

CANDIDATE
NAME

CENTRE
NUMBER

--	--	--	--	--

CANDIDATE
NUMBER

--	--	--	--



BIOLOGY (PRINCIPAL)

Paper 1 Structured Questions

9790/01

May/June 2015

2 hours 30 minutes

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.

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.

Electronic calculators may be used.

Section A

Twenty questions for which you must choose what you consider to be the right answer. Marks will not be deducted for any wrong answers. Write your answers in the spaces provided on the Question Paper.

Section B

Write your answers in the spaces provided on the Question Paper.

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 securely together.

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

For Examiner's Use	
Section A	
21	
22	
23	
24	
25	
26	
Total	

The syllabus is approved for use in England, Wales and Northern Ireland as a Cambridge International Level 3 Pre-U Certificate.

This document consists of **33** printed pages and **3** blank pages.

Section A

Answer **all** the questions.

- 1 Which statement provides the best evidence for a single origin of life?
- A All eukaryotes have non-membrane-bound structures known as proteasomes.
 - B In organisms using the ubiquitin-proteasome mechanism, ATP hydrolysis is also required.
 - C The structural features of proteasomes are highly conserved in organisms of all kingdoms.
 - D The ubiquitin-proteasome mechanism is capable of breaking down a very diverse variety of proteins.

answer[1]

- 2 Which pair of hormones is produced by the placenta during pregnancy in a human female?
- A chorionic gonadotrophin and FSH
 - B human placental lactogen and FSH
 - C human placental lactogen and LH
 - D oestrogen and progesterone

answer[1]

- 3 Apple juice can be made by pressing the fruit and filtering the liquid obtained.
- What is an advantage of treating the fruit with pectinase during this process?
- A A greater volume of apple juice is produced.
 - B A more cloudy, natural-looking apple juice is obtained.
 - C Browning of the apple juice is prevented.
 - D Sweeter apple juice is produced.

answer[1]

- 4 Polypeptide synthesis is based on sequences of three nucleotides, each specific for an amino acid.

Which row shows the correct nucleotide sequences for an amino acid?

	nucleotide sequence of		
	non-transcribed DNA strand	mRNA codon	tRNA anticodon
A	GGT	CCA	GGU
B	GGG	CCC	CCC
C	CCG	CCG	GGC
D	CCT	CCU	CCU

answer[1]

- 5 Which observation of a feature indicates divergence due to evolution?

- A** Birds and butterflies both have wings but are distantly related. They can live in different environmental conditions.
- B** Birds and butterflies both have wings but are distantly related. They can live in the same environmental conditions.
- C** Some closely-related species of bird have different sizes and shapes of beaks. The species live in different environmental conditions.
- D** Some closely-related species of bird have the same size and shape of beak. The species live in different environmental conditions.

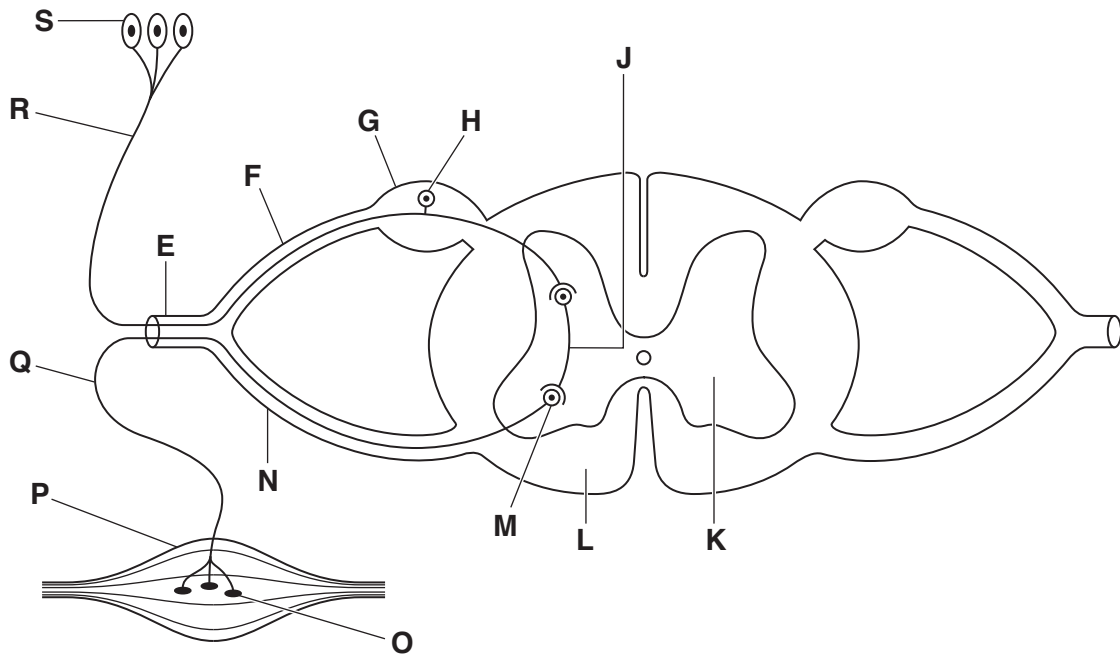
answer[1]

- 6 Which statement explains why cell membranes are described as having a 'fluid mosaic' structure?

