

## Mark schemes

**1**

(a) (During prophase)

1. Chromosomes coil / condense / shorten / thicken / become visible;
2. (Chromosomes) appear as (two sister) chromatids joined at the centromere;

(During metaphase)

3. Chromosomes line up on the equator / centre of the cell;
4. (Chromosomes) attached to spindle fibres;
5. By their centromere;

(During anaphase)

6. The centromere splits / divides;
7. (Sister) chromatids / chromosomes are pulled to opposite poles / ends of the cell / separate;

(During telophase)

8. Chromatids / chromosomes uncoil / unwind / become longer / thinner.

*No marks for naming the stages*

*Reject references to homologous chromosomes / pairing of chromosomes*

*Ignore references to spindle formation during prophase*

**5 max**

- (b)
1. Homologous chromosomes pair up;
  2. Independent segregation;
  3. Maternal and paternal chromosomes are re-shuffled in any combination;
  4. Crossing over leads to exchange of parts of (non-sister) chromatids / alleles between homologous chromosomes;
  5. (Both) create new combinations of alleles;

**5**

**[10]** (a) 1. Chromosome is formed of two chromatids;

**2**

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]

(a) PKNJ.

**3**

- (b) *Lutra lutra*. 1
- (c) Bone / skin / preserved remains / museums. 1
- (d) 1. (Hunting) reduced population size(s), so (much) only few alleles left; *Accept bottleneck*  
2. Otters today from one / few surviving population(s); *Accept founder effect*  
3. Inbreeding. *Allow any two* 2 max
- (e) 1. Population might have been very small / genetic bottleneck;  
2. Population might have started with small number of individuals / by one pregnant female / founder effect; 3. Inbreeding. *Allow any two* 2 max [7]

(a) Translation.

**4**

- (b) Transfer RNA / tRNA. 1
- (c) TAC;  
UAC. 2
- (d) Have different R group.  
*Accept in diagram* 1
- (e) 1. Substitution would result in CCA / CCC / CCU;  
2. (All) code for same amino acid / proline;

3. Deletion would cause frame shift / change in all following codons / change nextcodon from UAC to ACC.

3  
[8] (a) (No – no mark)

5

Graph / bar chart only shows number of species, not the name of the species.

1

(b) (No – no mark)

1. Mutations are spontaneous / random;
2. Only the rate of mutation is affected by environment;
3. Different species do not interbreed / do not produce fertile offspring;
4. So mutation / gene / allele cannot be passed from one species to another.

*Ignore references to correlation does not prove causation*

4

- (c)
1. Initially one / few insects with favourable mutation / allele;
  2. Individuals with (favourable) mutation / allele will have more offspring;
  3. Takes many generations for (favourable) mutation / allele to become the mostcommon allele (of this gene).

3

[8] (a) 1. Kingdom, Phylum, Class, Order, Family;

6

2. *Luscinia svecica.*

*1 mark for each correct column*

*Allow Genus and Species if both placed in box for species but not if both placed in genus box*

2

(b) Number of different alleles of each gene.

*Accept number of different base sequences (found) in each gene*

1

- (c)
1. Has greater proportion of genes / percentage of genes showing diversity;
  2. Percentage is 35% compared with 28% / proportion is 0.35 compared with 0.28.

*Allow correct figures that are not rounded up, i.e., 34.9% / 0.349 and 27.8% / 0.278*

2 [5]

(a) (D)CBEA.

7

1

(b)

Step	Reason
(Taking cells from the root tip)	Region where mitosis / cell division occurs;
(Firmly squashing the root tip)	To allow light through / make tissue layer thin;

2

- (c) (Increase)
1. Chromosomes / DNA replicates;  
(First decrease)
  2. Homologous chromosomes separate;  
(Second decrease)
  3. Sister chromatids separate.

3

- (d) 1. (DNA would) double / go to 2 (arbitrary units).

1 [7]

- (a) 0.32.

8

*Correct answer = 2 marks*

*Accept 32% for 1 mark max*

*Incorrect answer but identifying 2pq as heterozygous = 1 mark*

2

- (b)
1. Mutation produced *KDR minus* / resistance allele;
  2. DDT use provides selection pressure;
  3. Mosquitoes with *KDR minus* allele more likely (to survive) to reproduce; 4. Leading to increase in *KDR minus* allele in population.

