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| <b>1(a)(i)</b> | B is the correct answer <ul style="list-style-type: none"> <li>A is not the correct answer as actin does not join bone to bone</li> <li>C is not the correct answer as muscle does not join bone to bone</li> <li>D is not the correct answer as tendon does not join bone to bone</li> </ul> |                                                                                                                                                                                                          | Computer<br>(1) |
| <b>1(b)(i)</b> | An explanation that includes two of the following points: <ul style="list-style-type: none"> <li>muscles are in antagonistic pairs / have extensor and flexor muscles (1)</li> <li>the muscles contract (with equal strength) (1)</li> <li>ligaments hold the joint in place (1)</li> </ul>   | muscles if named - rectus femoris and gastrocnemius / fibialis<br>accept muscles work antagonistically<br><br>ignore one contracts and the other relaxes<br><br>accept ligaments hold the bones in place | Expert<br>(2)   |

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| <b>2(c)</b> | An answer that includes the following points: <ul style="list-style-type: none"> <li>exercise increases the rate of heat loss (1)</li> <li>(eventually) the rate of heat loss reaches its maximum (1)</li> </ul> | ACCEPT the rate of heat loss levels off | (2) |
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| <b>3(a)(i)</b>  | Choose an item. <ul style="list-style-type: none"> <li>B is the correct answer</li> </ul> A is not the correct answer as cytoplasm is not the site of the ETC<br><br>C is not the correct answer as mitochondrial matrix is not the site of the ETC<br><br>D is not the correct answer as outer mitochondrial membrane is not the site of the ETC                        |  | Computer<br>(1) |
| <b>3(a)(ii)</b> | Choose an item. <ul style="list-style-type: none"> <li>D is the correct answer</li> </ul> A is not the correct answer as a carbohydrate is not an enzyme in the production of ATP<br><br>B is not the correct answer as a lipid is not an enzyme in the production of ATP<br><br>C is not the correct answer as a phospholipid is not an enzyme in the production of ATP |  | Computer<br>(1) |

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| 3(b)(i) | <p>An answer that includes the following points:</p> <ul style="list-style-type: none"> <li>less ATP produced (1)</li> <li>(because) haemoglobin cannot transport (as much) oxygen / {prevents / reduces} oxygen binding to haemoglobin (1)</li> <li>(therefore) so cells have {no / less} final electron acceptor (1)</li> </ul> | <p>may give numbers 2:36</p> <p>accept binds to haemoglobin instead of oxygen</p> <p>accept haemoglobin has a higher affinity for CO than oxygen</p> <p>accept aerobic respiration can't occur / less aerobic respiration</p> <p>do not accept anaerobic respiration on its own – it needs linking to ATP</p> <p>accept (more) anaerobic respiration occurs which produces fewer ATP molecules (per glucose) for 2 marks</p> | <p>Expert</p> <p>(3)</p> |
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| 3(b)(ii) | <p>An explanation that includes the following points:</p> <ul style="list-style-type: none"> <li>anaerobic respiration involves (just) glycolysis / ATP produced during glycolysis (1)</li> <li>anaerobic respiration occurs in cytoplasm / anaerobic respiration doesn't involve the {mitochondria/ETC}</li> </ul> | <p>accept substrate level phosphorylation for glycolysis</p> <p>accept ATP is produced when glucose is converted to pyruvate</p> | <p>Expert</p> <p>(2)</p> |
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| Question number | Answer                                                                                                                                                                                                                                            | Additional guidance                                                                                                                                    | Mark       |
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| 3(a)            | <p>An answer that includes two of the following points:</p> <ul style="list-style-type: none"> <li>• TB</li> <li>• Cystic Fibrosis</li> <li>• Asthma</li> <li>• COPD</li> <li>• Lung cancer</li> <li>• emphysema</li> <li>• bronchitis</li> </ul> | <p>examiners to check other alternatives</p> <p>Covid<br/>long covid<br/>pneumonia<br/>pulmonary fibrosis<br/>accept any named respiratory disease</p> | Expert (2) |

