Diploma Programme
Programme du diplôme
Programa del Diploma

# Markscheme

## November 2019

## Sports, exercise and health science

## Higher level

## Paper 2

25 pages

**Subject details: Sports, exercise and health science HL paper 2 markscheme**

**Mark Allocation**

Candidates are required to answer **ALL** questions in Section A **[50 marks]** and **TWO** questions in Section B **[40 marks]**.
Maximum total = **[50 marks]**.

**Markscheme format example:**

| Question | | | Answers | Notes | Total |
|---|---|---|---|---|---|
| **5** | **c** | **ii** | this refers to the timing of the movements<br>***OR***<br>the extent to which the performer has control over the timing of the movement ✓<br>external paced skills are sailing/windsurfing/receiving a serve ✓<br>internal paced skills are javelin throw/gymnastics routine ✓ | | **2 max** |

**1.** Each row in the "Question" column relates to the smallest subpart of the question.

**2.** The maximum mark for each question subpart is indicated in the "Total" column.

**3.** Each marking point in the "Answers" column is shown by means of a tick (✓) at the end of the marking point.

**4.** A question subpart may have more marking points than the total allows. This will be indicated by "**max**" written after the mark in the "Total" column. The related rubric, if necessary, will be outlined in the "Notes" column.

**5.** An alternative word is indicated in the "Answers" column by a slash (*/*). Either word can be accepted.

**6.** An alternative answer is indicated in the "Answers" column by "***OR***". Either answer can be accepted.

**7.** An alternative markscheme is indicated in the "Answers" column under heading **ALTERNATIVE 1** *etc*. Either alternative can be accepted.

**8.** Words inside chevrons **« »** in the “Answers” column are not necessary to gain the mark.

**9.** Words that are underlined are essential for the mark.

**10.** The order of marking points does not have to be as in the “Answers” column, unless stated otherwise in the “Notes” column.

**11.** If the candidate’s answer has the same “meaning” or can be clearly interpreted as being of equivalent significance, detail and validity as that in the “Answers” column then award the mark. Where this point is considered to be particularly relevant in a question it is emphasized by ***OWTTE*** (or words to that effect) in the “Notes” column.

**12.** Remember that many candidates are writing in a second language. Effective communication is more important than grammatical accuracy.

**13.** Occasionally, a part of a question may require an answer that is required for subsequent marking points. If an error is made in the first marking point then it should be penalized. However, if the incorrect answer is used correctly in subsequent marking points then **follow through** marks should be awarded. When marking, indicate this by adding **ECF** (error carried forward) on the script. “ECF acceptable” will be displayed in the “Notes” column.

**14.** Do **not** penalize candidates for errors in units or significant figures, **unless** it is specifically referred to in the “Notes” column.

## Section A

<table>
<tr><th colspan="3">Question</th><th>Answers</th><th>Notes</th><th>Total</th></tr>
<tr><td>1.</td><td>a</td><td>i</td><td>67.95 ✓</td><td></td><td>1</td></tr>
<tr><td></td><td></td><td>ii</td><td><u>dribbling</u>, <u>variable</u> ✓</td><td></td><td>1</td></tr>
<tr><td></td><td></td><td>iii</td><td>82.73–65.23 ✓<br>=17.50/17.5 ✓</td><td>Accept calculation in the converse.</td><td>2</td></tr>
<tr><td></td><td>b</td><td></td><td>
<table>
<tr><td></td><td>Fixed</td><td>Variable</td><td>Game-based</td><td></td></tr>
<tr><td>Trapping</td><td>improved</td><td>improved</td><td>improved</td><td>✓</td></tr>
<tr><td>Passing</td><td>improved</td><td>improved</td><td>improved</td><td>✓</td></tr>
<tr><td>Shooting</td><td>improved</td><td>declined</td><td>declined</td><td>✓</td></tr>
<tr><td>Dribbling</td><td>declined</td><td>declined</td><td>improved</td><td>✓</td></tr>
</table>
variability reduced for all skills/practice groups post-test ✓<br><br>shooting and dribbling appear to be more advanced skills compared to trapping and passing ✓<br><br>post-test mean for trapping improved significantly ($p<0.05$) through variable and game-based practice and passing improved significantly for game-based practice ✓
</td><td></td><td>4 max</td></tr>
<tr><td></td><td>c</td><td></td><td>there is significant improvement in the post-test scores ✓</td><td></td><td>1</td></tr>
<tr><td></td><td>d</td><td></td><td>specific movement pattern/skill e.g passing in pairs✓<br><br>the performer completes the skill through blocks<br><br>OR</td><td></td><td>2 max</td></tr>
</table>

