Diploma Programme
Programme du diplôme
Programa del Diploma

Markscheme

November 2015

Sports, exercise and health science

Standard level

Paper 2

24 pages

Subject Details: Sports, exercise and health science SL paper 2 markscheme

Mark Allocation

Candidates are required to answer **ALL** questions in Section A **[30 marks]** and **ONE** question in Section B **[20 marks]**. Maximum total = **[50 marks]**.

Markscheme format example:

Question			Answers	Notes	Total
5	c	ii	this refers to the timing of the movements **OR** the extent to which the performer has control over the timing of the movement✓ external paced skills are sailing/windsurfing/receiving a serve✓ internal paced skills are javelin throw/gymnastics routine✓		**1 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 wording is indicated in the 'Answers' column by a slash (/). Either wording can be accepted.

6. An alternative answer is indicated in the 'Answers' column by '**OR**' on the line between the alternatives. Either answer can be accepted.

7. Words in angled brackets ‹ › in the 'Answers' column are not necessary to gain the mark.

8. Words that are <u>underlined</u> are essential for the mark.

9. The order of marking points does not have to be as in the 'Answers' column, unless stated otherwise in the 'Notes' column.

continued…

10. 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).

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

12. 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.

13. 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		Group B **OR** semi-professional players✓		**1**
	b		7.14 ‹+ 0.00› + 0.33 + 0.27 + 0.60 + 2.40✓ =10.74 ‹injury rate per 1000 playing hours›✓		**2**
	c		the rate of injury at the shoulder continues to increase as the level of competition decreases✓ there are more upper arm and forearm injuries associated with higher level of competition/Group A/professional players OWTTE✓ rate of injury at the hand continues to increase as the level of competition decreases✓ there are more elbow and wrist injuries associated with Group B/ semi-professional players OWTTE✓ overall there are more upper limb injuries associated with lower level of competition/Group A total 6.08, Group B total 10.02, Group C total 10.74 per 1000 playing hours OWTTE✓ overall, the hypothesis is supported ‹for the total number of upper limb injuries›✓	*Accept answers in the converse for all marking points.*	**3 max**
	d		Upper arm and Group 1/90 kg and above✓		**1**

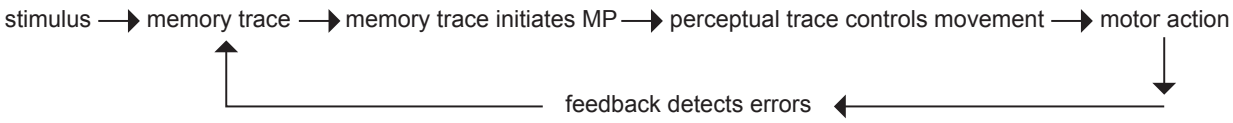
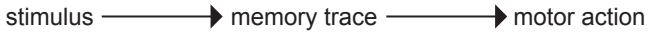
	e		Group 1 missed more games due to forearm injury than Group 2✓ Group 2 missed more games in all injury regions except forearm than Group 1 *OWTTE*✓ Group 2 missed more games overall due to upper limb injury than Group 1✓ Group 2 had more than four times the number of missed games for wrist injury than Group 1 *etc* **OR** the greatest difference in missed games between groups was for wrist injuries✓ Group 1 were the only group not to miss any games due to injury of the upper arm✓	*Accept any other reasonable responses related to the data.* *Accept answers in the converse for the first four marking points.*	**2 max**

	f		can occur from 24–48 hours post exercise✓ eccentric action is the primary initiator✓ linked to muscle damage/structural damage in muscle membrane/possibly in the sarcolemma✓ linked with elevations in plasma enzymes/enzymes in blood support structural damage in muscle membrane/tissue breakdown✓ linked with changes in contractile filaments and Z disks✓ linked with localized muscle pain/tenderness/swelling✓ link between inflammation and muscle soreness✓ linked with myoglobinemia ‹presence of myoglobin in the blood›✓ cell membrane damage disturbs calcium homeostasis in the injured fibre✓ products of macrophage activity and intracellular contents ‹*eg* histamine/kinins/K^+› accumulate outside cells and stimulate nerve endings in muscle✓ increase in protein turnover✓ reduction in force generating capacity of affected muscles/performance impact✓		**3 max**

