

# Inheritance

## Mark Scheme 5

|                   |                         |
|-------------------|-------------------------|
| <b>Level</b>      | IGCSE                   |
| <b>Subject</b>    | Biology                 |
| <b>Exam Board</b> | CIE                     |
| <b>Topic</b>      | Inheritance             |
| <b>Paper Type</b> | (Extended) Theory Paper |
| <b>Booklet</b>    | Mark Scheme 5           |

**Time Allowed:** 61 minutes

**Score:** /51

**Percentage:** /100

| Question | E Answers  | Marks   | Guidance   |
|----------|--|---------|--|
| 1 (a)    | <p><i>general marks</i><br/>                     roots absorb water ;<br/>                     idea of <u>both</u> gaining water over a large, volume / area, of soil ;<br/>                     AVP ;</p> <p><b>A</b> has deep roots / go a long way down ;<br/>                     to gain water that drains through soil / reach water table / AW ;</p> <p><b>B</b> has shallow roots / wide spreading roots / AW ;<br/>                     absorbs water, before it drains <i>or</i> evaporates / immediately after rainfall ;</p>   | [max 4] | <p>NB water absorption and area marks given once only</p> <p><b>R</b> long roots unqualified</p>   |
| (b)      | <p>thick cuticle ;<br/>                     longer distance for diffusion / not easy for water to pass through / ref to impermeable ;</p> <p>rolled leaves ;<br/>                     air trapped inside rolled leaf has <u>higher</u> humidity AW / stomata protected from wind <i>or</i> moving air (reduces transpiration) ;</p> <p>sunken stomata / stomata in pits <i>or</i> grooves <i>or</i> depressions ;<br/>                     chamber has <u>higher</u> humidity AW / stomata protected from wind <i>or</i> moving air (so reducing transpiration) ;</p> <p>hairs on leaf ;<br/>                     reduce air flow over the surface (so reducing transpiration) /<br/>                     increase humidity by 'trapping' water (molecules) ;</p> <p>small leaves / leaves reduced to spines / leaves are needles / no leaves / leaves shed in very dry periods ;<br/>                     small(er) / no surface area (for transpiration) ;</p> <p>fewer stomata / stomata closed during hot parts of day ;<br/>                     stomata are pores through which water can pass (so reducing transpiration) ;</p> | [2 + 2] | <p><b>R</b> cuticle unqualified or ref to 'waxy' without description of thickness</p> <p>Must be <b>TWO</b> descriptions (max) with appropriate linked explanations</p> <p><b>explanations alone cannot be accepted</b></p> <p><b>A</b> correct references to water potential / concentration gradient for rolled leaves or sunken stomata</p> <p>IGNORE references to succulent leaves and storage (not water loss)</p> <p>'sharp' leaves also need to be small</p> |

| Question           | Answers   |                        |   |      | Marks | Guidance  |
|--------------------|---|------------------------|---|------|-------|---|
| 1 (c)              | tissue  | substances transported | source  | sink | [6]   | <p><b>NB</b> substances transported score:-</p> <p><b>ONE</b> mark for <b>TWO</b> correct responses</p> <p><b>R</b> references to single cells as sources or sinks e.g. root hairs</p> <p><b>R</b> glucose</p> <p>mark each box independently</p> |
| xylem              | water, ions / named ion / mineral / salts ;                     | roots ;                | stem / growing points / buds / leaf / flower / fruit / seed / storage organ ; |      |       |   |
| phloem             | Sucrose / sugar, amino acids ;                                  | <i>either</i>          |   |      |       |   |
|                    |   | leaf ;                 | stem / growing points / buds / root / flower / fruit / seed / storage organ ; |      |       |   |
|                    |   | <i>or</i>              |   |      |       |   |
| storage organ ;    | <u>young AW</u><br>leaf / stem / growing points / buds / root ; |                        |   |      |       |   |
| <b>[Total: 14]</b> |   |                        |   |      |       |   |

