

Mark schemes

- 1**
- (a) (i) Restriction endonuclease; 1
- (ii) (DNA) ligase; 1
- (b) (For those plants that contained the desired gene in the nucleus/plant DNA)
1. (DNA of desired gene) copied/replicated with host DNA/inside nucleus;
 2. Passed on by mitosis/plant grows by mitosis;
 3. Produces genetically identical cells/clones;
- Ignore references to protein synthesis or plasmids not taking up the gene*
1. *Accept DNA replication during mitosis*
 1. and 2. *Accept converse for plants with the gene in the cytoplasm*
 3. *Neutral 'identical unqualified'*
 3. *Accept description, e.g., DNA is the same*
- 3
- (c) 1. Genetic code is universal/triplets in DNA always code for same amino acid;
2. It/insect DNA can be transcribed;
3. Can be translated (process/mechanism same in all organisms/cells);
- 2. Accept (basic) transcription (process/mechanism) same in all organisms/cells;*
- 2. Accept descriptions of process*
- 3. Accept descriptions of process*
- 3
- [8]
- 2**
- (a) 1. Binding (of interferon gamma) changes shape/tertiary structure of receptor (protein);
2. This activates/switches on the enzyme;
3. Use of ATP (to phosphorylate STAT1);
- 1. Accept reference to second messenger mechanism/process*
- 3. Context is important*
- 2 max
- (b) 1. Phosphorylated STAT1;
2. IRF (protein);
- Accept in either order*
1. *Must be phosphorylated but accept STAT1P*
 2. *Ignore references to phosphorylated*
- 2

- (c) 1. Causes more helper T cells to form;
 2. (So) more interferon (gamma) production (by helper T cells);
1. and 2. require idea of more 2
- (d) 1. (Tumour suppressor gene) slows cell division/causes death of damaged/tumour/cancer cells;
 2. *IRF* gene leads to formation of IRF (protein) that binds to gene B;
 3. (Gene B protein) causes death of damaged/mutated cells OR slows division;
2. 'It' means IRF gene
3. Context is important
*3. If clearly stated **and** includes the protein, scores 2 marks because it subsumes point 1* 3

[9]

3

- (a) (i) Does not code for amino acid/tRNA/rRNA;
Accept 'does not code for production of protein/polypeptide'
Reject 'that produces/makes amino acid' 1
- (ii) Deletion mutation;
Accept 'deletion'
Ignore references to splicing 1
- (b) (The) polymerase chain reaction;
Accept PCR 1
- (c) 1. Probes are single stranded / have a specific base sequence;
 2. Complementary base sequence on (specific) spacer
- OR**
3. Complementary/specific to (particular) spacer;
 4. (In white squares probe) binds (to single-stranded spacer) and glows/produces light/fluoresce;
2. Need idea of complementary to spacer
3. Accept converse for dark squares 3

- (d) 1. To see if strain is resistant to any antibiotics;
2. So can prescribe effective/right antibiotic;

OR

3. To see whether (any) vaccine works against this strain/ see which vaccine to use/ to produce specific vaccine;
4. (So) can vaccinate potential contacts/to stop spread;

OR

5. Can test other people to see if they have the same strain/ to trace where people caught TB;
6. Allowing control of spread of disease/vaccinate/treat contacts (of people with same strain) before they get TB;

Do not allow mix and match of points from different alternative pairs

2 max

[8]

4

- (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]

5

- (a) 1. Methylation prevents transcription of gene;
2. Protein not produced that prevents cell division / causes cell death / apoptosis;
3. No control of mitosis.

3

- (b) 1. Scatter graph;
2. Fat on x axis and death rate on y axis;
3. (Because) looking at relationship between two discrete / independent variables.

3

- (c) 1. (Trend) shows positive correlation / shows the more fat in diet, the higher death rate from breast cancer;
2. But number of points off line / anomalies.

2

[8]

6

- (a) 1. Rank all STs in ascending order;
2. Find value with same number (of people) above and below.

Accept find middle value

2

(b) Not ethical to fail to treat cancer.