2	a		long✓ short✓ flat✓ irregular✓	*Award **[1]** for two types.*	**1 max**
	b		the role of the agonist is to cause extension at the elbow joint ‹Triceps brachii›/ the agonist is the muscle that provides the force to complete the movement – prime mover✓ the role of the antagonist is to play a protective/controlling role during extension at the elbow joint ‹Biceps brachii›/ the antagonist refers to the opposing muscle to the agonist/ the relaxing muscle in the movement✓	*Award **[1]** max for each.*	**2 max**
	c		at race start, oxygen transport system does not immediately supply the demanded quantity of oxygen ‹to active muscles›✓ body incurs an oxygen deficit ‹during 100 m swimming race›✓ oxygen deficit is the difference between oxygen required and oxygen consumed✓ insufficient oxygen, muscles generate ATP via anaerobic pathways ‹during 100 m swimming race›✓ during recovery ‹muscles not actively working›, oxygen demand does not immediately decrease✓ during recovery, oxygen consumption remains elevated temporarily/oxygen debt/EPOC✓ during recovery, oxygen borrowed from oxygen stores ‹hemoglobin, myoglobin› must be replenished✓ during recovery, respiration remains temporarily elevated to clear CO_2, requiring more oxygen✓ during recovery, body temperature temporarily elevated ‹keeps metabolic and respiratory rates higher› requiring more oxygen✓ during recovery, elevated norepinephrine/epinephrine requiring more oxygen✓	*Award **[2]** max for oxygen deficit and oxygen debt.*	**3 max**

	d		Q is higher in trained during maximal exercise✓ SV is higher in trained during maximal exercise✓ HR is higher in trained during maximal exercise✓	*Accept answers in the converse for all marking points.*	**2 max**

3	a		erythrocytes **OR** red blood cells✓ leucocytes **OR** white blood cells✓ platelets **OR** thrombocytes✓	*Award **[1]** for two types.* *Accept specific names of leucocytes.*	**1 max**
	b		‹arteries and arterioles› carries blood containing O_2 ‹and nutrients› from the left ventricle to ‹systemic› capillaries throughout the body✓ ‹veins and venules› carry blood containing CO_2 ‹and wastes) to right atrium✓ all systemic arteries branch from the aorta ‹which rises from the left ventricle›✓ deoxygenated blood returns to the heart through the systemic veins/vena cava ‹to the right atrium›✓		**2 max**
	c		litres per minute: in non-weight bearing activities ‹*eg* cycling› endurance performance is more closely related to VO_2max measured in litres per minute **OR** VO_2max data are presented in litres per minute when total power output is important ‹*eg* rowing›✓ ml kg^{-1} min^{-1}: VO_2max is generally expressed relative to body weight ‹ml kg^{-1} min^{-1}› because individuals' needs for energy vary with body size✓ allows a more accurate comparison of different-sized individuals who exercise in weight-bearing events ‹*eg* running›✓	*Award **[1]** for litres per minute and **[1]** for ml kg^{-1} min^{-1}.* *accept in the converse*	**2 max**

4	a		<table><tr><th>Open loop</th><th>Closed loop</th></tr><tr><td>does not use feedback✓</td><td>uses feedback</td></tr><tr><td>control centre provides all the information for effectors to carry out movement✓</td><td>control centre uses information to effectors to initiate movement</td></tr><tr><td>stimulus → memory trace → motor action✓ *(see diagram below)*</td><td>stimulus → memory trace → memory trace initiates MP → perceptual trace controls movement → motor action → feedback detects errors → memory trace *(see diagram below)*</td></tr><tr><td>a fast movement *eg* a golf swing✓</td><td>a relatively slower movement *eg* following the flight path of a soccer ball in the air before jumping to head the ball</td></tr></table> Closed loop diagram:  Open loop diagram: 	*Award **[1]** per row.* *Accept diagram as an alternative form that compares the closed and open loop.*	**2 max**

