

# Markscheme

November 2017

**Sports, exercise and health science**

**Standard level**

**Paper 2**

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**Section A**

| Question |   | Answers  | Notes                      | Total |
|----------|---|--|----------------------------|-------|
| 1.       | a | Group 2/trained participants ✓   |                            | 1     |
|          | b | 0.3 «g min <sup>-1</sup> » ✓   | <i>Units not required.</i> | 1     |
|          | c | <p>a high r value «0.86» is a strong positive correlation<br/> <b>OR</b><br/>                     there is a positive trend between VO<sub>2</sub>max and fat oxidation «rate»<br/> <b>OR</b><br/>                     as VO<sub>2</sub> max increases so does fat oxidation «rate» ✓<br/>                     group 2/trained participants are running faster «therefore require more energy» ✓<br/>                     fats provide energy for the participants<br/> <b>OR</b><br/>                     respiration involves fat oxidation ✓<br/>                     the highest VO<sub>2</sub>max is not the highest fat oxidation «rate» value ✓<br/>                     the existence of a correlation does not establish that there is a causal relationship<br/>                     «between the two variables» ✓</p> |                            | 3 max |

|    |   |   |  |       |
|----|---|---|--|-------|
| 1. | d | <p>ensuring the safety/decreasing risk of the participant before/during the exercise testing procedure</p> <p><b>OR</b></p> <p>information provided in the questionnaire will allow the test administrator to identify any factors or contraindications / health status prior to participating in the study ✓</p> <p>to meet the criteria for ethical approval of the study ✓</p> |  | 2 max |
|    | e | <p>increase ✓</p> <p>«by» 0.6 «W kg<sup>-1</sup>» ✓</p> <p>from 11.8 to 12.4 «W kg<sup>-1</sup>» ✓</p>  | <p><i>Units not required.</i></p> <p><i>Accept the subtraction in a different order.</i></p> | 1 max |
|    | f | <p>i</p> <p>«all methods» have demonstrated a positive impact / an increase in peak power output ✓</p>  |  | 1     |
|    |   | <p>ii</p> <p>«all methods» have demonstrated a positive impact / an increase in VO<sub>2</sub>max ✓</p>   |  | 1     |

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|----|---|--|--|-------|
| 1. | g | <p>an increase in left ventricular volume</p> <p><b>OR</b></p> <p>increased stroke volume ✓</p> <p>lower resting heart rate ✓</p> <p>lower heart rate during submaximal exercise at the same relative exercise intensity ✓</p> <p>increased cardiac output during maximal exercise ✓</p> <p>increased capillarisation ✓</p> <p>higher arterio-venous difference ✓</p> <p>hypertrophy ✓</p> |  | 2 max |
|    | h | <p>arm ergometry involves less muscle mass compared to cycling ✓</p> <p>arm ergometry has a lower <math>VO_2</math>max compared to cycling ✓</p> <p>dependent on previous training the difference between <math>VO_2</math>max between the two modes could be very large ✓</p>   | <p><i>Must state the relative relationship between cycling and arm ergometry for MP.</i></p> | 2 max |

| Question |   | Answers   | Notes              | Total |
|----------|---|---|--------------------|-------|
| 2.       | a | flat ✓<br>short ✓<br>irregular ✓  | Accept "sesamoid". | 2 max |
|          | b | attach bone to bone ✓<br>provide strength/stability to a joint ✓  |                    | 1 max |
|          | c | i ratings of perceived exertion/Borg/Omni/CERT Scale ✓<br>the Karvonen method/HR calculation ✓<br>training heart rate range/zone<br><b>OR</b><br>percentage/target HR ✓   |                    | 1 max |
|          |   | ii abduction is the movement<br><b>OR</b><br>movement away from the midline ✓<br>deltoid is the agonist muscle ✓<br>pectoralis major / latissimus dorsi is/are the antagonist/s ✓<br>concentric contraction used to raise the weight ✓<br>movement takes place in frontal/coronal/lateral plane ✓<br>movement about sagittal/anterio-posterior axis ✓<br>the joint is a third-class lever ✓ |                    | 3 max |