| Question number | Answer                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Additional guidance                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Mark     |      |      |      |       |      |      |      |           |      |      |      |       |      |      |      |       |      |      |      |            |
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| 3(b)(i)         | <p>An answer that includes three of the following points:</p> <ul style="list-style-type: none"> <li>• as body mass increases the (mean resting) ventilation rate decreases / inverse relationship / negative correlation (1)</li> <li>• comment on the small number of {animals / species/ sample size} (1)</li> <li>• correlation doesn't imply causation / other aspects affect resting ventilation rate (1)</li> <li>• appropriate comment on standard deviations (1)</li> </ul> | <p>accept converse</p> <p>accept significant (difference) between xxx and xx because SDs do not overlap<br/>not a significant (difference) between xxx and xxx because SDs do overlap<br/>SD values are small which indicates higher {validity/reliability}</p> <p>don't accept {overlapping / not overlapping}<br/>SDs are (not significant / significant)<br/>unqualified<br/>ignore not-overlapping /overlapping<br/>unqualified?</p> <table border="1"> <tr> <td>talapoin</td><td>0.45</td><td>0.54</td><td>0.63</td></tr> <tr> <td>lemur</td><td>0.49</td><td>0.53</td><td>0.57</td></tr> <tr> <td>porcupine</td><td>0.27</td><td>0.30</td><td>0.33</td></tr> <tr> <td>tiger</td><td>0.21</td><td>0.27</td><td>0.33</td></tr> <tr> <td>hippo</td><td>0.09</td><td>0.12</td><td>0.15</td></tr> </table> | talapoin | 0.45 | 0.54 | 0.63 | lemur | 0.49 | 0.53 | 0.57 | porcupine | 0.27 | 0.30 | 0.33 | tiger | 0.21 | 0.27 | 0.33 | hippo | 0.09 | 0.12 | 0.15 | Expert (3) |
| talapoin        | 0.45                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 0.54                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 0.63     |      |      |      |       |      |      |      |           |      |      |      |       |      |      |      |       |      |      |      |            |
| lemur           | 0.49                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 0.53                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 0.57     |      |      |      |       |      |      |      |           |      |      |      |       |      |      |      |       |      |      |      |            |
| porcupine       | 0.27                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 0.30                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 0.33     |      |      |      |       |      |      |      |           |      |      |      |       |      |      |      |       |      |      |      |            |
| tiger           | 0.21                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 0.27                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 0.33     |      |      |      |       |      |      |      |           |      |      |      |       |      |      |      |       |      |      |      |            |
| hippo           | 0.09                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 0.12                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 0.15     |      |      |      |       |      |      |      |           |      |      |      |       |      |      |      |       |      |      |      |            |

| Question number | Answer                                                                                                                                                                                                                                                       | Additional guidance                                                                                                                                                                                                                                                                                                                                                | Mark                       |
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| 3(b)(ii)        | <p>A calculation showing the following steps:</p> <ul style="list-style-type: none"> <li>• calculation of number of breaths per minute (1)</li> <li>• calculation of tidal volume in dm<sup>3</sup> and answer given to 2 significant figures (1)</li> </ul> | <p>(0.54 x 60) = 32.4</p> <p>(32.4 x 0.04) = 1.3 dm<sup>3</sup></p> <p>include the other way round e.g.<br/>0.54x0.04 = 21.6<br/>(21.6 x 60) = 1.3 dm<sup>3</sup></p> <p>correct answer scores full marks</p> <p>1.30 = 1 mark only</p> <p>12960/1296/ 1.296 / 32.4 / 21.6 /<br/>(0.54 x 60) / (0.54x0.04)/<br/>(0.54 x 40/1000) somewhere = 1 mark<br/>no ecf</p> | <p>Graduate</p> <p>(2)</p> |

