

# Markscheme

November 2020

**Sports, exercise and health science**

**Higher level**

**Paper 2**

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**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 = [**90 marks**].

**Markscheme format example:**

| Question |   |    | Answers  | Notes | Total |
|----------|---|----|--|-------|-------|
| 5        | c | ii | this refers to the timing of the movements<br><b>OR</b><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 semi colon (;) 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**

| Question |   |    | Answers   | Notes  | Total |
|----------|---|----|---|--|-------|
| 1.       | a | i  | 70 < mg dL <sup>-1</sup> min <sup>-1</sup> lbs <sup>-1</sup> >;   |  | 1     |
|          |   | ii | 58–50;<br>8 <mg dL <sup>-1</sup> min <sup>-1</sup> lbs <sup>-1</sup> >;   |  | 2     |
|          | b |    | to ensure participants have similar <distribution of> characteristics and that the trials are comparable;<br><br>to prevent effects of fatigue / adaptation<br><b>OR</b><br>to control all of the factors influencing the blood glucose;<br><br>to prevent effects of familiarization;<br><br>to remove bias; |  | 2 max |
|          | c |    | insulin / exercise stimulates <GLUT4 protein to the> muscle cells to increase uptake;<br><br>as exercise duration increases muscle phosphagen/ATP & PC stores have been used;<br><br>ATP needs to be resynthesized by glycolysis;<br><b>OR</b><br>blood glucose decreases for ATP resynthesis;                | <i>No gender effect evident on the change</i><br><br><i>Do not accept only description of the change</i> | 2 max |
|          | d |    | C <sub>6</sub> H <sub>12</sub> O <sub>6</sub><br><b>OR</b><br>carbon, hydrogen and oxygen, C, H, and O;   | <i>Do not accept CHO</i>   | 1     |

| Question |   | Answers  | Notes   | Total |
|----------|---|--|---|-------|
| 1        | e | <p><i>Reasons:</i><br/>fasting will cause low blood glucose;</p> <p>low blood glucose is detected by the pancreas/chemoreceptors;</p> <p><i>Mechanism:</i><br/>&lt;alpha&gt; cells of the pancreas release glucagon;</p> <p>glucagon stimulates glycogenolysis to increase blood glucose;</p> <p>stimulates lipolysis;</p> <p>stimulates gluconeogenesis by the liver;</p> | Award [2] max for mechanism                                     | 3 max |
|          | f | <p>regulate and coordinate a range of bodily functions;</p> <p>to act on specific target cells;</p>  |   | 2     |
| 2.       | a | tibialis anterior;   |   | 1     |
|          | b | <p>415–388;</p> <p>= 27 &lt; N m<sup>-1</sup>&gt;;</p>   | <p><i>ECF</i><br/><i>Accept calculation in the converse</i></p> | 2     |
|          | c | no / limited <significant / meaningful> effect;  |   | 1     |
| 3.       | a | sit & reach test;  |   | 1     |
|          | b | flexion;   |   | 1     |
|          | c | towards the back/rear <i>eg</i> the vertebral column is posterior to the sternum;  |   | 1     |

|           |                 |   |  |              |
|-----------|-----------------|---|--|--------------|
|           | <b>d</b>        | anterior of the hip;  |  | <b>1</b>     |
|           | <b>Question</b> | <b>Answers</b>  | <b>Notes</b>   | <b>Total</b> |
| <b>3</b>  | <b>e</b>        | diaphragm <u>and</u> <external> intercostal muscles contract <more forcefully>;<br>causing the rib cage to move <further> upwards <u>and</u> outwards;<br>with assistance of the accessory muscles, eg deltoids, pectoralis;<br>therefore increasing the thoracic volume;<br>therefore reducing the thoracic pressure;<br>causes air to rush in <faster due to a greater pressure difference>;<br>increase of the depth of inhalation <per breath>;<br>increase of the frequency/rate of inhalation <per minute>; | <i>Award [3] max if the student does not refer to the effect of exercise on the mechanism of inspiration</i> | <b>4 max</b> |
| <b>4.</b> | <b>a</b>        | <i>cranium:</i><br>protects the brain;<br><br><i>vertebral column:</i><br>protection of spinal cord/ supports the head / movement of the torso / attachment for ribs and muscles;<br>support posture;   | <i>Award [1] max per part</i>  | <b>2</b>     |
|           | <b>b</b>        | <brachiocephalic trunk> common carotid artery;<br><br><left/right> internal/external carotid arteries;<br><br>cerebral/vertebral arteries;  |  | <b>2 max</b> |
|           | <b>c</b>        | platelets help form a clot / scab at the site of the cut;   |  | <b>1</b>     |