- A** Different types of membrane have different sets of proteins, each with a specific pattern.
- B** Phospholipids diffuse within their own monolayer, with many of the membrane proteins also moving around.
- C** The fluidity of membranes changes as temperature changes, with cholesterol molecules maintaining stability.
- D** There are different kinds of transport protein scattered within the phospholipid bilayer, allowing facilitated diffusion and active transport.

answer[1]

7 The diagram is a section through the spinal cord, showing a reflex arc.



Which set of labels is correct?

A	E = spinal nerve	L = grey matter	M = cell body of motor neurone	S = receptor
B	F = dorsal root	H = cell body of sensory neurone	L = white matter	Q = motor neurone
C	G = dorsal root ganglion	J = synapse	K = white matter	R = sensory neurone
D	K = grey matter	O = motor end plate	N = dorsal root	P = effector

answer[1]

- 8 In gene technology, which of the following is not a valid reason for transferring a promoter together with a desired gene?
- A Promoters allow attachment of transcription factors to aid the initiation of transcription.
 - B Promoters allow attachment of DNA polymerase to enable gene cloning.
 - C Promoters allow control of gene expression in the host organism via transcription factors.
 - D Promoters allow flexibility as to where the desired gene is inserted into the host genome.

answer[1]

- 9 α - and β -amylase enzymes can break the α -1,4-glycosidic bonds of polysaccharides, but not the α -1,6-glycosidic bonds.

α -amylase acts randomly within polysaccharides and can produce glucose, maltose, trisaccharides and short, branched chains.

β -amylase acts at the ends of polysaccharides to remove successive maltose molecules.

Which statement about polysaccharide digestion is correct?

- A Both α -amylase and β -amylase are required for the complete digestion of starch to produce only glucose molecules.
- B Digestion of amylose by α -amylase will produce only branched molecules.
- C Digestion of amylose using β -amylase will yield a higher proportion of disaccharides than digestion using α -amylase.
- D Disaccharides can be produced from the digestion of cellulose using β -amylase, but not using α -amylase.

answer[1]

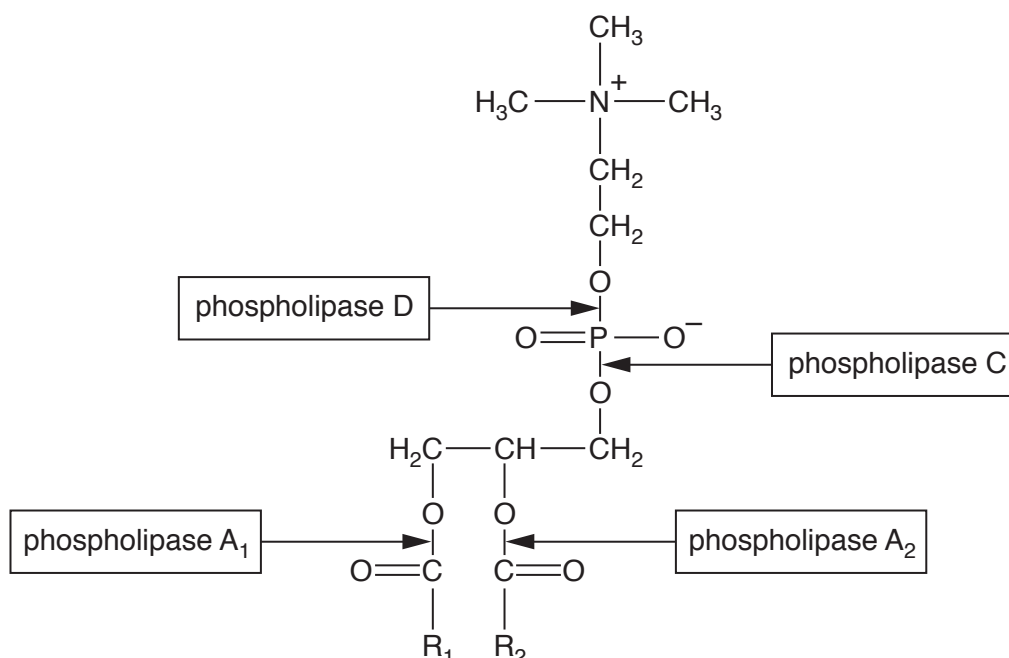
10 Phosphatidylcholines are phospholipids that have choline as part of the polar head section.

