Gel Electrophoresis and Antibiotics (Core Practicals 14 and 15): Edexcel SNAB A Level Biology Exam Questions

10 questions · 39 marks · about 47 minutes. Answer in the spaces, then check the mark schemes at the end.

Question 1 · A level Paper 1 · June 2023 · Q1(b)(i) · 3 marks

(b) A fossil bone discovered in China is thought to be from a new species, *Homo longi*.

(i) Samples of DNA from this bone and bones from other *Homo* species can be amplified using PCR.

Describe how these amplified samples of DNA can be prepared for analysis using gel electrophoresis.

(3)

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2 Skulls can be used as evidence for human evolution.

The only type of human present today is the modern human. In the past, another type of human, called Neanderthal, occupied the same geographical area.

The photograph shows the skulls of both types of human.



Modern human skull Neanderthal skull

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Genetic studies now show that these two types of human have interbred.

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Question 2 · A level Paper 1 · November 2021 · Q2(b) · 4 marks

(b) Devise a procedure, using electrophoresis, to compare the amplified DNA from these two types of human.

(4)

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Question 3 · A level Paper 1 · June 2025 · Q4(a)(ii) · 3 marks

(ii) There are two populations of cheetah: the Asian cheetah and the African cheetah.

Describe how gel electrophoresis can be used to determine that these two populations of cheetah are closely related.

(3)

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3 A study of the genetics of grass snakes has led to the identification of a new species of grass snake in the UK.

The barred grass snake was thought to be a variation of the common grass snake, *Natrix natrix*.

However, the barred grass snake, *Natrix helvetica*, has been found to be a different species.

Both types of grass snake are normally found in lowland regions in the south of England. The snakes can be more than a metre long, are found near water and eat mainly amphibians such as frogs and newts.

The common grass snake is olive green with a bright yellow collar.

The barred grass snake, shown in the photograph, is grey with black markings.



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Question 4 · A level Paper 1 · June 2019 · Q3(b) · 4 marks

(b) Describe how DNA profiling could be carried out to show that these snakes are different species.

(4)

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Question 5 · A level Paper 3 · June 2018 · Q1(b) · 5 marks

(b) The DNA produced by PCR was analysed to find out if a black panther was involved.

Explain how gel electrophoresis could be used to find out if this DNA came from a black panther.

(5)

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(b) The presence of coastal tailed frogs in streams is used as an indicator of the health of an ecosystem.

In the past, scientists observed frogs and recorded their locations.

Scientists can now use eDNA to study the locations of these frogs. This method detects frog DNA collected from the water and amplified by PCR.

In one investigation, the two methods were compared.

Observational studies and eDNA methods were used to determine if coastal tailed frogs were present or absent in 45 streams.

The results were:

- Observational studies found these frogs in 9 of the 45 streams.
- Frog eDNA was also detected in those 9 streams.
- Frog DNA was also found in 21 streams in which these frogs were not observed.

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Question 6 · A level Paper 3 · June 2025 · Q6(c) · 4 marks

(c) The Rocky Mountain tailed frog is closely related to the coastal tailed frog.

Devise an eDNA method that could be used to identify which of these species of frog is present in streams.

(4)

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Question 7 · A level Paper 3 · June 2022 · Q2(c) · 4 marks

(c) Changes in the RNA of influenza produce new strains of the virus with an altered spike protein.

Devise a procedure to determine the similarity of the strains of influenza in saliva samples collected from different people.

(4)

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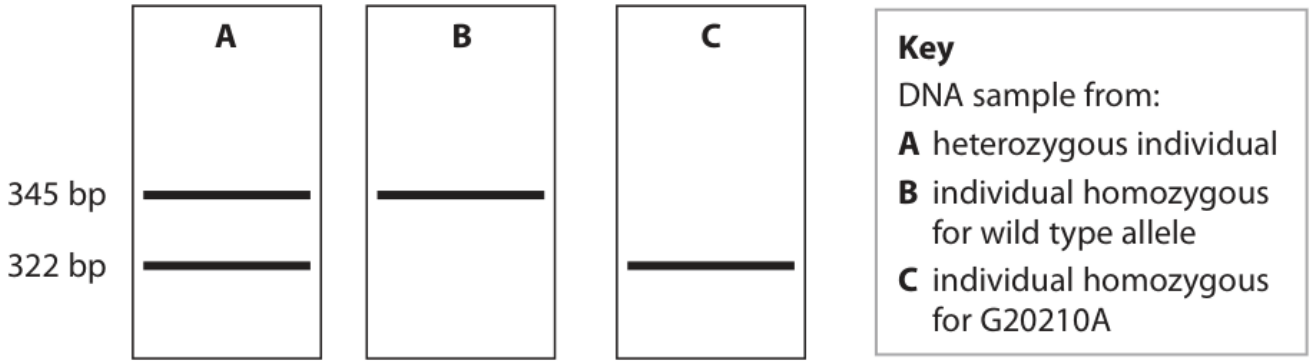
(b) Individuals with a family history of DVT may be offered a genetic test for the G20210A allele.