| number |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                    |                          |
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| 3(c)   | <p>A description that includes four of the following points:</p> <ul style="list-style-type: none"> <li>• (because) increase {activity/ aerobic respiration} leads to an {increase in carbon dioxide /decrease in pH}(1)</li> <li>• which is detected by chemoreceptors (1)</li> <li>• (which causes transmission of) impulses to the {respiratory centre / medulla (oblongata)} (1)</li> <li>• which (increases) impulses (via SNS) to increase contraction of {breathing / intercostal / diaphragm} muscles (1)</li> <li>• increase in ventilation rate (1)</li> </ul> | <p>do not accept signals or messages for impulses</p> <p>accept impulses to ventilation centre</p> <p>accept impulses (via SNS) for further contraction of {breathing / intercostal / diaphragm} muscles</p> <p>accept increase breathing rate</p> | <p>Expert</p> <p>(4)</p> |

| Question number | Answer                                                                                                                                                                                                                                                                                   | Additional guidance                                                                                                                                                                      | Mark            |
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| 4(a)            | Choose an item. <ul style="list-style-type: none"> <li>• B is the correct answer</li> </ul> A is not the correct answer as only one statement is correct<br>C is not the correct answer as only one statement is correct<br>D is not the correct answer as only one statement is correct |                                                                                                                                                                                          | Computer<br>(1) |
| 4(b)(ii)        | A calculation showing the following steps: <ul style="list-style-type: none"> <li>• calculation of magnification (1)</li> <li>• answer given in standard form (1)</li> </ul>                                                                                                             | = 15500<br>(accept 15000-16000)<br>= $1.55 \times 10^4$<br>accept $1.5 \times 10^4$ - $1.6 \times 10^4$<br>factor of 10 error 1 mark<br>if not in standard form 15000-16000 gains 1 mark | Graduate<br>(2) |

| number    |                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                         |                          |
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| 4(b)(iii) | <p>A description that includes four of the following points:</p> <ul style="list-style-type: none"> <li>fast twitch have fewer {capillaries / blood vessels} (1)</li> <li>fast twitch have fewer mitochondria (1)</li> <li>fast twitch have less myoglobin (1)</li> <li>fast twitch are {larger in diameter/ longer / have more sarcoplasmic reticulum} (1)</li> <li>have more {glycogen / creatine phosphate} (1)</li> </ul> | <p>ALLOW converse</p> <p>ignore less blood supply as not structural</p> | <p>Expert</p> <p>(4)</p> |

| Question number | Answer                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Additional guidance                                                                                                                                                                                                                                                                                                                          | Mark                     |
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| 4(c)            | <p>An explanation that includes the following points:</p> <ul style="list-style-type: none"> <li>increase in velocity of contraction decreases the force of contraction (1)</li> <li>(cross bridges) are formed when myosin (head) binds to {actin / myosin binding site (on actin)} / (cross bridge) are broken when ATP binds to the myosin (head) (1)</li> <li>therefore reducing the total number of cross bridges (at any one time) (1)</li> </ul> | <p>accept slower muscle contractions have more force / converse</p> <p>accept inversely proportional / negative correlation</p> <p>accept description of a cross bridge forming</p> <p>accept there are more cross bridges formed in slow contraction / there are fewer cross bridges formed in fast contractions</p> <p>accept converse</p> | <p>Expert</p> <p>(3)</p> |

| Question number | Answer                                                                                                                                                                                                                                                                                                                                                                                                                                           | Additional guidance | Mark                       |
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| 5(a)(i)         | <p>Choose an item.</p> <ul style="list-style-type: none"> <li>B is the correct answer</li> </ul> <p>A is not the correct answer as glucose and prothrombin are not filtered from the blood in the renal capsule</p> <p>C is not the correct answer as glycogen and urea are not filtered from the blood in the renal capsule</p> <p>D is not the correct answer as urea and prothrombin are not filtered from the blood in the renal capsule</p> |                     | <p>Computer</p> <p>(1)</p> |

