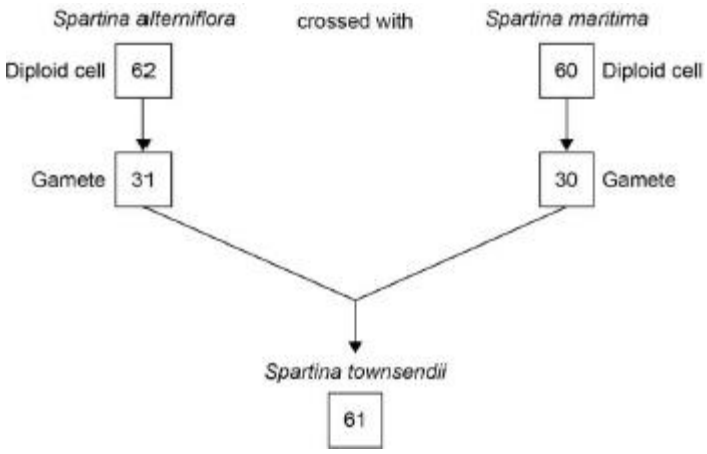
Mark schemes

Q1.

(b) (A factor that) increases (the rate of) mutations;

1

(c) Correct answer - 60, 31 **and** 30;



1

(d) Name of mutation

1. Non-disjunction;

   Explanation

   Ignore homologous

2. (In) meiosis;

   Accept reference to first division or second division as indicating meiosis

   Ignore mitosis

3. Chromosomes not separated

   OR

   All chromosomes stay in one cell

   OR

   Chromosomes do not form (homologous) pairs;

   *Accept 'move to one side' **OR** 'move to one pole'*

3

(e) 1. Random fusion of gametes

OR

Random fertilisation;

Accept for 'gametes',

2. (Produces) new allele combinations

OR

(Produces) new maternal and paternal chromosome combinations;

Reproductive cells

Ignore genes

2

Q2.

(c) Serine Alanine Glycine Proline;

Must be in this order Accept Ser Ala Gly Pro / S A G P

1

(d) Mark as pairs. 1 and 2 **or** 3 and 4.

(No)

1. G to C (in the second codon/for Glycine)

OR

CGT to CCT (in second codon/for Glycine);

2. (So), substitution (not addition mutation);

Reject if substitution of Glycine (for Alanine)

OR

3. (If addition) frameshift / all triplets moved;
4. (So), affects more than one amino acid;

2

[7]

Q3.

(b) Mark each column;;

Number of chromosomes	Mass of DNA / arbitrary units
	50
80	
40	12.5

2

(c) Independent segregation
OR

Crossing over;

Accept labelled diagram

Accept (eggs produced) have different combinations of maternal and paternal chromosomes

1

(d) 120;

1

(e) 1. Too many/extra set/three copies of chromosomes;

Accept 1 paternal, 2 maternal

2. (Homologous) chromosomes do not pair

OR

(Homologous) chromosomes do not separate (evenly);

Accept divide for separate

3. (So) no meiosis;

2 max

Q4.

(c) (Definition of gene mutation)

1. Change in the base/nucleotide (sequence of chromosomes/DNA);

For 4 marks at least one mark must be scored in each section of the answer.

Accept named mutation for 'change'.

2. Results in the formation of new <u>allele;</u>

(Has no effect because)

3. Genetic code is degenerate (so amino acid sequence may not change);

OR

Mutation is in an intron (so amino acid sequence may not change);

Accept description of 'degenerate', eg some amino acids have more than one triplet/codon.

4. Does change amino acid but no effect on tertiary structure;

5. (New allele) is recessive so does not influence phenotype;

(Has positive effect because)

6. Results in change in polypeptide that positively changes the

properties (of the protein)

OR

Results in change in polypeptide that positively changes a named protein;

For 'polypeptide' accept 'amino acid sequence' or 'protein'.

7. May result in increased reproductive success

OR

May result in increased survival (chances);

4 max

Q5.

(b) Mitosis given first

Differences must be given as comparisons

Ignore references to asexual / sexual reproduction, growth, repair & replacement

1. One division, two divisions in meiosis;

2. (Daughter) cells **genetically** identical, daughter cells **genetically** different in meiosis;

Reference to 'genetically' needed once

3. Two cells produced, (usually) four cells produced in meiosis;

4. Diploid to diploid/haploid to haploid, diploid to haploid in meiosis;

Accept same number chromosomes in mitosis, but half the number in meiosis

5. Separation of homologous chromosomes only in meiosis;

6. Crossing over only in meiosis;

7. Independent segregation only in meiosis;

2 max

(c) 28;