4

- (c)
1. Neurones remain depolarised;
  2. So no action potentials / no impulse transmission.

2

- (d)
1. (Mutation) changes shape of sodium ion channel (protein) / of receptor(protein);
  2. DDT no longer complementary / no longer able to bind.

2

- [10] (a) 1. Reduction in ATP production by aerobic respiration;

9

2. Less force generated because fewer actin and myosin interactions in muscle;
3. Fatigue caused by lactate from anaerobic respiration.

3

(b) Couple **A**,

1. Mutation in mitochondrial DNA / DNA of mitochondrion affected;
2. All children got affected mitochondria from mother;
3. (Probably mutation) during formation of mother's ovary / eggs;

Couple **B**,

4. Mutation in nuclear gene / DNA in nucleus affected;
5. Parents heterozygous;
6. Expect 1 in 4 homozygous affected.

4 max

- (c) 1. Change to tRNA leads to wrong amino acid being incorporated into protein;
2. Tertiary structure (of protein) changed;
3. Protein required for oxidative phosphorylation / the Krebs cycle, so less / noATP made.

3

- (d) 1. Mitochondria / aerobic respiration not producing much / any ATP;
2. (With MD) increased use of ATP supplied by increase in anaerobic respiration;3. More lactate produced and leaves muscle by (facilitated) diffusion.

3

- (e) 1. Enough DNA using PCR;
2. Compare DNA sequence with 'normal' DNA.

2

[15]

10

- (a) 1. (So) age not a factor in female choice;  
2. (So) will attract a mate;  
3. (So similar) sexual maturity;  
4. (So) have the correct feathers;  
*4. Accept 'have blue feathers'* 2 max
- (b) Number the birds, then numbers out of hat / random number generator;  
*Both aspects needed for mark* 1
- (c) 1. That movement was not related to some other factor (than the male);  
2. That movement (towards the male) indicated mating behaviour;  
3. (Females) only respond to throat feathers (of the male) / do not respond to other visual display / sounds / calls (by the male); 2 max
- (d) 1. Change in sequence of bases / nucleotides;  
2. (As a result of a) deletion / substitution;  
3. Change in amino acid sequence / primary structure;  
4. Change in tertiary structure of protein;  
*1. Do not accept 'change in the DNA sequence'*  
*2. Accept e.g. addition / inversion / duplication / translocation* 3
- (e) **Yes**
1. (From resource A) birds can detect UV light;  
2. (From resource B) difference between UVR and NR significant/ not due to chance;  
3. As error bars do not overlap;  
*1. max if only **No** marks awarded*  
*2. Reject idea that 'results' in resource B are significant / not due to chance, must include idea of 'difference'* 3. *Reject 'as standard deviations do not overlap'*
- No**
4. UV light may not be involved in mating / other factors may be involved in mating;  
5. Some birds in UVR group were attractive to females;



6. (Experiment in resource B) carried out in artificial conditions /only 40 birds used / small sample size;

*6. Neutral: idea that this is only one study / that there are no repeats*

4 max

[12]

- (a) 1. Different parts/areas/amino acid sequences (of amyloid-precursor) protein;

**11**

*Accept APP*

2. Each enzyme is specific/fits/binds/complementary to a different part of the APP;

*Point 2 subsumes point 1 and is worth 2 marks total.*

2

- (b) 1. Peptide bond broken;  
2. Using water;

*Hydrolysis in stem*

2

- (c) 1. Mutations prevent production of enzyme(s)/functional enzyme;  
2. (Increase in  $\beta$ -secretase) leads to faster/more  $\beta$ -amyloid production

**OR**

(Decrease in  $\alpha$ -secretase) leads to more substrate for  $\beta$ -secretase;

*'This' must refer to  $\alpha$ -secretase*

3. (Leads to) more/greater plaque formation;

3

- (d) 1. (Inhibitor) binds to/blocks active site of  $\beta$ -secretase/enzyme;  
2. Stops/reduces production of  $\beta$ -amyloid/plaque;

2

- (e) 1. Some  $\beta$ -amyloid required/needed (to prevent side effects)

**OR**

(Some)  $\beta$ -secretase needed;

*Accept 'Both enzymes needed'*

2. Leads to build-up of amyloid-precursor protein (that causes harm)

**OR**

Too much product of  $\alpha$ -secretase (causes harm);

