

Interactive Example Candidate Responses

Paper 4 (May/June 2016), Question 10

Cambridge International AS & A Level Biology 9700

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Your
Mark

10(a)

10 (a) Describe the behaviour of chromosomes during meiosis. [9]

(b) Outline the differences between structural and regulatory genes. [6]

[Total: 15]



Meiosis is divided into meiosis I and Meiosis II. reduction in number of chromosomes occur during meiosis I while meiosis II lead to like mitosis. This lead to formation of 4 daughter gametes having half number of chromosomes. In prophase I, chromosomes begin to condense, nuclear envelope and nucleolus degenerate. During Metaphase I, chromosomes that consist of double chromatids are lined at equator and joined to one spindle fibres. half number of chromosomes goes to other side and half also goes to opposite side leading to two groups of haploid number and all of them composed of double chromatids. During telophase I, some plant cells don't undergo telophase I, where nucleolus and nuclear envelope degenerate. Meiosis II began by

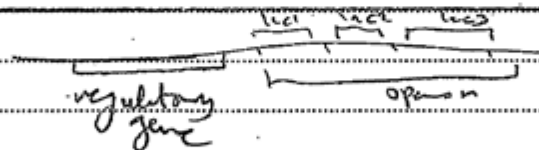
10(b)

Q10	Mark scheme
(a)	<p>1 ref. to nuclear envelope 1 names of stages meiosis I</p> <ol style="list-style-type: none"> chromosomes, condense / thicken / spiralise ; homologous chromosomes pair / bivalents form ; crossing over / described ; chiasma(ta) ; spindle fibres / microtubules, attach to / pull, centromeres / kinetochores ; allow once in mp5 or in meiosis II bivalents line up on, equator / mid-line ; A pairs of homologous chromosomes independent assortment (of homologous pairs) / described ; A random assortment chromosomes move to, two ends of cell / poles ; A (pairs of) homologous chromosomes separate <p>meiosis II</p> <ol style="list-style-type: none"> (individual) chromosomes / pairs of chromatids, line up on, equator / mid-line ; at right angles to first equator ; centromeres divide ; chromatids separate ; A chromatids move to (opposite) poles ref. to haploid / chromosome number halved / one set of chromosomes ; A n for haploid <p>[max 9]</p>
(b)	<p>1 polypeptide throughout structural gene</p> <ol style="list-style-type: none"> structural protein / enzyme / rRNA ; A any named protein other than a transcription factor (e.g. transporter / receptor / named hormone / immunoglobulin / haemoglobin / etc.) R if any of these are identified as product of regulatory gene named, structural protein / other protein / enzyme, or tRNA ; R named protein if function wrongly described idea that needed for, structure / function, of cell ; <p>regulatory gene</p> <ol style="list-style-type: none"> (product) controls, gene expression / transcription ; A promote / prevent / start / stop, gene expression or transcription (codes for) transcription factor / DNA-binding protein ; binds to, promoter / operator / DNA response element ; stops / allows, binding of RNA polymerase ; ref. to repressor / repressible ; A silencer ref. to inducer / inducible ; A activator / enhancer named example of regulatory gene ; A lac repressor / DELTA repressor / homeobox or homeotic or Hox gene <p>[max 6] [Total: 15]</p>

complete question 10) a)

prophase II, where chromosomes are seen as double chromatids with no chiasmata. During metaphase II, chromosomes are attached to spindle fibres and split into two sister chromatids. Anaphase II of which each have single chromatid. Telophase II, chromosomes decondense once more, crossing over which is a cause of variation, occurs at prophase I, where chromosomes are lined in bivalents forming chiasmata and crossing over of genes takes place leading to new allelic combination and later on a cause of variation is random assortment of chromosomes during Metaphase I and Metaphase II.

10) b)



Regulatory gene and structural gene both codes for polypeptide chains that are responsible for specific function. Structural gene has an operator that lead to binding of RNA polymerase to start transcription. Regulatory genes sometimes codes for protein that bind to such products to control its transcription rate. Regulatory gene carry transcription to code for protein that is not carrying physical process for the cell, but it help in regulating the transcription rate for structural gene.

