### INSTRUCTION TO CANDIDATES:

1. **Read** through the paper to familiarise yourself with all of the questions.
2. Use a **blue or black** ballpoint / ink pen. Use pencil for drawing any graphs.
3. **Write** your answers in this booklet.
4. Should you require more space than you have been given please use **the spare sheet** (at the back of this booklet) and ensure that you include your name and the question / statement to which you are responding.

No other items may be taken into the examination room.

It is your responsibility to ensure that you do not have any unauthorised notes or other items of a non-personal nature in the examination room. If you have any unauthorised material with you, hand it to the supervisor **BEFORE** reading any further. All iPads and mobile phones must be turned off and in your bag along with any other devices and notes. Bags are to be closed and placed under the desk.

### AT THE END OF THE EXAMINATION:

- Any planning sheets or other pieces of paper **MUST** be handed in with this booklet.
- At the end of the examination make sure that your name is on your booklet and any other pieces of paper used.
Note: Do not turn the page until you are asked to do so.
1. Organisms have **adaptations** that make them better suited to their environment. These adaptations can be classified into three different types. Complete the table below on adaptation types:

<table>
<thead>
<tr>
<th>Adaptation type</th>
<th>Description</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Structural</td>
<td>An adaptation that affects the internal workings of the organism</td>
<td>Desert animals are more active at night</td>
</tr>
</tbody>
</table>

(6 marks)

2. Malaria is a deadly disease caused by a parasite that invades your red blood cells. It is passed to humans when they are bitten by infected mosquitoes. The species of mosquito that carries the disease is only found in countries near the equator.

Sickle Cell Disease is an inherited disease that changes the shape of your red blood cells, making it difficult to transport oxygen around your body. It occurs as a natural variation in humans. People with sickle cell disease have a variety of serious health issues.

People with sickle cell disease cannot contract malaria.

a. In terms of natural selection, why do you think sickle cell disease is very rare in ethnic groups from northern Europe?

____________________________________________________________________

____________________________________________________________________

____________________________________________________________________

(3 marks)

b. Do you think sickle cell disease would be more or less common in ethnic groups from equatorial areas? Explain your answer.

____________________________________________________________________

____________________________________________________________________

____________________________________________________________________

(4 marks)
3. a. What is selective breeding?

___________________________________________________________________

___________________________________________________________________

(2 marks)

b. Would selective breeding bring about changes in populations faster or slower than natural selection? Explain your answer.

___________________________________________________________________

___________________________________________________________________

(3 marks)

c. Suggest two characteristics in any agricultural species that humans might want to selectively breed for

___________________________________________________________________

(2 marks)

4. Peppered moths are a type of insect that has two, naturally occurring, colourations. They are either light in colour or dark in colour. The light colouration gives excellent camouflage against clean tree trunks, while the dark colouration gives excellent camouflage against a black background. During the industrial revolution of the late 1800s, when factories produced a lot of pollution in the form of black dust, or soot, dramatic changes were observed in the population of peppered moths in England.

The table below gives the results of a study of moth numbers from this time:

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of light moths</th>
<th>Number of dark moths</th>
<th>Year</th>
<th>Number of light moths</th>
<th>Number of dark moths</th>
</tr>
</thead>
<tbody>
<tr>
<td>1882</td>
<td>536</td>
<td>113</td>
<td>1888</td>
<td>147</td>
<td>493</td>
</tr>
<tr>
<td>1883</td>
<td>483</td>
<td>195</td>
<td>1889</td>
<td>85</td>
<td>545</td>
</tr>
<tr>
<td>1884</td>
<td>399</td>
<td>217</td>
<td>1890</td>
<td>55</td>
<td>600</td>
</tr>
<tr>
<td>1885</td>
<td>236</td>
<td>275</td>
<td>1891</td>
<td>60</td>
<td>577</td>
</tr>
<tr>
<td>1886</td>
<td>225</td>
<td>337</td>
<td>1892</td>
<td>79</td>
<td>560</td>
</tr>
<tr>
<td>1887</td>
<td>194</td>
<td>412</td>
<td>1893</td>
<td>122</td>
<td>497</td>
</tr>
</tbody>
</table>

a. On the grid below (over the page), plot a line graph showing the change in moth populations over time. You should have two lines on your graph, one for light moths and one for dark moths.
b. Describe what happens to the numbers of light moths between 1882-1893

___________________________________________________________________

___________________________________________________________________

(2 marks)

c. Describe what happens to the numbers of dark moths between 1882-1893

___________________________________________________________________

___________________________________________________________________

(2 marks)

d. A law was passed during this period forcing factories to reduce the pollution they produced. What year do you think this happened? Explain your answer.