| Question |   |    | Answers  | Notes  | Total |
|----------|---|----|--|--|-------|
| 3.       | a |    | adipose tissue ✓<br>skeletal muscle ✓  |  | 1 max |
|          | b |    | fats are broken down during beta ( $\beta$ ) oxidation ✓<br>fatty acids are broken down into acetyl CoA ✓<br>acetyl CoA enters the Krebs cycle ✓   |  | 2 max |
| 4.       | a | i  | the effect of learning/performance of one skill on the learning/performance of another ✓   |  | 1     |
|          |   | ii | stage to stage transfer/positive transfer/skill to skill transfer ✓<br>«motor skill development» depends on building each new skill upon those learned previously ✓<br>triple jump adds the stage of hop & step to the long jump ✓   | <i>Accept other applicable explanations.</i> | 2 max |
|          | b |    | pose less risk to the performer ✓<br>can be used by a wide range of the population/children/elderly/untrained ✓<br>do not require high levels of motivation ✓<br>allow estimation of an individual's maximal capacity ✓<br>the prediction of data is made to an unknown maximum and small inaccuracies in measurement can make significant errors in estimating maximal capacity ✓ |  | 3 max |

**Section B**

| Question |   | Answers  | Notes  | Total |
|----------|---|--|--|-------|
| 5.       | a | <p><i>Axial skeleton:</i><br/>                     provides protection of vital organs ✓<br/>                     eg, skull protects the brain «during a tackle in rugby» ✓<br/>                     supports the weight of the upper body ✓<br/>                     eg, vertebral column supports the weight of the upper body «while balancing on a beam in gymnastics» ✓<br/> <i>Appendicular skeleton:</i><br/>                     provides attachment for muscles ✓<br/>                     eg, scapula provides attachment for rotator cuff muscles «which support the shoulders during the rings and vaulting» ✓<br/>                     provides levers to allow movement ✓<br/>                     eg, humerus and ulna articulate to form a lever «that allows for a more effective release of a javelin» ✓</p> | <p>Award <b>[2 max]</b> per skeleton type for both function and example.<br/>                     Award <b>[1 max]</b> if either an outline or example has not been provided.<br/>                     Accept any other suitable examples.</p> | 4 max |
|          | b | <p>diaphragm contracts<br/> <b>OR</b><br/>                     flattens ✓<br/>                     «external» intercostal muscles contract ✓<br/>                     raising the rib cage upwards <u>and</u> outwards ✓<br/>                     this increases the thoracic volume ✓<br/>                     this decreases the thoracic pressure ✓<br/>                     final stages of the race accessory muscles contract (eg, <i>pectoralis</i> minor, sternocleidomastoid and scalenes) increase (thoracic) volume further ✓</p>   | <p>Award <b>[4 max]</b> if there is no reference to accessory muscles.</p>   | 5 max |



|           |          |  |   |                     |
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| <p>5.</p> | <p>c</p> | <p>all energy systems work in a continuum during physical activity depending on the intensity / duration / fuel availability / oxygen availability ✓</p> <p><i>ATP-CP System/PC system/lactic system:</i><br/>resynthesizes ATP during brief high intensity exercise «for more than 3 seconds to less than 10 seconds» ✓<br/>eg, in hockey/soccer when performing a sprint/explosive movement for the ball at speed 20-60 m ✓</p> <p><i>The lactic acid system / anaerobic glycolysis:</i><br/>resynthesizes ATP during short/medium high intensity exercise «between 10s–2 mins range» ✓<br/>eg, in hockey/soccer during transition of play such as a counter attack from defense ✓</p> <p><i>Aerobic system:</i><br/>hockey/soccer requires moderate/high intensity movements but is ongoing «more than 2 minutes» ✓<br/>used during recovery between high intensity bouts or during lower intensity periods ✓<br/>eg, returning to the half way line after a goal is scored ✓</p> | <p><i>Accept any reasonable ranges for duration. Accept other suitable examples.</i></p> <p><i>Award [5 max] if all three systems are not mentioned.</i></p> <p><i>Award [3 max] without applied examples.</i></p> <p><b>[2 max].</b></p> | <p><b>6 max</b></p> |
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| <p>5.</p> | <p>d</p> | <p>greater fibres per motor neuron therefore more fibre recruitment per contraction ✓<br/>fast motor neuron conduction transports action potential quickly ✓<br/>a highly developed sarcoplasmic reticulum helps spread the action potential across the muscle fibre quickly ✓<br/>«therefore» delivery of calcium is increased to the muscle cell ✓<br/>«therefore» the contractile speed is fast ✓<br/>high PC and ATP stores provide immediate source of energy for fast muscle contraction ✓<br/>high glycogen stores provide energy for high intensity movements ✓<br/>have a high anaerobic capacity «which is important for sprinters» ✓<br/>can produce an explosive performance «which is required at the start of the event» ✓</p> |  | <p>5 max</p> |
|-----------|----------|--|--|--------------|