*Accept build-up of substrate (leads to harm)*

1 max

[10]

- (a) 1. Change in DNA base/nucleotide (sequence);

*Accept: mutation in DNA base (sequence).*

*Accept: deletion/substitution/addition of a DNA base/nucleotide.*

2. Change in amino acid (sequence)/primary structure;  
*Reject: different amino acid formed.*

**12**

*Ignore: change in code for amino acid.*

3. Alters (position of) hydrogen/ionic/disulfide bonds;
4. Change in tertiary structure (of receptor); *Reject: any reference to active site.*

*Ignore: 3°.*

4

- (b) 1. (Receptor) is not complementary  
**OR**  
 (HIV) cannot bind/attach and enter/infect (helper) T cell;  
*Accept: 'complimentary'.*  
*Accept: invade as alternative to infect.*

2. No replication (of virus)  
**OR**  
 No destruction of (helper) T cell;  
*Accept: reproduction (of virus).*

2

- (c) 1. Low/lower exposure to HIV (in Europe)  
**OR**  
 Low/lower number of HIV/AIDS (infections/cases);  
*Accept: converse.*
2. (HIV) has only been present for a short time period  
**OR**  
 (HIV relatively) recently evolved;
  3. Mutation/CCR5 has been around for many years;  
*Accept: frequency of mutation has always been high.*
  4. Mutation/CCR5 is advantageous (for something else);

2 max

[8] (a)

**13**

	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) DNA 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

(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]

(a) 1. Change / mutation in base / nucleotide sequence (of DNA / gene);

14

Q.

*Ignore: references to changing base-pairing*

*Accept: affect for change, if in correct context*

*Accept: changes triplets / codons*

2. Change in amino acid sequence / primary structure (of enzyme);

*Accept: different amino acid(s) coded for*

**Q** *Reject: different amino acids produced / formed / made*

3. Change in hydrogen / ionic / disulfide bonds; *Accept: references to sulfur bonds*

4. Change in the tertiary structure / shape;

*Neutral: alters 3D structure / 3D shape*

5. Change in active site;

6. Substrate not complementary / cannot bind (to enzyme / active site) / no enzyme-substrate complexes form.

*Accept: no E S complexes form*

6

- (b) 1. Non-SR strain falls more / SR strain falls less / up to  $10(\mu\text{g} / \text{cm}^{-3})$ ;  
*Must include 10 but only required once in either MP1 or MP2*  
*Ignore: units or absence of*  
*This must be a comparative statement*
2. Above  $10(\mu\text{g} / \text{cm}^{-3})$ , SR strain levels out / off and non-SR strain continues to decrease;
3. Greater difference between strains with increasing concentration of antibiotic.  
*This must be a comparative statement*

2 max

- (c) 1. Division stopped (of both strains by scientist); *Reject: references to mitosis stopping*
2. SR strain still more resistant / fewer die / none die (at higher concentrations of antibiotic).  
*Accept: SR strain and non-SR strain would be similar if resistance is due to only stopping division*  
*Need some comparison with non-SR*

2

- (d) 1. Make a competitive / non-competitive inhibitor;  
*Mark in pairs either MP1 and MP2 OR MP3 and MP4*
2. Competitive competes with / blocks active site / non-competitive inhibitor affects / changes active site;  
*Do not mix and match*
- OR
3. (Make a drug) that inhibits / denatures / destroys enzyme / stringent response; *Accept: drug that 'knocks out' / destroys enzyme*
4. Give at the same time as / before an antibiotic.

2 max

- (e) (SR strain)
1. Fewer free radicals (than non-SR);  
*Note: has to be comparative statement*
2. Produces more catalase (than non-SR);  
*Accept converse statements for non-SR.*
3. Catalase (might be) linked to production of fewer free radicals / breaking down / removing free radicals.  
*Accept: hydrolysis of radicals by catalase.*

3

[15] (a) (i) 1. Groups within groups;



15

*Accept: idea of larger groups at the top or smaller groups at the bottom*

- 2. No overlap (between groups); 2
  
- (ii) 3; 1
  
- (iii) Chordata; 1  
*Accept: if phonetically correct eg 'Cordata'*
  
- (b) (i) 1. (To provide) genetic variation;  
*Genetic variation must be directly stated and not implied*
  
- 2. (Allows) different combinations of maternal and paternal chromosomes / alleles;  
*Accept: any allele of one gene can combine with any allele of another gene* 2

