M1. (a) (Different) form/type/version of a gene/different base sequence of a gene; 1

(b) Two/sister chromatids;

Due to DNA replication;

Joined by a centromere;

2 max

(c) (i) Crossing over;

1

Exchange (of alleles) between chromatids/chromosomes;

Negate first marking point for answers which refer to independent segregation.

Chiasma/chiasmata = first marking point

1

(ii) Is infrequent/rare;

References to it being 'random', 'occurs by chance' or 'doesn't always occur' should not be credited without a clear idea that it is rare or infrequent.

1

(d) (i) Three chromosomes shown;

1

One from each homologous pair;

For first mark point allow drawings showing three chromosomes as single or double structures.

1

(ii) 8;

1

[9]

M2. (a) (i) 9;

Accept: nine

1

(ii) Introns / non-coding DNA / junk DNA;

Start/stop code/triplet;

Neutral: Repeats.

Accept: 'Introns and exons present'.

Reject: 'Due to exons'.

1 max

(b) Change in amino acid/s /primary structure;

Change in hydrogen/ionic/ disulfide bonds;

Alters tertiary structure;

Reject: 'Different amino acid is formed' – negates first marking point.

Neutral: Reference to active site.

3

(c) Number of bases

	Number of bases			
	C	G	A	T
Strand A	26	**19**	**20**	**9**
Strand B	19	**26**	9	**20**

Second column correct;

Columns three and four correct;

2

[7]

M3. (a) (i) Deoxyribose;

pentose/5C sugar = neutral

1

(ii) Phosphate/Phosphoric acid;

phosphorus/P = neutral

1

(b) Hydrogen (bonds);

1

(c) 381/384/387;

1

(d) (Gln) Met Met Arg Arg Arg Asn;

1

(e) Change in (sequence of) amino acids/primary structure;

Change in hydrogen/ionic/disulfide bonds;

Alters tertiary structure/active site (of enzyme);

Substrate cannot bind/no enzyme-substrate complexes form;

Q *Reject = different amino acids are formed*

3 max

[8]

M4. (a) Independent assortment/random alignment of (homologous) chromosomes;
Different combinations of maternal and paternal chromosomes;

OR

*C*rossing over;
Different combination of alleles/exchange of genetic material;

2

(b) (i) Variety **A** plants are taller;
Variety **A** with a greater range of height_s;
Variety **A** plants are normal distribution/less skewed;

Q *Do not credit imprecise references to plant **A** being taller. Accept unambiguous description for third point. Unqualified pronouns in the context of this question refer to artery*

2 max

(ii) Will give higher yield as shorter stems;
More energy goes to producing grain/less likely to be blown down;

Q *Do not accept unqualified references to such features as expense*

2

(c) Show greater variation;
Likely some individuals will have alleles/characteristics for survival;

2

[8]

M5. (a) (i) where mitosis/division/growing/ occurs
(reject growing cells)

1

(ii) to distinguish chromosomes/chromosomes not visible without stain;

1

(iii) to let light through/thin layer;

1

(b) (i) 74 + 18/982;
= 9.4% / 9%;

2

(allow 1 mark for identifying prophase & metaphase i.e.92 or correct method using wrong figures*)*

(ii) genetic differences/different types of garlic;
time of day;
chance;
age of root tip;
water availability;
temperature;
nutrient availability;

(environmental factors = 1 but cannot be awarded in addition to a name environmental factor)

2 max

[7]

M6. (a) First meiotic division (**A**) will show cells with
chromosomes appearing as double structures/two chromatids still joined/
chromosomes in **A** and chromatids in **B** /homologous pairs are separating;

Must be in context of anaphase

Diploid number of chromosomes /appropriate number for **A** and **B**;

*Allow reverse argument for second meiotic division If answer is unqualified, assume that it refers to cells at **A**, since this is the logic of the question.*

2

(b) Crossing over / chromatids exchange sequences of DNA / chiasmata;
Random/independent segregation/assortment (of chromosomes) /
chromosomes from homologous pairs move independently at meiosis I;
And meiosis II;

max 2

[4]

M7. (a) (meiosis) anaphase I;
chromosomes are moving apart;
chromosomes still double structures;

3

(b) chromosomes in each (homologous) pair twist around each other;
chromatids break and rejoin to chromatid on sister chromosome;

(accept points from a suitable diagram)

2

[5]

M8. (a) **X**, phosphate;
Y, deoxyribose / pentose / 5-carbon sugar;
Z, (nitrogenous) base;
(accept named base)

3

(b) (specific) hydrogen (bonds);

1

(c) thymine 28% so adenine 28%
therefore 44% cytosine and guanine;
therefore 22% cytosine;
(idea of equal amounts T and A, C and G – 1 mark, correct answer 2 marks)

2

[6]

M9. (a) Later fertilisation/cell fusion; (NOT just 'sexual reproduction')
Restoring diploid/original number/not doubling chromosome number;
ALLOW ref '½ + ½'

2

(b) Any three pairs from:
need comparison of meiosis and mitosis each time

Meiosis	Mitosis
(Homologous) chromosomes associate in pairs	(Homologues) independent/do not pair (IGNORE ref. separation
Crossing-over/chiasmata formation	No crossing-over;
Two/(nuclear stages) divisions/ → 4 offspring cells	One/(nuclear stage) division/ → 2 offspring cells;
Genetically different (product)	Genetically identical (product);

IGNORE refs. To location

max 3

[5]

M10. (a) appropriately placed box;

1

(b) (i) B;

(ii) A;

2

(c) (i) determines (sequence of) amino acids / specific protein produced / mRNA formation;

1

(ii) hydrogen bonds;

1

(iii) stability / protects bases / replication;

1

[6]