Manipulating Genomes (6.1.3): OCR A Level Biology Exam Questions by

18 questions · 36 marks · about 43 minutes. Answer in the spaces, then check the mark schemes at the end.

Question 1 · A level Paper 2 · June 2018 · Q21(a) · 1 mark

21 Fred Sanger developed an effective DNA sequencing technique in 1977.

(a) Define the term *DNA sequencing*.

.....

.....

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

Question 2 · A level Paper 2 · June 2018 · Q21(c)(i) · 1 mark

(c) One technique that has allowed the speed of DNA sequencing to increase has been the development of nanopores.

Fig. 21 shows how nanopores can be used to sequence DNA.

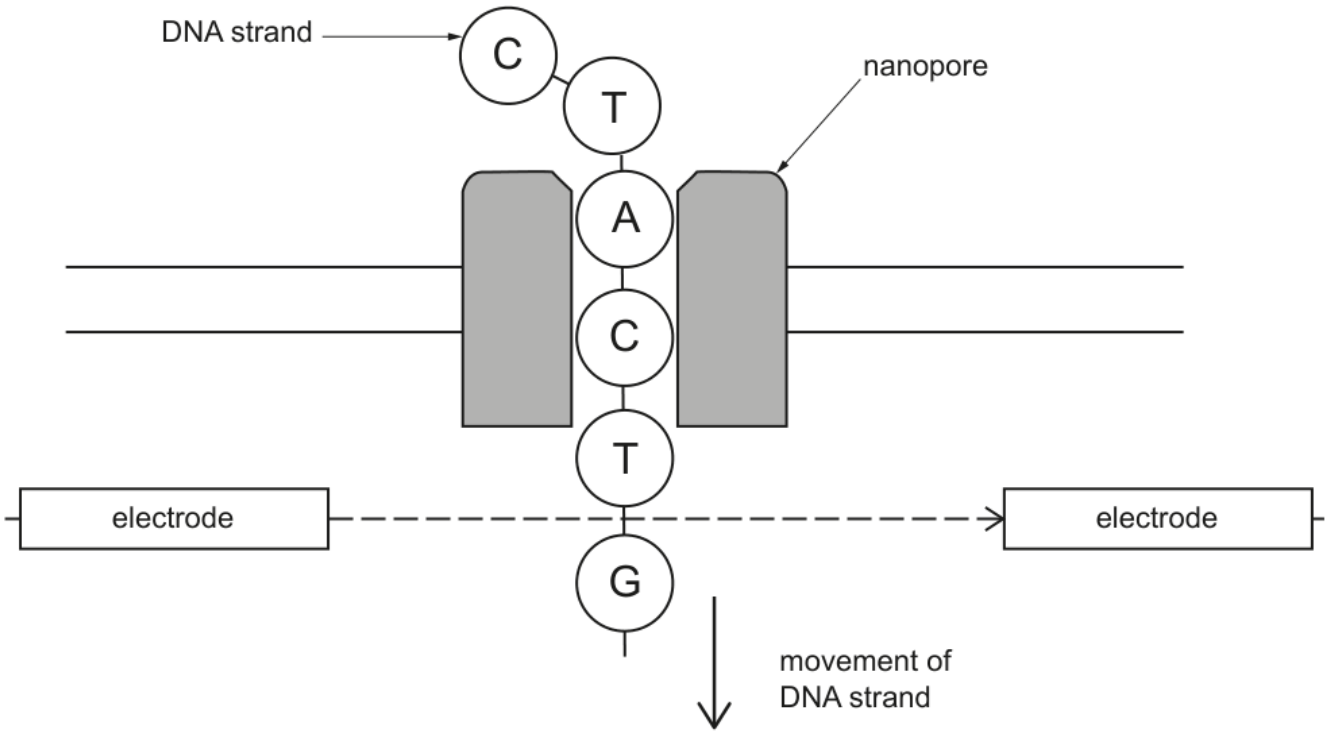


Fig. 21

(i) State one development, other than nanopore technology, that has led to an increase in the speed at which DNA can be sequenced.

