

- M1.** (i) mRNA attaches to ribosome;
codon on mRNA;
binds to an anti-codon on tRNA;
each tRNA brings a specific amino acid;
sequence of codons/bases on mRNA determines order of amino acids;
formation of peptide bonds/amino acids joined by condensation reactions;
- 4 max
- (iii) inserted gene/mRNA complementary to normal gene/mRNA;
binds to it to prevent protein synthesis/form double strand/prevents mRNA binding to ribosomes;
will not stop all translation, some mRNA reaches ribosomes/
because not all mRNA is bound by inserted gene mRNA;
- 2 max
- [6]**
-
- M2.** (a) a length of DNA;
that codes for a single protein / polypeptide;
- 2
- (b) by heating;
to break the H-bonds (between complementary bases);
- 2
- (c) (i) to allow the DNA polymerase to attach / start addition of nucleotides / mark start and end of sequence to be copied /prevents strands re-joining;
- 1
- (ii) because the sequences at the ends of the target sequence are different / one is at the beginning and one at the end;
- 1
- (d) 8;
- accept 7*
- 1
- [7]**
-
- M3.** (a) use restriction enzyme/endonuclease/named, e.g. Bam/Eco;
to cut DNA in specific place/base sequence;
- 2
- (b) heat DNA to 90 – 95 °C;
strands separate;
add primers;
and nucleotides;
cool so that primers bind to DNA;
(DNA) polymerase forms new strands/joins nucleotides;
- 4 max

- (c) (i) virus is inhaled/sprayed into the lungs;
gets into cells, inserting the healthy gene; 2
- (ii) makes DNA from RNA
rather than other way round 1

[9]

- M4.** (a) 1 *DNA is cut;*
- 2 *Using restriction enzyme;*
- 3 *Use electrophoresis;*
- 4 *Separates according to length/mass;*
- 5 *Southern blotting/transfer to (nylon) membrane;*
- 6 *Make single-stranded;*
- 7 *Apply probe;*
- 8 *Radioactive/fluorescent;*
- 9 *Reference to tandem repeats/VNTRs/minisatellites;*
- 10 *Autoradiography/eq;*
8 and 10 should be consistent
- max 6
- (b) (i) All bands in cub which don't come from mother;
Must be in father's DNA fingerprint;
Principle that all bands in cub must come from mother and father =
1 2
- (ii) Select pairs with dissimilar DNA fingerprints; 1
- (c) (i) Cells (from panda) in faeces/gut cells/blood cells; 1
- (ii) To increase amount of DNA/only small amount present; 1
- (iii) DNA/primer has specific base-sequence;
Reference to specific/complementary base-pairing; 2

- (d) Taking samples from animals causes stress/injury to animal;
 Difficult to find animals;
 Pandas are dangerous/threat to human;

max 2

[15]

- M5.** (a) isolate wanted gene/DNA from another organism/mRNA from cell/organism;
 using restriction endonuclease/restriction enzyme/reverse transcriptase to get DNA;
 produce sticky ends;
 use ligase to join wanted gene to plasmid;
 also include marker gene;
 example of marker e.g. antibiotic resistance;
 add plasmid to bacteria to grow (colonies);
 (replica) plate onto medium where the marker gene is expressed;
 bacteria/colonies not killed have antibiotic resistance gene and (probably) the wanted gene;
 bacteria/colonies expressing the marker gene have the wanted gene as well;

6 max

- (b) (i) injection, rapid rise and fall;
 virus, slower rise and longer in effective/harmful range;
 capsule slowest rise, longest in effective/harmful range;
 injection and virus give harmful concentrations but capsule does not;

3 max

- (ii) advantage e.g.:
 substance never reaches harmful levels /no side effect/
 less likely to harm the organism, longer relief from symptoms/
 less frequent treatment needed/longer effective range/
 longer but without harmful side effects;

1 max

disadvantage e.g.:
 takes longer to take effect;

1

[11]

- M6.** (a) (i) number of bases = 4440
allow 4446 if they refer to start / stop

each amino acid coded for by triplet / three bases
 (so three times more bases than amino acids);

