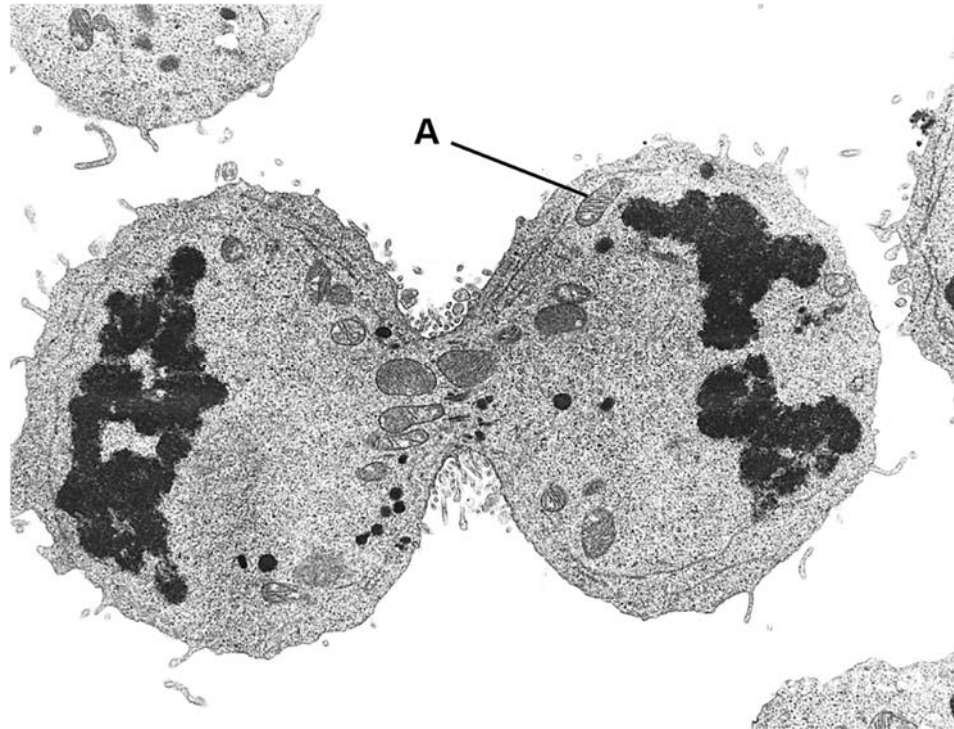


Fig. 1.1

Source: David M. Phillips, 2014

- (a) Name structure **A**.

[1]

- (b) Name process **X** and explain how it supports the cell theory.

[2]

- (c) Outline the role of **A** and explain its significance to process **X**. [3]

[Total: 6]

- 2 (a) Explain how the structure of fatty acids allow triglycerides to be a good store of energy. [2]

Fig. 2.1 shows the structure of a lipoprotein. Lipoproteins transport fats from the liver to other tissues via the bloodstream. The proteins of lipoproteins play an important role in the deposition of fats to the correct tissue.