Automarking

1

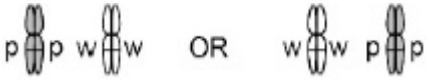
(d) 1. Separation of homologous chromosomes (occurred)
OR
(Independent) segregation (occurred);

Accept description of homologous chromosome

movement for 'separation'

Accept alleles for 'chromosomes'

Accept as a labelled diagram of chromosomes, eg



2. (Arrangement/separation/segregation of chromosomes is) random/ (almost) equally frequent (in tubes 1 and 2);

3. Crossing over occurred in tube 3/10 tubes;

Accept as labelled diagram of crossing over

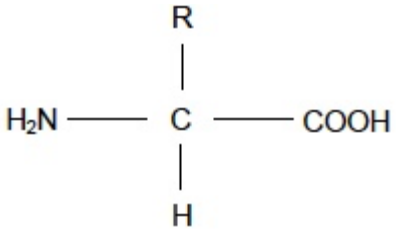
4. (Crossing over) is rare/infrequent/in only 10 tubes;

3. and 4. "Crossing over occurred in only 10 tubes" = 2 marks

3 max

Q6.

(a)



Accept other correct representations.

1

(c) 1395;

Accept 1398 and 1401 (for those that include start and/or stop codons)

Allow 2796 or 2802 or 2790

Ignore 'bases/base pairs/bp/bps' written after the numerical answer.

1

(d) ✓CAA → CGA

1

(e) 1. (Both) negatively charged to positively charged change in amino acid;

2. Change at amino acid 300 does not change the shape of the active site
OR
Change at amino acid 300 does not change the tertiary structure OR
Change at amino acid 300 results in a similar tertiary structure;

Reference to 'shape' of active site only needed once.

3. Amino acid 279 may have been involved in a (ionic, disulfide or

hydrogen) bond **and** so the shape of the active site changes
OR
Amino acid 279 may have been involved in a (ionic, disulfide or hydrogen) bond **and** so the tertiary structure changed;
OR
Amino acid 279 may be in the active site **and** be required for binding the substrate;

Reference to 'shape' of active site only needed once.

Both parts are required for each mark option.

For 'a bond' reject peptide bond.

3

[

Q7.

(a) 1. 1 long and 1 short chromosome, each made up of 2 chromatids held (by centromere), in each cell of 1st division;

2. 1 long and 1 short (separate) chromosome in each cell of 2nd division;

Allow ECF for correct chromosomes shown in each cell from candidate's 1st division cells.

Ignore drawing of centromere.

2

(b)

52	4

;;

Allow 1 mark for numbers totalling 56 except 14/42 - repetition of observed values.

If table is blank, award 1 mark for evidence of 56.

Both 52 and 4 required in table for two marks, do not credit 52 or 4 for one mark.

Award 1 max for answers not given as whole numbers.

2

Q8.

(a) Lowercase a in both boxes

1

(b) Tick in box next to 'Crossing over';

1

(c) 32.73 / 32.7 / 32 / 33;;

Award 1 max for either

409 (409.2) for difference in volume (but incorrect number of mitochondria);

OR

Answer of 262 (261.9) (using diameter, rather than radius);

2

Q9.

(a) D;

1

(b) 1. Homologous chromosomes (pair);
2. One of each (pair) goes to each (daughter) cell / to opposite poles;

Ignore descriptions of the second division of meiosis.

2

(c) 6;

1

(d) 1. Homologous pairs of chromosomes associate / form a bivalent;
2. Chiasma(ta) form;
3. (Equal) lengths of (non-sister) chromatids / alleles are exchanged;
4. Producing new combinations of alleles;

1. Accept descriptions of homologous pairs

2. Accept descriptions of chiasma(ta) e.g. chromatids / chromosomes entangle / twist

2. Neutral Crossing / cross over

3. Reject genes are exchanged

3. Accept lengths of DNA are exchanged

4. Do not accept references to new combinations of genes unless qualified by alleles

4

[8]

Q10.

(a) Three of chromosome 13 / an extra chromosome 13;

Accept trisomy 13

*Accept circle around three chromosomes or any other correct indication on **Figure 1***

Do not allow references to any other chromosomes.

Do not accept chromatids for chromosomes.

1

(b) 1. In meiosis;
2. Homologous chromosomes / sister chromatids do not separate;

2. Accept non-disjunction

2 max

(c) 1. Mutation / extra chromosome in gamete / egg / sperm (that formed zygote);

2. All cells derived (from a single cell / zygote) by mitosis;

OR

3. All cells derived from a single cell / zygote by mitosis;
4. Mitosis produces genetically identical cells / a clone;

*Mark points 1 and 2 **OR** 3 and 4*

4. Accept: have same DNA / same alleles

2