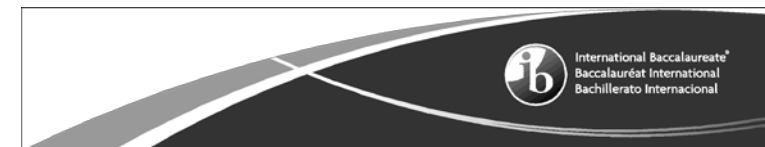# Markscheme

May 2018

Sports, exercise health science

Higher level

Paper 2

22 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** question 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 **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 ✔		**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 <u>underlined</u> 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**	45–60 min ✔		**1**
		ii	5.75–5.50 ✔ = 0.25 <m s^{-1} > ✔	*Accept the subtraction in a different order.*	**2**
		iii	for every time interval subjects' times were better with HC / condition 1 than placebo / condition 3 ✔ for every time interval subjects' times were better with HC / condition 1 than LC / condition 2 ✔ the speed of the HC group / condition 1 varies the least across the time intervals ✔	*Award **[1]** mark max if there is no comparison with the LC and placebo group. eg, HC group had the best performance*	**2 max**
	b		both subjects and the experimenter do not know which drink they are consuming «HC, LC, PL» ✔ this ensures that experimenters are not going to accidentally bias the results ✔ prevents psychological impact on results / placebo effect / participant bias ✔	*Both subjects and experimenter must be included for first mark point.*	**2 max**

1	c						3

	Lactic acid system	Aerobic system	
Glucose / glycogen	yes	yes	✔
Protein	no	yes	✔
Fat	no	yes	✔

1	d	68–48 ✔ = 20 <beats min^{-1} > ✔	*Accept the subtraction in a different order.*	2
2				

	e	lower HR in marathon runners is a result of: stronger / larger heart / hypertrophy in marathon runners ✔ greater stroke volume / cardiac output in marathon runners ✔ greater capillarization in muscle / lung tissue of marathon runners ✔ greater red blood cell count in marathon runners **OR** increased release of hormones < such as erythropoietin> that affect red blood cells of marathon runners ✔ more effective blood redistribution / shunting in marathon runners ✔ a greater arterio-venous oxygen difference in marathon runners ✔	*Award [2] max for a list*	3 max

Question			Answers	Notes	Total
2.	a		A. gluteus maximus ✔ B. biceps femoris ✔ C. gastrocnemius ✔		**3**
	b		*Contractility:* ability of muscle to shorten under tension **OR** lengthen under tension ✔ *Extensibility:* ability to stretch / lengthen beyond its resting length ✔ *Elasticity:* ability to return to its resting length when relaxed / stretch is removed ✔		**3**

	Question		Answers	Notes	Total
3.	**a**		A. hypothalamus ✓ B. pituitary gland ✓ C. pineal gland ✓		**3**
	b		insulin is produced by the pancreas / beta cells of pancreas «islet of Langerhans» ***OR*** Blood glucose is monitored by receptors in the pancreas ✓ insulin is released due to high levels of blood glucose ✓ insulin stimulates the uptake of glucose by the liver and muscle cells «which impacts on blood glucose levels» ✓ ***OR*** insulin stimulates glucose to be stored as glycogen ✓ exercise inhibits the release of insulin ✓ the release of insulin reduces as the blood sugar levels drop ✓ this response is known as negative feedback ✓		**3 max**
	c		the process is the vascular shunt mechanism ***OR*** Blood is redistributed from an area of low demand to high demand ✓ <vaso>dilation of blood vessels to the <working/skeletal> muscles <to increase respiration> ✓ precapillary sphincters open to increase blood flow working tissues ✓ <vaso>dilation of blood vessels to the skin <to promote cooling> ✓ <vaso>constriction of blood vessels from low demand tissues <*eg*, non-essential organs> ✓ precapillary sphincters close to decrease blood flow to low demand tissues <*eg,* non-essential organs> ✓		**3 max**

Question			Answers	Notes	Total
4.	a		low resistance pathway for airflow ✓ provides defence against chemicals / harmful substances inhaled ✓ warms and moistens the incoming air ✓		**2 max**
	b		*Inspiration:* <Chemo>receptors <in the carotid artery/aorta> detect a decrease in pH / increase in CO_2 / H+ ions ***OR*** <Proprio>receptors in the muscles detect muscle contraction ✓ brain stem / medulla oblongata receives information from receptors and sends an impulse to <inspiratory> muscles <via phrenic nerve> ✓ respiratory muscles contract <u>more</u> forcefully ✓ *Expiration:* Stretch receptors detect lung stretch ✓ Brainstem / medulla <oblongata> sends an impulse to stimulate expiratory muscles to contract ✓ Additional respiratory muscles cause a greater depth and rate of breathing ✓		**3 max**