| Question |   | Answers  | Notes | Total |
|----------|---|--|-------|-------|
| 6.       | a | <p>is an increase in HR during prolonged exercise ✓<br/>                     blood volume is reduced through sweating<br/> <b>OR</b><br/>                     increased blood viscosity<br/>                     therefore causing a reduction in venous return ✓<br/>                     stroke volume is directly affected by venous return<br/> <b>OR</b><br/>                     reduction in stroke volume/SV ✓<br/> <math>HR \times SV = Q</math>/ cardiac output is the product of HR times SV ✓<br/>                     the compensation takes place to help maintain cardiac output during exercise ✓<br/>                     exercise in a hot environment exaggerates cardiovascular drift<br/> <b>OR</b><br/>                     dehydration contributes to cardiovascular drift ✓<br/>                     as blood is redirected to the skin to help temperature regulation ✓</p> |       | 5 max |
|          | b | <p><math>Ca^{2+}</math> binds with troponin ✓<br/>                     tropomyosin are lifted from the actin filament binding sites ✓<br/>                     myosin heads attach to actin to form a cross bridge ✓<br/>                     heads of myosin tilt and drag the actin filaments, referred to as the power stroke ✓<br/>                     cross bridge breaks as ATP splits ✓<br/>                     Z lines move closer together<br/> <b>OR</b><br/>                     H zone disappears ✓<br/>                     ratchet mechanism continues until the ends of the myosin filaments reach the ends of the Z lines ✓</p>  |       | 4 max |

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| <p>6.</p> | <p>c</p> | <p><i>Rehearsal:</i><br/>                     by practising the sequence as much as possible they can become overlearned ✓<br/>                     this means that they become automatic and therefore effective in establishing a memory trace ✓<br/>                     however this requires time and may not be accessible to the performer ✓<br/>                     therefore other methods such as mental rehearsal may be required ✓</p> <p><i>Organization:</i><br/>                     the sequence can be organized in meaningful ways to help learn and remember them more easily ✓<br/>                     for example ensuring that the movements are practised in sequence so the end of one movement is followed by the start of one movement ✓<br/>                     verbalizing the routine as it is organized may also assist the learner to memorize the routine ✓<br/>                     organization of the routine still requires rehearsal and therefore in isolation may not be the only method ✓</p> | <p>Award <b>[3 max]</b> per method.</p> | <p><b>5 max</b></p> |
|-----------|----------|--|---|---------------------|



|  |  |   |   |  |
|--|--|---|---|--|
|  |  | <p>limited cost implications ✓</p> <p>non-invasive ✓</p> <p><i>Limitations:</i></p> <p>reliability of the data is affected by the experience and consistency of the tester ✓</p> <p>accuracy is affected by the number of sites and the calculation being used to determine density ✓</p> <p>equations are based mostly on cadaver studies ✓</p> <p><i>Underwater weighing/Hydrostatic weighing:</i></p> <p>the athlete is weighed totally immersed in water <b>OR</b> where the difference between their scale weight and underwater weight is measured ✓</p> <p><i>Strengths:</i></p> <p>considered one of the most accurate measures of body composition ✓</p> <p>perhaps considered the most reliable and valid ✓</p> <p><i>Limitations:</i></p> <p>major weakness is in the conversion of body density to estimate relative body fat ✓</p> <p>equation assumes that fat mass and fat-free mass is constant in all people ✓</p> <p>specialized equipment ✓</p> <p>high cost ✓</p> | <p><b>[3 max].</b></p> <p>At least <b>one</b> strength and <b>one</b> limitation per test. Accept other suitable examples of strengths and limitations.</p> |  |
|--|--|---|---|--|

| Question |   | Answers  | Notes   | Total        |
|----------|---|--|---|--------------|
| 7.       | a | <p>addition of monosaccharides/glucose «molecules» form disaccharide «if two molecules»/polysaccharide «if many molecules»/glycogen ✓</p> <p>a condensation reaction takes place to form a disaccharide/polysaccharides/ glycogen ✓</p> <p>condensation polymerization/condensation reaction releases/removes a water «molecule» from the reaction ✓</p> <p>glycogenesis is the formation of glycogen from glucose ✓</p> | <i>Accept answers presented in a diagram.</i> | <b>4 max</b> |

