DNA, Genes and Chromosomes: AQA A Level Biology Exam Questions b

15 questions · 31 marks · about 40 minutes. Answer in the spaces, then check the mark schemes at the end.

Question 1 · AS Paper 2 · November 2020 · Q02.3 · 1 mark

0 2 . 3 Name the protein associated with DNA in a chromosome.

[1 mark]

Question 2 · A level Paper 1 · November 2020 · Q08.1 · 3 marks

0 8 . 1 Complete **Table 2** to show **three** differences between DNA in the nucleus of a plant cell and DNA in a prokaryotic cell.

[3 marks]

Table 2

DNA in the nucleus of a plant cell	DNA in a prokaryotic cell
1	
2	
3	

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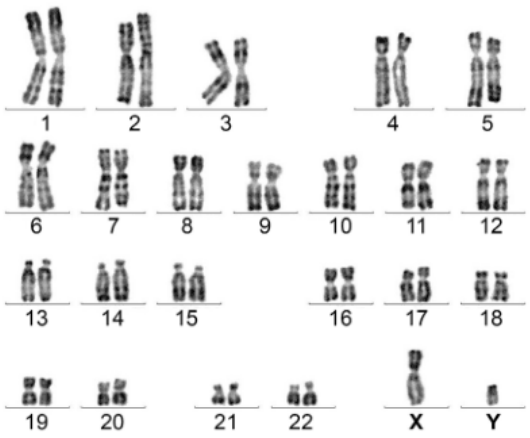
Question 3 · information from earlier in the question

0 1 **Figure 1** shows all the chromosomes present in one human cell during mitosis. A scientist stained and photographed the chromosomes. In **Figure 2**, the scientist has arranged the images of these chromosomes in homologous pairs.

Figure 1



Figure 2



Question 3 · A level Paper 1 · June 2018 · Q01.6 · 2 marks

0 1 . 6 Give **two** ways in which the arrangement of prokaryotic DNA is different from the arrangement of the human DNA in **Figure 1**.

[2 marks]

1. _____

2. _____

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Question 4 · A level Paper 1 · June 2018 · Q01.4 · 1 mark

0 1 . 4 The dark stain used on the chromosomes binds more to some areas of the chromosomes than others, giving the chromosomes a striped appearance.

Suggest **one** way the structure of the chromosome could differ along its length to result in the stain binding more in some areas.

[1 mark]

Question 5 · AS Paper 1 · June 2019 · Q01.1 · 3 marks

0 1 . 1 The nucleus and a chloroplast of a plant cell both contain DNA.

Give **three** ways in which the DNA in a chloroplast is different from DNA in the nucleus.

[3 marks]

1

2

3

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0 5 . 2 Scientists grew two groups of plants:

- control plants with all the inorganic ions needed
- iron-deficient plants with all the inorganic ions needed **but** without iron ions.

After 1 week, the scientists measured the mass of protein and the mass of chlorophyll in the chloroplasts isolated from samples of leaves of these two groups of plants.

Table 4 shows the scientists' results.

Table 4

Mass of protein / percentage of control	Mass of chlorophyll / percentage of control
40	10

Some proteins found inside the chloroplast are synthesised inside the chloroplast.

Give **one** feature of the chloroplast that allows protein to be synthesised inside the chloroplast **and** describe **one** difference between this feature in the chloroplast and similar features in the rest of the cell.

[2 marks]