Question			Answers	Notes	Total
5.	a		inflammation ✓ clotting ✓ lymphocyte production ✓ antibody production ✓ increase in temperature ✓		**2 max**
	b		can cause tissue damage ✓ leads to inflammation ✓ causes increases in levels of cortisol / adrenaline ✓ suppresses the immune system ✓ leucocyte numbers drop «compared to sedentary people» ✓		**3 max**
	c	i	sedentary are more susceptible than moderately active ✓ sedentary are less susceptible than elite athletes ✓ moderately active is less susceptible than elite athletes ✓	*Accept a relevant J curve diagram that demonstrates the susceptibility* *Accept reference to position in the J curve:* *Elite is highest susceptibility* *Sedentary is moderate susceptibility* *Moderate is the lowest susceptibility*	**2 max**
		ii	due to lower leucocyte numbers caused by the stress of the «intense» exercise ✓ inflammation caused by muscle damage ✓ «greater» exposure to «airborne» bacteria / viruses because of an increased rate / depth of breathing ✓		**2 max**

Question			Answers	Notes	Total
6.	a	i	a person's phenotype is the physical expression of a trait as a result of genes ✔		1
		ii	a person's genotype is the «actual» genes that a person possesses ✔		1
	b		the identification of life-threatening conditions such as risk of sudden cardiac death, connective tissue disorder ✔ the identification of potential for certain sports; based on genetic profile ✔ the potential to predict susceptibility to injury and so reduce risk **OR** improve safety for an individual athlete / the sport ✔ could be linked to gene doping to remedy identified conditions ✔		2 max
	c		could predict a performer's potential but success is also influenced by the training environment ✔ elite athletes could be distinguished with respect to inherited (genetic) characteristics «*eg,* anaerobic threshold, lung capacity and flexibility> ✔ the nature of the sport determines the influence of the genetic factors on performance ✔ multiple genes determine the measurable heritable characteristics for each individual so it is highly unlikely that a single or even a few genetic elements are associated with superior athletic performance ✔ genes can be turned on and off therefore characteristics influencing performance may not be permanent ✔		2 max

Section B

Question			Answers	Notes	Total
7.	a		*Distance runner:* *eg,* aerobic capacity *e,g* Cooper's 12-minute run ✓ *eg,* speed *eg,* 30 m sprint test ✓ *eg,* muscular endurance *eg,* maximal sit-ups ✓ *eg,* flexibility *eg*, sit and reach ✓ *eg,* body composition, *eg,* anthropometry *Basketball player:* *eg,* aerobic capacity tests *eg,* beep / bleep ✓ *eg,* agility tests *eg,* Illinois agility ✓ *eg,* power *eg,* vertical jump ✓ *eg,* speed such *eg,* 30 m sprint test ✓ *eg,* coordination *eg,* hand ball toss ✓ *eg,* balance *eg,* stork stand ✓ *eg,* reaction time *eg,* drop test ✓ *eg,* strength *eg,* hand grip dynamometer ✓	*Award [4] max for each.* *Award [1] max for each component with a valid test per athlete.*	**6 max**

Question			Answers				Notes	Total
7	b						*Award [1] mark for each correct line.*	6 max

	Field	Laboratory	
Fitness components that can be tested	all	all	✓
Use of PAR-Q / informed consent	yes	yes	✓
Use of specific protocol	yes	yes	✓
Ease of protocol / equipment	easier	harder	✓
Accuracy	variable	high	✓
Cost	lower	higher	✓
Relevant to real world / validity	higher	lower	✓
Reliability	lower	higher	✓
Sample size	greater	lower	✓

	Question		Answers	Notes	Total
7	**c**		used in sports such as tennis, cricket to track the motion of the ball ✔ *eg*, Hawkeye ✔ a video analysis tool which enables complex coding and analysis of team sports such as football, hockey ✔ *eg*, Dartfish ✔ can be used to analyse player loading and performance ✔ *eg,* Prozone ✔ Can be used to assess nutritional status / body composition / energy requirements of an individual✔ *eg,* Bodybyte✔	*Award **[2]** max for name.* *Award **[2]** max for use of named technology.* *Accept any other suitable examples*	**4 max**