| | | | | | |
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| | | | practised repeatedly ✓<br><br>there is limited variance in the practice ✓<br><br>low levels of cognitive interference<br><br>***OR***<br><br>practice is in a closed environment✓ | | |
| | **e** | | practice to performance ✓<br><br>performers develop skills through practice, which they then transfer into a competitive environment ✓ | | **2** |
| | **f** | | a coordination of physical maturation and motivation has an optimal (positive) effect on learning ✓<br><br>motivation is required to help/have a positive effect on how a performer learns ✓<br><br>a lack of physical maturation has a negative effect on physically demanding skills ✓<br><br>learning cannot go beyond / capped by a learners' physical development / developmental readiness ✓<br><br>physical maturation within a particular school/college year group can have a positive effect on learning ✓ | Accept answers in the converse | **3 max** |

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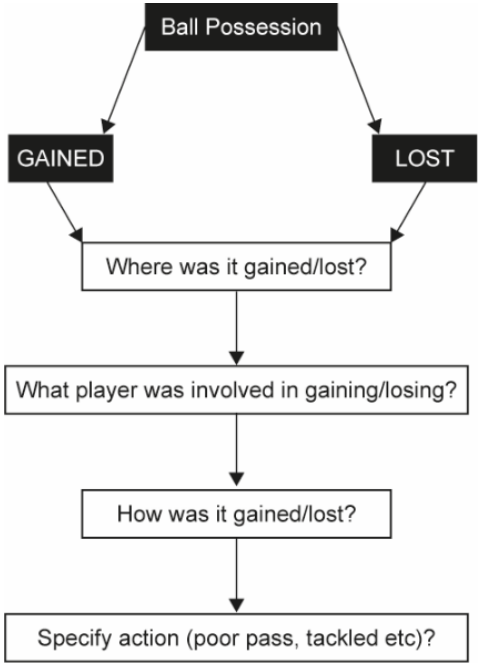
| **2.** | **a** | **i** | athlete information helps the coach design a practice environment to bring about desired behaviour of the athlete ✓<br><br>provides an objective way of recording performance<br><br>***OR***<br><br>a way of recording performance to manage overtraining✓<br><br>a way of recording the effectiveness of the coaching process✓<br><br>quantifying performance <in a consistent and reliable manner> ✓<br><br>facilitating quantitative and qualitative feedback to aid learning / motivation ✓ | | **2 max** |
| | | **ii** |  | *Candidates should present this information in a flow chart.* | **3** |

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| | | | Location: reference to where possession is on the field of play *eg* attack/defence/left, right, centre of the pitch<br>Player: who is in possession *eg* GK, outfielder (attacker/defender)<br>Player: team mates not in possession of the ball. *eg* GK, outfielder (attacker/defender)<br>Options available to the player in possession: *eg* pass, shoot or dribble with the ball<br>Outcome: what is the outcome of the selected option *eg* pass completed / pass intercepted / shot on target/shot off target. | | |

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| **3.** | **a** | **i** | X: <u>triceps brachii</u> ✓<br><br>Y: <u>tibialis anterior</u> ✓ | | **2** |
| | | **ii** | extension ✓ | | **1** |
| | | **iii** | <isotonic> concentric, the muscle shortens under tension ✓ | | **1** |

| | | | | | |
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| **3.** | **b** | **i** | X=epimysium ✓<br><br>Y= fascicle/perimysium ✓ | | **2** |

