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ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Education

Biology 5416

Specification B

BYB2 Genes and Genetic Engineering

Mark Scheme

2007 examination - June series

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Question 1

(a) (i) Stage A is anaphase;
Chromatids/chromosomes moving apart/centomere divided; 2

(ii) Stage B is telophase;
Chromosomes are uncoiling;
(Accept new nuclei forming) 2

(b) Embryo split into separate cells;
These (cells) are undifferentiated/totipotent;
Each cell grows by mitosis (into new embryo/organism); 2 max

Total 6

Question 2

(a) Heat (DNA) to 95°C, to separate strands/break hydrogen bonds/denature;
Cool to 40°C, to allow primers/nucleotides to bind;
Primers provide starting point for copying/prevent strands rejoining;
Heat to 70°C, optimum for polymerase/enzyme;
DNA polymerase then joins nucleotides together; 4 max
(Accept Taq polymerase)

(b) Reason with explanation;;

For example:
Easy to insert genes into bacteria;
Using a vector/plasmid/virus;

Bacteria reproduce rapidly;
Producing many copies of (inserted) gene;

Bacteria can be grown on a large scale/ in industrial fermenters;
To get a lot of the product of the gene; 2 max

Total 6

Question 3

(a) (i) Meiosis;

(ii) Reference to homologous/pairs of chromosomes/bivalents;
One of each pair goes to each cell/gamete;
(In second division) centromere divides/chromatids separate; 3 max
(Accept crossing over/independent assortment for 1 mark)

(b) (i) F between 'gamete-producing structure and zygote;

(ii) M between '2N' and spores; 2

(c) Advantage and explanation;;

For example:
Many spores released nearby;
So more of nutrient source used/used more rapidly;

Produces genetically identical fungi;
So all well suited to nutrient source/ environment; 2 max

Total 7

Question 4

(a) Plasmid cut;
Restriction enzyme/endonuclease;
(Complementary) sticky ends (however formed);
Use of ligase; 3 max

(b) (Bee) gene will get into/expressed in all cells (of the mosquito);
So, the gene gets passed to future generations; 2

(c) To identify mosquitoes which had taken up the gene;
So, only these are used;
Identify by looking for those that produce green light; 2 max

(d) Could save birds from malaria, so reversing harm done by humans;
Islands isolated, so fewer problems if trial goes wrong;
If malaria parasite becomes resistant to bee protein, resistance not in human malaria strain;
Resistance will spread through the mosquito population; 1 max

Total 8

Question 5

(a) More radiation, more non-mobile sperm;
Radioactive material source of high energy/ionising radiation/ high energy particles/named;
Which cause mutations (and abnormal sperm);
Detail of how mutation affects sperm movement; 3 max

(b) Both reduced in high radiation area/correct use of figures for both;
Antioxidant 1 most affected; 2

(c) Reference to sperm unable to fertilise (eggs);
Damage to egg DNA (because of lower antioxidants);
So non-viable egg/zygote/embryo/offspring;
(Mutations) produces individuals with (new) harmful characteristics; 3 max

Total 8

Question 6

(a) Base sequence different/named mutation;
Comparison to functional allele/gene/DNA/mRNA;
Leads to different sequence of amino acids;
So enzyme/protein with different/non-functional shape; 3 max

(b) Gene inserted into vector/virus/liposomes;
Inhaled/sprayed (into lungs);
Vector carries gene into (epithelial) cells; 3
(*Accept plasmids as a vector)*

(c) They will have one functional allele/gene;
This produces (enough) functional protein; 2

Total 8

Question 7

(a)
1 Sequence of bases in gene/on DNA determine amino acid sequence;
2 Transcription to form mRNA;
3 Codons on mRNA;
4 Reference to base-pairing;
5 A to U, T to A and C to G;
6 Specific tRNA for each amino acid;
7 Has anticodon to bind to mRNA codon;
8 At the ribosome;
9 Role of sites on ribosomes in translation. 6 max

(b) (i) X is phosphate and Y is pentose/deoxyribose;

(ii) Hydrogen; 2

(c) (i) AZT binds to adenine/ A (on single DNA strand);
But lacks phosphates/ OH;
Unable to bind to another nucleotide;
So (AZT) enzyme unable to form new strand/DNA; 2 max

Total 10