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The action verb likely to be used for Paper 2 problems is ‘Deduce’. This means that you have to use the information given to find an answer. It is always sensible to give your reasoning.

**First Steps**

The alleles are represented by letters. You may be given these or you may have to choose them. There are rules to apply –
- the dominant allele usually determines the chosen letter and is a capital;
- the recessive allele is the lower case of the same letter;
- therefore you MUST choose a letter where the upper and lower case are CLEARLY distinguishable.

For example NEVER use letters such as O, W, C, S, P etc.

Here are some suitable examples, where the first phenotype is the dominant one and the second its recessive –
- Tall T short t
- Grey G black g
- White E pink e ........ W is no good so use another letter in the word ‘white’.
- Rough H round h ........ R is not sensible as this could be for both rough and round.
- Long L short l

**Homozygous**

We will start with homozygous tall and short plants – remember ‘homo’ means ‘same’.

<table>
<thead>
<tr>
<th>Phenotype</th>
<th>Genotype</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tall</td>
<td>TT</td>
</tr>
<tr>
<td>Short</td>
<td>tt</td>
</tr>
</tbody>
</table>

1. Using the letters given above you complete the boxes.

<table>
<thead>
<tr>
<th>Phenotype</th>
<th>Genotype</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grey</td>
<td></td>
</tr>
<tr>
<td>Black</td>
<td></td>
</tr>
<tr>
<td>Rough</td>
<td></td>
</tr>
<tr>
<td>Round</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Phenotype</th>
<th>Genotype</th>
</tr>
</thead>
<tbody>
<tr>
<td>White</td>
<td></td>
</tr>
<tr>
<td>Pink</td>
<td></td>
</tr>
</tbody>
</table>

Heterozygous

Now what if the dominant phenotype was heterozygous? – remember ‘hetero’ means ‘different’.

<table>
<thead>
<tr>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phenotype</td>
</tr>
<tr>
<td>Tall</td>
</tr>
<tr>
<td>Long</td>
</tr>
</tbody>
</table>

2. Using the letters given above you complete the boxes.

<table>
<thead>
<tr>
<th>Phenotype</th>
<th>Genotype</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grey</td>
<td></td>
</tr>
<tr>
<td>Rough</td>
<td></td>
</tr>
</tbody>
</table>

Notice that the recessive phenotype cannot be heterozygous. Since the allele is recessive it has to be homozygous to show in the phenotype. Look at the black, pink and round genotypes you have just completed in box 1.

**Key points summary for alleles**
- Alleles are in pairs.
- Choose a capital letter to represent the dominant phenotype and the lower case of the same letter to represent the recessive phenotype.
- The dominant phenotype can have either a homozygous or heterozygous genotype.
- The recessive phenotype has to have a homozygous recessive genotype.
What happens when gametes are produced? Remember that gametes are produced by meiosis which halves the chromosome number, ie the pair of alleles will be split into two. If the parent has the alleles TT then all of the gametes will have just a T. Gametes must be placed in a circle when setting out the answer to a problem.

If the genotype is heterozygous then we will have two different types of gametes but in equal numbers.

Key points summary for gametes
- A gamete contains only a single allele.
- Homozygous parents produce only one type of gamete.
- Heterozygous parents produce two types of gamete in equal numbers.
- In a genetics diagram gametes are enclosed in circles.

The Punnett Grid

The Punnett Grid is a simple and less confusing way to show fertilisation of the gametes. The male and female gametes are the first column and row, and it does not matter which way round they go. There is no need to put the gametes in circles in the grid. Some grids are drawn with horizontal and vertical lines and some with diagonal lines – it makes no difference which you use, but the first is easier. Always make the boxes large enough to show the phenotypes as well. This saves time and reduces the possibility of mistakes. Always use a Punnett grid if there are more than two types of gametes.