# A-Level Biology

## Meiosis

## Mark Scheme

## Time available: 65 minutes
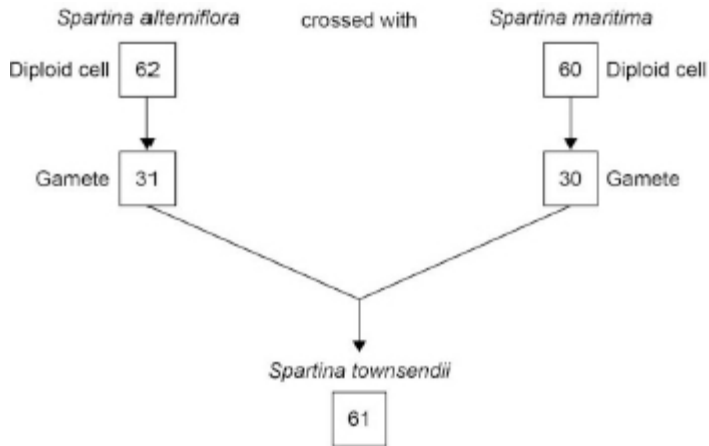## Marks available: 49 marks

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# Mark schemes

**1.** (a) Binomial;

1

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

1

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

*Spartina alterniflora*    crossed with    *Spartina maritima*

Diploid cell | 62        60 | Diploid cell

Gamete | 31        30 | Gamete

*Spartina townsendii*

61

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** 2

**[8]**

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

2. 1 long and 1 short (separate) chromosome in each cell of 2<sup>nd</sup> division;
   *Allow ECF for correct chromosomes shown in each cell from candidate's 1 st 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**

(c)  1.  There is a less than 0.05/5% <u>probability</u> that the <u>difference</u>(s) (between observed and expected) occurred by <u>chance</u>;

*Reject 'results (without reference to difference) occurring by chance'. Overall max 1 with this statement.*

*Accept 'there is a greater than 0.95/95% <u>probability</u> that the difference did **not** occur by <u>chance</u>'.*

*Ignore 'difference is significant'*

2.  Calculated value is greater than critical value so the null hypothesis can be rejected;

*Ignore 'difference is significant'*

*Do not accept 'P value' for 'critical value'.*

3.  (The scientists can conclude that) the proportion of plants that produce 2n gametes does change from one breeding cycle to the next;

**2 max**

(d)  1.  The scientists selected/used for breeding plants that produced 2n gametes;

*Answer must be in context of the scientists selecting plants to breed. Accept 'artificial selection' or 'selectively bred'.*

2.  (So these plants) passed on their alleles (for production of 2n gametes to the next generation);

*Both mark points can be awarded if one correct reference is made to alleles (in either context).*

3.  The frequency of alleles for production of 2n gametes increased (in the population).

*Both mark points can be awarded if one correct reference is made to alleles (in either context).*

*For 'production of 2n gametes' accept 'abnormal meiosis'.*

*Do not accept 'number' for frequency.*

*Accept converse answers linked to plants that produce n gametes.*

**3**

**[9]**

**3.**

(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**

(d)  1.  Egg (created) has nucleus / DNA / genes of (affected) woman / mother;

    *Accept ref. to zygote / embryo / child for egg*

    *Accept genetic information*

    *Ignore references to alleles*

    *Reject if nucleus from wrong egg / woman*

  2.  It has mostly / many / lots of normal mitochondria (of unaffected woman)
      **OR**
      There are few faulty mitochondria;

    *Reject ref. to **production** of healthy mitochondria as result of treatment*

                                                                                    **2**

(e)  1.  Not enough / little ATP produced;

    *One reason asked for, so list rule applies*

    *Ignore ref. to no ATP produced*

  2.  ATP provides **energy** for (enzyme) reactions
      **OR**
      ATP phosphorylates substrates / enzymes, **so** making them (more) reactive;

    *Accept (leads to) lower activation energy for reaction*

    *Reject if mention energy produced*

                                                                            **2 max**
                                                                               **[8]**

**4.**  (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]**

**5.** (a) 1. Chromosome is formed of two chromatids;
2. (Because) DNA replication (has occurred);
3. (Sister) chromatids held together by centromere.

**3**

(b) 1. Chromosomes in homologous pair;
2. One of each into daughter cells / haploid number.

**2**

(c) Separation of (sister) chromatids / division of centromere.

**1**

(d) 1. Independent segregation (of homologous chromosomes);
   *Accept random assortment*
2. Crossing over / formation of chiasmata.

**2**

**[8]**

**6.** (a)

| | Cell B | Cell C | Cell D |
|---|---|---|---|
| homologous chromosomes are present | ✓ | ✓ | |
| a stage of mitosis | | ✓ | |

*Mark horizontally*

*1 mark for each correct row*

**2**

(b) Mark as pairs, do not mix and match
1. (Chromosomes consist of) two chromatids connected at centromere;
   *Accept: sister chromatids for two chromatids*
2. (Because) <u>DNA</u> has replicated;

   OR

3. K is on equator of spindle;
   *Ignore: 'middle'*
4. (because) attached at centromere;
   *Ignore reference to meiosis / bivalents / homologous pairs*

**2**

(c) 1. Crossing over / exchange of alleles /lengths of DNA / recombination;
   *Accept: description of crossing over eg sections of chromatids break and re-join*
   *Accept: reference to chiasma/ chiasmata*
2. Between (chromatids of) homologous chromosomes;
   *Accept: 'between non-sister chromatids'*
   *Accept: 'bivalent' for homologous*
   *Ignore: genes exchanged*

**2**

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(d)     Separation/segregation of pairs/homologous chromosomes;

*Accept: result of meiosis I / result of division of cell B*

*Accept: pulled to opposite poles for 'separation'*

*Ignore ref to chromatids*

**1**

(e)     (DNA) replication taking place/not finished;

*Accept: they are cells in S phase*

**1**

**[8]**