In this test, a sequence of 345 base pairs (bp) from this gene is amplified using the polymerase chain reaction (PCR).

A specific restriction enzyme is then added to the amplified DNA.

The DNA fragments produced are then separated using gel electrophoresis.

The diagram shows the results of gel electrophoresis for three individuals, A, B and C.



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Question 8 · A level Paper 3 · October 2020 · Q5(b)(iii) · 4 marks

(iii) Devise an investigation to determine the optimum number of cycles for the polymerase chain reaction used to amplify the DNA for this test.

(4)

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Question 9 · A level Paper 1 · June 2025 · Q6(c)(i) · 4 marks

(c) Antibiotics are used to control bacterial infections.

Many organisms produce substances with antibiotic properties.

The table shows some information about two of these substances.

Antibiotic substance	Potential use
Seraticin	Effective against MRSA, *C. difficile*, *E. coli*
Reutericyclin	Effective against MRSA

Some of these antibiotics may be effective against resistant bacteria such as MRSA.

(i) Devise an investigation to compare the effectiveness of these two antibiotic substances.

(4)

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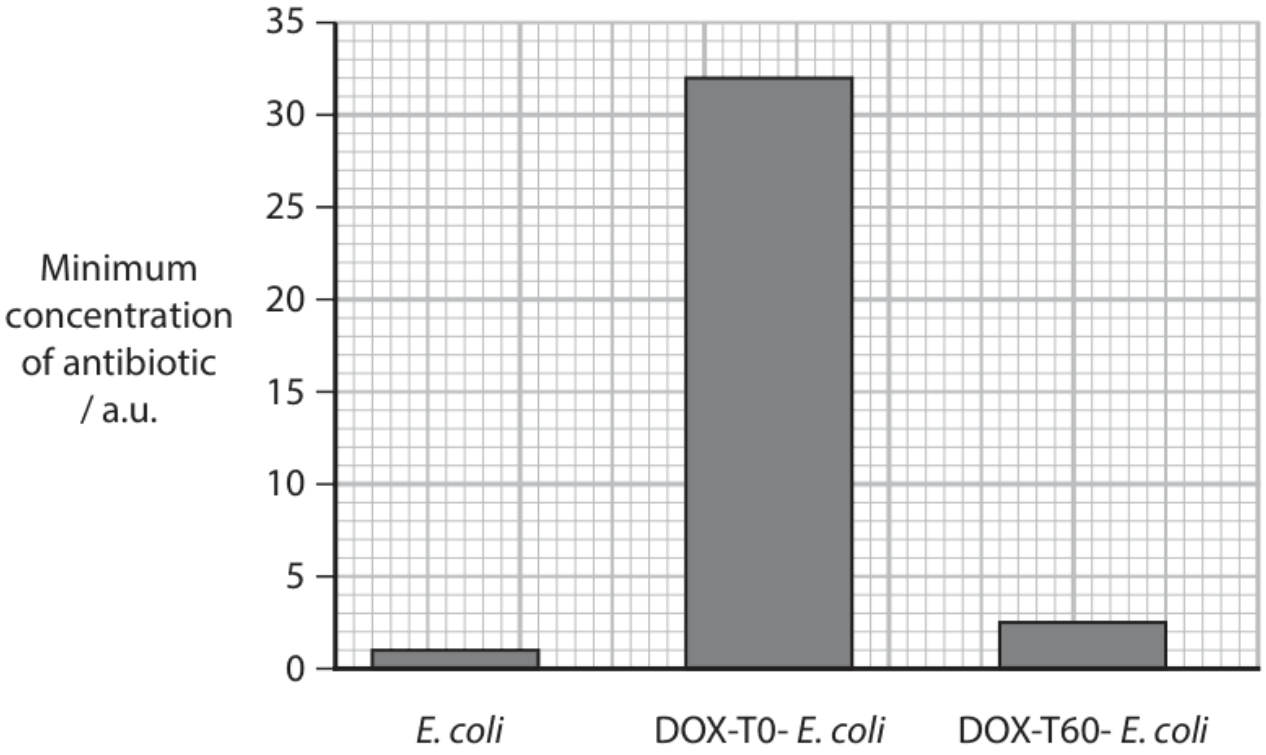
(b) Antibiotic resistance to DOX was investigated.