<table>
<tr>
<td></td>
<td>b</td>
<td>ii</td>
<td>
<table>
<tr><td>Contrast</td><td>Type IIa fast oxidative glycolytic</td><td>Type IIb fast glycolytic</td></tr>
<tr><td>Myoglobin content</td><td>large amount</td><td>small amount</td></tr>
<tr><td>Capillary density</td><td>large</td><td>low</td></tr>
<tr><td>Fibre diameter</td><td>intermediate</td><td>large</td></tr>
<tr><td>Mitochondria</td><td>large amount</td><td>small amount</td></tr>
<tr><td>Glycogen stores</td><td>high</td><td>high</td></tr>
<tr><td>Compare</td><td>Type IIa fast oxidative glycolytic</td><td>Type IIb fast glycolytic</td></tr>
<tr><td>Triglycerides</td><td>low</td><td>low</td></tr>
<tr><td>ATP/PC stores</td><td>high</td><td>high</td></tr>
<tr><td>Sarcoplasmic recticulum</td><td>high</td><td>high</td></tr>
</table>
</td>
<td>Sub max [3]<br><br>Sub max [3]</td>
<td>4 max</td>
</tr>
<tr>
<td></td>
<td>c</td>
<td>i</td>
<td>genotype is influenced by genes whereas phenotype is influenced by the interaction between genes and environmental factors/ reflects the expression of our genes ✓</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ii</td>
<td>muscle fibre type <cross-section> is inherited from parents ✓<br><br>environmental factors, such as training/climate, may affect the characteristics of muscle fibre types ✓<br><br>training maximizes the likelihood of achieving a performance level with a genetically controlled ceiling ✓</td>
<td></td>
<td>2 max</td>
</tr>
<tr>
<td></td>
<td>d</td>
<td></td>
<td>aerobic performance is hindered by a depletion in glycogen stores as ATP resynthesis slows ✓<br><br>a reduction in $Ca^{2+}$ release reduces the ability of muscles to contract effectively ✓</td>
<td>Max [1] for a list of two or more causes of peripheral fatigue</td>
<td>3 max</td>
</tr>
</table>

| | | | | | |
|---|---|---|---|---|---|
| | | | depletion of acetylcholine reduces the ability of an action potential to pass to the muscle fibres ✓<br><br>electrolyte loss occurs through sweating, which can lead to cramp ✓<br><br>dehydration can occur due to loss of essential fluids used to help with temperature regulation ✓<br><br>overheating can impair muscle function ✓ | | |
| | **e** | | a high-intensity exercise programme involving eccentric exercise is likely to generate the most soreness ✓<br><br>is associated with injury <within the muscle>/micro tears of fibres/inflammatory actions/overtraining ✓<br><br>normally occurs 24–72 hours after exercise ✓<br><br>symptoms can last up to 5 days ✓ | | **2 max** |

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| **4.** | **a** | **i** | protects the body from infectious disease ✓<br><br>involved in tissue repair and protection against potential pathogens ✓ | | **1 max** |
| | | **ii** | *eg* when a rugby player is cut by studs from a players boots during a ruck ✓<br><br>platelets clot the blood to prevent blood loss ✓ | *Accept any suitable sporting example.* | **2** |
| | **b** | **i** | X: thyroid ✓<br><br>Y: adrenal ✓<br><br>Z: pancreas ✓ | | **3** |

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| | | **ii** | brain triggers adrenal glands in response to stress <of the race>✓<br><br>adrenaline released into bloodstream ✓<br><br>circulates to target cells ✓<br><br>appropriate physiological response: heart rate increase / blood pressure increase / increased sweating / bronchiole dilation/promotes glycogenolysis ✓ | *Accept suitable diagram.* | **3 max** |
| | **c** | | fasting can cause hypoglycemia ✓<br><br>adrenaline is released to increase <liver> glycogenolysis✓<br><br>if fasting persists it can stimulate gluconeogenesis in the liver and kidneys ✓ | | **2 max** |

## Section B

| Question | | | Answers | Notes | Total |
|---|---|---|---|---|---|
| **5.** | **a** | **i** | *performance-related fitness* is based on attributes such as agility/balance/coordination/power/reaction time/speed, whereas *health-related fitness* is related to body composition/cardio-respiratory fitness (aerobic capacity)/flexibility/muscular endurance/strength ✓ | | **1** |
| | | **ii** | *Aerobic capacity:*<br><br>capacity of the runner to take in, transport and use oxygen system to sustain movement or effort over a period of time ✓<br><br>*Muscular endurance:*<br><br>the capacity of legs to repeat movements over a period of time without undue fatigue ✓<br><br>*Body composition:*<br><br>a low percentage of fat reduces amount of work required by leg muscles ✓<br><br>*Flexibility:*<br><br>can increase stride length ✓<br><br>*Strength:*<br><br>enables athlete to maintain speed up hill ✓ | *Accept other acceptable examples of application to a marathon runner.* | **2 max** |