Feature _____

Structural difference _____

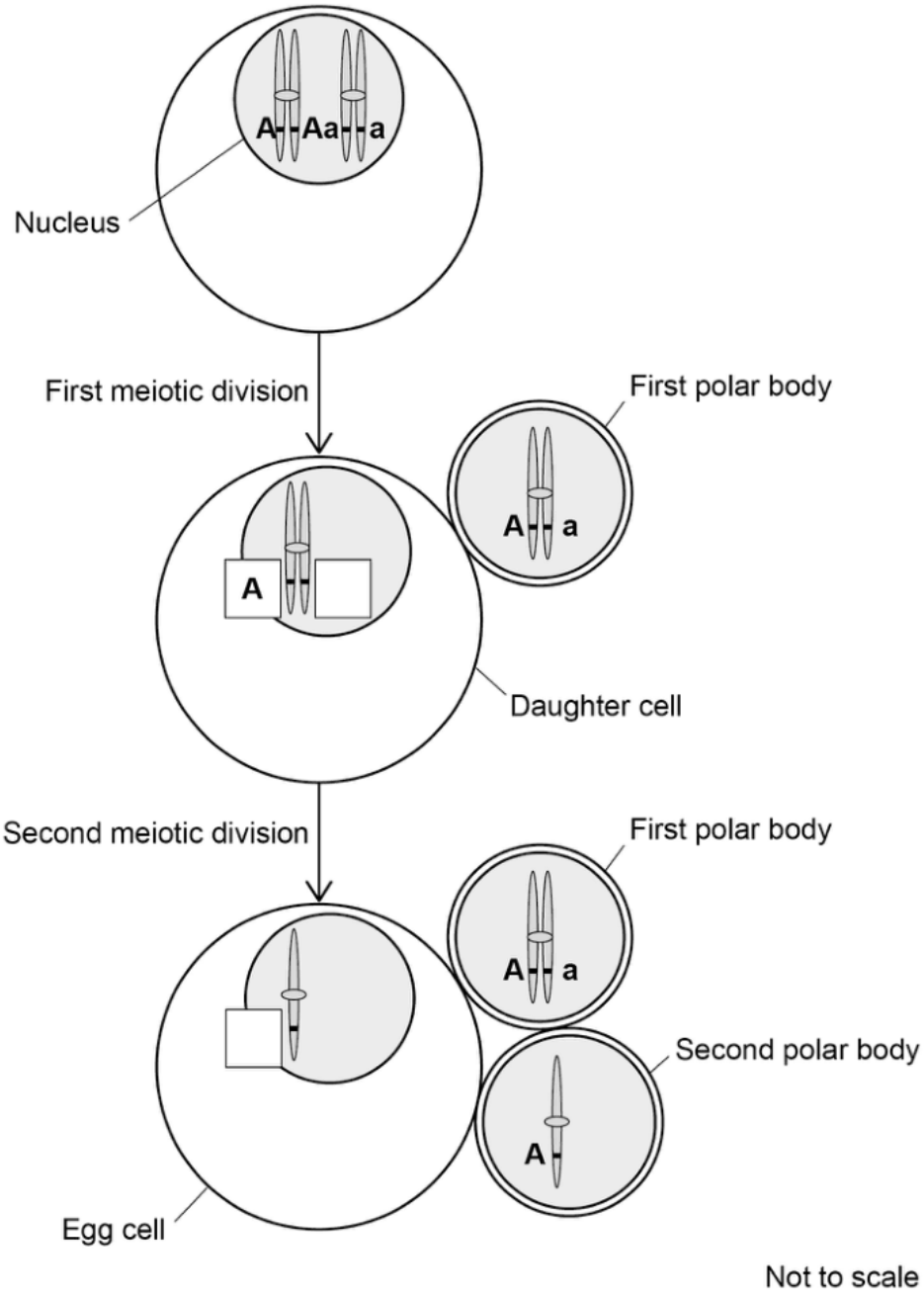
_____

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0 3 In women, the first division of meiosis produces one daughter cell that has almost all of the cytoplasm. The other daughter cell consists of a nucleus surrounded by a very small amount of cytoplasm and a cell-surface membrane. This very small daughter cell is called a polar body. Polar bodies do not usually divide. The same process occurs in the second division of meiosis, resulting in one egg cell and two polar bodies.

The diagram in **Figure 3** shows the formation of an egg cell and two polar bodies during meiosis. It also shows what happens to one pair of homologous chromosomes. This pair carries two alleles of gene A.

Figure 3



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Question 7 · A level Paper 3 · June 2018 · Q03.4 · 2 marks

0 3 . 4 Mitochondrial diseases are caused by faulty mitochondria. All of a person's mitochondria are inherited from their mother via the egg cell. An egg cell contains approximately 3×10^5 mitochondria.

One proposed treatment to prevent passing on faulty mitochondria involves

- removing the nucleus from an egg cell donated by a woman with healthy mitochondria
- replacing this nucleus with the contents of the polar body from a woman whose egg cells are affected by mitochondrial disease.

Suggest how this treatment prevents inheritance of mitochondrial diseases.

[2 marks]

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Question 8 · AS Paper 1 · November 2021 · Q04.4 · 3 marks

0 4 . 4 Describe how a gene is a code for the production of a polypeptide. Do **not** include information about transcription or translation in your answer.

[3 marks]

Question 9 · AS Paper 1 · November 2021 · Q04.3 · 1 mark

0 4 . 3 Name the fixed position occupied by a gene on a DNA molecule.

[1 mark]

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Question 10 · AS Paper 1 · June 2023 · Q01.2 · 3 marks

0 1 . 2 This question is about the genetic code.

Define **universal**, **non-overlapping** and **degenerate**.

[3 marks]

Universal _____

_____

_____

Non-overlapping _____

_____

_____

Degenerate _____

_____

_____

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Table 1 shows mRNA codons and the amino acids coded for by each codon. It also shows some properties of the R group of each amino acid.