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|  | <ul style="list-style-type: none"> <li>{fluid / filtrate} (in the two limbs of the loop of Henle) moves in opposite directions (1)</li> <li>(sodium / potassium / chloride) ions move out of ascending limb (into surrounding fluid) (1)</li> <li>(ions move) by active transport (1)</li> <li>(resulting in) increase in {(ion) concentration / decrease in water potential} (of surrounding fluid) (1)</li> <li>(therefore) water leaves {the descending limb / by osmosis / through aquaporins} (1)</li> </ul> | <p>accept symbols for ions eg Na<sup>+</sup><br/>do not accept sodium</p> <p>accept idea of active transport – / actively pumped / pumped / moved actively<br/>can get this even if the ions were pumped in wrong direction</p> <p>accept (surrounding) fluid becomes hypertonic<br/>accept a (water / ion / solute) concentration gradient formed<br/>accept there is a greater (solute) concentration outside the base of the descending limb</p> <p>accept diffusion of water<br/>accept (because) the descending limb is permeable to water<br/>accept the ascending limb is impermeable to water</p> | (4) |
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| number  |                                                                                                                                                                                                                                                  |                                                                                         |                            |
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| 5(c)(i) | <p>A calculation showing the following steps:</p> <ul style="list-style-type: none"> <li>correct readings from the graph for the three sets of females put into a ratio (1)</li> <li>calculation of ratio to 1 significant figure (1)</li> </ul> | <p>100:840:440 in working = 1 mark</p> <p>1:8:4 = 2 marks</p> <p>1:8.4:4.4 = 1 mark</p> | <p>Graduate</p> <p>(2)</p> |

| number    |                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                    |            |
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| 5(c)(iii) | <p>An explanation that includes two of the following points:</p> <ul style="list-style-type: none"> <li>increased water {potential / concentration} (of blood) (1)</li> <li>ADH not released / less ADH released (1)</li> <li>decreased permeability of walls of {distal convoluted tubule / collecting duct} to water (1)</li> <li>less reabsorption of water (into blood) (1)</li> </ul> | <p>ALLOW reference to detected by osmoreceptors<br/>allow increased water in blood</p> <p>ignore loop of Henle</p> | Expert (2) |

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| 3  | <ul style="list-style-type: none"> <li>consideration of concentration or distribution of two or more ions using the graph / data</li> </ul>                                                                                                                                                                                |
| 3, | <ul style="list-style-type: none"> <li>consideration of role of Na<sup>+</sup> in the human body ( linked to comment about relative concentration)</li> <li>role in muscle contraction /role in nerve impulse /role in water balance as an electrolyte</li> </ul> <p>accept any correct stated role for Na<sup>+</sup></p> |
|    | <ul style="list-style-type: none"> <li>consideration of role of K<sup>+</sup> in the human body ( linked to comment about relative concentration)</li> <li>role in nerve impulse / role in muscle contraction / role in active transport / role in protein synthesis / role in activation of some enzymes</li> </ul>       |

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| )(i) | <p>An answer that includes the following point:</p> <p>D is the correct answer</p> <ul style="list-style-type: none"> <li>A is not the correct answer as myoglobin is not an enzyme</li> <li>B is not the correct answer as myoglobin is not part of the sarcolemma</li> <li>C is not the correct answer as myoglobin does not act as an immediate source of energy</li> </ul> |  | (1) |
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| points:                                                                                                                                                                                                                                                                                                                |                     |                                                                              | (3) |
| <ul style="list-style-type: none"><li>• as sprinting demand fast speed (over a short distance/ in a short time) (1)</li><li>• because fast twitch fibres contract more quickly (than slow twitch) (1)</li><li>• because fast twitch rely on anaerobic respiration (to supply the energy for contraction) (1)</li></ul> | accept fast / quick | accept contraction of fast twitch fibres does not rely on a supply of oxygen |     |