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| | **b** | | there are increasing levels of $CO_2$ during exercise ✓<br><br>diffusion gradient / rate of exchange is increased ✓<br><br>gases move from an area of high concentration to an area of low concentration ✓<br><br>$CO_2$ is carried in the blood as bicarbonate (ions) dissolved in plasma (bound to hemoglobin)<br><br>***OR***<br><br>$CO_2$ is carried in the form of bicarbonate ✓<br><br>$CO_2$ <dissolved in plasma> diffuses from <pulmonary> capillaries into the alveoli and exhaled ✓<br><br>(when blood enters the lungs) carbonic acid dissociates into $CO_2$ and $H_2O$ ✓<br><br>$CO_2$ is released from hemoglobin (carbaminohemoglobin) in the lungs and into the alveoli and exhaled ✓ | | **4 max** |
| | **c** | | the greater the intensity of the exercise, the greater the EPOC ✓<br><br>initial stages of exercise, oxygen demand cannot be met by the aerobic system <oxygen deficit><br><br>***OR***<br><br>initial stages are met by anaerobic processes ✓<br><br>oxygen deficit is paid back after exercise/oxygen debt ✓<br><br>alactic/fast component is replenished with <3–4 litres of> oxygen ✓ | | **5 max** |

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| | | | ATP and CP/PC stores are replenished ✓<br><br>myoglobin oxygen levels are replenished ✓<br><br>aerobically metabolize lactic acid ✓<br><br>resynthesize lactate to glycogen ✓<br><br>replacement of muscle / liver glycogen stores ✓ | | |
| | **d** | **i** | *Surface drag:*<br><br><sum of> friction forces between fluid molecules and the object. ✓<br><br>as a body moves through a fluid, its outer surface catches a layer of the fluid nearby, slowing it down ✓<br><br>this can be minimized by changing the surface to reduce the interaction between surface and fluid ✓<br><br>*Form drag:*<br><br>as a body pushes against a fluid, the fluid pushes back (action and reaction) ✓<br><br>the greater the surface area the greater the drag ✓<br><br>*Wave drag:*<br><br>acts where there is a reaction between two types of fluids ✓<br><br>when a body moves along the surface of a fluid, some fluid is displaced to form a wave that can oppose motion ✓ | | **4 max** |

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| | | **ii** | by wearing closer-fitting, smoothing clothing/head gear ✓<br><br>through shaving down body hair ✓<br><br>swimming underwater as much as possible ✓<br><br>swimming in a deck level pool/ using specialized wave limiting lane ropes✓<br><br>streamlining their body position ✓<br><br>use of drafting behind another swimmer/cyclist ✓<br><br>modifications to bicycle to make it more aerodynamic ✓ | | **4 max** |
| **6.** | **a** | **i** | decrease in innate and adaptive immune functions✓<br><br>due to increases in levels of cortisol and adrenaline over long periods ✓<br><br>low concentrations of lymphocytes ✓<br><br>leucocytes may drop compared to sedentary individuals✓ | | **1** |
| | | **ii** | ensure that the athlete plans sufficient recovery within their training/avoid overtraining<br><br>***OR***<br><br>ensure that the athlete achieves sufficient sleep ✓<br><br>maintain a varied diet providing suitable vitamins and minerals<br><br>***OR***<br><br>ensure the athlete maintains fluid levels ✓ | | **3 max** |

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| | | | drink pathogen-free water<br>***OR***<br>maintain good food hygiene standards when preparing food ✓<br>athlete maintains good personal hygiene<br>***OR***<br>maintains oral hygiene ✓<br>minimize/avoid contact with infectious individuals ✓<br>do not train during illness ✓ | | |
| | **b** | **i** | *Receptors:*<br>chemoreceptors detect an increase in $CO_2$ ✓<br>baroreceptors detect an increase in blood pressure ✓<br>proprioceptors detect an increase in muscular movement ✓<br>*Autonomic nervous system:*<br>information is received by the <cardiovascular control centre in the> medulla oblongata ✓<br>the sympathetic nervous system < accelerator nerve > sends a signal to the SA node ✓<br>SA node increases firing to increase HR ✓ | Sub Max **[2]**<br>Sub Max **[2]** | **3 max** |