2

- (ii) deletion;
(deletion) of three bases;
because substitution/addition would change amino acid(s);
- 2 max
- (b) (i) codon on mRNA;
specific/complementary base pairing with;
anti-codon on tRNA;
specific tRNA for each amino acid;
protein formed by condensation reactions /
peptide bonds formed;
- 4 max
- (ii) (loss of amino acid) changes tertiary structures/3D shape;
so sugar molecules cannot be attached (to form glycoprotein/
functional protein);
so (defective) unable to bind to chloride ions/use ATP;
- 2 max
- [10]
- M7.** (a) (i) to separate polynucleotide strands/form single strands;
- 1
- (ii) not denatured (at 95°C);
- 1
- (iii) for binding of primers/nucleotides (to DNA strands);
- 1
- (b) (i) doubling (of DNA) each cycle;
but very low numbers to start with, so appears flat;
then exponential growth;
- 2 max
- (ii) suggestion; with explanation e.g.:
- nucleotides being used up;
so less/nothing to make complementary chains;
- primers used up;
so cannot start complementary chains;
- enzymes losing activity/denatured;
so no polymerisation of complementary strands;
- 2 max
- [7]

- M8.** (a) (i) Different genes/characteristics/features;
Base sequence determines protein;
Different species have different protein sequences;
Reference to mutations;
max 2
- (ii) Primer has different DNA sequence;
DNA specific / complementary base-pairing;
2
- (iii) Electrophoresis separates DNA;
(So they can be) identified by position on gel;
Smaller/shortest fragments travel furthest/quicker / or
reverse argument;
3
- (b) (*conventional*) Many lengths/all DNA / (*new*) one length;
Each rung is DNA of one/specific length;
2
- (c) 1 Heat DNA;
2 Breaks hydrogen bonds/separates strands;
3 Add primers;
4 Add nucleotides;
5 Cool;
6 (to allow) binding of nucleotides/primers;
7 DNA polymerase;
8 Role of (DNA) polymerase;
9 Repeat cycle many times;
max 6
- [15]**
- M9.** (a) (cut out gene using an) endonuclease / restriction enzyme;
reference to specificity / recognition site;
sticky ends;
use the same enzyme to cut;
plasmid / virus / potato DNA;
fixed by ligase;
method of introducing vector e.g. micropipette / virus injects DNA /
remove plant cell wall;
6 max
- (b) introduced gene / characteristic passed to offspring;
rapid process;
larger number of plants produced;
asexual reproduction genetically identical / sexual reproduction
causes variation;
3 max

	(c) different genes are expressed; producing different enzymes/proteins;	2	[11]
M10.	(a) to separate the two strands / break hydrogen bonds;	1	
	(b) (i) enables replication/sequencing to start (<i>allow keeps strands separate</i>);	1	
	(ii) joins DNA nucleotides (<i>not complementary bases</i>);	1	
	(c) (i) 64;	1	
	(ii) replication of DNA from crime scene/tissue sample / for DNA sequencing / gene cloning;	1	
	(d) (transcription uses) RNA polymerase; RNA nucleotides / uracil; one (template) strand / PCR both strands; start / stop codons; (<i>accept enzyme separates strands</i>)	2 max	[7]
M11.	(a) introduction of healthy gene / 'replacement' of defective gene;	1	
	(b) can enter cells / infect cells / inject DNA into cells; targets specific cells; replicates (in cells);	2	
	(c) reproductive cells/gamete cells do not contain ADA allele / gene;	1	
	(d) (i) to 'prevent' rejection / immune response;	1	
	(ii) T lymphocytes have a limited life span / die off / do not reproduce; bone marrow provides continual supply of T lymphocytes / (ADA) gene enzyme;	2	[7]

- M12.** (a) probe will attach (to mutant allele);
attaches to one DNA strand;
as a result of complementary base pairing;
radioactivity detected on film/X-ray / by autoradiography
(if mutant allele present); 4
- (b) for
gene is only active in mammary cells / only affects milk / easy to
obtain product / product produced in large amounts / gene passed to
offspring; 1
- against
long term effects not known / qualified reference to animal exploitation
e.g. use of embryos / effect of inserted gene on other sheep
tissues/genes; 1
- [6]
- M13.** (a) polymerase chain reaction / PCR; 1
- (b) (i) joins nucleotide together; (*not complementary bases*) 1
- (ii) enables replication / sequencing to start / keeps strands separate; 1
- (c) (i) (modified nucleotide) does not form bonds/react with other
nucleotides; 1
- does not "fit" DNA polymerase/enzyme/active site;
- (ii) AC; 1 max
(*accept reading from right hand side i.e. TC*)
- (d) (i) different lengths / sizes / mass; 1
- (ii) radioactive primer; 1
- (iii) GAAGTCTCAG; 1
(*accept reading from autoradiogram i.e. CTCAGAGTC*)
- [8]