.....

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

Questions, mark schemes and examiners' report extracts © OCR.

Question 3 · A level Paper 2 · June 2018 · Q21(c)(iii) · 2 marks

(iii) Explain how DNA sequencing allows the sequence of amino acids in a polypeptide to be predicted.

.....

.....

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

Question 4 · A level Paper 2 · June 2024 · Q16(a) · 1 mark

16 DNA profiling is an important technique with many uses.

The steps involved in creating a DNA profile can be outlined as follows:

1. DNA extraction
2. Digestion
3. Separation
4. Analysis

(a) DNA profiling is used in the investigation of crime and in paternity cases.

State **one** other use of DNA profiling.

.....

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

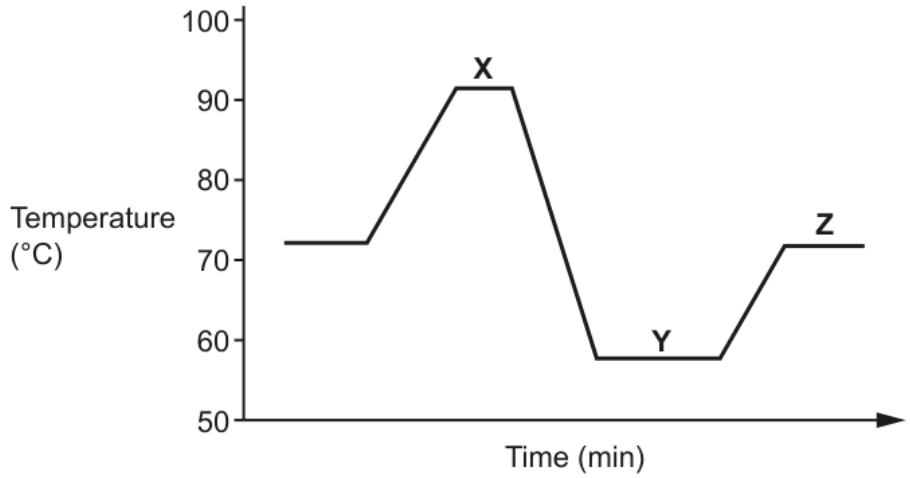
Turn over

Questions, mark schemes and examiners' report extracts © OCR.

Question 5 · information from earlier in the question

(b) When creating a DNA profile from a crime scene, an intermediate step between DNA extraction and digestion, known as PCR, is usually carried out.

The technique of PCR involves a cycle of changes in temperature, shown in the graph.



(i) Name the technique known as PCR.

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

Question 5 · A level Paper 2 · June 2024 · Q16(b)(ii) · 3 marks

(ii) Outline the process of PCR, with reference to steps **X**, **Y** and **Z**.

X .....

.....

Y .....

.....

Z .....

.....

[3]

Questions, mark schemes and examiners' report extracts © OCR.

Question 6 · A level Paper 2 · June 2024 · Q16(b)(iii) · 3 marks

(iii) Explain why a temperature of 72–75 °C is used for step **Z**.

.....

.....

.....

.....

.....

.....

.....

