



- (c) (i) 21; 1
- (ii) 1. *T. aestivum* has 2 copies of each type of chromosome/is diploid;  
 2. *T. aestivum*'s chromosomes can form bivalents/can assort in meiosis/  
 can produce haploid gametes;  
 3. *T. aestivum*'s gametes receive a copy of every chromosome/  
 receive all the genetic information; 3  
 [ACCEPT converse argument for hybrid plants]

[15]

3. (a) Later fertilisation/cell fusion; (NOT just 'sexual reproduction')  
 Restoring diploid/original number/not doubling chromosome number; 2  
 [ALLOW ref ' $\frac{1}{2} + \frac{1}{2}$ ']

- (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;
<u>Genetically</u> different (product)	Genetically identical (product);

[IGNORE refs. To location]

max 3

[5]

4. (a) (i) Continuous variation – range of values/not discrete categories/  
 many categories/no gaps; 1
- (ii) Crossing over / chiasmata;  
 Random segregation / independent assortment;  
 In meiosis I and meiosis II; max 2

- (b) Range influenced by single ‘outlier’ (*accept anomaly*) /  
converse for S.D.;  
S.D. shows dispersion/spread about mean;  
Range only shows highest and lowest values/extremes;  
S.D. allows statistical use;  
Tests whether or not differences are significant; max 2

[5]

5. (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**; 2  
*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.*

- (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]

6. (a) (i) *Selecting the nettle plant:*  
Random number table avoids bias in placing of quadrat;  
‘Nearest centre’ avoids bias in choosing plant to measure; 2  
*I mark for “method avoids bias”*
- (ii) *Measuring the sixth leaf:*  
To allow valid comparison/so as not to introduce another variable;  
Reduces/avoids influence of growth/age;  
Reduces/avoids influence of light/shading; max. 2

- (b) (i) Definition of range + SD / effect of outliers on range + SD;  
Ranges are similar in both areas;  
Suggests that variation within populations is similar;  
SD smaller in area of high light intensity;  
Shows that area of high light intensity is a more uniform population; 4
- (ii) Standard error (of the mean); 1

- (c) 1.164 / 1.16 / 1.2 , however derived = 2 marks  
 0.83 – 0.86 / 1.1, however derived = 1 mark 2

*Evidence of correct use of both sets of figures, but  
 inappropriate answer = 1 mark*

[11]

7. (a) polygenic inheritance / several genes;  
 many categories / continuous range / single or multiple allele inheritance  
 would produce discrete categories / eq.; 2

- (b) (SE gives idea of) variability of mean;  
 time / population mean would lie within these limits in 68% / 70% /  
 2/3 of samples; 2

[4]

8. (a) greater prospect for selecting egg mass using values from table;  
 genetic influence is much higher / lower influence of environment; 2

- (b) (i) position of a gene / allele on a chromosome; 1

- (ii) 87.5%; 1

- (iii) pairing together of (deleterious) recessive alleles; 1

[5]

9. (a) (i) continuous 1

- (ii) caused by more than one gene 1

- (b) Sicco is shorter than Spelt;  
 greater range of height in Spelt 2

[4]

10. (a) continuous variation;  
 suggests many genes involved / polygenic inheritance; 2

(b) identical twins have same genotype;  
 compare data from identical and non-identical twins /  
 identical twins who have been separated;  
 if genetic, - greater similarity between identical twins;  
 large sample required / use a statistical test; max 3

[5]

11. (a) (i) 1.00;  
 because they have the same genes; 2

(ii) dizygotic twins share an average of 50% of their genes;  
 only an average, therefore may be higher or lower than this; 2

(b) (i) Yes because MZ have high concordance;  
 DZ lower concordance; 1

(ii) intra-uterine environment may be different for the two twins;  
 further qualification, e.g. one may receive more nutrients 2

[7]

12. (a) continuous; 1

(b) (i) difference in mean of parents/significant difference in length of parents;  
 mean cob length of  $F_1$  generation halfway between parental lengths;  
 more variation in  $F_2$  than  $F_1$ ; 2

(ii) variation present in parental/ $F_1$  generation;  
 plants in parental/ $F_1$  generation genetically identical; 2

(c) mean halfway between means for Tom Thumb and  $F_1$ /  
 between 9 and 11 cm cob length; 1

[6]

13. (a) Variation results from environmental factors;  
 Slight differences in uterus which affect development of twins;  
 Such as nutrient supply; max 2

- (b) (i) Need to rule out differences due to “accidents”/more likely to determine effect on longevity 1
- (ii) Smaller differences between monozygotic twins;  
Suggests genes involved;  
Not identical, therefore environment involved;  
Differences may not be significant/may be due to chance; max 3

[6]

14. (a) (i) range between extremes/no discrete types;  
strong environmental influence;  
polygenic/many genes involved;  
quantitative. 2
- (ii) discrete types;  
little/no environmental influence/only genetic;  
(often alleles of) 1/2 gene;  
qualitative.  
(*reject references to few genes*) 2

- (b) blood groups no environmental influence, (so only two types);  
height has environmental factors (producing a range for each type) 2

[6]

15. (a) sections of chromatids exchanged;  
sections have different alleles;  
new combinations of (linked) alleles;  
(*allow 1 mark for idea that ‘genes’ are exchanged, if no other marks gained*) 3

- (b) (i) length controlled by many genes /polygenes;  
each gene may have different alleles / idea of additive effects;  
OR  
environmental factors / or named factor;  
how named factor may affect growth of seeds; 2 max

- (ii) 1. selection of large seeds for sowing;  
 2. higher proportion of alleles for long length;  
 3. loss of alleles for short seeds from population;  
 4. reference to distribution curves, e.g lower end 'cut off';  
 5. (possible appearance of) new alleles through mutation;  
 6. process repeated over many generations;  
 (*G - allow 1 mark idea for that 'largeness' selected, survives and inherited*)

4

[9]  
 QWC 1

16. (a) one / two / few genes versus many / polygenic;  
 limited / none versus significant;  
 limited / few versus wide / many;

3

- (b) named difference in environmental factor during pregnancy  
 e.g. nutrient supply;

1

[4]

17. (a) greater environmental influence than genetic;

1

- (b) identical twins have same genotype / converse for non-identical;  
 compare identical and non-identical twins / identical twins who  
 have been separated /  
 non-identical twins in same environment;  
 if genetic - similarity between identical twins / converse;  
 large sample required / use a statistical test;

4

[5]

18. (a) Independent assortment/random alignment of (homologous) chromosomes;  
 Different combinations of maternal and paternal chromosomes;  
 OR  
 Crossing over;  
 Different combination of alleles/exchange of genetic material;

2

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

2 max

*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*

- (ii) Will give higher yield as shorter stems; 2  
More energy goes to producing grain/less likely to be blown down;

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

- (c) Show greater variation; 2  
Likely some individuals will have alleles/characteristics for survival;

**[8]**