- M14.** (a) (i) restriction (endonuclease) enzyme;
cuts DNA at specific/restriction points/after specific base sequence; 2
- (ii) PCR/polymerase chain reaction; 1
- (b) isolated cells divide by mitosis;
 can get many plants (producing toxin) / rapid production of
 (toxin producing) plants;
all cells (in the new plant/clone) will produce the toxin;
 only small number of cells in the whole plant would produce the toxin /
 express gene; 3 max
- [6]
- M15.** (a) 1 DNA heated to 90 to 95°C;
 2 strands separate;
 3 cooled / to temperature below 70°C
 4 primers bind;
 5 nucleotides attach;
 6 by complementary base pairing;
 7 temperature 70 - 75°C;
 8 DNA polymerase joins nucleotides together;
 9 cycle repeated; 6 max
- (b) 1 percentage risk is too high for human application;
 2 incorrect mRNA;
 3 different tRNA/tRNA brings incorrect amino acid;
 4 structure of protein synthesised unknown/sequence of
 amino acids changed/ incorrect shape/folding of polypeptide changed;
 5 produce a toxic/harmful protein;
 6 protein no
 n-functional / chloride ions not transported / thick mucus results; 4 max
- [10]
- M16.** (a) (i) transfer/carry genes from one organism to another/into
 bacteria/cells; 1
- (ii) cut open plasmid;
 cut donor DNA, to remove gene/length of DNA;
 cut donor DNA and plasmid with the same enzyme/enzyme
 that cuts at the same base sequence;
 sticky ends/(overhanging) ends with, single strand/bases exposed;
 association/attachment/pairing of complementary strand; 2 max

- (iii) annealing/splicing/backbones joined/phosphodiester bonds; 1
- (b) (i) L and M; 1
- (ii) fragments 64 and 36(kilobases obtained) 1
- [6]
- M17.** (a) only small amounts obtained;
PCR increases the amount/mass of DNA;
so enough DNA available for genetic fingerprinting; max 2
- (b) (i) to separate the two strands of the DNA /
to break the hydrogen bonds;
(Reject "unzip") 1
- (ii) short lengths/fragments of DNA/nucleotides/
single stranded DNA; 1
- (iii) to mark beginning and/or ends of the part of DNA needed /
for attachment of enzymes or nucleotides / initiator /
keeps strands apart; 1
- (iv) would not be denatured;
must be heated to 95 °C / must withstand high temps; 2
- (c) 1 DNA extracted from sample;
2 DNA cut/hydrolysed into segments using restriction endonucleases;
3 must leave minisatellites/required core sequences intact;
4 DNA fragments separated using electrophoresis;
5 detail of process e.g. mixture put into wells on gel and electric
current passed through;
6 immerse gel in alkaline solution / two strands of DNA separated;
7 Southern blotting / cover with nylon/absorbent paper (to absorb DNA);
8 DNA fixed to nylon/membrane using uv light
9 radioactive marker/probe added (which is picked up by required
fragments) / complementary to minisatellites;
10 (areas with probe) identified using X-ray film/autoradiography; max 6
- (d) adult 3;
this is only one which, (with number 1), can provide (all) the DNA
fragments which children have / all bars match;
(Reject 'genes') 2
- [15]

- M18.** (a) Presence of resistant and non-resistant varieties / mutation produces resistant variety;
Resistant ones survive / non-resistant ones killed by treatment;
These will reproduce and produce more resistant parasites/pass on resistance allele;
Greater probability of another person being infected by resistant parasites;
- max 3**
- (b) Likelihood of being infected (by strain resistant to both drugs) is less;
 $1/500 \times 1/500 / 1/250\ 000$;
Drug has longer effective life;
- max 2**
- (c) (i) As comparison / to show that nothing else in the treatment was responsible;
- 1**
- (ii) Given injections of saline / injection without SPf66;
(otherwise) treated the same as experimental group;
- 2**
- (d) (i) 100%;
- 1**
- (ii) 10%;
- 1**
- (e) (i) Different lengths of DNA have different base sequences / cut at specific sequence;
Results in different shape / different shape of active site;
Therefore (specific sequence) will only fit active site of enzyme;
- 3**
- (ii) Recognition sites contain only AT pairs;
Which would occur very frequently;
- 2**
- [15]**
- M19.** (a) (i) contains genes/nucleotides/sections of DNA/artificial DNA from two species/2 types of organisms;
- 1**
- (ii) carries gene/DNA (into the other organism /gene carrier);
- 1**
- (iii) expose cells to the fungus;
non-resistant ones die, resistant ones survive;
OR identify by adding marker gene/gene probe/(qualified) marker probe; description of positive result
e.g. radioactivity/fluorescence / complementary base pairing;
- 2**