	b		sample size will have a vast influence on correlation✓ correlational research is where we observe what naturally goes on in the world without directly interfering with it *OWTTE*✓ the only way to infer causality is through comparison of two controlled situations ‹one in which the cause is present and one in which the cause is absent› *OWTTE*✓ these situations should be identical in all senses except the presence of cause *OWTTE*✓ with ecological validity it can be difficult to ensure identical situations *OWTTE*✓ a confounding variable ‹third-variable› *OWTTE* **OR** causality between two variables cannot be assumed because there may be other measured or unmeasured variables affecting the results *OWTTE*✓ correlation coefficients say nothing about which variable causes the other to change/a positive correlation does not confirm a causal relationship *OWTTE*✓ the inductive approach has a logical flaw eg although night and day are perfectly correlated, neither causes the other ‹both are caused by an external factor – the spinning of the Earth in relation to the sun› *OWTTE*✓ the coefficient of correlation ‹r› is a quantitive value of the relationship between two or more variables, perfect correlation is 1, no relationship is 0✓ the coefficient of variation ‹r^2› indicates the proportion of common association of the factors that influence two variables ‹if r^2 is 0.49, then 49 % is common and 51 % is unexplained variance›✓	*Accept common examples from sports based studies or investigations (eg related to body composition or techniques/skill).*	**3 max**

Section B

Question			Answers	Notes	Total
5	a		individuals' needs for energy vary with body size✓ males generally have higher VO_2max than females/healthy untrained girls and women have lower VO_2max values than healthy untrained boys and men✓ VO_2max decreases with age from young adult to elderly✓ VO_2max increases absolutely ‹litres per minute› from childhood to young adulthood✓ VO_2max relative to body weight ‹ml $kg^{-1}min^{-1}$› changes little in boys from around 6 yrs to young adulthood✓ VO_2max relative to body weight ‹ml $kg^{-1}min^{-1}$› changes little in girls from around 6 yrs to around 13 yrs✓ but after around 13 yrs aerobic capacity shows a gradual decrease ‹absolutely and weight relative›✓ if one of the groups has prior experience in undertaking VO_2max tests, this can influence results✓	*Accept answers in the converse.* *Accept answers in the converse.* *A valid reason is required for each in order to explain*	**4 max**

	b		cardiovascular drift is an increase in heart rate during exercise to compensate for a decrease in stroke volume✓ increase in heart rate helps maintain a constant cardiac output✓ cardiovascular drift is more of a challenge/occurs during prolonged or aerobic exercise **<**in a hot environment**>**✓ Heart rate increases are from reduced stroke volume caused by the loss of blood volume due to sweat loss✓ Heart rate increases are from reduced stroke volume caused by redistribution of blood to other regions of the body eg skin for cooling mechanism✓ Heart rate increases due to increasing blood viscosity✓ HR is used by athletes to monitor the intensity that they are working at/ training HR zone= 0.7 to 0.85 of (max HR-age)✓ athletes assume that if they keep their runs at a consistent pace, their heart rate will remain relatively constant as well *OWTTE* Using and monitoring HR for an athlete will indicate the additional stresses that they are undergoing/cardiovascular drift and enable them to plan for this by increasing appropriate hydration/by understanding the concept of cardiovascular drift as it relates to effort and heart rate, you can train more effectively and maximize your potential *OWTTE*		**4 max**

	c		exteroceptors: provide information about the external environment ‹*eg* touch›✓ are further subdivided into general exteroceptors that are present in the skin ‹cutaneous or the tactile receptors›, and the special exteroceptors present in the head ‹*eg* receptors for vision›✓ proprioceptors: provide information about the position and posture of our body in space✓ sense stimuli from the skeletal muscles, tendons and the joints as well from the vestibular apparatus✓ further subdivided into general proprioceptors present in the locomotor system ‹*eg* muscle spindles› and the special proprioceptors present in the head ‹*eg* receptors of the vestibular apparatus›✓ interoceptors: provide information about the events in blood vessels and viscera✓ information from receptors sensing blood pressure ‹plasma osmolarity, blood glucose concentration the degree of stretching of the urinary bladder›✓	*Award **[2 max]** per component.*	**6**