Table 1

1st base	2nd base				3rd base
	U	C	A	G	
U	Phe	Ser	Tyr	Cys	U
					C
	Leu		Stop	Stop	A
				Trp	G
C	Leu	Pro	His	Arg	U
					C
			Gln		A
					G
A	Ile	Thr	Asn	Ser	U
					C
	Met		Lys	Arg	A
					G
G	Val	Ala	Asp	Gly	U
					C
			Glu		A
					G

Key to the properties of the R group of each amino acid

No overall charge | Positively charged | Negatively charged

0 5 . 2 The genetic code is described as degenerate.

What is meant by this? Use an example from **Table 1** to illustrate your answer.

[2 marks]

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Question 12 · A level Paper 3 · June 2022 · Q04.2 · 2 marks

Recombinant DNA technology can involve the transfer of fragments of human DNA into bacteria. The bacteria are then used to produce human proteins.

0 4 . 2 Give **two** reasons why bacteria are able to use human DNA to produce human proteins.

[2 marks]

1 _____

2 _____

Question 13 · AS Paper 1 · November 2020 · Q06.2 · 1 mark

0 6 . 2 Define the term exon.

[1 mark]

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Question 14 · information from earlier in the question

0 9 Read the following passage.

DNA is a stable molecule but, even under normal cell conditions, spontaneous changes occur to the DNA nucleotide sequence. One example of a spontaneous change occurs when a cytosine base in a guanine–cytosine nucleotide pair is changed to a uracil base. This produces a guanine–uracil nucleotide pair in the DNA molecule. Scientists estimate this type of spontaneous change occurs to 100 guanine–cytosine nucleotide pairs in the genome of healthy human cells every day.

In healthy cells, enzyme-controlled processes repair these spontaneous changes in the DNA molecule by changing uracil bases back to cytosine bases. If these repairs do **not** happen, the uracil DNA nucleotide attracts an adenine DNA nucleotide when the DNA is replicated in the cell cycle. A mutation of the original DNA has now occurred.

Healthy cells with damaged DNA produce enzyme **X**. This enzyme slows the cell cycle by delaying the start of DNA replication. People with the disease ataxia telangiectasia (AT) do not produce functional enzyme **X**. Mutations occur at a higher rate in people with AT.

Use the information in the passage and your own knowledge to answer the following questions.

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Question 14 · AS Paper 1 · June 2024 · Q09.3 · 4 marks

0 9 . 3 The type of mutation that occurs when 'repairs do **not** happen' (lines 10–11) may still produce a functional protein.

Suggest and explain why.

[4 marks]

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A scientist investigated changes in the amino acid sequence of a human enzyme resulting from mutations. All these amino acid changes result from single base substitution mutations.
This enzyme is a polypeptide 465 amino acids long.

Table 2 shows the result of three of the base substitutions.

Table 2

Amino acid number	Correct amino acid	Amino acid inserted as a result of mutation
203	Val	Ala
279	Glu	Lys
300	Glu	Lys

0 5 . 3 What is the minimum number of bases in the gene coding for this polypeptide?

[1 mark]

Answer = _____

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Mark schemes

Question 1 · AS Paper 2 · November 2020 · Q02.3 · 1 mark

02.3	Histone;	1

Question 2 · A level Paper 1 · November 2020 · Q08.1 · 3 marks

08.1	Plant v prokaryote 1. (Associated with) histones/proteins v no histones/proteins; 2. Linear v circular; 3. No plasmids v plasmids; 4. Introns v no introns; 5. Long(er) v short(er);	3 max	Alternatives must be written directly opposite one another. Do not award if only half of a mark point is written. 2 and 3. Do not credit if suggestion that prokaryotic DNA only exists as plasmids. Reference to prokaryotic DNA being single stranded = max 2. Reference to prokaryotic DNA not being helical = max 2.

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Question 3 · A level Paper 1 · June 2018 · Q01.6 · 2 marks

01.6	(Prokaryotic DNA) is 1. Circular (as opposed to linear); 2. Not associated with proteins/histones ; 3. Only one molecule/piece of DNA OR present as plasmids;	2 max

Max 1 if prokaryotic DNA only found as plasmids OR if prokaryotic DNA is single stranded.

Ignore references to nucleus, exons, introns or length of DNA.

Do not credit converse statements.

Ignore descriptions of eukaryotic DNA alone.