A high proportion of phospholipids in erythrocyte membranes are phosphatidylcholines.

The table below shows the results of an analysis to determine the four most abundant component fatty acids of human erythrocyte phosphatidylcholines.

fatty acid	molecular formula
palmitic acid	$C_{16}H_{32}O_2$
linoleic acid	$C_{18}H_{32}O_2$
oleic acid	$C_{18}H_{34}O_2$
stearic acid	$C_{18}H_{36}O_2$

The diagram shows a phosphatidylcholine. The site of action of four different phospholipases, A_1 , A_2 , C and D, are indicated.



In phosphatidylcholines:

- saturated fatty acids are more commonly found in position R_1 than unsaturated fatty acids
- unsaturated fatty acids are more commonly found in position R_2 than saturated fatty acids.

Which statements about enzyme action on isolated erythrocyte phosphatidylcholines are correct?

- 1 The action of phospholipase A₁ is likely to yield a higher proportion of oleic acid than stearic acid.
- 2 The action of phospholipase A₂ is likely to yield a higher proportion of linoleic acid than palmitic acid.
- 3 The products of the combined action of phospholipases A₁, A₂ and D will be free fatty acids, glycerol and choline.
- 4 The action of phospholipases A₁, A₂ and C will cause an increase in the pH of the reaction medium.

- A** 2 only
B 1 and 3
C 2 and 4
D 3 and 4

answer[1]

11 Which two statements about the enzyme rubisco and the reactions it catalyses in C₃ plants are correct?

- 1 At a temperature of 20 °C, the carboxylation of RuBP will be favoured over the oxygenation of RuBP.
- 2 High concentrations of oxygen within the leaf result in the non-competitive inhibition of rubisco by oxygen to prevent carbon fixation.
- 3 If stomata close during the day, the carbon dioxide concentration within the leaf decreases and the oxygenation of RuBP by rubisco increases.
- 4 C₃ plants located in hot, dry areas have mechanisms to isolate rubisco molecules from oxygen and prevent photorespiration.

- A** 1 and 3
B 1 and 4
C 2 and 3
D 2 and 4

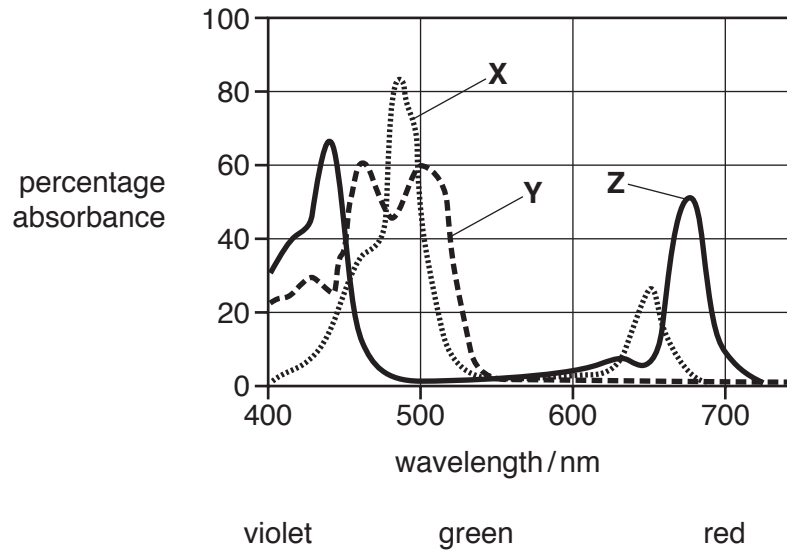
answer[1]

- 12 Graph **P** shows the absorption spectra of three types of photosynthetic pigment, **X**, **Y** and **Z**, extracted from the leaves of a flowering plant.

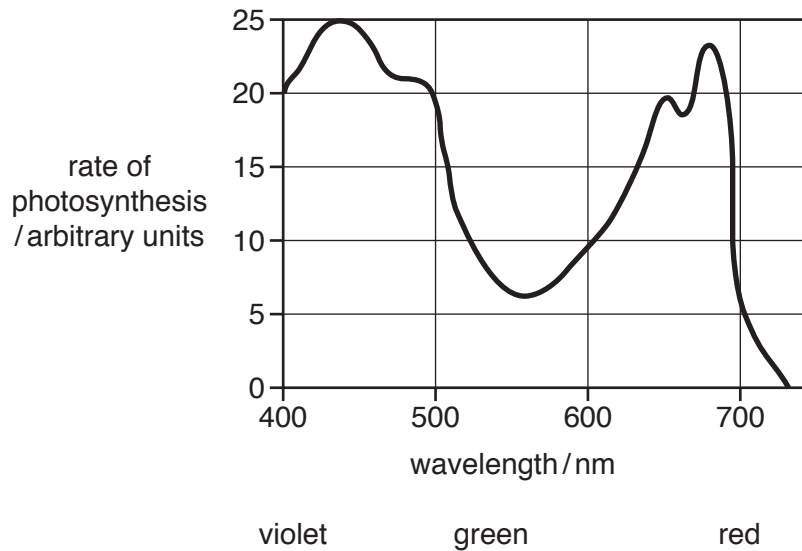
X is chlorophyll b.