- (ii) 1. (Zedonk has) 47 / odd / uneven number of chromosomes;  
*Accept: diploid number would be odd*  
*Reject: if wrong number of chromosomes is given*
2. Chromosomes cannot pair / are not homologous / chromosome number cannot be halved / meiosis cannot occur / sex cells / haploid cells are not produced;  
*Accept: cannot have half a chromosome*  
**Q** *Reject: meiosis cannot occur in sex cells*

2

[8]

16

- (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'*

6

- (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*

3

(c) 180;

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] (a) (i) (In all organisms / DNA,) the same triplet codes for the same amino acid;

17

*Accept codon / same three bases / nucleotides*  
*Accept plurals if both triplets and amino acids*  
*Reject triplets code for an amino acid*  
*Reject reference to producing amino acid*

1

(ii) 64;

1

(b) Splicing;

*Ignore deletion references*  
*Accept RNA splicing*

1

(c) (i) 1. (Mutation) changes triplets / codons after that point / causes frame shift;

*Accept changes splicing site*  
*Ignore changes in sequence of nucleotides / bases*

2. Changes amino acid sequence (after this) / codes for different aminoacids (after this);  
*Accept changes primary structure*  
*Reject changes amino acid formed / one amino acid changed*
3. Affects hydrogen / ionic / sulfur bond (not peptide bond);
4. Changes tertiary structure of protein (so non-functional); *Neutral 3-D structure*

**3 max**

- (ii) 1. Intron non-coding (DNA) / only exons coding;  
*Context is the **intron***  
*Do not mix and match from alternatives*  
*Neutral references to introns removed during splicing*  
*1. and 2. Ignore ref. to code degenerate and get same / different amino acid in sequence*
2. (So) not translated / no change in mRNA produced / no effect (on protein) / no effect on amino acid sequence;  
*Accept does not code for amino acids*

**OR**

3. Prevents / changes splicing;
4. (So) faulty mRNA formed;  
*Accept exons not joined together / introns not removed*
5. Get different amino acid sequence;

**2 max**

**[8] (a) (i) Centromere;**

**18**

*Accept: if phonetically correct*  
*Reject: centriole*

**1**

- (ii) 1. Holds chromatids together;
2. Attaches (chromatids) to spindle;
  3. (Allows) chromatids to be separated / move to (opposite) poles / (centromere) divides / splits at metaphase / anaphase;  
3. **Q Neutral: chromosomes or chromatids split / halved / divided**

3. *Reject: reference to homologous chromosomes being separated*  
*Accept 'chromosomes' instead of 'chromatids'*  
*Ignore incorrect names for X*

2 max

- (iii) (Homologous chromosomes) carry different alleles;  
*Accept alternative descriptions for 'alleles' eg different forms of a gene / different base sequences*  
*Neutral: reference to maternal and paternal chromosomes*

1

(b) (i) (In **Figure 2**)

1. Chromatids have separated (during anaphase);
  1. **Q** *Neutral: split / halved / divided*
  1. *Reject: reference to homologous chromosomes being separated or*
2. Chromatids have not replicated;
  1. & 2. *Accept 'chromosomes' instead of 'chromatids' or*
3. Chromosomes formed from only one chromatid;  
*Accept converse arguments for **Figure 1***  
*Ignore references to the cell not dividing as in the question stem*  
*Ignore: named phases*

1 max

- (ii) 1. Three chromosomes;  
*Ignore shading*
2. One from each homologous pair;  
*Only one mark for three chromosomes shown as pairs of chromatids*

2

- (iii) Crossing over / alleles exchanged between chromosomes or chromatids / chiasmata formation / genetic recombination;  
*Accept: description of crossing over eg sections of chromatids break and rejoin*  
*Neutral: random fertilisation*  
*Reject: reference to sister chromatids*  
**Q** *Neutral: genes exchanged*  
*Neutral: mutation*

1

[8] (a) (i) (Human cells) don't have a cell wall;

19

Accept "they" refers to human cells.

1

(ii) (Affects) protein synthesis;

Allow description e.g. 'amino acids not joined together / translation.

Reject: affects transcription.

1

(b) 1. Mutation present / occurs;

Ignore antibiotic causes mutation.

2. Resistance gene / allele;

1. or 2.

