Diploma Programme
Programme du diplôme
Programa del Diploma

Markscheme

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Sports, exercise and health science

Higher level

Paper 2

19 pages

Section A

Question			Answers	Notes	Total
1.	a	i	gymnasts with high training level ✓	*Both gymnast* ***and*** *high required for* ***[1]*** *mark.*	**1**
1.	a	ii	160–140 ✓ =20 «cm» ✓	*Accept the subtraction in a different order.* *Accept correct calculation if (a)(i) is incorrect.*	**2**
1.	a	iii	children who regularly participate in sport perform better on standing broad jump ✓ gymnasts perform better than children from other sports across all participation levels ✓ A high level/ >5hr per week of training appeared to have a significant effect on standing broad jump performance in every sport when compared to the other 2 groups/ the greater the training the greater the effect✓	*Accept other reasonable hypothesis.*	**2**
1.	a	iv	low to moderate training level group did not show «statistically» <u>significant</u> results ✓ moderate and high training level group did show «statistically» significant results/ showed they were significantly different to 95% ✓ low and high training level group did show «statistically» <u>significant</u> results/ showed they were significantly different to 99% ✓	*Accept response if "significant" is mentioned once but implied in the rest of the answers. Eg the low to moderate training level did not show significant results but the moderate and high training level group and the low and high training level group did.*	**3**
1.	b	i	vertical jump/Sargent test ✓	*Accept valid tests eg Wingate, Margaria-Kalamen, 1RM or 3RM leg press, leg dynamometer.*	**1**

1.	**b**	**ii**	place a vertical marker from a standing position ***OR*** create a "baseline" measurement ✓ perform a two-foot take-off ✓ bending knees/swinging the arms for the take-off ✓ place a vertical marker at the apex of the jump ✓ power is measured as the distance from standing position marker to marker at the apex of the jump;	*Despite current research award **[1]** mark for warm-up.* *Accept protocols for alternate valid test from (b)(i).*	**3 max**

2.	**a**		14 «points» ✓		**1**
2.	**b**		15–5 ✓ =10 «points» ✓	*Accept the subtraction in a different order.*	**2**
2.	**c**		*Non-linear pedagogy/variable practice yields stronger learning outcomes because:* individual differences are taken into consideration when teaching ✓ there is high level of connectivity between athlete and coach that develops a deeper understanding of the individual ✓ learning is process oriented and therefore the learner understands how the movement fits in the larger programme ✓ *Practicing in drill model creates improved retention because:* the motor programmes are developed and solidified ✓		**3 max**

3.	**a**		elasticity ✓		**1**
3.	**b**	**i**	*Origin*: ilium ✓ *Insertion*: tibia **«**tibial tuberosity**»** ✓		**2**
3.	**b**	**ii**	tendons connect muscles to bones ✓ ligaments connect bones to bones ✓ ligaments and tendons stabilize joints ✓ tendons enable flexion and/ or extension of the joint✓		**2 max**
3.	**c**		cycling produces higher maximal oxygen consumption/VO_2max values than arm ergometry ✓	*Accept in the converse.*	**1**
3.	**d**		Gases/O_2 move from a high to low partial pressure / concentration gradient✓ Oxygen partial pressure is higher in the lungs than in the capillary ***OR*** oxygen/O_2 moves from the lungs/alveoli to the pulmonary capillaries ✓ Gases/O_2 diffuse across the membranes / into blood✓ The capillary and alveoli walls are 1 cell thick <which assists in the high rate of diffusion>✓ A large surface area increases diffusion rate✓ the amount and rate of gas exchange that occurs across the membrane depends on the partial pressure of O_2, the thickness of the wall and the surface area <which is Fick's Law>✓ <98%> oxygen combines with hemoglobin <to form oxyemoglobin>✓		**4 max**

3.	**e**	**i**	secreted by endocrine glands «typically in short bursts but sometimes over longer period of time» ✓ communicate the regulation of «short term or long term» bodily functions ✓ specific to their receptor/target site ✓ most are carried in the blood ✓		**2 max**
3.	**e**	**ii**	regulated through a «negative» feedback loop mechanism ✓ regulated by signaling from the nervous system «adrenaline» ✓ regulated by the chemical changes in the blood «insulin» ✓		**2 max**

