AQA, OCR, Edexcel

# A Level

# A Level Biology

## DNA Technology Answers

Name:

M M E

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Total Marks:

**M1.**(a) (i) 1. (Tumour suppressor) gene inactivated / not able to control / slow down cell division;

*Ignore: references to growth*

2. Rate of cell division too fast / out of control.

*1 and 2 Accept: mitosis*

*1 and 2 Reject: meiosis* **2**

(ii) 1. (Genetic) code degenerate;

*Accept: codon for triplet*

*Accept description of degenerate code, e.g. another triplet codes for the same amino acid*

2. Mutation in intron.

*Accept: mutation in non-coding DNA* **1 max**

(b) 1. Antibody has specific tertiary structure / binding site / variable region;

*Do not accept explanations involving undefined antigen*

2. Complementary (shape / fit) to receptor protein / GF / binds to receptor protein / to GF;

*Ignore: same shape as receptor protein / GF*

3. Prevents GF binding (to receptor).

**3**

**[6]**

**M2.** (a) (i) Sticky ends / description;
Reference to complementary base-pairing

**2**

(ii) Ligase;

**1**

(b) Carrier of DNA / gene; *(context of foreign DNA)*
Into cell / other organism / host;

**2**

(c) Act as marker gene;
Allows detection of cells containing plasmid / DNA;

**2**

**[7]**

**M3.** (a) No cadmium;Other conditions same as cadmium-treated group;

**2**

(b) (i) As a measure of the effect due to cadmium / to make a comparison; **1**

(ii) Becoming more methylated;

*Ignore later slight decrease/no change*

**1**

(iii) Production of more methyltransferase enzyme / increased activity of transferase;

*Extra incorrect relevant information – cancel*

**1**

(c) RNA-polymerase could not bind (to DNA / to promoter);mRNA of p16 could not be made / no transcription of p16 gene;

**2**

(d) Any **four** from:1. Cadmium causes expression of methyltransferase gene / increased activity transferase (from 2 to 3 weeks in);2. Methyl groups on to promoter / p16 gene / suppressor (gene);3. (p16) normally suppresses tumour growth;4. p16 protein / p16 expression falls after 4 weeks / after methylation;5. Tumour formation occurs (after 10 weeks) after p16 falls /
after suppressor gene activity falls;

**4 max**

**[11]**

M**4.**(a) 1. Removes (main / largest) source of oestrogen / (different) mice produce different amounts of oestrogen;

*Accept: so oestrogen from ovaries not a confounding variable − idea of.*

2. (Allows) oestrogen to be controlled / oestrogen to be made by aromatase only / only oestrogen made in lungs to be involved.

*Reject: references to injection of aromatase.*

**2**

(b) 1. (Anastrozole) prevents / reduces oestrogen production;

2. (Fulvestrant) stops remaining oestrogen binding / less oestrogen binds to receptors.

*Note: brackets around drug names.*

**2**

c) (Yes for Group T)

1. Least tumours per animal (from fig. 1);

*Accept: 'mean values' for tumour area*.

2. Lowest (mean) tumour area / size (from fig. 2);
3. Lowest top of range;

(But)

4. Means (tumour area) are similar;

*Where candidates confuse range and standard deviation, do not give credit.*

5. Ranges overlap / share values so differences may not be real / treatments may be just effective in reducing tumour;

*Ignore significance*

6. Range affected by outliers / SD's would be better;

7. Done on mice / not done on women / humans;
8. Only 10 mice used per group / small sample size so may not be representative / reliable;
9. Might be side effects;
10. Only did for 15 weeks so maximum effect of drugs may not have been seen.

**5 max**

(d) 1. Tumours may be different depths / area does not take depth into account / tumours are 3-D / are not 2-D;

*Neutral: different sizes*

*Accept: height / thickness for depth*

2. (Measure) tumour volume / mass / weight.

**2**

(e) 1. Allows tumours to grow / develop / form;

*Neutral: gives drug more time to work.*

2. (So) can investigate treatment rather than prevention (of tumours) / when tumour / cancer is more advanced.