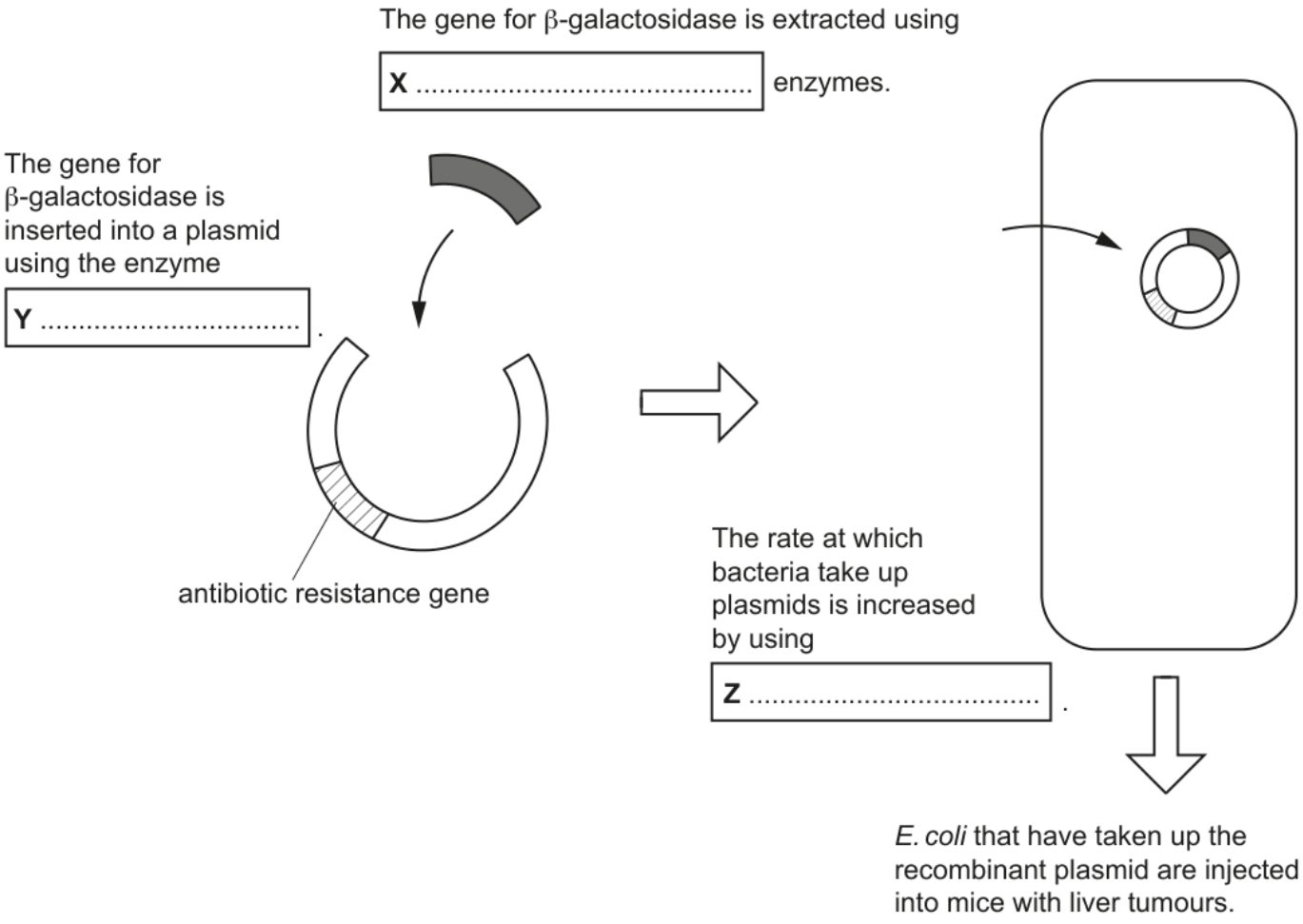
..... **[3]**

Questions, mark schemes and examiners' report extracts © OCR.

Question 7 · A level Paper 3 · November 2020 · Q4(c)(i) · 3 marks

(c) Bacteria such as *E. coli* can be genetically engineered for use in medical science.

An example of the genetic engineering of *E. coli* is shown in the diagram below.



(i) Complete the diagram above by writing the missing words or phrases in the boxes labelled **X**, **Y** and **Z**.

.....Answer **on** the diagram..... **[3]**

Question 8 · A level Paper 3 · June 2024 · Q5(e)(i) · 1 mark

(e) Bacteria can be genetically modified to produce insulin.