A culture of *E. coli* was treated with DOX and a resistant strain of *E. coli* called DOX-T0- *E. coli* was produced.

The DOX-T0- *E. coli* were then placed in antibiotic free conditions.

After 60 cycles of cell division, they became a different strain called DOX-T60- *E. coli*.

The graph shows the minimum concentration of DOX required to have a bacteriostatic effect on the bacteria.



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Question 10 · A level Paper 3 · June 2025 · Q5(b)(ii) · 4 marks

(ii) Devise a procedure to determine the minimum concentration of DOX required to have a bacteriostatic effect on the bacteria.

(4)

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Mark schemes

Question 1 · A level Paper 1 · June 2023 · Q1(b)(i) · 3 marks

Question Number	Answer
1(b)(i)	A description that makes reference to three of the following • DNA (from bones) is cut into fragments (1) • { radioactive tracers / fluorescent tags} attached to DNA (1) • (fragments of) DNA loaded onto (agarose) gel / samples placed in wells (1) • electric current passed through (the gel) / potential difference set up (through buffer/ across gel) (1)

Additional guidance	Mark
ALLOW restriction enzymes used on (DNA sample) ALLOW stains such as dye / ethidium bromide ALLOW gel IGNORE agar ALLOW negatively charged fragments move through the gel / DNA fragment moves toward positive electrode IGNORE references to anode or cathode	(3)

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Question 2 · A level Paper 1 · November 2021 · Q2(b) · 4 marks

Question Number	Answer
2(b)	An explanation that makes reference to four of the following • restriction { enzymes / endonucleases } used to cut DNA (from modern humans and Neanderthals) into fragments (1) • DNA samples are loaded onto (agarose) gel (1) • {electric current is passed through / potential difference is applied across} the gel (1) • markers are added to visualise the bands (1) • the position of the bands produced can be compared (1)

Additional guidance	Mark
ALLOW use of fluorescent dyes	**(4)**

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Question 3 · A level Paper 1 · June 2025 · Q4(a)(ii) · 3 marks

Question Number	Answer
4(a)(ii)	A description that makes reference to three of the following: • correct description of gel electrophoresis process (1) • analysis of DNA from both African and Asian cheetahs (1) • compare the position of the bands (1) • if the bands are similar, they are closely related (1)

Additional guidance	Mark
e.g. putting samples into wells of gel, use of buffer, passing a current through the gel, use of dye to make bands visible, use of agarose gel ALLOW use of DNA from both (cheetahs) ALLOW compare {distance bands have travelled / location of the bands / spacing of the bands} ALLOW the more similar the bands, the more closely related	(3)

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Question 4 · A level Paper 1 · June 2019 · Q3(b) · 4 marks

Question Number	Answer
3(b)	A description that makes reference to four of the following: • DNA obtained from the two types of grass snake (1) • { PCR / restriction enzymes } used to produce fragments of DNA (1) • gel electrophoresis used to analyse the DNA samples (1) • (gel electrophoresis) used to separate the fragments of DNA (1) • more differences in the pattern of bands produced would indicate that the snakes are different species (1)

Additional guidance	Mark
ALLOW produce different length sections of DNA or target regions of DNA ALLOW description of gel electrophoresis e.g. use of agarose gel and electric current ALLOW similar patterns in the bands would indicate they are the same species	**(4)**

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Question 5 · A level Paper 3 · June 2018 · Q1(b) · 5 marks

Question Number	Answer
1(b)	An explanation that makes reference to five of the following: • detail of loading of electrophoresis tank (1) • { current / potential difference } applied across the gel (1) • use { gene probe / DNA stain} (1) • use of { STRs / DNA } of black panther (1) • compare { bands / DNA profiles } (1) • a match would indicate that (DNA from) a black panther was present (1)