Graph **Q** shows the action spectrum for photosynthesis for the same plant.

graph **P**



graph **Q**



Five students were asked to relate the information shown in graphs **P** and **Q** to their knowledge and understanding of the light-dependent stage of photosynthesis.

student	comment
1	The high absorption of blue light by chlorophyll b provides evidence that this is the primary electron donor of photosystem 1.
2	The low rate of photosynthesis in green light suggests that more green light is reflected than absorbed by the three pigments.
3	The poor absorption of green light by all three pigment types will provide only enough energy for cyclic photophosphorylation to occur.
4	The presence of pigment Y extends the ability of the plant to absorb light in the blue-green part of the spectrum but not the yellow-green part of the spectrum.
5	Non-cyclic photophosphorylation occurs at a wavelength of 700nm, indicating that pigment Y is more likely to be chlorophyll a than pigment Z .

Which students made biologically correct comments?

- A** 1 and 3
- B** 1 and 4
- C** 2 and 4
- D** 2 and 5

answer[1]

13 Which statements concerning impulse transmission and action potentials are correct?

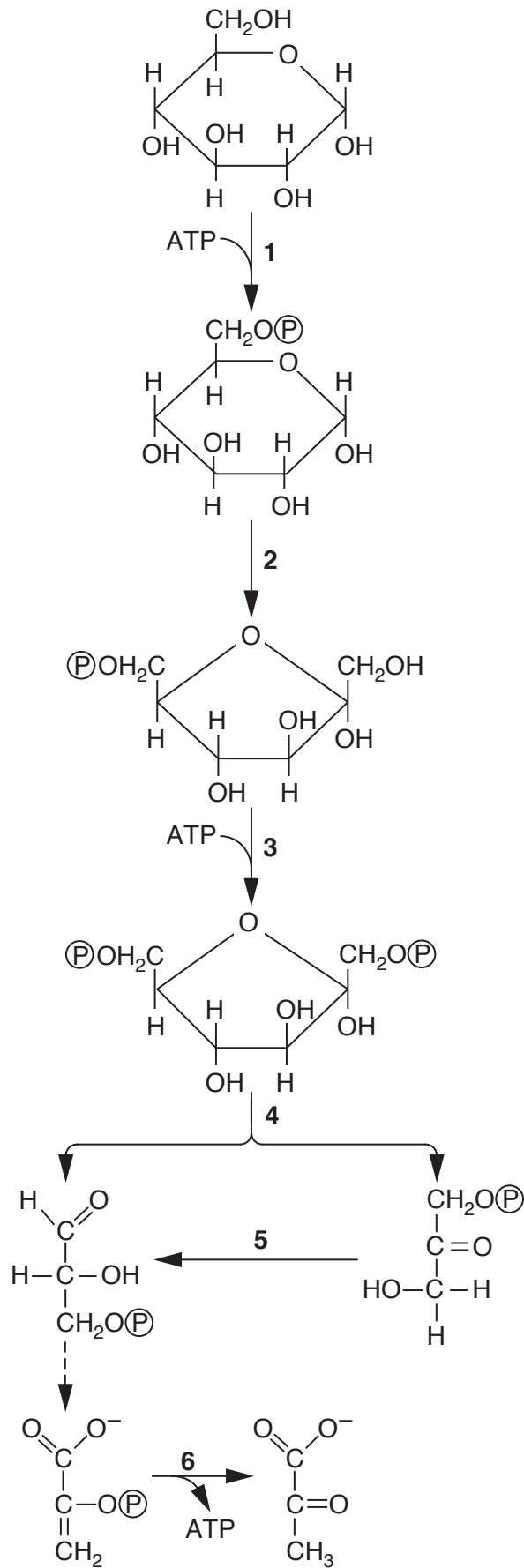
- 1 Binding of GABA neurotransmitter to post-synaptic membrane receptors causes initiation of an action potential.
- 2 Both decreasing the diameter of the axon of a neurone and increasing the body temperature will increase the speed of impulse transmission.
- 3 In the peripheral nervous system, the myelination of neurones by Schwann cells increases the speed of impulse transmission.
- 4 The repolarisation phase of the action potential occurring in a skeletal muscle cell is caused by the rapid diffusion outwards of potassium ions.