(i) State how a plasmid containing the gene coding for insulin can be transferred into a bacterial cell.

.....

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

Questions, mark schemes and examiners' report extracts © OCR.

Question 9 · A level Paper 3 · June 2024 · Q5(e)(ii) · 1 mark

(ii) Suggest how bacterial cells can be screened to check if they have taken up a recombinant plasmid.

.....

.....

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

Question 10 · A level Paper 2 · June 2019 · Q17(b)(i) · 3 marks

(b) Genes isolated from DNA can be used in gene therapy.

Cystic fibrosis (CF) is a disease that could be treated using gene therapy.

Healthy individuals have a gene that codes for a channel protein, called CFTR, found in the plasma membrane of a variety of cells, including those lining the airways of the lungs.

People suffering from CF have two copies of a recessive allele and so their cells do not synthesise the correct channel protein.

The allele that codes for the functioning CFTR protein can be inserted into the DNA of CF sufferers. The cells can then synthesise the correct CFTR protein and function as normal.

(i) The treatment of cystic fibrosis is described as **somatic** gene therapy. Another type of gene therapy is known as **germ-line** gene therapy.

Complete the table below to show **three** differences between somatic gene therapy and germ-line gene therapy.

Somatic	Germ-line

[3]

Questions, mark schemes and examiners' report extracts © OCR.

Question 11 · A level Paper 3 · June 2023 · Q3(a)(iii) · 1 mark

(iii) Often a single company holds the patent for a GM crop plant.

Suggest a potential ethical issue that may exist if one company holds the patent for a GM crop plant.

.....

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

Turn over

Question 12 · A level Paper 3 · June 2023 · Q3(b) · 3 marks

(b) Humans have been selectively breeding maize as a crop plant for thousands of years, which has resulted in many different varieties of maize.

Different varieties of maize have different genomes.

Describe how bioinformatics and computational biology can be used to compare the genomes of different varieties of maize.

.....

.....

.....

.....

.....

.....

.....

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

Questions, mark schemes and examiners' report extracts © OCR.

Question 13 · A level Paper 2 · June 2023 · Q19(e) · 2 marks

(e) Plants and microorganisms have traditionally been used as sources of new medicines.

Synthetic biology could play a major role in the development of new medicines.

Outline how synthetic biology can be used in the provision of new medicines.

.....

.....

.....

.....

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

Turn over

Question 14 · A level Paper 2 · June 2024 · Q18(b)(ii) · 1 mark

(ii) Suggest why some people might be concerned about the increase of synthetic biology.

.....

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

Questions, mark schemes and examiners' report extracts © OCR.

(ii) **Fig. 16.2** shows a DNA profile used to determine fatherhood in a paternity case.

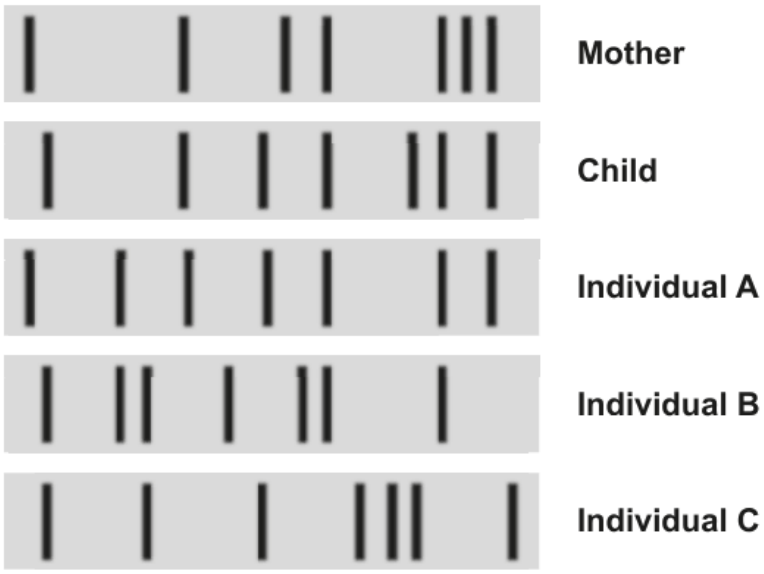


Fig. 16.2

Identify the individual who is most likely to be the child's father.