Additional Guidance	Mark
e.g. use of agarose gel, use of a buffer, sample placed in wells ALLOW voltage e.g. fluorescent dye, methylene blue, iodine or ethidium bromide ALLOW reference to Southern blot technique ALLOW compare lines	(5)

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Question 6 · A level Paper 3 · June 2025 · Q6(c) · 4 marks

Question number	Answer
6(c)	An answer that makes reference to four of the following: • collect DNA from both species (of frog) (1) • collect DNA from the {streams / water} (1) • amplify DNA using PCR (1) • cut DNA (into fragments) using restriction enzymes (1) • (separate DNA fragments) using gel electrophoresis (1) • identify species by comparing {distance bands have travelled / location of the bands / spacing of the bands / pattern of banding} (1)

Additional guidance	Mark
ALLOW identify differences in genome of the two frog species DO NOT ALLOW for collecting DNA directly from the frogs ALLOW use primers specific to DNA of each species ALLOW a description of electrophoresis e.g. putting samples into wells of gel, use of buffer, passing a current through the gel, use of dye to make bands visible, use of agarose gel e.g. identify bands of different {sizes/positions} that are unique to each species ALLOW band only seen if correct primers are used	(4)

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Question 7 · A level Paper 3 · June 2022 · Q2(c) · 4 marks

Question number	Answer
2(c)	An answer that makes reference to the following: • {isolate / extract} RNA from (saliva) samples (1) • amplify the {RNA/DNA/nucleic acid} by PCR (1) • cut the {RNA/DNA/nucleic acid} into fragments (using restriction enzymes) (1) • (separate fragments using) gel electrophoresis (1) • more similar the {banding / profile} (of the fragments) the more closely related the strain (1)

Additional guidance	Mark
ALLOW (reverse) transcribe RNA to DNA and amplify DNA ALLOW sequence the virus genome ALLOW the fewer the number of base changes the more closely related the strains	(4)

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Question 8 · A level Paper 3 · October 2020 · Q5(b)(iii) · 4 marks

Question number	Answer
5(b)(iii)	An answer that makes reference to four of the following: • identify an appropriate reagent to be provided (in excess) (1) • identify appropriate conditions (to control) (1) • change the number of cycles (1) • use gel electrophoresis (to determine quantity of DNA produced) (1) • choose the smallest number of cycles that produces an observable band (1)

Additional guidance	Mark
e.g. DNA, polymerase, primers, mononucleotides e.g. temperatures used are 95, 55 and 70°C / duration of steps in cycle ALLOW a description of gel electrophoresis ALLOW choose the number of cycles giving the {thickest / clearest} band	**(4)**

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Question 9 · A level Paper 1 · June 2025 · Q6(c)(i) · 4 marks

Question Number	Answer
6(c)(i)	An explanation that makes reference to four of the following: • prepare agar plates spread with {antibiotic resistant bacteria / MRSA} (1) • use same concentrations of Seraticin and Reutericyclin (1) • place the antibiotic {in a well / on a (filter paper) disc} (1) • incubate {at a stated temperature / for a stated period of time} (1) • compare the {diameter / area} of the zone of inhibition (1)

Additional guidance	Mark
ALLOW a bacterial lawn with agar / agar seeded with bacteria / agar spread with bacteria ALLOW same concentration of both antibiotics e.g. 20-40°C OR 24-48 hours ALLOW one with larger {area / diameter} of zone of inhibition is most effective	(4)

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Question 10 · A level Paper 3 · June 2025 · Q5(b)(ii) · 4 marks

Question number	Answer
5(b)(ii)	An answer that makes reference to four of the following: • use of agar plates with {*E. coli* / bacteria} (1) • method of applying {antibiotic / DOX} (1) • range of concentrations taken from graph 0 to 35 (au) (1) • incubate {at a set temperature / for a set period of time} (1) • method of determining minimum antibiotic concentration that has an effect (1)

Additional guidance	Mark
ALLOW a bacterial lawn with agar / agar seeded with bacteria / agar spread with bacteria ALLOW broth culture e.g. filter paper discs, wells in agar, mast rings IGNORE units ALLOW any values between 0 – 35 (au) ALLOW values between { 24 and 48 hours / 20 and 40 °C } e.g. lowest concentration on paper disc that produces a zone of inhibition, turbidity	(4)

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