Reference to immunity disqualifies first credited marking point.

3. Resistant bacteria (survive and) reproduce;

Reference to mitosis negates marking point 3.

2

[4] (a) (i) 4;

20

1

(ii) 1. Change in amino acid / (sequence of) amino acids / primary structure;

1. Reject = different amino acids are 'formed'

2. Change in hydrogen / ionic / disulphide bonds alters tertiary structure / active site (of enzyme);

2. Alters 3D structure on its own is not enough for this markingpoint.

3. Substrate not complementary / cannot bind (to enzyme / active site) / noenzyme- substrate complexes form;

3

(b) 1. Lack of skin pigment / pale / light skin / albino;

2. Lack of coordination / muscles action affected;

2 max

(c) Founder effect / colonies split off / migration / interbreeding;

Allow description of interbreeding e.g. reproduction between individuals from different populations

1

[7] (a) Difference in DNA / base sequence / difference in alleles / genes / gene pool;

21

Neutral: 'fewer alleles' unless qualified e.g. fewer different alleles.

1



- (b) Environmental;  
*Accept: Environment* 1
- (c) Reduced (genetic diversity);  
As fewer different / varied alleles / genes / reduced gene pool; 2
- [4] (a) (i) Antibiotics kill other bacteria / *Clostridium* is resistant;

22

- Less / no competition so (*Clostridium*)  
reproduces / replicates / multiplies / increases in number;  
*Reference to bacteria being 'immune' negates first marking point.*  
*Reference to mitosis negates second marking point.* 2
- (ii) Immune system less effective / more likely to have other  
infections / been in hospital;  
*Accept: 'Weak / lower' immune system'.* 1
- (b) Attaches to active site (of enzyme);  
(Methicillin) is a competitive inhibitor / prevents monomers / substrate  
attaching (to enzyme);  
*'Competes for active site' = 2 marks.*  
*Neutral: 'Prevents monomers joining / attaching to each other'.*  
*Allow one mark max for answers relating to non-competitive  
inhibitor changing active site / preventing substrate attaching. Do  
not penalise Methicillin forms an enzyme / substrate complex.* 2
- (c) (i) Have other illness / medical condition / 'weak' immune system / disease /infection;  
*Reject: Due to 'other factors', 'are smokers', 'are obese' unless  
related to disease or illness.* 1
- (ii) Increase up to 2006 / 20 (per 100 000) then decreases; 1
- (iii) Correct answer in range of 52 – 59.1% = two marks;  
Incorrect answer but shows change as between 4.8 – 5.2 / shows  
correct subtraction giving this change e.g. 14 – 9 = one mark. 2
- [9] (a) (i) 22;

- (ii) 1. Odd number of chromosomes / 33 chromosomes (in leaf cell);  
 2. Chromosomes cannot pair / cannot undergo meiosis / would result in half chromosomes / cannot form haploid cells;

2

- (b) (i) Fast growth / produces crop fast / produces large crop; *Do not insist on relative statement.*

*Accept similar terms for fast. E.g. "better" growth*

*Do not accept unqualified references to profit.*

1

- (ii) Leaves less likely to break / higher breaking strength;

1

- (c) Low genetic diversity because they are produced by mitosis;

Will all have the same DNA / genes / alleles / will be genetically identical / will be clones;

**OR**

Low genetic diversity because they are not produced by meiosis;

No crossing over / independent segregation / will not be genetically different;

*Independent segregation is the specification term. Accept other such as random assortment.*

2

[7]

- (a) **Shape**

1. Different penicillin has different shape / structure / enzyme / active site has specific shape / structure;

*Not different*

**Binding**

2. No longer fits / binds to active site / not complementary to active site / does not form E-S complex;

**Consequence**

3. (Different) penicillin not broken down;

3

- (b) (i) 1. Kills pathogenic / harmful bacteria / pathogens;

2. Disease less likely / improves health / animals healthier / reduces spread of infection;

3. Faster growth / more productive animals / more food converted to meat / greater survival / lower vet's bills / increased yield / less energy (for "fighting infection"); *Principles:*

*Action of antibiotic. Do not accept stops all disease*

*Action on health*

*Effect on production*

2 max

(ii) 1. (Adding antibiotics) selects in favour of antibiotic resistance / resistant bacteria more likely to survive;