Question 4 · A level Paper 1 · June 2018 · Q01.4 · 1 mark

01.4	Differences in base sequences OR Differences in histones/interaction with histones OR Differences in condensation/(super)coiling;	1	Answer must be in context of differences in arrangement of chromosomes not just related to the properties of the stain. Accept spec section 8 ideas e.g. different methylation/acetylation Accept different genes Reject different alleles

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01.1 In chloroplasts

1. DNA shorter;
2. Fewer genes;
3. DNA circular not linear;
4. Not associated with protein/histones, unlike nuclear DNA;
5. Introns absent but present in nuclear DNA;

3 max	Must be comparative statements. Accept alternatives in context of nuclear DNA 1. Accept smaller 3. Accept DNA in a loop not linear 3. Accept no chromosomes (in chloroplast) unlike nucleus Ignore references to double and single stranded DNA

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Question 6 · A level Paper 1 · November 2021 · Q05.2 · 2 marks

05.2	Mark in pairs, 1 **and** 2 OR 3 **and** 4 1. DNA; 2. Is not associated with protein/histones **but** nuclear DNA is **OR** Is circular **but** nuclear DNA is linear **OR** Is shorter than nuclear DNA; 3. Ribosomes; 4. Are small**er** than cytoplasmic ribosomes;	2	4. Accept: 70S ribosomes in chloroplast, but 80S ribosomes in cytoplasm

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03.4	1. Egg (created) has nucleus / DNA / genes of (affected) woman / mother; 2. It has mostly / many / lots of normal mitochondria (of unaffected woman) **OR** There are few faulty mitochondria;

2	1. Accept ref. to zygote / embryo / child for egg 1. Accept genetic information 1. Ignore references to alleles 1. Reject if nucleus from wrong egg / woman 2. Reject ref. to **production** of healthy mitochondria as result of treatment

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Question 8 · AS Paper 1 · November 2021 · Q04.4 · 3 marks

04.4	1. (Because) base/nucleotide sequence; 2. (In) triplet(s); 3. (Determines) order/sequence of amino acid sequence/primary structure (in polypeptide);	3	
TOTAL		**7**	

Question 9 · AS Paper 1 · November 2021 · Q04.3 · 1 mark

04.3	Locus/loci; 1

Question 10 · AS Paper 1 · June 2023 · Q01.2 · 3 marks

01.2	1. (Universal) The same codon/triplet always codes for the same amino acid; 2. (Non-overlapping) Each base is only part of one triplet/codon **OR** (Adjacent) codons/triplets do not overlap; 3. (Degenerate) More than one codon/triplet codes for each amino acid;	3 (3 x AO1)

Accept '3 bases' for triplet 2. Accept 'base/triplets/codons only read once'

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Question 11 · A level Paper 1 · June 2018 · Q05.2 · 2 marks

05.2	1. More than one codon codes for a single amino acid; 2. Suitable example selected from Table 1;	2	1. Accept 'triplet' or 'sequence of 3 bases/nucleotides' for 'codon'. 1. Reject 'production/produces' for 'codes for'. Do not infer mp1 from mp2.

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Question 12 · A level Paper 3 · June 2022 · Q04.2 · 2 marks

04.2	1. (The) genetic/DNA code is universal **OR** The same triplets/codons code for the same amino acids (in all species); 2. (The mechanism of) transcription is universal; 3. (The mechanism of) translation is universal;	2 max (2 x AO1)

1. Do not accept 'DNA is universal' unqualified
1. Reject the genetic code is degenerate
1. Ignore anything after 'genetic/DNA code is universal' unless incorrect
2. and 3. Accept descriptions of universal, eg transcription/ translation are the same in humans and bacteria
2. and 3. If neither is stated, accept '(the mechanism of) protein synthesis is universal' for 1 mark
3. Accept bacteria have ribosomes, and so could translate (human mRNA)

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06.2	Base/nucleotide/triplet sequence coding for polypeptide/sequence of amino acids/primary structure;	1

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09.3	1. Substitution (mutation occurred): 2. (Only) one nucleotide/base pair is changed (in a gene) **OR** (Only) one (DNA) triplet/codon changed; 3. Same amino acid (coded for); 4. (Because) DNA/genetic code is degenerate; 5. (So) tertiary structure is not changed; 6. (Change) could be in an intron; 7. Removed during splicing;	4 max (4 x AO2)

3. Reject same amino acid is produced

3. Accept one amino acid changed

4. Accept a description of degenerate code

3 and 4 can be awarded together, e.g 'different codons/ triplets code for the same amino acid' = MP3 and MP4

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05.3	1395; 1	Accept 1398 and 1401 (for those that include start and/or stop codons) Allow 2796 or 2802 or 2790 Ignore 'bases/base pairs/bp/bps' written after the numerical answer.

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