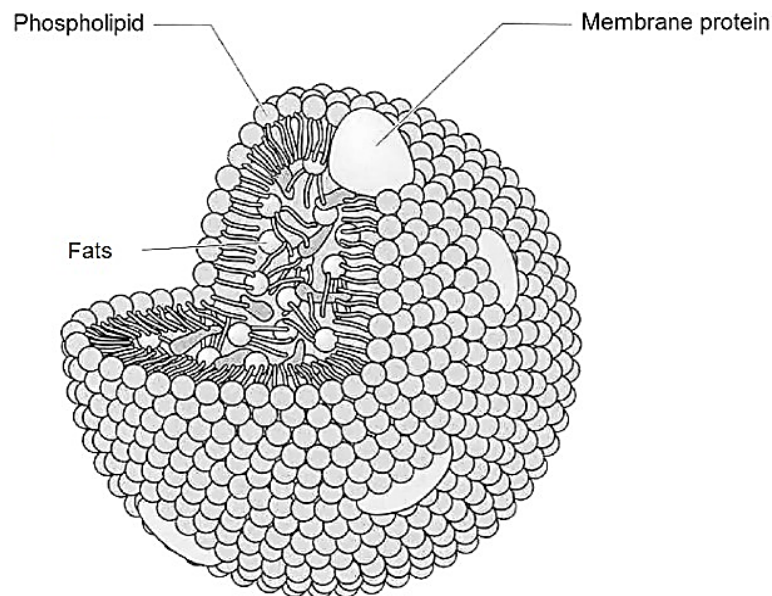


Fig. 2.1

- (b) Describe how lipoproteins allow for the transport of fats from the liver to a specific tissue via blood. [4]

Fig. 2.2 shows a protein embedded in a phospholipid bilayer.

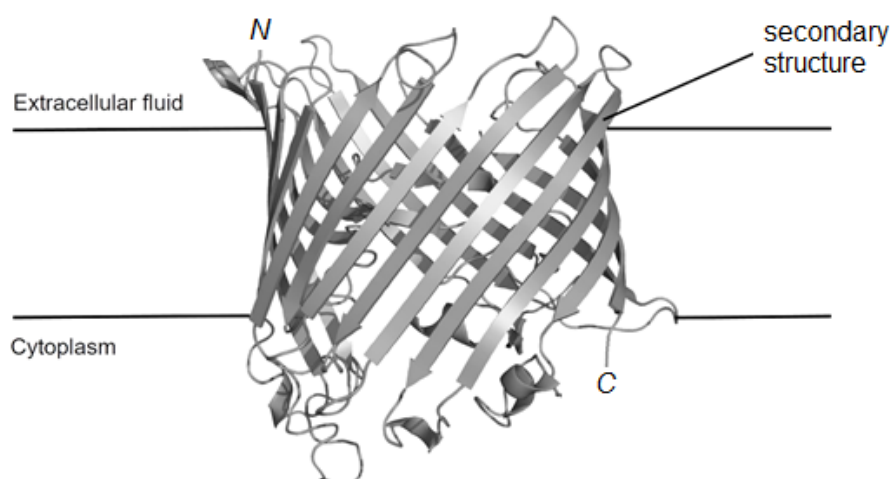


Fig. 2.2

Source: Adapted from RCSB Protein Data Bank

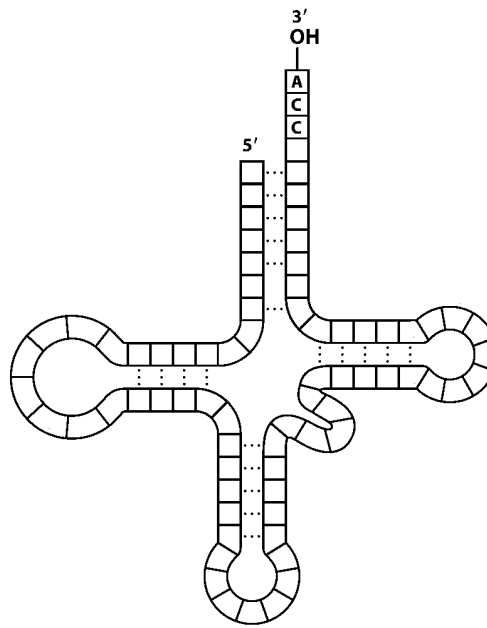
(c) With reference to Fig. 2.2,

(i) name the secondary structure and describe the bonding involved, and [3]

(ii) describe how the structure of haemoglobin differs from that of the protein in Fig. 2.2. [2]

[Total: 11]

- 3 Fig. 3.1 shows the structure of a tRNA.



Source: *Biochem, Seventh edition, 2012*

Fig. 3.1

- (a) Describe how the structure of tRNA allows for its role in translation. [4]

Synthetic RNA, which binds to bacterial mRNA, could interfere with translation. Fig. 3.2 shows the sequences of a bacterial mRNA and two different synthetic RNA.