| Question |   | Answers  | Notes  | Total |
|----------|---|--|--|-------|
| 4        | d | <p>pacemaker/SA node fires initiate electrical impulse;</p> <p>impulse travels across the atria walls;</p> <p>impulse arrives at the AV node &lt;base of the right atrium&gt;;</p> <p>impulse passes from the AV node down to the bundle of His &lt;through the septum&gt;;</p> <p>passes down the &lt;left and right&gt; bundle branches &lt;to the apex of the heart&gt;;</p> <p>travels up through the Purkinje fibres &lt;to stimulate the rest of the ventricles&gt;;</p>                                     | <p><i>Accept an annotated diagram.</i></p> <p><i>Responses must be in chronological order as shown in the MS to be credited, not just a list</i></p> | 4 max |
| 5.       | a | <p>a tucked body position decreases surface area/size while cycling decreases drag;</p> <p>decreased opposing wind decreases drag;</p> <p>clothing such as tight apparel will decrease drag;</p> <p>equipment for cycling such as appropriately designed/aerodynamic helmet and bicycle will decrease drag;</p> <p>avoidance of turbulent air/drafting/being behind the athlete in front decreases drag;</p> <p>shaving/waxing skin has a positive effect on reducing drag;</p> <p>lower speed decreases drag;</p> | <p><i>Accept answers in the converse</i></p> <p><i>Award [2] max for list</i></p>  | 5     |
|          | b | <p>A skill which is not affected by the environment eg basketball free throw;</p>  | <p><i>Accept all relevant examples</i></p>   | 1     |

| Question |   | Answers  |                   |                       |   | Notes  | Total |
|----------|---|--|-------------------|-----------------------|---|--|-------|
| 5        | c |  | boxer             | road cyclist          |   | Accept a justified answer for the relative positions of the sports on the continua<br><br>Max [3] for comparison only<br>Max [3] for contrast only | 4 max |
|          |   | fine-gross   | gross             | gross                 | ; |  |       |
|          |   | closed-open  | open              | open                  | ; |  |       |
|          |   | discrete-serial-continuous   | discrete / serial | continuous            | ; |  |       |
|          |   | individual-coactive-interactive  | interactive       | coactive/interactive  | ; |  |       |
|          |   | internally/self-paced-externally paced   | externally paced  | internally/self-paced | ; |  |       |
|          |   |  |                   |                       |   |  |       |
|          | d | periodization will allow the cyclist to plan their training for a season;<br><br>a macrocycle can be broken down into smaller mesocycles/1-3-month blocks;<br><br>consisting of pre-season, competition and transition / off season;<br><br>microcycles focus on short-term goals for each component/block/mesocycle/unit of training;<br><br>this can be achieved by manipulating principles of training (progression, overload, specificity, etc) for each phase of mesocycle; |                   |                       |   | 3 max  |       |

| <b>Question</b> | <b>Answers</b>   | <b>Notes</b> | <b>Total</b> |
|-----------------|--|--------------|--------------|
| <b>6.</b>       | ethical implications of involuntary exclusion from, or discrimination in, one or more sports;<br><br>ethical implications of discrimination beyond sport, for example, in employment;<br><br>may encourage application of gene modification to improve athletic performance;<br><br>genetic screening is still being developed and may be inaccurate / incomplete;<br><br>cost / accessibility are limiting factors; |              | <b>3 max</b> |

**Section B**

| Question |   | Answers  | Notes  | Total        |
|----------|---|--|--|--------------|
| 7.       | a | <p><i>Cardiac:</i><br/>striated branches &lt;of intercalated discs&gt;;</p> <p>myogenic/specialized cells contract on their own intrinsic rhythm<br/><b>OR</b><br/>involuntary muscle tissue which cannot be controlled consciously;</p> <p>contracts to pump blood/only example is the heart;</p> <p>extremely high resistance to fatigue;</p> <p><i>Smooth:</i><br/>non-striated tissue/spindle shaped tissue;</p> <p>predominantly involuntary muscle &lt;which cannot be consciously controlled&gt;<br/><b>OR</b><br/>sustain long periods of contractions;</p> <p>often found in the walls of hollow organs/blood vessels/eyes<br/><b>OR</b><br/>moves food/regulates blood flow/secretions;</p> <p><i>Skeletal:</i><br/>striated in appearance &lt;due to cylindrical cells&gt;;</p> <p>voluntary control of contractions by nerve impulses<br/><b>OR</b><br/>contract in short, intense bursts;</p> <p>attached to bones/ the skeleton &lt;via tendons&gt;;</p> <p>support posture/movement of the skeletal system;</p> <p>produces heat and protects organs;</p> | <p><i>Muscle type must be named to be awarded marks.</i></p> <p><i>Award [2] max for characteristics from only one muscle type (the one with the highest total marks).</i></p> | <b>2 max</b> |