1

(c) Yes since with ipilimumab:

1. Median ST increased by 2.1 months;
2. Percentage of patients showing reduction in tumours increased from 10.3% to 15.2%;

No because:

3. No standard errors shown / no (Student) t- test / no statistical test carried out;
4. (So) not able to tell if differences are (statistically) significant / due to chance (alone);
5. Improvement might only be evident in some patients / no improvement in some patients;
6. Quality of (extra) time alive not reported;

If answers relate only to 'Yes' or 'No', award 2 marks max

4 max

- (d)
1. Faulty protein recognised as an antigen / as a 'foreign' protein;
 2. T cells will bind to faulty protein / to (this) 'foreign' protein;
 3. (Sensitised) T cells will stimulate clonal selection of B cells;
 4. (Resulting in) release of antibodies against faulty protein.

3 max

[10]

7

- (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]

8

- (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]

9

- (a) 1. Cut (DNA) at same (base) sequence / (recognition) sequence;

Accept: cut DNA at same place

2. (So) get (fragments with gene) **R** / required gene.

Accept: 'allele' for 'gene' / same gene

2

- (b) 1. Each has / they have a specific base sequence;

2. That is complementary (to allele r or R).

Accept description of 'complementary'

2

- (c) 1. Fragments L from parent rr, because all longer fragments / 195 base pair fragments;
Ignore: references to fragments that move further / less, require identification of longer / shorter or 195 / 135
Accept: (homozygous) recessive
2. Fragments N from parent RR, because all shorter fragments / 135 base pair fragments;
1 and 2 Accept: A3 for 195 and A4 for 135
2. Accept: (homozygous) dominant
3. (M from) offspring heterozygous / Rr / have both 195 and 135 base pair fragments.
Accept: have both bands / strips
Reject: primer longer / shorter

3

- (d) 1. (Cells in mitosis) chromosomes visible;
 2. (So) can see which chromosome DNA probe attached to.

2

- (e) (i) 1. For comparison with resistant flies / other (two) experiments / groups;
Ignore: compare results / data / no other factors
2. To see death rate (in non-resistant) / to see effect of insecticide in non-resistant / normal flies.
Accept: 'pesticide' as 'insecticide'
Accept to see that insecticide worked / to see effect of enzyme

2

- (ii) (PM must be involved because)
1. Few resistant flies die (without inhibitor);
 2. More inhibited flies die than resistant flies;
 3. (PM) inhibited flies die faster (than resistant flies);
- (Other factors must be involved because)
4. Some resistant flies die;
 5. But (with inhibitor) still have greater resistance / die slower than non-resistant flies.
- Accept: (with inhibitor) die slower than non-resistant flies*

4 max

[15]

10

- (a)
1. Sugar-phosphate (backbone) / double stranded / helix **so** provides strength / stability / protects bases / protects hydrogen bonds;
Must be a direct link / obvious to get the mark
Neutral: reference to histones
 2. Long / large molecule **so** can store lots of information;
 3. Helix / coiled **so** compact;
Accept: can store in a small amount of space for 'compact'
 4. Base sequence allows information to be stored / base sequence codes for amino acids / protein;
Accept: base sequence allows transcription
 5. Double stranded **so** replication can occur semi-conservatively / strands can act as templates / complementary base pairing / A-T and G-C so accurate replication / identical copies can be made;
 6. (Weak) hydrogen bonds **for** replication / unzipping / strand separation / many hydrogen bonds **so** stable / strong;
Accept: 'H-bonds' for 'hydrogen bonds'
- (b)
1. (Mutation) in **E** produces highest risk / 1.78;
 2. (Mutation) in **D** produces next highest risk / 1.45;
 3. (Mutation) in **C** produces least risk / 1.30;
Must be stated directly and not implied
E > D > C = 3 marks
Accept: values of 0.78, 0.45 and 0.30 for MP1, MP2 and MP3 respectively
If no mark is awarded, a principle mark can be given for the idea that all mutant alleles increase the risk
- (c) **180;**

6

3

1

(d) **(Similarities):**

1. Same / similar pattern / both decrease, stay the same then increase;
2. Number of cells stays the same for same length of time;
Ignore: wrong days stated

(Differences):

(Per unit volume of blood)

3. Greater / faster decrease in number of healthy cells / more healthy cells killed / healthy cells killed faster;
Accept: converse for cancer cells
Accept: greater percentage decrease in number of cancer cells / greater proportion of cancer cells killed
4. Greater / faster increase in number of healthy cells / more healthy cells replaced / divide / healthy cells replaced / divide faster;
Accept: converse for cancer cells
*For **differences**, statements made must be comparative*

3 max

- (e)
1. More / too many healthy cells killed;
 2. (So) will take time to replace / increase in number;
Neutral: will take time to 'repair'
 3. Person may die / have side effects;

2 max

[15]