	Question		Answers	Notes	Total
7	**d**		*Strengths:* data provided is generally accurate ✔ data is objective / unbiased ✔ when used correctly can assist in ensuring the right decision is made ✔ *Weaknesses:* access to the technology at sub-elite level may be affected by expense ✔ officials need training to make effective use of, and to develop skill in, interpretation of data ✔ limited availability in many regions *eg*, tennis not all levels have it ✔ can lead to over-reliance on objective data / umpire's reluctance to make decisions ✔ if technology overrides the umpire's original decision can lead to crowd pressure / abuse **OR** due to limited challenges available could lead to hostility towards official ✔ technology has the potential to malfunction✔	*Award **[3]** max for weaknesses.*	**4 max**

	Question		Answers	Notes	Total
8.	**a**		cardiac hypertrophy / stronger / larger heart ✔ increased stroke volume / left-ventricular volume ✔ this results in lower resting heart rate ✔ results in a greater working range of heart rate ✔ these factors result in increased arterio-venous oxygen difference (a-VO$_2$ difference) ✔ increased capillarization of trained muscles / lungs ✔ blood plasma increases ✔ red blood cell count increases ✔ more effective blood redistribution ✔ lower resting blood pressure ✔ increased elasticity of blood vessel walls ✔	*Accept other suitable examples that focus on the cardiovascular adaptations.*	**6 max**
	b		stored ATP is broken down ADP + Pi + energy ✔ controlled by ATPase ✔ releasing energy for approximately 3 seconds ✔ *ATP/CP System:* creatine phosphate broken down for resynthesis of ADP to ATP ✔ controlled by creatine kinase ✔ <coupled reaction> energy and Pi + ADP to reform ATP ✔ <predominant> energy system for approximately 3–10 seconds ✔ 1 creatine phosphate molecule = 1 ATP molecule ✔ *Lactic Acid System:* breakdown of glucose to pyruvic acid ✔ controlling enzyme phosphofructokinase ✔ insufficient oxygen supply, pyruvic acid converted to lactic acid ✔	*Award **[4]** max per energy system*	**6 max**

			<predominant> energy system for approximately 10 seconds–3 minutes ✔ 1 glucose molecule = 2ATP ✔ *General:* ATP-CP and lactic acid systems work simultaneously ✔ with sufficient oxygen supply the aerobic system will become the predominant energy system ✔		
8	c		peripheral fatigue is fatigue of the body's muscle groups ✔ a depletion of energy sources affects the rate of fatigue «creatine phosphate, ATP, muscle and liver glycogen reserves» ✔ peripheral fatigue results from an increase in levels of the products of exercise such as lactate *OR* hydrogen ions ✔ reduction in Ca^{2+} release ✔ depletion of acetylcholine ✔ dehydration / electrolyte loss ✔ overheating ✔		**4 max**
	d		replace fluids lost with either water or a solution containing glucose and electrolytes ✔ eat recovery foods rich in CHO and protein ✔ stretching: a combination of static and dynamic stretching ✔ active recovery exercises to keep the blood moving and eliminating H^+ ions/ speed up EPOC✔ rest allows the muscle tissue to repair and liver and muscle glycogen stores to recover ✔ ice baths have been shown to improve recovery / reduce core temperature ✔		**4 max**

	Question		Answers	Notes	Total
9.	**a**		*Exteroceptors:* visual information about opponent positions on the field ✓ auditory could be a call from a team-mate to pass the ball ✓ feel of the ball as it gets wet / slippery ✓ sense touch *eg,* feel of players when marking ✓ *Proprioceptors:* neuromuscular information on stretch of muscles ✓ tension in muscles ✓ awareness of body position in space via the vestibular apparatus ✓ kinaesthesis feedback for correction of movement✓ *Interoceptors:* receptors detect pH changes would be detected as the athlete exercises ✓ changes to Na^+ levels as they begin to dehydrate ✓ pain receptors from an impact ✓	*Award **[2]** max per receptor.* *Award **[5]** max if no reference to sport*	**6 max**
	b		*Physical fitness:* size, shape and level of fitness may assist in learning ✓ one person may have more flexibility and strength than another helping them to perform a task more easily ✓ a learner has an ability to make decisions more effectively if they are not fatigued ✓ performer has particular individualised learning needs **OR** specific health conditions *eg,* asthma / injury may cause disruption to practice / not using preferred learning style ✓ *Motivation:* can be related to a person's inner drive (intrinsic) or external factors such as trophies (extrinsic) ✓	*Award **[5]** max if only two factors have been discussed.* *Candidates can only be awarded for three categories.*	**6 max**