Bacterial mRNA

5'- GUCAACCAUGCCAAUUAUCACGGACAUUCAUGGUAGGCCUUAGUAGACAACUG-3'

Synthetic RNA 1

5'- CAGUUGUCUA-3'

Synthetic RNA 2

5'- CUAGGUUGAC-3'

Fig. 3.2

(b) With reference to Fig. 3.2, suggest how synthetic RNA binds to mRNA. [1]

The effectiveness of synthetic RNA 1 and 2 are investigated by introducing them to separate bacterial cultures and incubating for 24 hours. The results of the investigation is shown in Fig. 3.3.

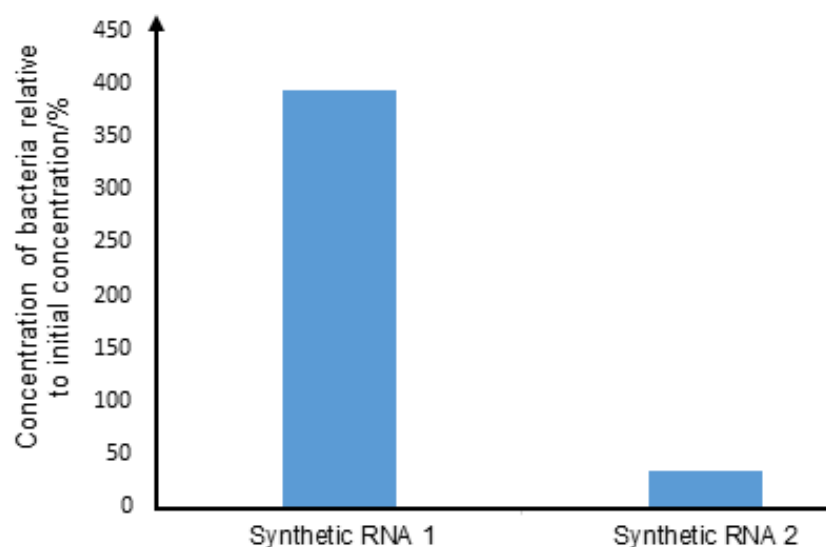


Fig. 3.3

- (c) With reference to Fig. 3.2 and Fig. 3.3, explain the results of the investigation. [6]

- (d) Suggest a limitation of using synthetic RNA as an oral antibiotic for bacterial infections in humans. [1]

[Total: 12]

- 4 *Morbillivirus*, which causes measles, has a structure as shown in Fig. 4.1.