| Question | Answers   | Marks | Additional Guidance  |
|----------|---|-------|--|
| 2 (a)    | pollen transferred from, anther / stamen, to stigma ;<br>within same <u>flower</u> / between <u>flowers</u> on same plant ; <b>R</b> if only 'same plant'   | [2]   | <b>R</b> complete answers given in context of fertilisation<br><b>R</b> 'single parent'  |
| (b)      | <p><i>cross 1</i></p> $\begin{array}{c} I^R I^R \times I^W I^W \\ I^R + I^W \\ \\ I^R I^W \end{array} ;$ <p><i>cross 2</i></p> $\begin{array}{c} I^R I^W \times I^R I^W \\ I^R, I^W + I^R, I^W \\ \\ I^R I^R, I^R I^W, (I^R I^W), I^W I^W \\ \\ 1 \text{ red} : 2 \text{ pink} : 1 \text{ white} ; \quad \mathbf{A} \text{ 25\% red : 50\% pink : 25\% white} \\ \quad \mathbf{A} \text{ multiples, e.g. 2 red: 4 pink : 2 white} \\ \\ \mathbf{R} \text{ if two different ratios given} \end{array}$ | [4]   | <p><b>A</b> other notation, e.g. R and r or mixture, e.g. I<sup>R</sup> and W. <b>R</b> I<sup>RR</sup>, etc.</p> <p><i>cross 1</i> 1 mark for parental genotypes, gametes and offspring all correct. Any mistake and no mark awarded.</p> <p><i>cross 2</i><br/>1 mark for cross genotypes and gametes all correct. Any mistake and no mark awarded.</p> <p>1 mark for giving all three genotypes (on answer line or in the white space e.g. in Punnett square). If correct on answer line ignore any errors in working.</p> <p>1 mark for ratio of offspring phenotypes <b>and</b> colours<br/><b>R</b> if no colours given</p> |
| (c)      | $\begin{array}{c} I^R I^W \times I^W I^W \\ I^R, I^W + I^W \\ \\ I^R I^W, I^W I^W \\ \\ 1 \text{ (pink)} : 1 \text{ (white)} ; \\ \mathbf{R} \text{ if two different ratios given} \end{array}$   | [3]   | <p>1 mark for parental genotypes and gametes all correct. Any mistake and no mark awarded.</p> <p>1 mark for offspring genotypes</p> <p>1 mark for ratio (colours not necessary)<br/><b>A</b> if no colours given</p>  |

| Question           | E Answers  | Marks   | Additional Guidance   |
|--------------------|--|---------|---|
| 2 (d)              | <p>1 ref. to meiosis ;</p> <p>2 mutation can occur <u>in meiosis</u> ;</p> <p>3 (gives) variation / diversity ; <b>R</b> 'varied species (plural)'</p> <p>4 ref. to, alleles / genes / DNA, from different, plants / parents ;</p> <p>5 allows mutations to be, expressed / AW ;</p> <p>6 allows adaptation to, new conditions / changed environment / AW ;</p> <p>7 (new species) can evolve / allows natural selection to occur ;</p> <p>8 seeds are dispersed ; <b>R</b> dispersed unqualified, <b>R</b> pollen dispersal</p> <p>9 can colonise new areas / AW ;</p> <p>10 less competition (with parent plant / among offspring) ;</p> | [max 4] | <p><b>R</b> sexual reproduction allows mutations to occur</p> <p><b>A</b> may allow resistance to disease<br/><b>A</b> 'suited to' / survive / AW for adapted</p> <p><b>R</b> 'passed on by natural selection'<br/><b>R</b> 'new species are made'</p> <p><b>A</b> 'go to new areas' or 'spread to new areas'</p> <p><i>competition is in context of seed dispersal not pollen dispersal</i></p> <p><b>R</b> 'multiply quicker'</p> |
| <b>[Total: 13]</b> |  |         |   |

3 (a) (length of) DNA / part of chromosome / on a chromosome ,  
that codes for a protein or polypeptide or enzyme / controls a characteristic ; [1]

(b)  $H^N H^S \times H^N H^S$  ; *accept N and S*

$H^N, H^S + H^N, H^S$  ; gametes must be clear *accept on dotted line or in Punnett square*