	d		example(s) from motor skill performance✓ perception is the process by which the brain interprets and makes sense of information from the sensory organs✓ perception consists of three elements: detection, comparison, recognition✓ detection is the process by which the brain identifies that a stimulus is present✓ brain detects many more stimuli than we are aware of✓ attend to the information, then passed on for further processing✓ do not attend to the information, then quickly fades✓ comparison is what happens when we attend to something we have sensed✓ stimulus ‹coded message› is passed through the memory and compared with similar codes stored in memory✓ preattentive, before we have become conscious of the stimulus **OR** preattentive, to identify those stimuli we need to be attending to✓ postattentive, after we have become aware of a stimulus **OR** postattentive, to interpret the important aspects of the environment in order to produce an appropriate response✓ recognition, the code of the incoming information matches a code stored in memory ‹LTM› and the stimulus is then perceived **OR** recognition, stimulus identified and recognized✓ recognition, preattentive✓ recognition, postattentive✓ noise can make it difficult to detect signals✓ sensory organ efficiency may determine whether a signal is detected or not✓ stimulus intensity can determine whether a signal is detected/ recognized✓ training/ practice can improve signal detection/ recognition✓ an increase in the number of stimuli can increase the time it takes to process/RT✓	*OWTTE applies to all marking points.* *Accept marking points in the form of a relevant example.* *Award **[3 max]** if no example is used.*	**6 max**

6	a		fibrous: no synovial cavity✓ bones held together by fibrous connective tissue✓ connective tissue contains collagen fibres✓ no or very limited movement✓ cartilaginous: no synovial cavity✓ bones held together by cartilage✓ limited movement ‹compared to fibrous›✓ synovial: synovial cavity✓ bones forming the joint are united by a surrounding articular capsule✓ ‹bones forming the joint are united by a surrounding articular capsule› and often by accessory ligaments✓ a greater range of movement ‹compared to cartilaginous and fibrous›✓ presence of synovial fluid inside joint capsule✓	*Award **[2 max]** per type of joint.*	**6 max**

	b		a rotating object has angular momentum about its axis of rotation✓ angular momentum = moment of inertia × angular velocity ‹about the axis of rotation›✓ moment of inertia of a rotating object can be changed by redistributing the mass of the object about the axis of rotation✓ angular momentum will remain constant unless the object is acted upon by an unbalanced ‹eccentric› force ‹from Newton's First Law of Motion›✓ gymnast rotates in median plane about a transverse axis through centre of gravity <about TAG>✓ whilst in flight there are no unbalanced forces/ momentum remains constant/ there are no additional forces being applied✓ tucking the body reduces moment of inertia <about TAG>✓ tucking, simultaneously increases angular velocity <about TAG>✓ increased angular velocity enables gymnast to complete front somersault quickly✓ gymnast opens out body to increase moment of inertia <about TAG>✓ simultaneous decrease in angular velocity ‹in preparation for landing›✓	*Allow converse application of inertia and angular velocity in an appropriate sporting example.* *Award **[3 max]** for the concept of angular momentum.* *Award **[6]** for an answer in the context of a front somersault.* *Accept other relevant examples eg front somersault in diving.*	**6 max**

	c		ends of axon terminals contain synaptic vesicles filled with chemical neurotransmitters✓ space between the axon terminal and sarcolemma is the synaptic cleft✓ synapse formed between axon terminals of a motor neuron and the motor end plate of a muscle fibre is known as the NMJ✓ arrival of nerve impulse at the synapse triggers release of acetylcholine✓ acetylcholine diffuses across the synaptic cleft ‹between motor neuron and motor end plate›/acetylcholine binds to receptors in the sarcolemma/ motor end plate ✓ binding of acetylcholine ‹to its receptors in motor end plate› opens ion channels✓ open ion channels allow sodium ‹Na^+› to flow across membrane✓ inflow of sodium ‹Na^+› generates muscle action potential✓ each nerve impulse generates one muscle action potential✓ if another nerve impulse releases more acetylcholine, then repeat✓ effect of acetycholine lasts only briefly✓ acetylcholine is rapidly broken down in the synaptic cleft✓ acetylcholine rapidly broken down by an enzyme called acetylcholinesterase✓ the action potential travels through the muscle and down the t-tubes✓ this causes the release of Ca ions✓ Ca ions opens the binding sites on actin/ exposes the binding sites as part of the troponin tropomyosin complex✓ myosin cross bridges move towards these sites to cause the muscle to contract✓	*Award **[1 max]** for first three marking points.*	**4 max**