Your
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10(a)

10(b)

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(b)	<p>I polypeptide throughout <i>structural gene</i></p> <ol style="list-style-type: none"> 1 structural protein / enzyme / rRNA ; A any named protein other than a transcription factor (e.g. transporter / receptor / named hormone / immunoglobulin / haemoglobin / etc.) R if any of these are identified as product of regulatory gene 2 named, structural protein / other protein / enzyme, or tRNA ; R named protein if function wrongly described 3 idea that needed for, structure / function, of cell ; <p><i>regulatory gene</i></p> <ol style="list-style-type: none"> 4 (product) controls, gene expression / transcription ; A promote / prevent / start / stop, gene expression or transcription 5 (codes for) transcription factor / DNA-binding protein ; 6 binds to, promoter / operator / DNA response element ; 7 stops / allows, binding of RNA polymerase ; 8 ref. to repressor / repressible ; A silencer 9 ref. to inducer / inducible ; A activator / enhancer 10 named example of regulatory gene ; A lac repressor / DELTA repressor / homeobox or homeotic or Hox gene <p>[max 6] [Total: 15]</p>

can also be

where structural gene which consists of lac operon and promoter leads to its transcription forming polypeptide that is important for the cell function for example enzyme or structural protein in cell's face membrane of the cell. regulatory gene does not have lac operons. Regulatory genes carry helping role in transcription of structural gene. Each structural gene has regulatory gene to control its function.

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10(b)

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10(a)

10(b)

10 (a) Describe the behaviour of chromosomes during meiosis. [9]

(b) Outline the differences between structural and regulatory genes. [6]

[Total: 15]

10 a) During meiosis I, chromosomes are arranged at the equator of the cell. Homologous chromosomes are pulled to opposite poles without the separation of their centromeres. This results in 2 daughter cells each with one set of chromosomes, 2 haploid cells. In meiosis 2, the chromosomes are again arranged at the equator of the cell and sister centromeres are ~~parted~~^{separated} and sister chromatids are pulled apart to opposite poles. Each daughter cell divides into 2 others. This results in the formation of four daughter cells which are all genetically identical to each other. Each of the 4 daughter cells is haploid.

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⑥ Structural genes code for the production of enzymes or cell structures which are responsible or have a role in controlling or maintaining the structure of the cell while regulatory genes are the genes which code for the production of proteins which are responsible in regulating the expression of other genes. Examples of structural genes can be the genes coding for the production of cell walls and examples for regulatory genes can be the genes coding for the production of DELLA proteins.

Your
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10(a)

10(b)

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(b) Outline the differences between structural and regulatory genes. [6]

[Total: 15]

a. During ~~meiosis~~ prophase I of ~~meiosis~~ chromosomes match up together in their homologous pairs. During this phase crossing over can occur & parts of chromatids of adjacent chromosomes are switched.
^{in the metaphase} These chromosomes line up along the equator of the cell & ~~each~~ each complementary ~~these~~ chromosome in a homologous pair go to opposite ~~other~~ poles of the dividing cells in anaphase I. Then, the cell divides.
 In ~~prophase~~ metaphase 2, chromosomes line up along the equator of a cell & are pulled apart along the centromeres of each chromosome. In anaphase II. Then, ~~Telophase~~, the ~~nucleus reforms & chromatids are~~. Each gamete now has a full set of chromatids.

10(b)

Q10 Mark scheme

- (a) I ref. to nuclear envelope I names of stages
 meiosis I
 1 chromosomes, condense / thicken / spiralise ;
 2 homologous chromosomes pair / bivalents form ;
 3 crossing over / described ;
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 5 spindle fibres / microtubules, attach to / pull, centromeres / kinetochores ; allow once in mp5 or in meiosis II
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 10 named example of regulatory gene ; A lac repressor / DELTA repressor / homeobox or homeotic or Hox gene [max 6]

[Total: 15]

Your
Mark

10(a)

10(b)

Structural genes are directly related to the structure & function of an organism. Examples of a structural gene is the gene coding for lactase. Its function is to break down lactose in the organism. A regulatory gene is responsible for controlling when a structural gene is allowed to act. These genes often inhibit the expression of a structural gene & only release when the substrate of the structural gene is present. Regulatory genes don't affect the structure of an organism, but have its functions.

Q10	Mark scheme
(a)	<p>I ref. to nuclear envelope I names of stages</p> <p><i>meiosis I</i></p> <ol style="list-style-type: none"> 1 chromosomes, condense / thicken / spiralise ; 2 homologous chromosomes pair / bivalents form ; 3 crossing over / described ; 4 chiasma(ta) ; 5 spindle fibres / microtubules, attach to / pull, centromeres / kinetochores ; <i>allow once in mp5 or in meiosis II</i> 6 bivalents line up on, equator / mid-line ; A pairs of homologous chromosomes 7 independent assortment (of homologous pairs) / described ; A random assortment 8 chromosomes move to, two ends of cell / poles ; A (pairs of) homologous chromosomes separate <p><i>meiosis II</i></p> <ol style="list-style-type: none"> 9 (individual) chromosomes / pairs of chromatids, line up on, equator / mid-line ; 10 at right angles to first equator ; 11 centromeres divide ; 12 chromatids separate ; A chromatids move to (opposite) poles 13 ref. to haploid / chromosome number halved / one set of chromosomes ; A n for haploid <p>[max 9]</p>
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