___________________________________________________________________

___________________________________________________________________

(3 marks)
5. The diagram below shows an ambulance, with its siren sounding, speeding off to an emergency:

![Diagram of an ambulance with siren, and two characters, Zoe and Tom.]

Although the siren continually produces the same sound, the pitch of that sound appears to change depending on whether the ambulance is moving towards you or away from you.

a. The ambulance is moving away from Zoe and towards Tom. For each of Tom and Zoe, state whether the pitch sounds higher or lower. (2 marks)

For Zoe the pitch sounds ____________________
For Tom the pitch sounds ____________________

b. Explain your answer to part a. You should use the words wavelength, frequency, higher, lower, pitch, stretched and compressed in your answer. You may also draw a diagram to help explain your answer. (8 marks)

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c. What is the name given to this apparent change in pitch. (1 mark)

___________________________________________________________________
6. a. Name the eight planets of our solar system (4 marks)

___________________________________________________________________

___________________________________________________________________

b. The eight planets are sometimes grouped as the four inner planets and the four outer planets. State two physical/structural differences between the inner planets and the outer planets. (2 marks)

___________________________________________________________________

___________________________________________________________________

___________________________________________________________________

c. All eight planets spin around an imaginary line that runs from their north pole, through the centre of the planet, to their south pole. What is this line called? (1 mark)

___________________________________________________________________

d. One of the planets spins with a retrograde motion. What does retrograde motion mean? (1 mark)

___________________________________________________________________

e. Which planet is it that has a retrograde motion? (1 mark)

___________________________________________________________________

7. When the Space Shuttle returns to Earth after a mission it becomes very hot due to air resistance as it re-enters the Earth’s atmosphere. For this reason, it has a heat resistant material throughout its structure.

Scientists wanted to test a new material to use for this purpose. To do this they built a scale model of the space shuttle and tested it in a special wind tunnel where they could alter the air pressure acting on the model to mimic conditions in different areas of the atmosphere. Temperature sensors inside the model allowed them to compare the effectiveness of the new materials they were testing.

The graph below (over the page), shows their results for two materials:
(Answer question on next page)
a. When they tested material 1 what were the:

Independent variable - ________________________________________________

Dependent variable - ________________________________________________ (2 marks)

b. Name one thing, when comparing the two materials, which would need to have been kept the same to ensure it was a fair test.

______________________________________________________________ (1 mark)

c. Use the graph to predict the temperature for:

Material 1 at a pressure of 300mb-____________________________________

Material 1 at a pressure of 1100mb-____________________________________

Material 2 at a pressure of 500mb-____________________________________

Material 2 at a pressure of 1100mb-____________________________________ (4 marks)

d. Use the graph to predict the pressure when:

Material 1 was at a temperature of 110C-________________________________

Material 1 was at a temperature of 165C-________________________________

Material 2 was at a temperature of 33C-________________________________

Material 2 was at a temperature of 25C-________________________________ (4 marks)

e. Which was the better material at lower air pressures? (1 mark)

______________________________________________________________

f. Which was the better material at higher air pressures? (1 mark)

______________________________________________________________

g. Which material would you choose to line the Space Shuttle? Explain your answer.

__________________________________________________________________

__________________________________________________________________

__________________________________________________________________ (2 marks)
8. Answer either Question A or Question B below. DO NOT ATTEMPT BOTH QUESTIONS.

A. (VET Classes) Most organisms rot and decay when they die, but some are preserved and form some type of fossil. The places where dead matter does not decay are called preserving environments. In the space below:

- Name the four things that must be present for dead matter to decay (4 marks)
- Name and describe four different preserving environments and say why dead matter doesn’t rot in each. (11 marks)

OR

B. (ATAR Classes) In humans, brown eyes (B) are dominant to blue eyes (b).

- Draw punnet squares to calculate the phenotype ratios for all three possible genotype combinations of a brown-eyed couple. (9 marks)
- With reference to your punnet squares, explain what their actual genotypes must be if their first born child has blue eyes. (2 marks)
- If they have another three children, will they all be brown eyed? Explain your answer (4 marks)
9. Answer either Question A or Question B below. **DO NOT ATTEMPT BOTH QUESTIONS.**

A. **(VET Classes)** Describe meteors, meteorites, comets and asteroids (include at least three pieces of information for each) **(12 marks)**

and list them in general size order from largest to smallest **(3 marks)**

OR

B. **(ATAR Classes)** Write an essay about the greenhouse effect

- Describe what the greenhouse effect is **(3 marks)**
- Describe what the enhanced greenhouse effect is, naming two greenhouse gases and where they come from **(6 marks)**
- Use examples of other planets in our solar system to describe the effect extreme atmospheric differences can have on the planets’ climate **(6 marks)**