

4.4 Genetic engineering and biotechnology – summary of mark schemes

4.4.4	<p>Describe the application of DNA profiling to determine paternity and also in forensic investigations.</p> <p>Mark Scheme</p> <ul style="list-style-type: none">A. sample of DNA / blood / saliva / semen is obtained;B. satellite DNA / repetitive sequences used for profiling;C. reference samples of DNA are obtained;D. PCR used to amplify / produce more copies of the DNA;E. DNA broken into fragments by restriction enzymes;F. DNA fragments are separated by gel electrophoresis;G. separation according to the length of the fragments;H. pattern of bands obtained / different pattern of bands with DNA from different individuals;I. bands compared between different DNA samples;J. if pattern of bands is the same then DNA is (almost certainly) from same source;K. if some bands are similar then individuals are (almost certainly) related;L. used for criminal investigations / example of use in criminal investigation;M. used to check paternity / who is the father / mother / parent;N. used to check whether two organisms are clones;
4.4.6	<p>Outline three outcomes of the sequencing of the complete human genome.</p> <p>Mark Scheme</p> <ul style="list-style-type: none">A. may lead to an understanding of genetic / inherited diseases / conditions;B. may lead to the production of gene probes to detect carriers of genetic diseases;C. may lead to the production of pharmaceuticals based on DNA sequences;D. study of similarities / differences between human race / population;E. find location of genes / produce a complete gene map;F. study of human origins / migration / relationships with other species;
4.4.8	<p>Outline a basic technique used for gene transfer involving plasmids, a host cell (bacterium, yeast or other cell), restriction enzymes (endonucleases) and DNA ligase.</p> <p>Mark Scheme</p> <ul style="list-style-type: none">A. mRNA is extracted;B. DNA copy of RNA is made using reverse transcriptase;C. plasmid is a small piece of circular DNA;D. plasmid removed from (host) cell;E. plasmids are cut open with endonucleases (at specific sequences);F. genes / DNA fragments from another organism cleaved by same restriction enzyme;G. gene of interest and plasmid are mixed together;H. addition of “sticky ends” to the DNA copy (so that it will combine with the cut plasmid);I. DNA ligase will seal the plasmid;J. recombinant plasmid is inserted into E. coli/host cell;K. E coli is cultured;L. E coli begins to make protein coded by the gene of interest;
4.4.10	<p>Discuss the potential benefits and possible harmful effects of one example of genetic modification.</p> <p>Mark Scheme</p> <p><i>Possible benefits:</i></p> <ul style="list-style-type: none">A. benefits include more specific (less random) breeding than with traditional methods;B. faster than traditional methods;C. some characteristics from other species are unlikely in the gene pool / selective breeding cannot produce desired phenotype;D. increased productivity of food production / less land required for production;E. less use of chemicals (eg pesticides);F. food production possible in extreme conditions;

- G. less expensive drug preparation;
- H. eg pharmaceuticals in milk;
- I. human insulin engineered so no allergic reactions;
- J. may cure genetic diseases;
- K. allows use of herbicide on growing crop;
- L. higher yield due to less weed competition;
- M. weeds that are very similar to the crop plants can be controlled;

Possible harmful effects:

- N. some gene transfers are regarded as potentially harmful to organism (especially animals);
- O. release of genetically engineered organisms in the environment;
- P. can spread and compete with the naturally occurring varieties;
- Q. some of the engineered genes could also cross species barriers;
- R. technological solution when less invasive methods may bring similar benefits;
- S. reduces genetic variation / biodiversity;
- T. uncertainty about long-term effect;
- U. uncontrollable superweeds might be produced;
- V. foreign DNA in the crop plant might cause allergies in humans;
- W. fewer weeds for wildlife that feed on them;

Examples:

- X. name of organism that was genetically modified;
- Y. source of the DNA / gene used to modify organism;
- Z. effect of the gene / characteristic coded for by the gene;
- AA. reference to gene transfer between species being a natural process (with viral vectors);
- BB. wheat / maize / other crop plant;
- CC. Salmonella typhimurium;
- DD. resistance to glyphosate / roundup herbicide;

4.4.13 Discuss the ethical issues of therapeutic cloning in humans.

Mark Scheme

Arguments against cloning

- A. reduces the value / dignity of the individual / causes psychological problems;
- B. high miscarriage rates / cloned individuals are likely to have developmental disorders / health problems / cloned individuals may show premature aging;
- C. costly process and money could be better spent on other types of healthcare;
- D. cloning may be done for inappropriate motives / replace lost loved one / perfect race etc.;

Arguments for cloning

- E. identical twins are formed by cloning so it is a natural process;
- F. cloned embryos can be tested for genetic disease / genetic screening;
- G. increased chance of children for infertile couples;
- H. cloning research may lead to spin-offs for other research areas such as cancer / transplant research / regeneration research;