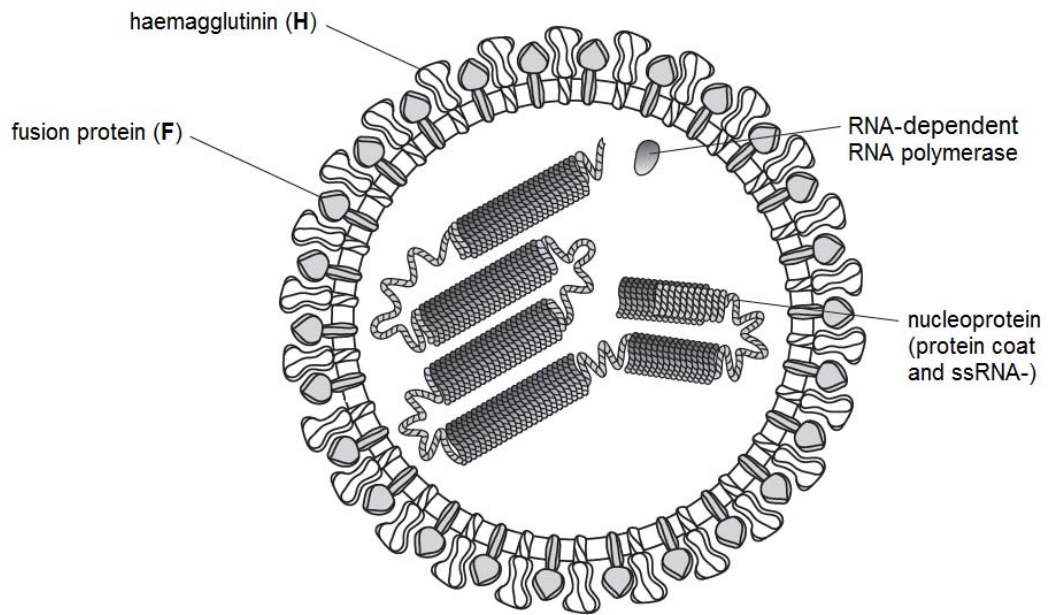


Fig. 4.1

Source: UCLES, 2016

Morbillivirus only infects cells that have a membrane glycoprotein known as signaling lymphocyte activation protein (SLAM). When *Morbillivirus* infects a cell, **H** acts before **F**.

- (a) State how the structure of *Morbillivirus* envelope is similar to that of human immunodeficiency virus (HIV). [2]

- (b) *Morbillivirus* and HIV utilise a similar mechanism to enter host cells.

Describe how *Morbillivirus* enters a host cell.

[3]

- (c) Describe how the *Morbillivirus* genome enables the *Morbillivirus* reproductive cycle.

[3]

[Total: 8]

- 5 The *ara* operon is an inducible operon involved in the breakdown of a pentose sugar, arabinose. The organisation of the *ara* operon differs from that of a *lac* operon. Fig. 5.1 shows the organisation of the *ara* operon in a bacterium.

The *ara* operon encodes three structural genes (*araB*, *araA* and *araD*) and is regulated by the regulatory gene *araC*. The arrows in Fig 5.1 represent the directions of transcription of the respective genes.

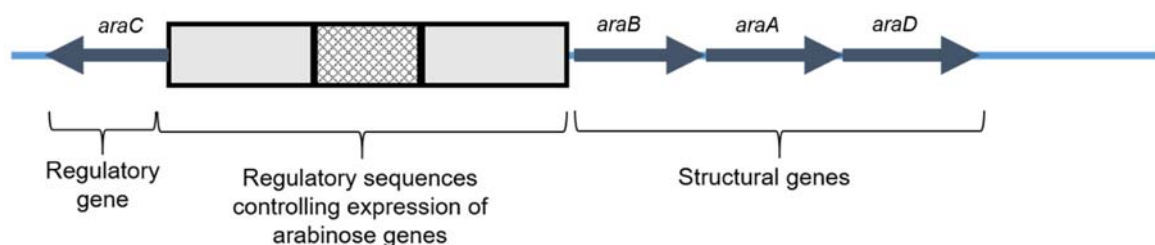


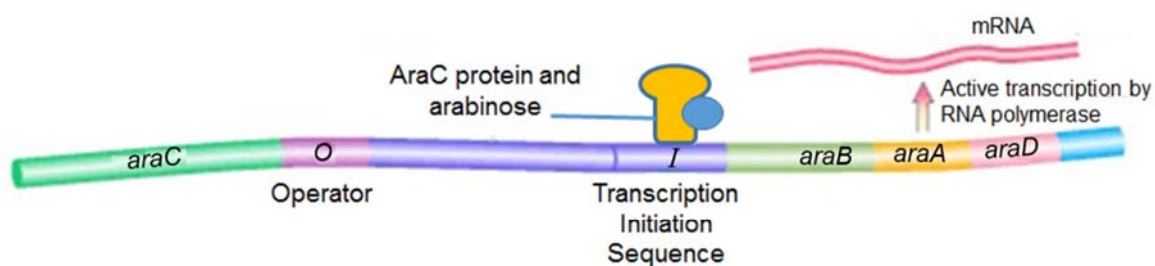
Fig. 5.1

- (a) Using the *ara* operon, explain what is meant by the term operon. [2]

- (b) Suggest why the transcription of the structural genes (*araB*, *araA* and *araD*) proceeds in a different direction from the regulatory gene (*araC*). [2]

Fig. 5.2 shows how *araC* protein interact with arabinose and the regulatory sequences to regulate the expression of the structural genes of the *ara* operon.