| Question |   | Answers   | Notes | Total |
|----------|---|---|-------|-------|
| 7        | b | <p>high capillary density which allows large amounts of oxygen/nutrients to be delivered during rowing;</p> <p>high myoglobin content which allows for increased transport of oxygen from capillaries into the cell;</p> <p>high number of mitochondria which allows greater ATP production through aerobic processes;</p> <p>high triglyceride stores therefore greater aerobic capacity and ability to metabolize large amount of ATP for rowing;</p> <p>therefore greater fatigue resistance and ability to maintain performance during distance rowing;</p>   |       | 4 max |
|          | c | <p>inheritance is the process whereby genetic information is passed from parent to child;</p> <p>a child receives two genomes (one from each parent);</p> <p>children inherit genes from their parents via the sex cells (gametes), with 50% from the mother and 50% from the father</p> <p><b>OR</b></p> <p>most of our cells (except gametes) contain two sets of 23 chromosomes;</p> <p>potential athletic ability will be higher if both parents had potential higher athletic ability;</p> <p>a genotype of an individual influences the phenotype of the individual;</p> <p>a phenotype is the physical characteristics of the individual &lt;eg eye colour&gt;;</p> <p>some characteristics are expressed by genes others also require an environmental switch &lt;eg VO<sub>2</sub>max&gt;;</p> |       | 5 max |

| Question |   | Answers  | Notes                              | Total        |
|----------|---|--|------------------------------------|--------------|
| 7        | d | <p>endurance training results in increased stroke volume / left ventricular volume;<br/>therefore increase in cardiac output;</p> <p>endurance training results in increased capillarization of muscle<br/><b>OR</b><br/>therefore increased delivery of blood flow to working muscles;</p> <p>endurance training results in increased hemoglobin;</p> <p>endurance training results in increased myoglobin<br/><b>OR</b><br/>therefore increase in arteriovenous oxygen difference;</p>   |                                    | <b>4 max</b> |
|          | e | <p><i>Strengths:</i><br/>provides data not available through traditional analysis techniques (for example, power output measurements);</p> <p>data is objective and accurate;</p> <p>processed data improves visualization and allows image comparison<br/><b>OR</b><br/>allows coach to set training targets;</p> <p>if feedback is immediate and efficient &lt;commonly with smaller datasets&gt;;</p> <p>many new software technologies are relatively inexpensive / free applications;</p> <p><i>Limitations:</i><br/>effectiveness of the data is determined by the knowledge and application of the coach;</p> <p>may lead to over-reliance on objective data;</p> <p>if feedback is delayed / outdated &lt;commonly with larger datasets&gt;;</p> | <i>Award max [4] for strengths</i> | <b>5 max</b> |

| Question |   | Answers   | Notes  | Total |
|----------|---|---|--|-------|
| 8.       | a | X=pancreas;<br>Y=adrenal gland(s);  |  | 2     |
|          | b | stimulate glycogenolysis <in the liver and active muscles>;<br>stimulate lipolysis <in adipose tissue and active muscles>;<br>block glucose storage by the muscles;<br>facilitate sympathetic nervous activity within the body;<br>increase heart rate/cardiac output/contractility of the heart;<br>increase vasodilation of blood vessels within the muscles;   |  | 4 max |
|          | c | primarily controlled by negative feedback<br><b>OR</b><br>a stimulus elicits the release of a substance;<br><br>once the substance reaches a certain level, it sends a signal that stops further release of the substance;<br><br>chemical control of hormone release in response to changes in extracellular fluids<br><i>eg</i> a rise in blood glucose levels triggers the pancreatic release of insulin;<br><br>endocrine glands release hormones when stimulated by hormones released by other endocrine glands <i>eg</i> the hypothalamus produces hormones that stimulate the anterior portion of the pituitary gland;<br><br>the nervous system directly stimulates endocrine glands to release hormones, <i>eg</i> adrenaline stress response; | <i>Award [1] max for a list with relevant examples</i> | 4 max |