$H^S H^S$  ; *ecf from correct gametes if wrong parental genotype* [3]

(c) check <http://www.sicklecellsociety.org/education/healthpr.htm> for AVPs

1 red (blood) cells become, sickle shaped / distorted / AW ; **R** abnormal unqualified

2 in areas of low oxygen concentrations / in tissues ;

3 fewer / less elastic / less flexible / short-lived, red blood cells ; *ora*

4 less haemoglobin ;

5 blood / haemoglobin, less efficient at transporting oxygen ; **R** no oxygen

6 less respiration ; **R** no respiration

7 less energy / fatigued / exhaustion / less active / feeling faint *or* tired / breathless ;

8 capillaries are blocked ;

9 pain ;

10 death of tissues linked to blood supply ;

11 'sickle cell crisis' ; **A** 'attacks needing oxygen'

12 slow / poor, growth ;

13 susceptible to infections ;

14 reduced life span ;

15 AVP ;

16 AVP ;

[4 max]

- 3 (d) 1 *idea that* areas with high percentage of sickle cell (allele) are places with malaria ;
- 2  $H^S H^S$  / homozygous recessive, reduced life span because of sickle cell anaemia ;
- 3  $H^N H^N$  / homozygous dominant / without  $H^S$  , susceptible to malaria / AW ;
- 4  $H^N H^S$  / heterozygous / carrier/ with  $H^S$ , resistant / not affected / less susceptible ;  
    **A**  $H^S H^S$     **R** immune / immunity
- 5  $H^N H^S$  (carrier) survive and have children /  $H^N H^N$  or  $H^S H^S$  do not ;
- 6  $H^N H^S$  / carrier, pass on the allele /  $H^S$  ;
- 7 (if  $H^N H^S \times H^N H^S$ ) 1 in 4 chance of,  $H^S H^S$  / homozygous recessive ;
- 8 2 in 4 / 50% /  $\frac{1}{2}$  , have advantage of resistance to malaria ; **[5 max]**

- (e) 1 *idea that* distinct groups / categories ; ref to bar chart
- 2 *either* sickle cell anaemia ( $H^S H^S$ ), sickle cell trait ( $H^N H^S$ ), normal ( $H^N H^N$ ) /  
or normal, anaemic ; **A** 'some people have disease, some do not'  
    **A** 'some people have the allele, some do not'
- 3 no intermediates / no continuous scale of anaemia / AW ;
- 4 genetic condition / environment has no effect (or its expression) ;  
    **A** ref to small number of, genes / alleles, involved **[3 max]**

**[Total: 16]**

4 ( i)

| process       | materials moved   | source of materials in the plant                             | sink for materials in the plant  |
|---------------|---|--|--|
| transpiration | water + (mineral) salts / AW ;<br><b>A</b> ions / minerals / named ion<br><b>R</b> nutrients  | roots / root hairs ;   | leaves / shoot / stem ;<br><b>A</b> flowers / fruits named, cell(s) / tissue(s)  |
| translocation | <i>two from</i><br>sugars / sucrose<br>amino acids<br>ions / minerals / AW<br>hormones / named hormone;<br><b>R</b> glucose<br><b>R</b> nutrients | leaves /<br>(named) storage organ /<br>seed(s) / cotyledon ; | roots / stem / shoot /<br>named growing region /<br>(named) storage organ ;<br><b>A</b> buds / flowers / fruits /<br>tubers<br><b>A</b> named cell(s) /<br>tissue(s) |

[6]

(ii) *answer needs to make clear which structures are source and sink*

during germination / AW, (source is) seed / cotyledon ;  
*idea that* leaves grow and start to photosynthesise (so become source) ;

leaves may, be shed / die / be shaded / AW ;  
leaves may stop photosynthesising (so become sink) / AW ; **A** 'slow down'

(in early growth) root (is sink) ;  
(later) flowers / fruits / seeds / tubers / AW (become sinks) ;

[max. 2]

**[Total: 8]**