*Accept: to see whether it can destroy / treat / stop growth of a tumour (that already exists) / to allow / assess treatment of a tumour*

**2**

(f) 1. Unethical (not to treat patients) / may increase probability of patients dying / getting more ill;

*Reject: references to giving people tumours*

2. Use normal cancer drugs / treatment.

*Accept: named type of cancer treatment, e.g. chemotherapy*

**2**

**[15]**

**M5.** (a) (i) plasmid;

**1**

(ii) the bacteria divide / grow, producing many copies of desired gene / plasmid;
OR
the bacteria divide / grow to cover the agar;

**1**

(iii) plant tissue that has antibiotic resistance survives;
identifies plant tissue which has desired gene / plasmid;

**2**

(iv) to clone plants / produce genetically identical plants with gene / characteristic;
and produce large numbers / quickly;

**2**

(b) (i) (*one reasonable suggestion*),

e.g. toxin present all the time;
save costs of buying / application of spray;
no spray drift onto other fields / insects;

**1 max**

(ii) (*one reasonable suggestion*),
e.g. killing of harmless / useful insects that feed on wild plants;
damage to food chains starting with wild plants;

**1 max**

**[8]**

**M6.** (a) only small amounts obtained / PCR increases the amount / mass of DNA;
so enough DNA available for genetic fingerprinting;

**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]**

**7.** (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]**

**M8.** (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]**

**M9.** (a) Restriction (enzyme / endonuclease);

**1**

(b) Move towards anode / move because charged;

Different rates of movement related to charge / size;

**2**

(c) (i) Piece of DNA;
Single stranded;
Complementary to / binds to known base sequence / gene;

**max 2**

(ii) DNA invisible on gel / membrane;
Allows detection;

**2**

**[7]**

**M10.**(a) 1. (If injected into egg), gene gets into all / most of cells of silkworm;
2. So gets into cells that make silk.

**2**

(b) 1. Not all eggs will successfully take up the plasmid;
2. Silkworms that have taken up gene will glow.

**2**

(c) Promoter (region / gene).

**1**

(d) 1. So that protein can be harvested;
2. Fibres in other cells might cause harm.

**2**

**[7]**

**M11.** (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]**

**M12.** (a) Will replace themselves / keep dividing / replicate;

Undifferentiated / can differentiate / develop into other cells /
totipotent / multipotent / pluripotent;

*Accept tissues*

**2**

(b) Reverse transcriptase;

*Allow phonetic spelling*

**1**

(c) (i) Alters base / nucleotide sequence / causes frame shift;

Different sequence of amino acids in polypeptide / protein / primary structure alters the tertiary structure;

*Accept any reference, such as adding bases, to changing the base sequence of the gene. Reject deletion / substitution.*
*Idea of sequence essential so not makes different amino acids.*

*Accept answers involving stop / start codons and effect on protein.*

**2**

(ii) Affects tumour suppressor gene;

Inactivates (tumour suppressor) gene;

Rate of cell division increased / tumour cells continue to divide;

*Ignore answers relating to oncogenes. May gain third point.*

**2 max**

d) Yes
SCID patients unlikely to survive / quality of life poor unless treated;
Cancer that develops is treatable / only affects 25% / five children;

No
Risk of developing cancer is high / 25%;
Cancer may recur / may not be treated successfully in future / only short time scale so more may develop cancer;

*No mark for yes or no. Marks are for supporting argument based on biological reasoning.*
*Accept any points*

**2 max**

**[9]**

**13.**(a) RNA polymerase;

*<u>D</u>NA polymerase is incorrect*
*Ignore references to RNA dependent or DNA dependent*
*Allow phonetic spelling*

**1**

(b) (i) (Receptor / transcription factor) binds to promoter which stimulates RNA polymerase / enzyme X;

Transcribes gene / increase transcription;

**2**

(ii) Other cells do not have the / oestrogen / ERα receptors;

*But do not accept receptors in general.*

**1**

c) Similar shape to oestrogen;

Binds receptor / prevents oestrogen binding;

Receptor not activated / will not attach to promoter / no transcription;

*Accept alternative*
*Complementary to oestrogen;*
*Binds to oestrogen;*
*Will not fit receptor;*

**2 max**

**[6]**

**M14.**(a) Restriction / endonuclease;

*Ignore specific names of restriction enzymes e.g. EcoR1*

**1**

(b) (i) 1. (Acts as a) marker gene to show that the (human) gene has been taken up / expressed;