| Question |   | Answers  | Notes | Total |
|----------|---|--|-------|-------|
| 8        | d | <p>fatigue is perceived differently by individual athletes and may depend on multiple factors, such as age;</p> <p>prior training / level of fitness &lt;will determine phosphate levels&gt;;</p> <p><i>in high intensity activities such as a sprint:</i><br/>duration of the sprint will determine the rate of peripheral fatigue;</p> <p>depletion of ATP stores<br/><b>OR</b><br/>depletion of creatine phosphate;</p> <p>increase in levels of the products of exercise such as lactate and hydrogen ions<br/><b>OR</b><br/>lactate tolerance / body's ability to buffer lactate;</p> <p>diet / hydration status;</p> |       | 5 max |

| Question |   | Answers  | Notes | Total |
|----------|---|--|-------|-------|
| 8        | e | <p>the greater the intensity of the exercise, the greater the EPOC;</p> <p>initial stages of exercise, oxygen demand cannot be met by the aerobic system<br/>&lt;oxygen deficit&gt;<br/><b>OR</b><br/>initial stages are met by anaerobic processes;</p> <p>oxygen deficit is paid back after exercise/oxygen debt;</p> <p>alactacid/fast component is replenished with the first few minutes<br/><b>OR</b><br/>alactacid/fast component requires relatively less oxygen compared to the<br/>lactacid/slow component;</p> <p>ATP and CP/PC stores are replenished;</p> <p>myoglobin oxygen levels are replenished;</p> <p>aerobically metabolize lactic acid;</p> <p>resynthesize lactate to glycogen;</p> <p>replacement of muscle / liver glycogen stores;</p> |       | 5 max |

| Question |   | Answers  | Notes | Total |
|----------|---|--|-------|-------|
| 9.       | a | <p><i>Newton's first law states:</i><br/>a body will remain/continue in a state of rest or uniform motion/velocity unless acted upon by external (or unbalanced) forces;</p>   |       | 1     |
|          | b | <p><i>Newton's first law:</i><br/>remain stationary unless external or unbalanced forces applied, eg goal keeper during a penalty kick;</p> <p>remain at constant velocity, eg midway in sprint for a ball;</p> <p><i>Newton's second law:</i><br/>the greater the force applied to the ground / equipment the greater the acceleration of the performer / equipment, eg kicking a football;</p> <p><i>Newton's third law:</i><br/>as the athlete pushes down and backwards on the ground, the ground pushes upwards, eg during a rebound in basketball;</p> |       | 4     |

| Question |   | Answers   | Notes  | Total               |
|----------|---|---|--|---------------------|
| 9        | c | <p>intrinsic:<br/>is the physical feel of the movement as it is being performed eg the feeling of shooting in basketball;</p> <p>extrinsic:<br/>provided by external sources, during or after a performance eg teammates or a coach providing feedback on the shot;</p> <p>knowledge of results:<br/>focuses on the end of the performance or the result/outcome of the movement eg was the shot successful?;</p> <p>knowledge of performance:<br/>focuses on how well the athlete performed the movement, eg the quality of the technique/movement pattern of the shot;</p> <p>positive:<br/>usually provided by a coach or more experienced player. eg receiving praise for the shot;</p> <p>negative:<br/>received when the movement is incorrect/unsuccessful. eg no praise;</p> <p>concurrent:<br/>feedback received throughout the skill. eg information received from the shooter whilst shooting;</p> <p>terminal:<br/>feedback received after the performance has been completed eg at the end of the basketball shot;</p> | <p><i>Award [2] max for a list of feedback types with a relevant example</i></p> | <p><b>5 max</b></p> |