	d		exhalation occurs when pressure in lungs is greater than pressure of atmosphere✓ exhalation results from elastic recoil of chest wall and lungs ‹passive process›✓ rib cage moves downwards and inwards✓ exhalation begins when diaphragm relaxes✓ ‹diaphragm relaxes› decreasing volume of thoracic cavity✓ lung volume decreases and alveolar pressure increases✓ to about 762 mmHg✓ air flows from area of higher pressure to lower atmospheric pressure✓ exhalation ends when pressure balances equal ‹alveolar to atmosphere›✓ exhalation only becomes active during moderate to high intensity exercise **OR** muscles of exhalation ‹abdominals and internal intercostals› contract during moderate to high intensity exercise✓		**4 max**

7	a		intake 45–65 % carbohydrate, 10–35 % fat, 20–35 % protein✓ energy balance estimates range from 6694 kJ to 10 042 kJ per day for adult women and 8368 kJ to 12 552 kJ per day for adult men, depending on age and physical activity level✓ reduce daily sodium intake✓ consume less than 10 percent of energy from saturated fatty acids✓ consume less than 300 mg per day of dietary cholesterol✓ keep trans fatty acid consumption as low as possible ‹by limiting foods that contain synthetic sources of trans fats, such as partially hydrogenated oils, and by limiting other solid fats›✓ reduce the intake of calories from solid fats and added sugars✓ limit the consumption of foods that contain refined grains✓ choose a variety of protein foods ‹*eg* seafood, lean meat and poultry, eggs, beans and peas, soy products, and unsalted nuts and seeds›✓ replace protein foods that are higher in solid fats with choices that are lower in solid fats and calories and/or are sources of oils✓ other reasonable example *eg* eat a variety of vegetables, especially dark-green and red and orange vegetables and beans and peas✓ adequate water consumption✓	*Accept calorie equivalent.*	**6 max**

	b		condensation is a chemical process by which two molecules are joined together to make a larger, more complex molecule✓ with the loss of water✓ molecules with projecting -H atoms are linked to other molecules with projecting -OH groups, producing H_2O✓ in carbohydrates, the sub-units to be joined are monosaccharides ‹*eg* glucose›✓ both of the groups which combine are -OH groups✓ joining two -OH groups with the removal of H_2O results in a disaccharide containing an -O- bridge between the 2 monosaccharide units✓ each polysaccharide molecule contains many ‹tens/hundreds› of monosaccharides joined through dehydration synthesis reactions✓	*Accept marking points in the form of a diagram.*	**4 max**

	c		*field testing:* can be performed more frequently✓ can often require minimal equipment✓ enables the testing of large numbers of subjects✓ provides a meaningful/authentic environment for the athlete **OR** higher ecological validity✓ simulates specific conditions✓ *laboratory testing:* can be expensive✓ provides a controlled environment✓ uses specific equipment that cannot be transferred to the field✓ frequently requires a higher level of technical support compared to field testing✓ less readily available✓	*Accept answers in the converse to all marking points.* *Award **[3 max]** for field testing.* *Award **[3 max]** for laboratory testing.*	**6 max**

	d		*Karvonen method:* ‹heart rate reserve› the difference between HRmax and resting heart rate ‹HRrest›✓ training heart rate is calculated by taking a given percentage of maximal heart rate reserve and adding it to HRrest✓ training heart rate percentage of heart rate reserve is equivalent to the same percentage of VO_2max ‹at moderate to high intensities›✓ *training heart rate:* based on linear relationship between heart rate and VO_2 ‹with increasing rates of work›✓ training heart rate is calculated using the heart rate that is equivalent to a set percentage of VO_2max✓ exercise intensity necessary to achieve a given percentage of VO_2max✓ results in a much higher heart rate than that same percentage of HRmax✓	*Award **[2]** for $THR_{35\%} = HRrest + 0.35 (HRmax – HRrest)$.* *Award **[2 max]** for Karvonen.* *Award **[2 max]** for training heart rate.*	**4 max**