- A** 1 and 3
- B** 1 and 2
- C** 2 and 4
- D** 3 and 4

answer[1]

Questions 14, 15 and 16

Six of the enzyme-controlled reactions occurring in glycolysis in muscle tissue are shown below.



14 Which reactions are phosphorylation reactions?

- A 1 and 3
- B 2 and 4
- C 4 and 6
- D 1, 2 and 5

answer[1]

15 The enzymes that catalyse the reactions are listed below in alphabetic order. Isomerase enzymes catalyse structural changes within a molecule.

- fructose 1,6-bisphosphate aldolase
- hexokinase
- phosphofructokinase
- phosphoglucose isomerase
- pyruvate kinase
- triosephosphate isomerase

Which is a correct match of enzymes to reactions?

A	2 = phosphofructokinase	5 = triosephosphate isomerase	6 = pyruvate kinase
B	1 = hexokinase	2 = phosphoglucose isomerase	5 = fructose 1,6-bisphosphate aldolase
C	3 = phosphofructokinase	4 = fructose 1,6-bisphosphate aldolase	5 = triosephosphate isomerase
D	1 = phosphoglucose isomerase	4 = hexokinase	6 = pyruvate kinase

answer[1]

16 Additional information about the enzymes that catalyse the reactions is shown in the table below.

enzyme	information
fructose 1,6-bisphosphate aldolase	<ul style="list-style-type: none"> four identical subunits changes to any one of the subunits means that the enzyme cannot function
hexokinase	<ul style="list-style-type: none"> one subunit active site changes shape to enclose the reactants
phosphofructokinase	<ul style="list-style-type: none"> four identical subunits has allosteric sites in addition to an active site
phosphoglucose isomerase	<ul style="list-style-type: none"> two identical subunits has a cytokine function when secreted into the external medium
pyruvate kinase	<ul style="list-style-type: none"> four identical subunits ATP acts as an inhibitor to regulate glycolysis
triosephosphate isomerase	<ul style="list-style-type: none"> two identical subunits each subunit has 14 alpha helices and 8 beta-pleated sheets

A student made the following deductions using the information provided in the table:

- Phosphoglucose isomerase, when secreted, can have a non-catalytic role.
- Only three of the six enzymes display quaternary protein structure.
- The active site of phosphofructokinase will change shape to allow the enzyme to act as a regulator in glycolysis.
- Each enzyme is coded for by one gene.
- The reaction catalysed by hexokinase is an induced-fit mechanism.

How many of the student's deductions are correct and can be supported using the additional information provided?

- A 1
B 2
C 3
D 4

answer[1]

Questions 17, 18, 19 and 20

State the most appropriate term for each of the descriptions that follow.

17 The name of the covalent bond formed from the condensation of nucleotides to produce a molecule of tRNA.

answer[1]

18 The entry of extracellular liquids into a cell by endocytosis.

answer[1]

19 The system of giving each species a name composed of two parts.

answer[1]

20 An anticoagulant drug prescribed for people with cardiovascular disease.

answer[1]

Section B

Answer **all** the questions.

- 21 Fig. 21.1 and Fig. 21.2 show the 46 chromosomes present in a dividing human cell at metaphase of mitosis. The chromosomes have been rearranged by size to show the homologous pairs. The sex chromosomes are shown separately.

Fig. 21.1 is a scanning electronmicrograph.

Fig. 21.2 is a light micrograph, with the chromosomes stained to show a banding pattern.

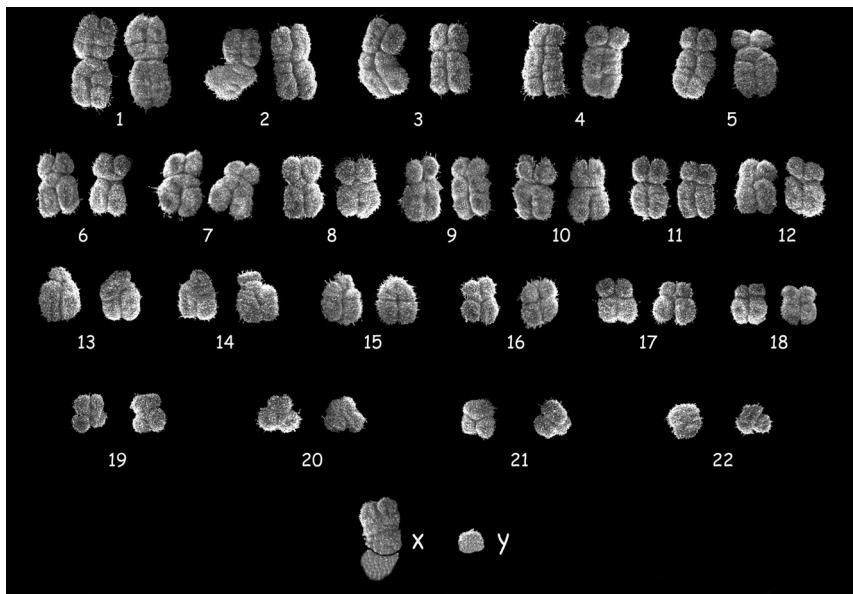


Fig. 21.1



Fig. 21.2

- (a) Explain why cells in metaphase are used to produce these images of chromosomes, rather than cells in prophase.