	(b)	EITHER	1 cut desired gene (from DNA) of oat plant; 2 using restriction endonuclease/restriction enzyme;		
		OR	1 use mRNA from oat which will code for resistance; 2 and use reverse transcriptase to form desired DNA;		
		OR	1 make artificial DNA with correct sequence of bases; 2 using DNA polymerase; 3 cut plasmid open; 4 with (same) restriction endonuclease/restriction enzyme; 5 ref. sticky ends/unpaired bases attached; 6 use (DNA) ligase to join / ref. ligation; 7 return plasmid to (bacterial) cells; 8 use of Ca ²⁺ /calcium salts/electric shock; (if ref. to 'insulin' allow 5 max.)		
				max 6	[10]
M20.	(a)	(i)	<u>Sticky ends</u> /description; Reference to complementary base-pairing	2	
		(ii)	Ligase;	1	
	(b)		Carrier; DNA/gene; (<i>context of foreign DNA</i>) Into cell/other organism/host;	max 2	
	(c)		Act as marker gene; Allows detection of cells containing plasmid/DNA; Reference to growing bacteria on antibiotic;	max 2	[7]
M21.	(a)	(i)	<u>Sticky ends</u> /description; Reference to complementary base-pairing	2	
		(ii)	Ligase;	1	
	(b)		Carrier; DNA/gene; (<i>context of foreign DNA</i>) Into cell/other organism/host;	max 2	

- (c) Act as marker gene;
Allows detection of cells containing plasmid/DNA;
Reference to growing bacteria on antibiotic;
- max 2
- [7]
- M22.** (a) Mother and father both heterozygotes / Tt / carriers;
Probability of thalassaemia 1/4 and female 1/2;
Probability of both 1/8;
- 3
- (b) (i) Cut at same base sequence as same enzyme used;
Fragments are same length / size / have same charge;
Only differs by a single base;
- max 2
- (ii) Single base occurs many times;
Sequence of 20 unlikely to occur elsewhere;
Allow one mark for establishing the principle where neither marking point clearly made.
- 2
- [7]
- M23.** (a) Endonuclease / restriction enzyme;
- 1
- (b) DNA made of base pairs;
Each base pair is same length / occupies same distance
along backbone;
- 2
- (c) (i) Second blank box from left labelled 6;
- 1
- (ii) Distance moved depends on length / number of base pairs /
second longest fragment / second shortest distance identified;
- 1
- (d) 5;
- 1
- [6]

- M24.** (a) (i) Reverse transcriptase; 1
- (ii) Idea that mRNA is present in large amounts in cell making the protein / mRNA has been edited / does not contain introns / mRNA codes for single protein; 1
- (b) (Ligase) splices / joins two pieces of DNA / “sticky ends”; 1

[3]

M25. General principles for marking the Essay:

Four skill areas will be marked: scientific content, breadth of knowledge, relevance and quality of language. The following descriptors will form a basis for marking.

Scientific content (maximum 16 marks)

Category	Mark	Descriptor
	16	
Good	14	Most of the material of a high standard reflecting a comprehensive understanding of the principles involved and a knowledge of factual detail fully in keeping with a programme of A-level study. Some material, however, may be a little superficial. Material is accurate and free from fundamental errors but there may be minor errors which detract from the overall accuracy.
	12	
	10	
Average	8	A significant amount of the content is of an appropriate depth, reflecting the depth of treatment expected from a programme of A-level study. Generally accurate with few, if any fundamental errors. Shows a sound understanding of most of the principles involved.
	6	
	4	
Poor	2	Material presented is largely superficial and fails to reflect the depth of treatment expected from a programme of A-level study. If greater depth of knowledge is demonstrated, then there are many fundamental errors.
	0	

Breadth of Knowledge (maximum 3 marks)

Mark	Descriptor
3	A balanced account making reference to most if not all areas that might realistically be covered on an A-level course of study.
2	A number of aspects covered but a lack of balance. Some topics essential to an understanding at this level not covered.
1	Unbalanced account with all or almost all material based on a single aspect
0	Material entirely irrelevant.