Justify your answer.

Individual .....

Justification .....

.....

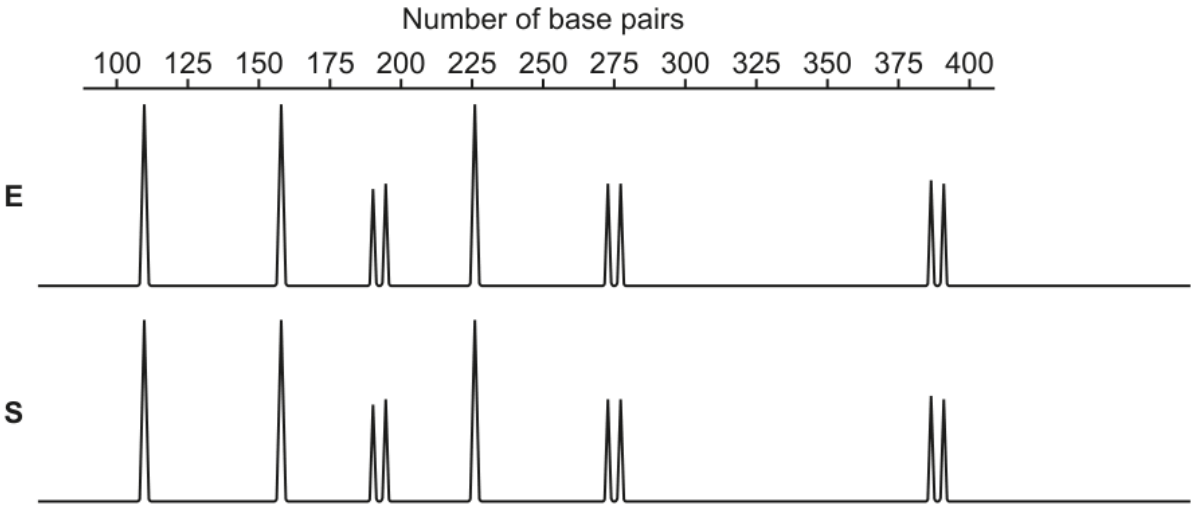
.....

[2]

Questions, mark schemes and examiners' report extracts © OCR.

Question 16 · information from earlier in the question

(c) This is part of a DNA profile for six loci from a sample of DNA found at a crime scene (**E**), and DNA from a potential suspect (**S**).



(i) Suggest why some loci have two peaks but some have only one.

.....

.....

.....

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

Question 16 · A level Paper 2 · June 2024 · Q16(c)(ii) · 3 marks

(ii) Using the evidence in the DNA profile it was claimed that suspect **S** had been at the crime scene.

Explain how strongly the evidence supports this claim.

.....

.....

.....

.....

.....

.....

.....

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

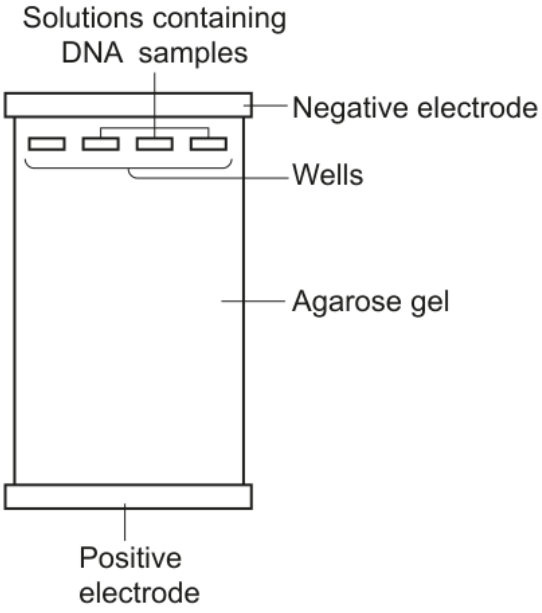
Turn over

Questions, mark schemes and examiners' report extracts © OCR.