.....
.....
.....[1]

- (b) The presence of banding can be seen in the chromosomes in Fig. 21.2, but not in the chromosomes in Fig. 21.1.

With reference to Fig. 21.1 and Fig. 21.2, describe other ways that the chromosomes differ and explain these differences in terms of the properties of the microscopes used to produce the image.

.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....[4]

- (c) Explain how it is possible to deduce that Fig. 21.1 and Fig. 21.2 were **not** produced as a result of images taken during metaphase 2 of **meiosis**.

.....
.....
.....[1]

Fig. 21.3 shows the location on human chromosome 6 of two genes, *HFE* and *EPM2A*.

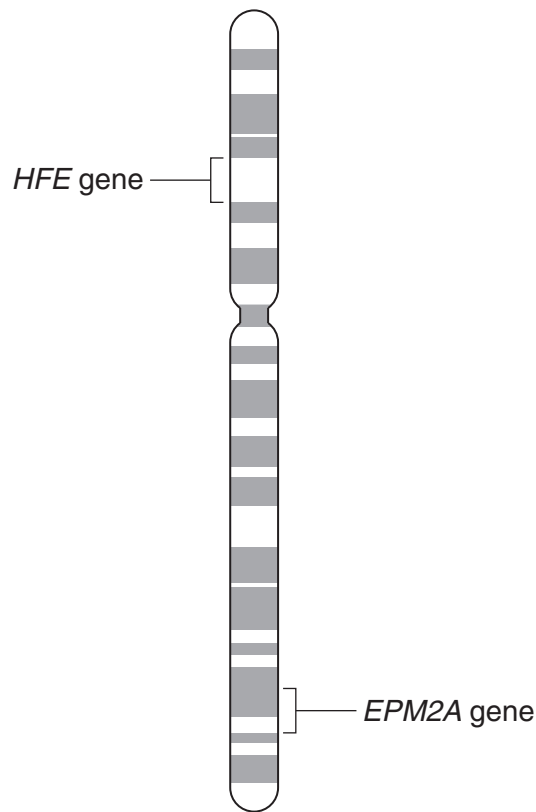


Fig. 21.3

The protein product of the *HFE* gene is involved in the absorption of iron. A mutation of the *HFE* gene, where a cysteine in position 282 is replaced by tyrosine, can lead to the disorder hereditary haemochromatosis.

Laforin, the protein product of the *EPM2A* gene, has a number of roles in the body. A mutation of the *EPM2A* gene has been linked to Lafora disease, a rare form of epilepsy.

(d) Hereditary haemochromatosis and Lafora disease are autosomal recessive disorders.

With reference to either hereditary haemochromatosis or Lafora disease, explain what is meant by the term *recessive*.

.....

.....

.....

.....

.....

.....[2]

- (f) Fig. 21.4 shows the genotype for hereditary haemochromatosis and Lafora disease of a healthy human female.

In the past, geneticists were not able to locate on specific chromosomes the genes responsible for a genetic disorder, but were sometimes able to confirm whether the disorder was autosomal or sex-linked by studying the inheritance of the trait over generations.