Relevance (maximum 3 marks)

Mark	Descriptor
3	All material presented is clearly relevant to the title. Allowance should be made for judicious use of introductory material
2	Material generally selected in support of title but some of the main content of the essay is of only marginal relevance.
1	Some attempt made to relate material to the title but considerable amounts largely irrelevant.
0	Material entirely irrelevant or too limited in quantity to judge.

Quality of language (maximum 3 marks)

Mark	Descriptor
3	Material is logically presented in clear, scientific English. Technical terminology has been used effectively and accurately throughout.
2	Account is logical and generally presented in clear, scientific English. Technical terminology has been used effectively and is usually accurate.
1	The essay is generally poorly constructed and often fails to use an appropriate scientific style and terminology to express ideas.
0	Material entirely irrelevant or too limited in quantity to judge.

[25]

Additional notes on marking

Care must be taken in using these notes. It is important to appreciate that the only criteria to be used in awarding marks to a particular essay are those corresponding to the appropriate descriptors. Candidates may gain credit for any information providing that it is biologically accurate, relevant and of a depth in keeping with an A-level course of study. Material used in the essay does not have to be taken from the specification, although it is likely that it will be. These notes must therefore be seen merely as guidelines providing an indication of areas of the specification from which suitable factual material might be drawn.

In determining the mark awarded for breadth, content should ideally be drawn from each of the areas specified if maximum credit is to be awarded. Where the content is drawn from two areas, two marks should be awarded and where it is taken only from a single area, one mark should be awarded. However, this should only serve as a guide. This list is not exhaustive and examiners should be prepared to offer credit for the incorporation of relevant material from other areas of study.

- M26.** (a) 1. DNA is cut;
2. using restriction enzyme;
3. electrophoresis;
4. separates according to length/mass/size;
5. DNA made single-stranded;
6. transfer to membrane/ Southern blotting;
7. apply probe;
8. radioactive/ single stranded/ detected on film/ fluorescent;
9. reference to tandem repeats/VNTRs/minisatellites;
10. pattern unique to every individual;
- 6 max**
- (b) cells on toothbrush;
DNA present in cell;
- 2**
- (c) (i) toothbrush gives small sample of DNA/ need more DNA
for analysis;
PCR gives many copies;
- 2**
- (ii) uses heat;
to separate strands;
OR
PCR replicates pieces of DNA;
because DNA has been cut;
OR
primer added in PCR;
to initiate replication
- 2 max**
- (d) (i) PCR/amplification needed;
- 1**
- (ii) other DNA present; need to identify 'required' DNA from rest;
- 2**
- [15]**
- M27.** (a) restriction (enzyme) / endonuclease / named example;
- 1**
- (b) unpaired bases / sticky ends / staggered;
complementary / explained;
- 2**
- (c) *1 mark for each correct outcome*
plasmid with foreign DNA joined in ring;
ring with plasmid only; ring of foreign DNA only;
ignore linear structures
- 3**
- [6]**

- M28.** (a) (i) Hydrolysis; 1
- (ii) Shape / configuration complementary to (shape of) active site of enzyme; 1
Q Credit must not be awarded to answers that state the shapes are the same.
- (iii) Consists of six antiparallel base pairs / six base pairs that read the same in opposite directions; 1
- (b) (i) 3; 1
- (ii) Partial digestion produced fragments of other lengths; 2
 e.g., (3 + 2 = 5) / (4 + 1 = 5) / (4 + 2 = 6) / (3 + 2 + 1 = 6) / (4 + 3 = 7) / (4 + 3 + 2 = 9);
- (iii) 3 kb fragment is the smallest to be radioactive (so must be on left); 2
 4 kb fragment is next smallest to be radioactive (so 1 kb fragment must be attached directly on to 3 kb fragment);
Q Credit should be given where answers show a clear understanding that the 3 kb and 4 kb fragments are the smallest to be radioactive and that the 4 kb fragment must be formed by the 3 kb and 1 kb fragments joined together.
- [8]**
- M29.** (a) Strand of DNA; 3 max
 Short strand / up to 20 bases long;
 With base sequence that is complementary to part of target gene;
 Radioactive labelling / fluorescent labelling;
- (b) Identify carrier (of cancer gene); 2 max
 Identify which (cancer) gene present;
 Identify most effective treatment;
- [5]**
- M30.** (a) (i) 1. Has the restriction site (cut by *Kpn1*);
 2. Once;
 3. 1000bp from *Kpn1* on site of plasmid / 1/3 way along;
2. Must be explicit.
Has a restriction site is point 1 only. 2