2. Increase in numbers / higher proportion of resistant bacteria;

*Penalise immune only on the first occasion it occurs in this part of the question.*

2

[7] (a) Introns;

25

(b) Ile Gly Val Ser;

1

(c) (i) Has no effect / same amino acid (sequence) / same primary structure;

*Q Reject same amino acid formed or produced.*

1

Glycine named as same amino acid;

*1 It still codes for glycine = two marks.*

(ii) Leu replaces Val / change in amino acid (sequence) / primary structure;

Change in hydrogen / ionic bonds which alters tertiary structure / active site;

*Q Different amino acid formed or produced negates first marking point.*

Substrate cannot bind / no longer complementary / no enzyme-substrate complexes form;

*Active site changed must be clear for third marking point but does not need reference to shape.*

3

(d) (i) Interphase / S / synthesis (phase);

1

(ii) DNA / gene replication / synthesis occurs / longest stage; *Allow 'genetic information' = DNA.*

*Allow 'copied' or 'formed' = replication / synthesis*

1 (a) (So results) can be compared / so measurement is the same each time / because eye is

**26**

not perfectly round / uniform;

*Accept eye opens to different amounts*

1

- (b) (i) 1. Eye (diameter) is smaller and antennae longer;  
 2. Antennae detecting touch;  
 3. Data only refers to shrimps / data may not apply to all animals / only in one area;

*The principle here is that candidate has recognised that both features confirm suggestion. Exact wording does not matter.*

2 max

- (ii) 1. Standard deviation gives a measure of spread / variation;  
 2. More standard deviations overlap, the less likely it is that differences are real / significant / the more likely they are caused by chance;

*Do not accept range*

*Accept converse.*

*Although we are looking for the idea of significance, we cannot require this term.*

2

- (c) (i) Qualitative statement about  
 difference in size /

difference in variation /

overlap in size;

Quantitative statement about

difference in size /

difference in variation /

overlap in size;

Supported by relevant two sets of figures from graph;;

*Note simplistic answer involving a quantitative statement gains 1 mark.*

*More specific answer involving quantitative information gains 2 marks.*

- (ii) (No) for same body length, antenna are longer / antenna are shorter / some with longer body have short antennae / some with shorter body length have longer antennae;

**OR**

(Yes) positive correlation in open / in cave;

*Habitat not critical as a term.*

*Must refer to idea of same habitat*

*Accept description*

1

- (d) More alleles of each gene / shrimps in open have all the alleles;

*Candidates are required to use the information from the table. Must therefore refer to alleles.*

1

- (e) 1. A small number of shrimps were / went into the cave;

2. All / high proportion of shrimps had allele L;

3. Cave population descended from these / these reproduce;

3

- (f) (i) 1. Cross shrimps from two sites / watch courtship;

2. Breed young together / observe mating;

3. Allow 1 mark for any method of improving quality of results e.g. carry out reciprocal crosses / large number of crosses / isolate beforehand; *Other valid equivalent suggestions should be accepted.*

- (ii) If same species the shrimps would breed, producing fertile young / courtship species specific;

*Accept any form of evidence – mating / laying eggs / giving birth to young.*

3

[15] (a) (Different) form / type / version of a gene / different base sequence of a gene;

**27**

1

- (b) Two / sister chromatids joined by a centromere;

Due to DNA replication;

2

- (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] (a) Isolation / quarantine / 'kept separate';

**28**

Screening / testing (of patients / doctors etc);

Sterilisation of wards / equipment / method to improve hygiene;

*Do not allow improve 'hygiene' or 'cleanliness' without named example such as 'washing hands' use of gloves etc.*

2 max

(b) May not all be absorbed;

May be broken down / metabolised / excreted quickly;

To kill the microorganisms / bacteria;

Reference to antibiotic resistance;

*Reference to becoming 'immune' negates last marking point.*

2 max

(c) (i) P;

1

(ii) S;

1

(d) (i) Prevents bias;

Vested interest (of scientists);

Prevents 'placebo' / positive / negative / psychological effects / 'demand characteristics' (in volunteers);

2 max

(ii) Age;

Ethnicity;

Lifestyle;

Body mass;

Health;

Sex of person;

*Ignore references to same or different*

2 max

(e) Gradual / slight increase followed by rapid / greater increase;

*Allow more detailed descriptions which describe similar trend of gradual increase followed by rapid increase.*

1

[11]