*1. Accept: gene marker*

2. (Only) implant cells / embryos that show fluorescence / contain the jellyfish gene;

**2**

(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. sNeed 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]**

**M15.**(a) 1. No effect at 25°C

*The question only refers to plants <u>with</u> GB*

*1. Reject same mass*

2. Keeps growing at 30°C and 35°C / up to 35°C (more than without GB);

3. Above 35°C, falls but grows more than plant without GB;

*3. Accept at all temperatures above 25°C more growth than without GB*

**2 max**

(b) (i) <u>Significantly</u> different / SEs do not overlap ;

*Accept converse without GB*

**1**

ii) (As temperature increases,)

1. Enzyme activity reduced / (some) enzymes denatured;

2. Less photosynthesis, so fewer sugars formed;

3. Less respiration / less energy / ATP for growth;

4. Less energy for named function associated with growth

*4. Eg mitosis, uptake of mineral ions*

**4**

(c) 1. (Rubisco activase attaches to thylakoid and) this changes shape / tertiary structure (of enzyme) / blocks active site / changes active site;

*Note - question states enzyme stops working when it attaches to thylakoid, not before*

*1. Accept rubisco in this context*

2. (This) prevents substrate / RuBP entering active site / binding;

*2. Accept prevents ES complex forming*

*2. Accept no longer complementary to substrate / RuBP*

**2**

(d) 1. GB prevents / reduces binding of rubiscoactivase to (thylakoid membrane);

*1. Accept enzyme instead of rubiscoactivase.*
*Accept rubisco*

2. (Prevents it) up to 35°C;

3. (So) rubiscoactivase / enzyme remains active;

4. (So) photosynthesis / light-independent stage still happens;

*4. Accept descriptions of light-independent stage*

5. Above 35°C, some binding still occurs but less than without GB, so less reduction in growth;

**4 max**

(e) 1. Looked for information / journals, on crop plants that grow at high temperatures;

*1. "other research" is minimum accepted*

*1. Accept previous experiments research with temperature resistant crops*

*Ignore simple references to looking at previous studies / other plants - need to relate to this context*

2. (Crop plants cited in this research) contain / make GB;

3. So assumed making plants produce GB makes them resistant to high temperatures;

**2 max**

**[15]**

**M16.**(a) 1. Carriers are heterozygous / have one normal copy and one mutant copy of gene / have one recessive allele / don't have the condition;

2. Both have DNA that binds (about) half / 50% amount of probe (that non-carrier does);

3. Probe binds to dominant / healthy allele so only one copy of exon in their DNA / have one copy of gene without exon / base sequence for probe to bind to;

*3. Accept normal and gene*

*3. Accept have <u>a</u> deletion mutation*

**3**

(b) 1. Introns not translated / not in mRNA / (exons) code for amino acids / introns do not code for amino acids;

*1. Accept not expressed*

*1. Accept polypeptide / protein for amino acids*

2. Mutations of these (exons) affect amino acid sequences (that produce) faulty protein / change tertiary structure of protein;

*2. Accept deletion leads to frameshift*

*2. In this context, accept affects protein made*

3. So important to know if parents' exons affected, rather than any other part of DNA / introns;

*Accept converse arguments involving - eg introns do not code for amino acids / proteins*

*Reject references to making amino acids, once*

**3**

(c) 1. Restriction mapping / described;

2. DNA / base sequencing (of fragments) / description / name of method;

**2**

**[8]**

**M17.**(a) Cytosine with Guanine <u>and</u> (Adenine) with Uracil;

*Ignore G, C and U*

**1**

b) Two reasons, with suitable amplification;;

***Q***

Only infected cells have HIV protein on surface;

So carrier only attaches to / specific to these cells / siRNA can only enter these cells;

***OR***

siRNA (base sequence) complementary / specific to one mRNA;

*Accept idea of specificity*

Only infected cells contain mRNA of HIV / this gene / stops translation of this gene / only binds to this mRNA / destroys this mRNA;

*Accept could not inhibit other / non-HIV mRNA*

**4 max**

c) 1. Carrier binds to (protein on) HIV;

*1. Accept references to HIV membrane*

2. Prevents HIV / it binding to (receptor on human) cell;

*2. Reject references to binding to HIV protein on human cell*

**2**

**[7]**