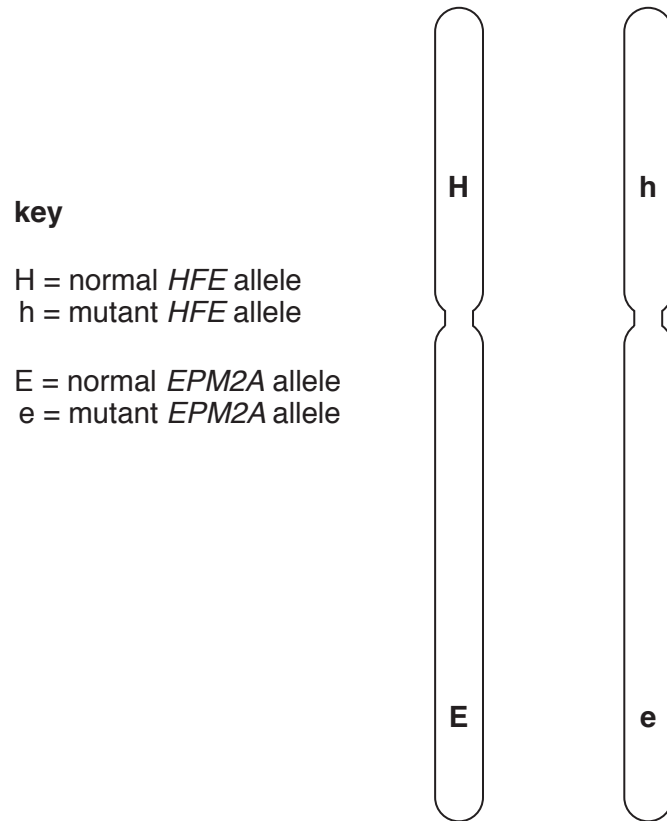


Fig. 21.4

The female whose genotype is shown in Fig. 21.4 has two children:

- one daughter, who is healthy
- one son, who has both hereditary haemochromatosis and Lafora disease.

The children's father has hereditary haemochromatosis and Lafora disease.

22 *Zostera marina*, shown in Fig. 22.1, is a highly productive seagrass that is considered to be a keystone species.



Fig. 22.1

Z. marina is widely distributed in coastal and estuarine ecosystems. It can cover large areas of the seabed where it acts as a habitat for many species. The plants have roots and rhizomes (underground stems) that anchor the plant into the seabed.

Globally the area covered by the species is in decline. Complete loss of populations of *Z. marina* has occurred near some areas that are densely populated by people.

(a) In some regions where *Z. marina* is present, habitat fragmentation occurs.

With reference to *Z. marina*,

(i) explain what is meant by habitat fragmentation,

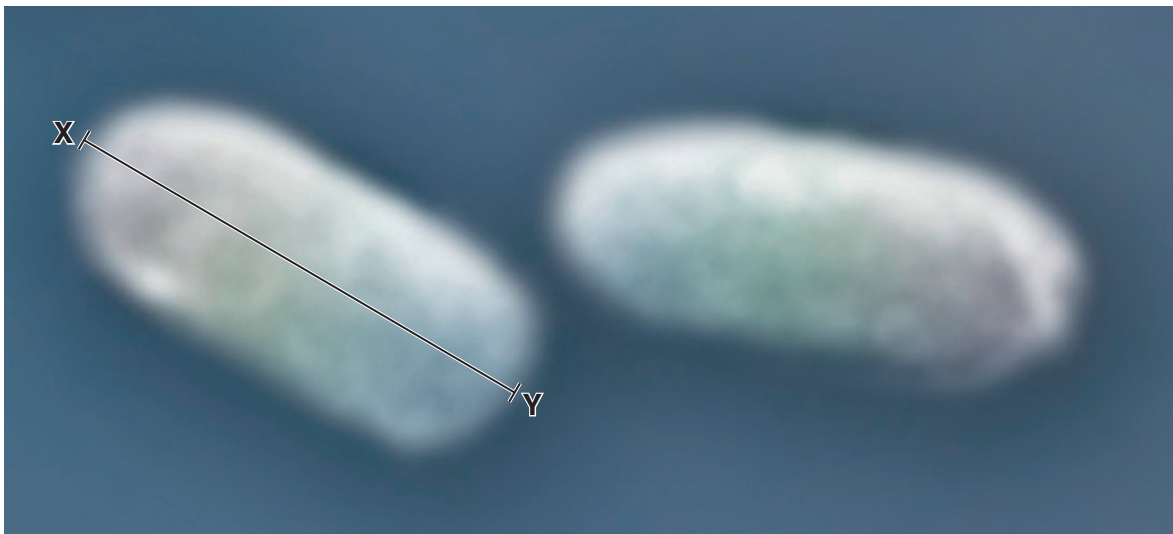
.....
.....
.....
.....
.....[2]

(ii) suggest one **human** activity that can contribute to habitat fragmentation,

.....
.....[1]

24 *Agrobacterium tumefaciens* is a rod-shaped, Gram negative soil bacterium that has been very closely studied for its importance as a plant pathogen and as a tool for genetic engineering.

Fig. 24.1 is a scanning electronmicrograph of *A. tumefaciens*.



×30 000

Fig. 24.1

(a) Outline the structure of the cell wall of a Gram negative bacterium.

.....
.....
.....
.....
.....[2]

(b) Calculate the actual length X–Y of the *A. tumefaciens* cell shown in Fig. 24.1.

actual lengthµm [2]

(ii) *A. tumefaciens* has been used extensively in genetic engineering.

Suggest reasons for this.

.....
.....
.....
.....
.....
.....[2]

(d) Describe how the presence of auxins promotes plant cell growth in the crown gall.