In the presence of arabinose:



In the absence of arabinose:



Fig. 5.2

- (c) With reference to Fig. 5.2, describe how transcription of the *ara* operon is inhibited. [3]

Plasmids can be transferred from one bacterium to another via the process shown in Fig. 5.3.

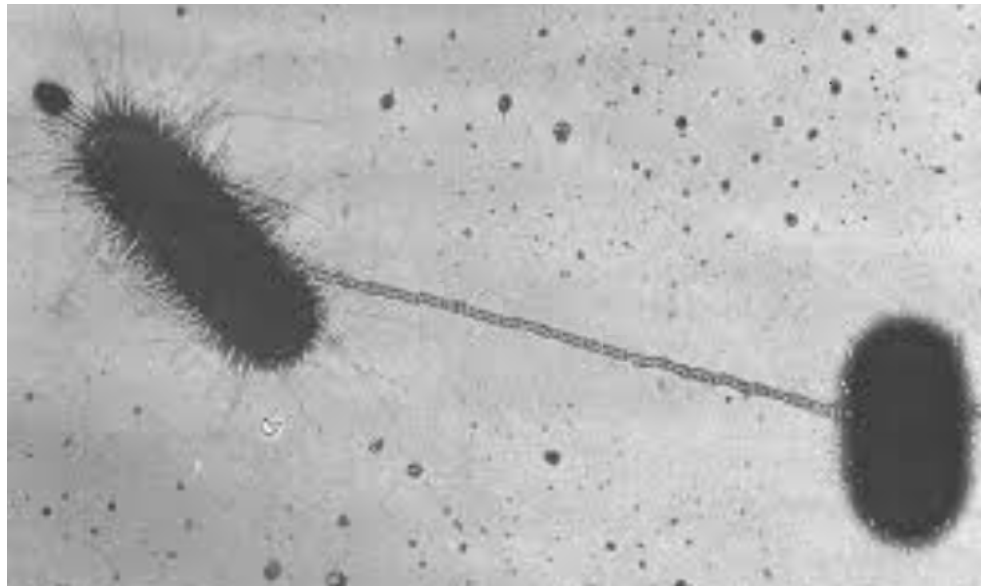


Fig. 5.3

Source: Appl. Environ. Microbiol. October 2016 vol. 82 no. 19 5940-5950

(d) With reference to Fig. 5.3,

(i) state the process, and

[1]

(ii) describe the main features of the process.

[4]

[Total: 12]

- 6 A germline cell is undergoing meiosis to produce gametes. Fig. 6.1 shows a stage in this process.

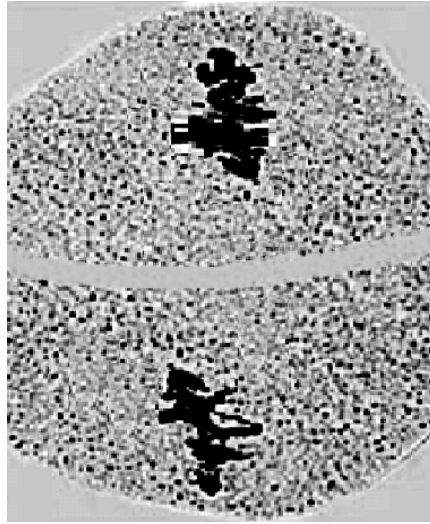


Fig. 6.1

- (a) (i)** Identify the stage of meiosis shown in Fig. 6.1 [1]

- (ii)** Explain your answer in **(a)(i)**. [2]

- (b)** Describe the role of centrioles in the next stage of meiosis. [3]

Fig. 6.2 shows an error in anaphase II.