Question 17 · A level Paper 3 · June 2025 · Q4(d)(i) · 4 marks

(d) Electrophoresis is used to separate fragments of DNA so that the separated DNA fragments can be compared and analysed.

(i) The diagram shows an electrophoresis box. Solutions of DNA samples have been added to three of the wells in the box.



State **two other** solutions that should be added to the box before performing electrophoresis **and** explain the purpose of each solution.

Solution .....

Explanation .....

.....

Solution .....

Explanation .....

.....

[4]

Questions, mark schemes and examiners' report extracts © OCR.

Question 18 · information from earlier in the question

(ii) DNA samples can be amplified using the polymerase chain reaction (PCR).

In theory, how many fragments of DNA might be present after 12 cycles of PCR?

Assume one DNA fragment was present at the beginning of the PCR process. Represent your answer as a $\log_{10}$ value.

..... fragments **[2]**

Question 18 · A level Paper 3 · June 2018 · Q4(c)(iii) · 1 mark

(iii) Suggest why the figure you calculated in **(ii)** may not be achieved in practice.

.....

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

Questions, mark schemes and examiners' report extracts © OCR.

Mark schemes

Question 1 · A level Paper 2 · June 2018 · Q21(a) · 1 mark

21	(a)	working out the sequence / AW , of nucleotides / bases ✓	1	**IGNORE** base pairs

Question 2 · A level Paper 2 · June 2018 · Q21(c)(i) · 1 mark

(c)	**(i)**	high throughput sequencing ✓ shotgun sequencing ✓ whole genome sequencing / WGS ✓ next generation sequencing / NGS ✓ pyrosequencing / use of luciferase ✓ massive parallel sequencing ✓	**1 max**

ALLOW swapping radioactive tags for fluorescent tags

Question 3 · A level Paper 2 · June 2018 · Q21(c)(iii) · 2 marks

(iii)	sequence / order , of bases codes for , sequence / order , of amino acids ✓ (each) triplet / three bases / codon , (codes) for , one amino acid ✓

2	**IGNORE** base pairs **IGNORE** base pairs

Questions, mark schemes and examiners' report extracts © OCR.

Question 4 · A level Paper 2 · June 2024 · Q16(a) · 1 mark

16	**(a)**	identifying / AW , genetic diseases / disease risk / evolutionary relationships / disaster victims ✓ classifying organisms / evidence for evolution ✓ (as part of) breeding programmes ✓

1 max	**1.1**	*Mark the first answer* **ALLOW** identifying , siblings / ancestry **IGNORE** to see if people are related (as could be paternity) **IGNORE** medical , diagnosis / screening (for non-genetic diseases) **IGNORE** investigating , genetics / research / mutations **IGNORE** organ transplants / personalised medicine

Question 5 · A level Paper 2 · June 2024 · Q16(b)(ii) · 3 marks

	(b)	**(ii)**	**X** (represents) denaturation / strand separation / breaking of H-bonds ✓ **Y** (represents) annealing / primers added (to DNA) ✓ **Z** (represents) synthesis of a new strand / addition of nucleotides (to new DNA strand) ✓	**3**	**1.2 x 2** **2.6 x 1**	**X IGNORE** H^+-bonds **Z ALLOW** synthesis / extension / elongation (of DNA strand) **Z ALLOW** description of forming a complementary strand **Z IGNORE** bases / replication

Questions, mark schemes and examiners' report extracts © OCR.