.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....[4]

(e) The higher levels of plant hormones ensure that the crown gall is well supplied with xylem and phloem tissue.

(i) State the function of xylem tissue in the crown gall.

.....
.....[1]

(ii) The conducting cells of phloem tissue are known as sieve tube elements. Explain the relationship between the structure of sieve tube elements and their function.

.....
.....
.....
.....
.....
.....
.....
.....[3]

(iii) Suggest why the fast-growing crown gall is said to act as a strong sink.

.....
.....
.....
.....
.....[2]

[Total: 20]

25 Globally, there are more people requiring an organ transplant than there are organs available.

(a) Many pig organs are of a similar size to human organs. Some researchers hope that by bringing together genetic modification and cloning techniques, pigs that are suited for human organ transplantation can be produced.

(i) The first instance of successful pig cloning was announced in March 2000. Five pig clones were created using a technique known as nuclear transfer.

Explain what is meant by *pig clones*.

.....
.....
.....
.....
.....[2]

(ii) State one ethical issue related to the use of the cloning of pigs for organ transplantation.

.....
.....
.....
.....[1]

(iii) Pigs produce an enzyme that catalyses the addition of sugar groups to the cell surface membranes. Researchers aim to inactivate the gene that codes for this enzyme in the pig clones.

Suggest why this change would make the organs of these pigs more suitable for transplantation into humans.

.....
.....
.....
.....
.....[2]

(b) In some cases, rejection of a human organ transplant can occur.

(i) Hyperacute rejection of a human organ transplant can begin within minutes of surgery being completed.

Outline the principles behind hyperacute rejection.

.....
.....
.....
.....
.....
.....
.....[2]

(ii) Acute rejection may occur a few days or weeks after the transplant.

Post-surgery treatment is available to prevent acute rejection.

Suggest and explain the post-surgery treatment provided to prevent acute rejection.

.....
.....
.....
.....
.....
.....
.....
.....
.....
.....[3]

[Total: 10]

26 Fig. 26.1 is a diagram of the circulatory system of an amphibian.

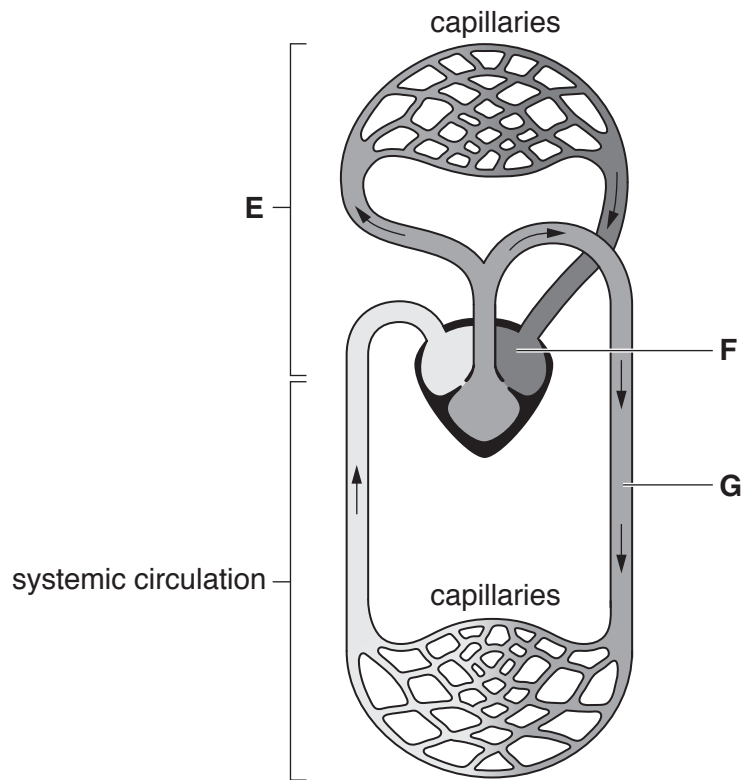


Fig. 26.1

(a) (i) Name circulation E.

.....[1]

(ii) Apart from a difference in pressure, state another difference between the blood in chamber F and the blood in vessel G.

.....
[1]

BLANK PAGE

Permission to reproduce items where third-party owned material protected by copyright is included has been sought and cleared where possible. Every reasonable effort has been made by the publisher (UCLES) to trace copyright holders, but if any items requiring clearance have unwittingly been included, the publisher will be pleased to make amends at the earliest possible opportunity.

To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced online in the Cambridge International Examinations Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download at www.cie.org.uk after the live examination series.

Cambridge International Examinations is part of the Cambridge Assessment Group. Cambridge Assessment is the brand name of University of Cambridge Local Examinations Syndicate (UCLES), which is itself a department of the University of Cambridge.