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| | | **ii** | *Regulation of body temperature:*<br><br>production of sweat <helps evaporation> for heat loss ✓<br><br>hairs erect to trap air to reduce heat loss ✓<br><br>vasodilation of blood vessels to the skin to release heat<br><br>***OR***<br><br>vasoconstriction of blood vessels to the skin to conserve heat ✓<br><br>*Protection and immunity:*<br><br>a barrier to microorganisms ✓<br><br>a barrier to physical trauma ✓<br><br>reduces harmful effects of radiation ✓<br><br>*Sensation:*<br><br>contains nerves that relay information about the environment, such as heat, cold and sensing touch or pain ✓<br><br>*Excretion:*<br><br>waste material, such as urea / uric acid / water / ammonia through sweat ✓<br><br>*Synthesis of vitamin D:*<br><br>organic chemical within the skin reacts with UVB ultraviolet light to synthesize vitamin D ✓ | | **4 max** |

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| | **c** | | overload is the increase of stress on the body during exercise training to bring about desired adaptations<br><br>***OR***<br><br>forcing the body to work harder/more intense/longer than normal ✓<br><br>frequency, intensity, time (type) are principles of overload ✓<br><br>as adaptation takes place, a further increase in training load is required to stimulate further increases ✓<br><br>*Frequency:*<br><br>*eg* 1500 m athlete could increase their frequency of training to 4 times a week instead of 3 ✓<br><br>*Intensity:*<br><br>*eg* 1500 m athlete could change from working at 70% MHR to 75% MHR ✓<br><br>*eg* include hill running rather than just road/track ✓<br><br>*Time:*<br><br>*eg* 1500 m athlete could run for 30 minutes instead of 25 minutes ✓ | | **4 max** |
| | **d** | | *Strengths:*<br><br>the test has validity/reliability for predicting $VO_2$ max/ assessing aerobic capacity✓<br><br>a number of participants can be assessed simultaneously ✓<br><br>relatively limited cost/equipment required ✓ | Sub Max **[3]** | **5 max** |

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| | | | relatively easy to administer ✓<br>*Limitations:*<br>due to the regular turning required it is more specific to games-based athletes✓<br>requires motivation of athletes to reach volitional exhaustion ✓<br>maximal test can place participants at risk ✓<br>administrators need to ensure cheating doesn't occur/follow strict protocol ✓<br>not specific for long-distance runners ✓<br>MSFT score is converted to estimate $VO_2$ max<br>***OR***<br>not a direct measure of $VO_2$ max ✓ | Sub Max **[3]** | |

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| **7.** | **a** | **i** | cerebellum is posterior/inferior to the cerebrum ✓ | Accept suitably labelled diagram.<br>Accept synonyms of anatomical terminology. | **1** |
| | | **ii** | maintains balance/posture through the receipt of sensory information ✓<br>coordinates movement to allow muscle actions to work smoothly ✓<br>coordinates eye movements ✓ | | **3 max** |

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| | | | helps to accurately follow and predict trajectories of moving objects ✓<br><br>helps the body learn motor skills ✓ | | |
| | **b** | | angular momentum is defined as moment of inertia x angular velocity ✓<br><br>angular velocity and moment of inertia are inversely proportional ✓<br><br>angular momentum is when a body is spinning about an axis ✓<br><br>a moment of inertia is determined by the distance of the load from the rotational axis ✓<br><br>angular momentum remains constant unless the figure skater is acted upon by an unbalanced force ✓<br><br>figure skater rotates in the transverse plane about the longitudinal axis ✓<br><br>a figure skater can increase their moment of inertia by moving their limbs away from the centre of their body/axis<br><br>***OR***<br><br>a figure skater can increase their angular velocity by moving their limbs close to the centre of the body/axis✓<br><br>in picture A the figure skater has a large moment of inertia and therefore their rate of spin (angular velocity) is low<br><br>***OR***<br><br>in picture B the figure skater has a small moment of inertia and therefore their rate of spin (angular velocity) is high ✓ | *Accept in the converse*<br><br>*Award max **[5]** if the student does not refer to figure skating.* | **6 max** |

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| | **c** | | *Exteroceptors:*<br><br>exteroceptors provide information about the external environment ✓<br><br>cutaneous/tactical exteroceptors are present in the skin ✓<br><br>special exteroceptors are present in the head ✓<br><br>examples of exteroceptors for figure skater include feel of skates / seeing the ice / hearing the music ✓<br><br>*Proprioceptors:*<br><br>proprioceptors provide information about position and posture of the body ✓<br><br>general proprioceptors are present in the locomotor system ✓<br><br>special proprioceptors are present in the head ✓<br><br>examples of proprioceptors for a figure skater include stimuli / feedback from the muscles <regarding balance or impact> / current body position ✓<br><br>*Interoceptors:*<br><br>interoceptors provide information about events in the viscera / internal organs ✓<br><br>examples of interoceptors for figure skater include sensing blood pressure / sensing blood oxygen level / sensing glucose concentration ✓ | | **4 max** |
| | **d** | **i** | lacks consistency in performing technical components ✓<br><br>limited control, *eg* balance ✓ | | **2 max** |