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| 7. | b |   | <i>Skill profile continuum</i>  | <i>Javelin throw</i>   | <i>Table tennis forehand</i>  |  | <p><i>Candidates can only be credited for identifying the skill profile continuum if they apply the skill profile to the javelin throw and table tennis forehand.</i></p> | <p><b>5 max</b></p> |   |
|    |   |   | Gross-fine  |  |   |  |   |                     |   |
|    |   |   |   | gross «body movement»  | fine «body movement»  |  |   |                     | ✓ |
|    |   |   | Open-closed   |  |   |  |   |                     |   |
|    |   |   |   | closed skill «as there is limited external influence»  | open skill «influenced by the return of the ball from the opponent and the opponent’s permission»   |  |   |                     | ✓ |
|    |   |   | Discrete-serial continuous  |  |   |  |   |                     |   |
|    |   |   |   | serial skill «javelin is more of a serial skill compared to the table tennis forehand as there are stages to the action which are run up, side step and release» | discrete skill «the forehand is a discrete skill as there is a distinct start and finish, but once the action starts it does not have specific elements to the skill» |  |   |                     | ✓ |
|    |   |   | Interaction continuum   |  |   |  |   |                     |   |
|    |   |   |   | individual skill «a javelin throw is an individual skill as they perform on their own at one time»   | interactive skill «forehand is an interactive skill where the performance is directly against an opponent and influenced by their performance»                        |  |   |                     | ✓ |
|    |   |   | Pacing continuum  |  |   |  |   |                     |   |
|    |   | self-paced «although there is a limited time for the throw to be completed, the execution of the skill is self paced» | externally paced «forehand is externally paced as is it is influenced by the speed of return from the opponent» |  | ✓   |  |   |                     |   |



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| 7. | c | <p><i>Newton's first law/law of inertia:</i><br/> swimmer is at rest as no external force is acting upon them ✓<br/> after the starting signal they apply a force to overcome their inertia to start moving ✓</p> <p><i>Newton's second law/law of acceleration:</i><br/> the greater the force they apply as the push off from the blocks the faster they accelerate ✓<br/> the swimmer's movement is made in the direction of the force applied ✓<br/> acceleration is dependent on swimmer's mass ✓</p> <p><i>Newton's third law/law of reaction:</i><br/> swimmer applies action force down and back on the blocks ✓<br/> the blocks apply an upwards and forwards reaction force ✓</p> | <p>Award <b>[2 max]</b> per law.<br/> Accept reference to impulse momentum relationship.</p> | <p><b>5 max</b></p> |
|----|---|---|--|---------------------|

|    |   |  |  |              |
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| 7. | d | <p>ANS/sympathetic nervous system shunts blood from an area of low demand to high demand ✓</p> <p>redistribution increased to 80–85% blood flow (Q) to the «working» muscles ✓</p> <p>causes a reduced blood flow to kidneys/liver/stomach/pancreas/intestines</p> <p><b>OR</b></p> <p>15–20% blood flow / Q to non-essential organs ✓</p> <p>blood flow to the brain remains constant/slightly lower ✓</p> <p>vasodilation «of arterioles» in the «working» muscles</p> <p><b>OR</b></p> <p>local dilation substances prevent vasoconstriction of the muscle tissue ✓</p> <p>vasoconstriction «of arterioles» in the organs ✓</p> <p>constriction of pre-capillary sphincters to the organs ✓</p> <p>dilation of pre-capillary sphincters to the «working» muscles ✓</p> <p>if the body starts to overheat as a result of exercise or high environmental temperatures more blood is redirected to the skin ✓</p> <p>the percentage blood flow to the heart remains the same at rest and during exercise</p> <p><b>OR</b></p> <p>in absolute values the heart receives greater volumes of oxygen as exercise intensity increases ✓</p> |  | <b>6 max</b> |
|----|---|--|--|--------------|