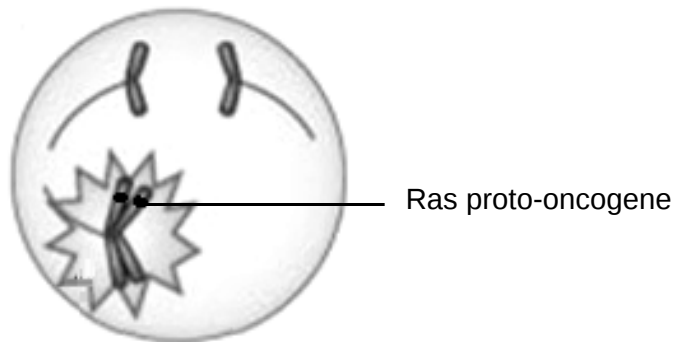


Fig. 6.2

- (c)** Explain why this error may increase the risk of cancer in a newborn. [3]

- (d)** Kinase inhibitors are often used to target such cancers associated with Ras proto-oncogenes by interrupting their downstream signalling. Suggest how kinase inhibitors can interrupt Ras signalling pathway. [1]

[Total: 10]

- 7 (a) Distinguish between polygenic inheritance and multiple allele inheritance. [3]

In humans, an individual's blood group is a combination of the ABO system and the Rhesus (Rh) system. The ABO system divides blood into four types: A, B, AB and O. The Rh system divides blood type into negative (–) or positive (+). The genes for ABO blood type and Rh blood type are inherited independently.

As part of family planning, Claudia, with blood group O[–] consulted a genetic counsellor who charted the inheritance of Rh blood type in the family, shown in Fig. 7.1.

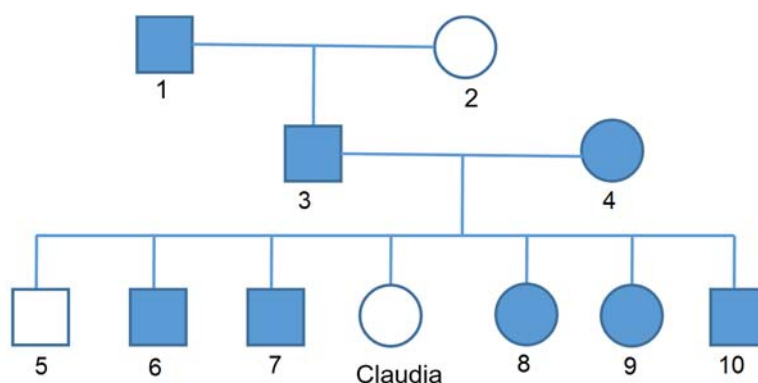


Fig. 7.1

- (b) With reference to Fig. 7.1, explain why the two claims below are correct.

Claim 1: The Rh⁺ phenotype is expressed in heterozygotes.

Claim 2: The Rh gene is not found on sex chromosomes.

[3]

Claim 1:

Claim 2:

Claudia is married to a man whose blood group is AB⁺. Their first child has blood group A⁻. She is expecting a second child.

- (c) Using the symbols **I^A**, **I^B** and **I^O** to represent the alleles of the ABO blood type and the symbols **Rh⁺** and **Rh⁻** to represent the alleles of the Rh blood type, draw a genetic diagram to show all the possible phenotypes of her second child.

[4]

[Total: 10]

- 8 Fig. 8.1 shows the absorption spectrum (—) of a photosynthetic pigment from a plant, and the rate of photosynthesis (- - -) of the same plant in different colours of light.