- (ii) (Most of) plasmid and rest of unknown DNA / rest of recombinant plasmid / rest of plasmid but not 1000 bp part;
Looking for idea rather than precise wording. 1
- (b) 2; 1
- (c) (i) Give one mark for answer confined to smaller fragments move further/faster;

Give two marks for comparing with distance/speed moved by fragments of known size/markers / DNA ladder;; 2
- (ii) 1. Large pieces of DNA present;

2. Add up to more than total length of original DNA / plasmid plus inserted DNA;

3. Because this would add undigested to total (original) length; 2
- [8]**
- M31.** (a) (i) 1. Negative correlation;
1. *Accept: description for 'negative correlation'*
Neutral: 'correlation'
Reject: positive correlation

2. Wide range;

3. Overlap;

4. (Graph suggests that) other factors may be involved (in age of onset);
2 / 3 Accept the use of figures from the graph
2 / 3 Can refer to age of onset or number of CAG repeats
Ignore references to methodology 3 max
- (ii) 1. Age of onset can be high / symptoms appear later in life;
Accept: 'gene' for 'allele'

2. (So) individuals have already had children / allele has been passed on;
- OR**
3. Individuals have passed on the allele / already had children;

4. Before symptoms occur; 2 max

- (b) (i) 1. Person **K**;
2. (As has) high(est) band/band that travelled a short(est) distance/
slow(er) so has large(st) fragment/number of CAG repeats;
2. *Must correctly link distance moved and fragment size* 2
- (ii) Run fragments of known length / CAG repeats (at the same time);
Accept: references to a DNA ladder / DNA markers
Do not accept DNA sequencing 1
- (iii) Homozygous / (CAG) fragments are the same length / size / mass;
Accept: small fragment has run off gel / travelled further 1
- [9]
- M32.** (a) 1. Adenylate cyclase activated / cAMP produced / second messenger produced;
2. Activates enzyme(s) (in cell);
3. (So) glycogenolysis / gluconeogenesis occurs / glycogenesis inhibited;
3. *Neutral: 'glucose produced' as given in the question stem*
Accept: correct descriptions of these terms 2 max
- (b) (i) 1. Glucose/sugar in food would affect the results;
1. *Accept references to starch / carbohydrate*
2. Food/eating would affect blood glucose (level);
3. (Allows time for) blood glucose (level) to return to normal;
3. *Neutral: allows time for insulin to act* 1 max
- (ii) Type 2 diabetes is a failure to respond to insulin / still produces insulin /
is not insulin-dependent; 1

(iii) (For) – 3 max

A maximum of three marks can be awarded for each side of the argument

1. Avoids injections / pain of injections;
2. Long(er) lasting / permanent / (new) cells will contain / express gene;
Ignore references to methodology e.g. sample size not known
3. Less need to measure blood sugar / avoids the highs and lows in blood sugar;
4. Less restriction on diet;

(Against) – 3 max

5. Rats are different to humans;
6. May have side effects on humans;
6. Accept: virus may be harmful / disrupt genes / cause cancer
7. Long(er) term effects (of treatment) not known / may have caused effects after 8 months;
8. (Substitute) insulin may be rejected by the body;

4 max

[8]

M33. (a) Restriction / endonuclease;

Ignore specific names of restriction enzymes e.g. EcoR1

1

(b) (i) 1. (Acts as a) marker gene;
1. Accept: gene marker

2. Shows that the (human) gene has been taken up / expressed;
3. (Only) implant cells / embryos that show fluorescence / contain the jellyfish gene;

2 max

(ii) 1. Factor IX present in / extracted from milk;

2. Gene only expressed in mammary glands/udder / gene not expressed elsewhere;

*2. Ignore references to milk
The 'only' aspect is important here.*

3. Do not need to kill sheep (to obtain Factor IX);

2 max

- (c) (i) 1. Mutation / nucleus / chromosomes / DNA may be damaged / disrupts genes;
 1. *Neutral: cell may be damaged*
2. May interfere with proteins (produced) / gene expression / translation;
Ignore references to hormone levels or time of implantation

OR

3. Embryo / antigens foreign;
 3. *Neutral: antigens change*
4. Embryo is rejected / attacked by immune system;
 4. *Need idea that the immune system is involved if mark point 3 has not been given*
'Embryo foreign so rejected' = 2 marks
'Embryo rejected by immune system' = 1 mark
'Embryo is rejected' = 0 marks

2 max

- (ii) 1. Saves time / money for others;
2. Same work is not repeated / methods can be compared / improved / amended / same errors are not made;

2

[9]