| Question |   | Answers  | Notes  | Total               |
|----------|---|--|--|---------------------|
| 9        | d | <p><i>Maximize</i><br/>                     footwear with grip, eg spikes/studs/cleats;<br/><br/>                     change playing surface, eg astroturf/tarmac;<br/><br/>                     gloves/talc to increase friction;<br/><br/>                     warming, eg balls in squash / tyres<br/> <b>OR</b><br/>                     surface area increase, eg cyclist indoor velodrome;</p> <p><i>Minimize</i><br/>                     change playing surface, eg waxing floor;<br/><br/>                     footwear, eg skates;</p>       | <p>Award max <b>[4]</b> for either max or min</p>  | <p><b>5 max</b></p> |
|          | e | <p>scatter diagrams can represent the playing area and allow for the location of events;<br/><br/>                     eg location of shots made in a soccer match;<br/><br/>                     frequency tables can be used to record tallies of events/skills;<br/><br/>                     eg number of successful passes made by the defenders in a soccer game;<br/><br/>                     sequential systems record chronologically ordered list of match events;<br/><br/>                     eg position of team during transition;</p> | <p>Award max <b>[3]</b> per system<br/><br/>                     Accept relevant graphs/ diagrams.</p> | <p><b>5 max</b></p> |

| Question |   | Answers  | Notes | Total |
|----------|---|--|-------|-------|
| 10.      | a | stretching activities eg static/dynamic/ballistic/PNF stretches;   |       | 1     |
|          | b | <p>training heart rate range/zone:<br/>60–80% max HR is required to elicit improvements in aerobic capacity;</p> <p>max HR calculated 220–age;</p> <p>HR &amp; oxygen uptake relationship:<br/>regardless of age/sex or fitness the (linear) relationship between percentage max HR &amp; percentage max oxygen uptake is maintained;</p> <p>training intensity can be expressed as a relative intensity of a person’s VO<sub>2</sub>max/max HR:<br/>activities with smaller muscle mass eg arm ergometry percentage max HR may be affected;</p> <p><i>Karvonen method:</i><br/>Karvonen method calculates the heart rate reserve (HRR);</p> <p>HRR=maximal heart rate–resting heart rate;</p> <p>Once HRR has be calculated, the next step is to calculate target heart rate (THR);</p> <p>THR = (HRR x exercise intensity) + resting HR;</p> |       | 4 max |

| Question |   | Answers  | Notes | Total |
|----------|---|--|-------|-------|
| 10       | c | <p>skin:<br/>provides a barrier from physical or chemical damage to the internal organs/invasion from pathogens/loss of excess water;</p> <p>epithelial linings have cilia which help to reduce foreign bodies entering the body;</p> <p>mucosal secretions eg those found in the respiratory tract which trap bacteria and small particles;</p> <p>pH of bodily fluids help to destroy pathogens eg low pH within the stomach;</p> <p>hormones and other soluble factors:<br/>white blood cells that fight disease eg phagocytes consume germs and dead/damaged cells;</p> <p>inflammation when tissues are injured and fluids are released from the blood to cause swelling (isolate the foreign substance);</p> <p>clotting by platelets in the blood help to provide a protective layer around a wound/damage to tissue;</p> <p>an antibody is a protein produced by the body's immune system when it detects harmful substances, called antigens;</p> <p>B lymphocytes produce antibodies &amp; T lymphocytes attack antigens directly;</p> |       | 5 max |

| Question |   | Answers  | Notes                    | Total |
|----------|---|--|--------------------------|-------|
| 10       | d | <p><i>cerebellum:</i><br/>evaluates movements initiated by the cerebrum <i>eg</i> evaluating the execution of a forward roll;</p> <p>helps to smooth and coordinate sequences of skeletal muscle contractions to produce fluid movements, <i>eg</i> smooths the actions of skills linked together in the routine;</p> <p>regulates posture and balance through sensory information, <i>eg</i> when performing a bridge;</p> <p><i>parietal lobe:</i><br/>determine the orientation of one object to another/sense the relationship of one body part to another <i>eg</i> location of body parts in relation to each other;</p> <p>determine the shape and texture of an object without looking at it <i>eg</i> balls, hoops and ribbons during rhythmic gymnastics;</p> <p>storage of memories of past experiences <i>eg</i> allowing the performer to compare current sensations such as kinesthetics of a move with a previous experience;</p> | Award [3] max per region | 5 max |

| Question |   | Answers  | Notes | Total |
|----------|---|--|-------|-------|
| 10       | e | <p>in order to move the gymnast will move their centre of mass closer to the edge of their base of support;</p> <p>as the body moves the COM repositions itself to represent the point where the mass is concentrated;</p> <p>COM can move outside of the body depending on the type of position;</p> <p>to maintain balance the gymnast must keep their COM/line of gravity above the base of support;</p> <p>a gymnast can lower their COM to increase their stability on the beam;</p> <p>by widening the base of support/adding more points of contact the COM/line is more likely to remain balanced;</p> |       | 5 max |

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