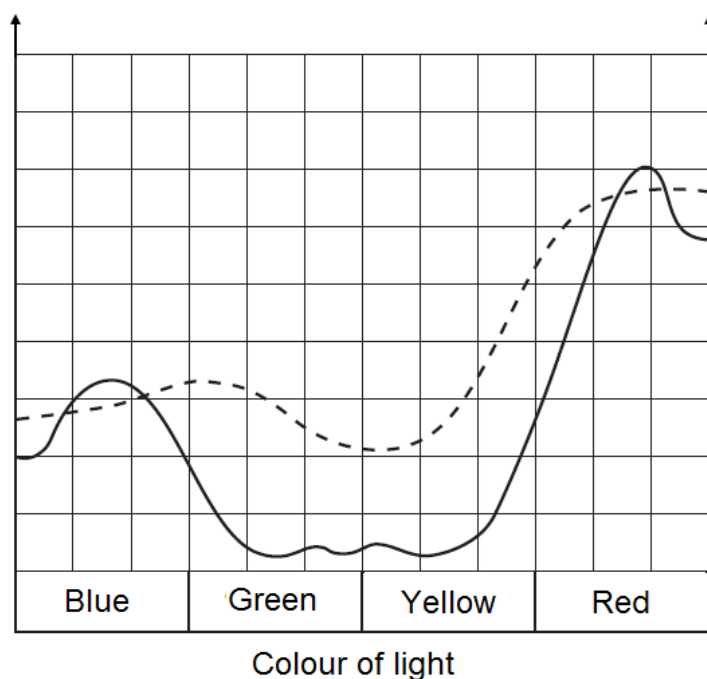


Fig. 8.1

- (a) Explain what is meant by an absorption spectrum. [2]

- (b) State whether this plant contains more than one type of photosynthetic pigment. Explain your answer. [2]

- (c) Plants typically have several photosynthetic pigments, some of which function as accessory pigments.

Suggest the role of accessory pigments in photophosphorylation.

[1]

In a separate experiment to study photophosphorylation in plants, chloroplasts are isolated, and the pH levels in various compartments are monitored.

The table below shows the results of this experiment.

Table 8.1

environmental condition	pH	
	stroma	thylakoid lumen
dark	7.2	6.8
light	8.8	5.2

- (d) Describe and explain the changes in pH as environmental conditions change from dark to light.

[6]

[Total: 11]

- 9 Mudskippers are fish which have evolved to use their modified pectoral fins to move onto land to avoid being eaten by larger oceanic fish.

Fig. 9.1 shows a mudskipper. The arrow indicates the modified pectoral fin.

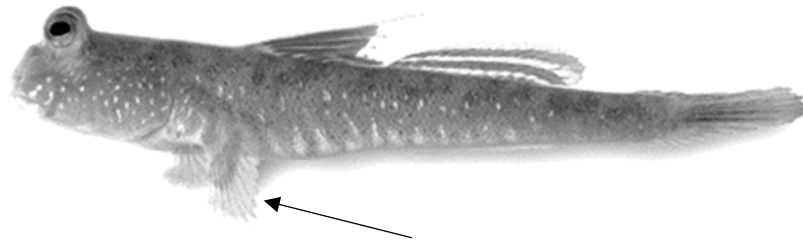


Fig. 9.1

Adapted from: <http://www.mudskipper.it/ita/SpeciesPages/noveIT.html>

- (a) Explain how mudskippers evolved from their fully aquatic ancestors to have modified pectoral fins. [4]

Fig. 9.2 shows the body plan of Ichthyosaurs, which are extinct marine reptiles, and dolphins, which are mammals. Both types of animals can swim quickly to catch prey.

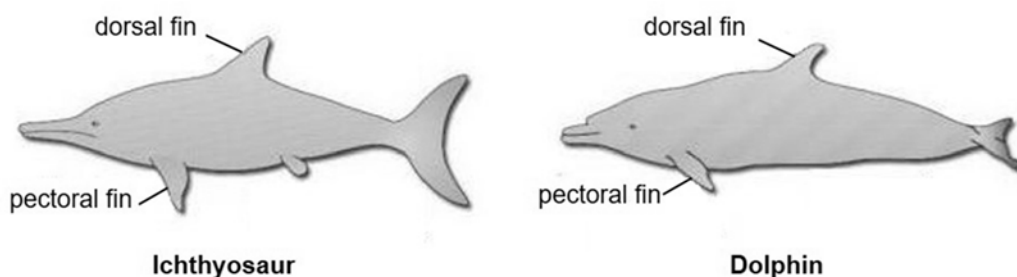


Fig. 9.2

- (b) (i)** State the type of evolution shown by Ichthyosaurs and dolphins. [1]

- (ii)** Explain your answer in **(b)(i)**. [2]

There are more than 40 species of dolphins known to scientists. To determine the evolutionary relationships between the different species, scientists are gathering genomic data to construct a phylogenetic tree.