9	b		the strength of a learner's drive to achieve is (very) individual ✓		
			motivation is also linked to a person's state of arousal ✓		
			the more the performer practices, the better the rate of learning ✓		
			Age: physical maturation of a person may not allow them to carry out some tasks if they are either too young or too old ✓ experience may be lacking for some people who are too young whereas someone who has experience will be familiar with expectations ✓ emotional maturity will affect the progress of a learner and whether they can focus on the learning task safely with understanding ✓		
			Difficulty of task: progress will be slowed if the task is too difficult for the learner ✓ if the task is too easy or too difficult, this may have an impact on the motivation of the learner ✓		
			Teaching environment: a safe teaching environment will improve learning if people feel that they can try things ✓ limited distractions will enhance focus for learning ✓ small group learning enables a performer to have more opportunities and feedback ✓		
			Individual difference of coaches: a coach's teaching style (command / reciprocal) may appeal to one learner but not another ✓ good rapport improves rate of learning ✓ knowledge/experience of the coach✓		

Question			Answers	Notes	Total
9.	**c**		[Source: Adapted from annotated lobes of the cerebrum, https://commons.wikimedia.org/wiki/File:Cerebrum_lobes.svg by Jkwchui (image traced and labels removed), licenced under Creative Commons Attribution-Share Alike 3.0 Unported license, https://creativecommons.org/licenses/by-sa/3.0/legalcode.]	*Award **[4]** max.*	**4**
	d		*Frontal lobe:* functions such as reasoning / motivation / planning / emotions and problem-solving ✓ also contains the speech and movement motor areas ✓ *Parietal lobe:* somatic sensory and motor areas linked to, body awareness / orientation / navigation ✓ also contains symbolic and speech association areas ✓ *Occipital lobe:* visual sensory ✓ *Temporal lobe*: auditory sensory / language comprehension ✓ many aspects of long-term and visual memory / facial recognition ✓ *Limbic lobe:* concerned with association processes such as emotion / behaviour / motivation ✓ long-term memory ✓	*Award **[1]** max each.*	**4 max**

Question			Answers	Notes	Total
10.	**a**		elbow extension as they straighten the arm ✔	*Sub Max 3 Extension*	
			triceps agonist / prime mover ✔		
			triceps contracts concentrically ✔		
			biceps relaxes «reciprocal inhibition» ✔	*Sub Max 3 Flexion*	
					6
			elbow flexion as they pick up the ball ✔		
			biceps agonist / prime mover ✔		
			biceps contracts concentrically ✔		
			triceps relaxes «reciprocal inhibition» ✔		

Question			Answers	Notes	Total
10	**b**		*Speed of release*: speed of release is defined as the magnitude of the projectile's velocity vector at the instant of release ✔ when projectile angle and height are held constant, speed of release will determine range (horizontal displacement) ✔ speed of club head can be improved / increased through training good technique / strength, coordination and power / optimal club weight / club selection ✔ *Height of release*: greater the height of the tee off point to the landing point the greater the horizontal distance that can be gained ✔ use of the golf tee ✔ *Angle of release:* there is an optimal angle for various shots in order to gain maximum distance ✔ optimal angle can depend on wind resistance / height of release compared to landing ✔ club faces are angled to provide various release angles ✔ spin on a ball has a contributing influence on the motion / distance achieved ✔ how the club face contacts/interacts with the ball will determine the nature of the spin on the ball ✔	*Award [5] max if no reference to a sport.* *Note examples provided are from golf.*	**6 max**

	Question		Answers	Notes	Total
10	**c**		Surface drag: make the surface of the object / person a smooth texture <which will prevent a fluid layer forming> ✓ *eg*, wearing tight clothing / shaving down / wearing swimming hats ✓ Form drag: reduce front cross-sectional area will reduce the amount of drag produced ✓ *eg,* adopting a streamlined position/tucked position in track cycling ✓ a curved design allows fluid to pass more smoothly (laminar flow) minimizing drag ✓ *eg,* use of a specialist cycling helmet ✓ Wave drag: by reducing the interface between two fluids will reduce drag ✓ *eg,* swimming underwater. ✓	*Award **[2]** max for a list.*	**4 max**
	d		the texture of a surface «*eg*, cricket ball smooth one side and rough the other will curve through the air» ✓ nature of the playing surface «*eg*, wet tennis court makes it harder to change direction / wet golf ball will roll less / dirty basketball court makes it hard to change direction» ✓ the age of the interacting surfaces «*eg*, sports shoe is smooth which would lower the coefficient of friction» ✓ use of specialist equipment such as golf gloves / wax in surfing to improve the contact between surfaces / grip ✓ mass of an object determines the perpendicular force and this affects static friction ✓ motionless objects <static friction>often experience more friction than moving ones <dynamic friction> ✓ temperature of surface *eg,* warming of F1 / Superbike tyres to increase grip on the track ✓	*Award **[2]** max for a list.*	**4 max**