Question 6 · A level Paper 2 · June 2024 · Q16(b)(iii) · 3 marks

(b)	(iii)	optimum (temperature for enzyme) ✓ Taq polymerase allows high(er) rate , of DNA replication / AW ✓ (enzyme) obtained from , thermophilic / AW , organisms ✓ enzyme is able to withstand high(er) temperatures (than normal DNA polymerase) ✓

3 max	**2.5 x 2** **2.6 x 2**	**ALLOW** Taq polymerase allows fast(er) rate of reaction **ALLOW** e.g., from bacteria that live in hot springs **ALLOW** doesn't denature at such high temperatures / thermostable **ALLOW** optimum is higher than other forms of DNA polymerase

Question 7 · A level Paper 3 · November 2020 · Q4(c)(i) · 3 marks

c	i	X Y Z	restriction (endonuclease) ✓ (DNA) ligase ✓ electroporation / culture heating / heat shock / calcium salts ✓	**3**	1.2

ALLOW electric shock
ALLOW calcium ions

Questions, mark schemes and examiners' report extracts © OCR.

Question 8 · A level Paper 3 · June 2024 · Q5(e)(i) · 1 mark

5	(e)	(i)	culture heating / heat shock / electroporation ✓	1
Question			**Answer**	**Mark**

ALLOW electric shock / electric pulse / virus (as a vector) / transfection / add calcium ions and heat **IGNORE** *Agrobacterium tumefaciens (as used to infect plant cells)* / electrofusion *(used to fuse 2 cells together)* / vector unqualified
Guidance

Question 9 · A level Paper 3 · June 2024 · Q5(e)(ii) · 1 mark

5	(e)	(ii)	marker / reporter, genes (added to plasmid) ✓ gene for, antibiotic resistance / fluorescence / nutrient deficiency (added to plasmid) ✓

1 max	**ALLOW** use of PCR / DNA sequencing / pyrosequencing / use of electrophoresis **DO NOT ALLOW** 'add fluorescent, tag / dye'

Questions, mark schemes and examiners' report extracts © OCR.

Question 10 · A level Paper 2 · June 2019 · Q17(b)(i) · 3 marks

(b)	(i)	**Somatic**	**Germ-line**	
		cannot be , inherited / passed to offspring	can be , inherited / passed to offspring	✓
		(gene introduced into) / body / non-reproductive , cell	(gene introduced into) sperm / egg / gamete / sex cell / embryo / zygote	✓
		only some cells get (functional) , gene / allele	all cells get (functional) , gene / allele	✓
		short-term / temporary / needs repeating / non-permanent	long-term / permanent / does not need repeating	✓

3 max	**IGNORE** refs to legality or ethics **IGNORE** affects / does not affect (offspring) **IGNORE** adult / diploid **DO NOT CREDIT** alters DNA **ALLOW** gamete producing cell **ALLOW** somatic cell / germ-line cell

Question 11 · A level Paper 3 · June 2023 · Q3(a)(iii) · 1 mark

3	(a)	(iii)	*idea that* company could charge high prices (to farmers / countries) ✓ *idea that* GM crop not available to everyone ✓
Question			**Answer**

1 max	1.1	e.g. 'poorer farmers cannot afford GM seed'
Mark	**AO Element**	**Guidance**

Questions, mark schemes and examiners' report extracts © OCR.