- (c)** Describe the advantages of using molecular methods in constructing a phylogenetic tree. [3]

[Total: 10]

- 10 (a) Describe how *Mycobacterium tuberculosis* is transmitted. [2]

- (b) (i) Penicillin is often used to treat bacterial infections due to its ability to interfere with bacterial cell wall synthesis.
Describe the mode of action of penicillin. [2]

- (ii) Suggest why penicillin is ineffective against *M. tuberculosis*. [1]

[Total: 5]

- 11** Arctic foxes in Iceland hunt for prey such as lemmings, which are rodent-like animals. Due to global warming, there were milder and shorter winters from 2000 to 2006. This led to the melting of and collapse of snow burrows inhabited by the lemmings.

Fig. 11.1 shows the populations of arctic foxes and lemmings between 2000 and 2008.

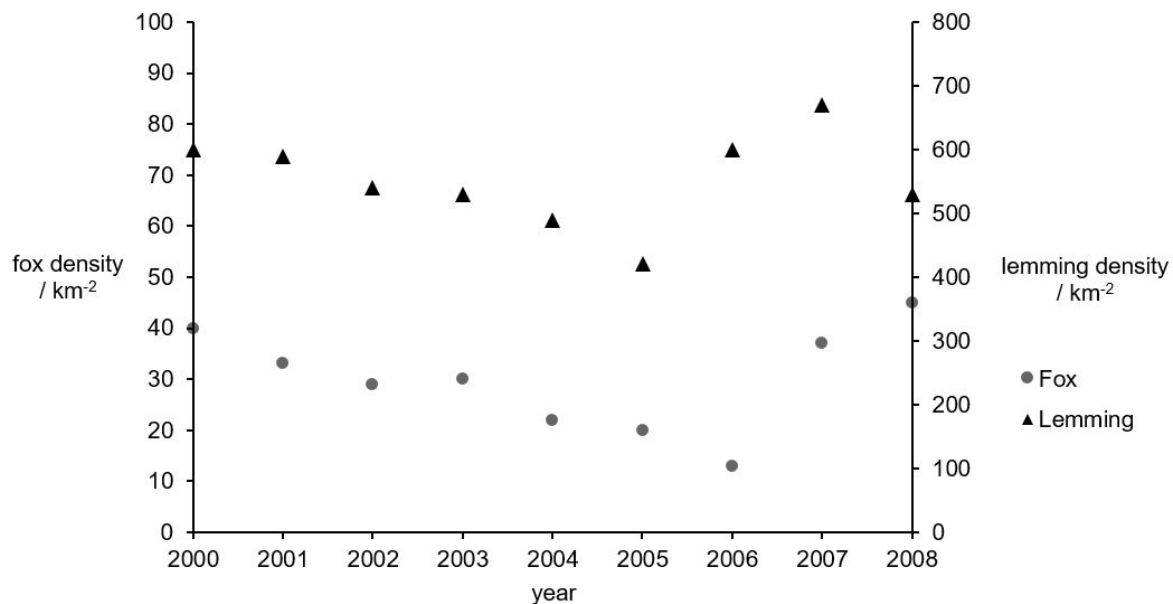


Fig. 11.1

- (a)** Explain how the melting of snow may lead to further warming of the island. [1]

- (b)** With reference to Fig. 11.1,

- (i)** describe the change in fox density, [2]

- (ii) explain why the density of lemmings increased from 2005 to 2006, and [1]

- (iii) suggest why arctic fox population density would not increase indefinitely beyond 2008. [1]

[Total: 5]