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| | | | simplistic routines ✓<br><br>lacks efficiency / grace, effortful ✓<br><br>seems unsure of the outcome / lacks goal direction / looks nervous ✓<br><br>lacks fluency ✓ | | |
| | | **ii** | *Environment:*<br><br>limit the space available to participants, *eg* in netball, have attackers and defenders in specific zones so that players focus on their own tasks<br><br>***OR***<br><br>increase the space available, *eg* by decreasing the number of participants or increasing pitch/court size ✓<br><br>physical factors of the environment such as surface/weather/playing surface *eg* such as performing on a hard flat surface to make it easier for performers ✓<br><br>*Task:*<br><br>the coach can modify the equipment to make it more challenging, *eg* using a lighter ball in field hockey to improve first touch<br><br>***OR***<br><br>the coach can modify the equipment to make it easier, *eg* increase the size of the golf ball (use a tennis ball) and the size of the golf club ✓<br><br>modify the rules *eg* no tackling allowed ✓<br><br>modify the time permitted in task ✓ | Award max **[2]** if no examples are given | **4 max** |

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| **8.** | **a** | **i** | catabolism is the breakdown of complex molecules into simpler molecules, with the release of energy ✓ | | **1** |
| | | **ii** | glycolysis / Krebs cycle occurs before the ETC ✓<br><br>glycolysis takes place in the muscle sarcoplasm ✓<br><br>glucose is broken down to pyruvic acid ✓<br><br>pyruvic acid enters the Krebs cycle <via conversion to acetyl-coA> in the presence of oxygen ✓<br><br>fatty acids are catabolized into acetyl-coA✓<br><br>acetyl-coA and oxaloacetic acid combine to form citric acid ✓<br><br>glycolysis: net 2 ATP resynthesized ✓<br><br>Krebs cycle takes place in the mitochondria <matrix> ✓<br><br>citric acid enters the Krebs cycle ✓<br><br>carbon dioxide is released ✓<br><br>hydrogen ions are released into the ETC ✓<br><br>Krebs cycle: 2 ATP resynthesized ✓<br><br>***OR***<br><br>net 4 ATP yield for glycolysis and Krebs cycle ✓ | | **6 max** |

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| | **b** | | endurance training significantly reduces muscle/liver glycogen stores ✓<br><br>muscle glycogen recovery will be preferential over liver ✓<br><br>both muscle/liver glycogen can be replenished within 24 hours of activity ✓<br><br>to optimize on glycogen synthesis, carbohydrates should be eaten immediately and at frequent intervals <1.2 g per kg> ✓<br><br>optimal window within the first 2 hours ✓<br><br>5–12 g per kg of body weight will allow replenishment within 24 hours ✓ | | **4 max** |
| | **c** | | aerobic training is likely to cause a higher $VO_2$ max than those with no training ✓<br><br>anaerobic non-interval training is likely to have little effect on $VO_2$ max compared to those with no training<br><br>*OR*<br><br>high-intensity interval training produces improvements in maximum oxygen consumption ✓<br><br>activities where individuals have trained a greater area of muscle mass are likely to have a higher $VO_2$ max ✓<br><br>due to an increase in stroke volume/ maximal cardiac output ✓<br><br>increased oxygen carrying capacity/hemoglobin content ✓<br><br>increased capillary density in muscles✓ | *Accept other appropriate physiological adaptations.*<br><br>*Award max **[4]** if only physiological adaptions given.* | **5 max** |

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| | | | increased mitochondrial density / arteriovenous difference ✓<br><br>increased maximal minute ventilation/increased muscular endurance of respiratory muscles ✓ | | |
| | **d** | | *Strengths:*<br><br>identify potential health conditions that may be life threatening, *eg* sudden cardiac death ✓<br><br>identify susceptibility to injury and so reduce its risk ✓<br><br>potentially use for talent identification ✓<br><br>*Limitations:*<br><br>possible exclusion from sport due to predetermined factors ✓<br><br>discrimination from future employment ✓<br><br>could support the development of gene doping ✓ | | **4 max** |