Question 12 · A level Paper 3 · June 2023 · Q3(b) · 3 marks

Question	Answer
3 (b)	sequence genomes (of different varieties) ✓ (*use bioinformatics and computational biology to*) develop / use, (appropriate) software ✓ use , algorithms / statistical tests / (mathematical) models ✓ store , data / information (from different DNA sequences) ✓ analyse / identify, differences / similarities, in DNA (sequences) / alleles ✓

Mark	AO Element	Guidance
3 max	1.2 2.5 2.7	**ALLOW** 'develop theoretical models' **ALLOW** 'use a database' / 'storing genomes (on a database)' **ALLOW** 'comparison of, differences / similarities, in their genes '

Question 13 · A level Paper 2 · June 2023 · Q19(e) · 2 marks

(e)	genetic modification of (named) organisms ✓ to produce , (named) drug / (therapeutic) proteins / vaccine ✓	**2**	1.2

IGNORE humans

Must be linked to (attempt at) first marking point
CREDIT e.g. insulin / artemisinin
IGNORE 'medicine'

Questions, mark schemes and examiners' report extracts © OCR.

Question 14 · A level Paper 2 · June 2024 · Q18(b)(ii) · 1 mark

18	(b)	(ii)	*idea of* unknown consequences ✓ (named) ethical issues ✓	1	2.5

IGNORE tampering with nature / not natural / designer babies / animal welfare
ALLOW creating bioweapons

Question 15 · A level Paper 2 · November 2021 · Q16(b)(ii) · 2 marks

		(ii)	Individual C ✓ *idea of* highest number of matches (3) that cannot have come from mother	2	3.1	**DO NOT CREDIT** if bands are described as , genes / bases
			or 5th (child) band (from left) can only have come from C ✓			

Questions, mark schemes and examiners' report extracts © OCR.

	(ii)	*claim is supported because…* **1** (DNA profiles) are identical / match / AW ✓ **2** probability / chance , of 2 people having identical profiles is very low / AW ✓ *however…* **3** (6 is) a low number of , loci / peaks ✓ **4** … so they could have been , closely related / AW ✓ **5** could be identical twins ✓	**3 max**	**3.2** **3.2** **3.2** **3.1**
Question		**Answer**	**Mark**	**AO Element**

Guidance
Assume correct context unless answer contradicts it **1 ALLOW** are the same **1 IGNORE** similar / same number of base pairs **2 ALLOW** very low likelihood / near impossibility , that 2 people would have matching profiles **2 IGNORE** so they probably come from the same person **3 ALLOW** only 6 genes were tested **3 ALLOW** 17 loci are needed in court **3 IGNORE** small sample **4 ALLOW** only if mp 3 has been **AWARDED**

Questions, mark schemes and examiners' report extracts © OCR.

4	**(d)**	**(i)**	**S1** buffer (solution) ✓ **E1** maintains / controls / for optimum , pH **or** carry / provides ions for , current (through gel) ✓ **S2** reference / marker / ladder , DNA (fragments in solution) ✓ **E2** (to) compare / know / observe / identify , position / mass / size (of sample fragments) ✓ **S3** dye / stain / fluorescent marker / fluorescent tag (solution) ✓ **E3** to , see / monitor progress of , bands / DNA / fragments ✓

Question	**Answer**

4 max	3.3 3.4	**Only award an explanation mark when it is paired with the correct solution** *mark as prose* **IGNORE** a stated pH value **ALLOW** AW, e.g. 'allows charge to pass across (gel)' **ALLOW** DNA fragments of known , length / mass / size **IGNORE** probe / UV **ALLOW** radioactive marker / colour marker / colour tag **ALLOW** named dyes, e.g. ethidium bromide
Mark	**AO Element**	**Guidance**

Questions, mark schemes and examiners' report extracts © OCR.

Question 18 · A level Paper 3 · June 2018 · Q4(c)(iii) · 1 mark

iii	temperature damage to, template / strand / fragment ✓ (sometimes, once separated) template / strands, may rejoin (rather than bonding to primers) ✓ lack of, primers / (free) nucleotides ✓ primers fail to, join / attach / anneal (to fragment) ✓	**1 max**

IGNORE 'temperature damage to DNA'
IGNORE 'damage to fragment'
ALLOW 'strands fail to separate'

IGNORE lack of, enzymes / bases

Questions, mark schemes and examiners' report extracts © OCR.