4.	**a**		changes the electrical/neural impulse into a chemical stimulus at the motor end plate ***OR*** ACh is released when an action potential/nerve arrives at the motor end plate ✓ ACh binds to post synaptic receptors✓ increases membrane permeability to sodium ions/Na^+ ✓ which causes Ca^{++} to be released <into the muscle cell> ✓ ACh is broken down < by cholinesterase> to prevent continual muscle stimulation✓		**2 max**
4.	**b**		Type I has a high density of capillaries and mitochondria ✓ high capillary density allows for increased oxygenation ✓ high mitochondrial density allows for increased use of oxygen ***OR***		**2 max**

			high mitochondrial density allows for use of aerobic respiration «producing high amounts of ATP» ✓ both contribute to activities that require prolonged energy supply ***OR*** increases fatigue resistance ✓		
4.	**c**		in diagram A the centre of mass/COM is perpendicular to the contact point on the beam/ ✓ in diagram B the centre of mass/COM shifts to the left «of the beam» ✓ in order for the COM to remain above «the beam» the gymnast needs to move her body in line above the beam ***OR*** e.g the gymnast needs to move her legs further to the right in order to compensate for the torso moving to the left ✓ in diagram B the gymnast could lower their COM ***OR*** e.g by moving into a tucked position above the beam ✓		**3 max**
4.	**d**	**i**	A: air resistance ✓ B: ground reaction force ✓ C: friction ✓	*2 correct for [1] mark* *3 correct for [2] marks*	**2 max**
4.	**e**		wave drag can be reduced by avoiding motion at the interface between air and water ✓ swimming underwater for as long as is allowed at the start of a race ✓ by using wave limiting lane ropes✓		**2**

5.	**a**		sensory: receiving sensory impulses ✓ association: interpreting and storing input/initiating a response ✓ motor: transmitting impulses to effectors ✓		**2 max**
5.	**b**		*Strengths:* the identification of life-threatening conditions such as risk of sudden cardiac death, connective tissue disorder ✓ the potential to predict susceptibility to injury and so reduce risk/improve safety for an individual athlete ✓ the possibility of benefits from pre-selection for more suitable sporting activities ✓ *Limitations:* ethical implications of involuntary exclusion from, or discrimination in, one or more sports ✓ ethical implications of discrimination beyond sport, for example, in employment ✓ may encourage application of gene modification to improve athletic performance ✓		**5 max**

Section B

Question			Answers	Notes	Total
6.	a		glucose and oxygen are used to make ATP using aerobic respiration ✓ if the blood has low level of glucose or oxygen mental state can be altered negatively ***OR*** without glucose or oxygen, the person may experience dizziness or convulsions ✓ glucose storage in the brain is limited ✓ glucose moves rapidly into the brain cells ✓		**3 max**
6.	b		separates the relevant information from the irrelevant/noise information ***OR*** only relevant information is passed to the short-term memory ✓ an athlete concentrates on a specific cue or stimulus such as the ball/position of player and excludes the others such as the other players/cheering crowd ✓ can be improved by learning through past experience and interaction with long-term memory ✓ operates in the short-term sensory store ✓	*Award **[2 max]** only if no example is provided.*	**3 max**
6.	c	i	motor programme is a set of movements stored as a whole in the memory «regardless of whether feedback is used in their execution» OR consists of an executive programme and subroutines✓		**1**
6.	c	ii	practice of the motor programme/subroutines for a jump/gymnastic routine improves proficiency ✓	*Accept any valid example that refers to a gymnastics routine.*	**2 max**

			improved proficiency reduces executive programmes to subroutines as the movement has become more fluid ✓ this results in opportunity to practice more complex motor programmes such as a hand spring ✓		
6.	**d**		*Genetic factors:* a combination of height and flexibility allows for the optimal stride length and strength ✓ an athlete with more slow twitch/type I muscle fibres does better in long distance running ✓ an athlete with a higher lung capacity has an advantage in long distance running ✓ mental toughness/resilience enables runners to endure longer practices/training resulting in improvement in performance ✓ *Environmental factors:* training maximizes the likelihood of obtaining a performance level with a genetically controlled ceiling ✓ balanced diet/proper nutrition high in «low glycemic index» carbohydrates are best for an endurance athlete ✓ technological aids «such as timing equipment» can help improve pacing and performance ✓ altitude training can improve endurance performance at sea level ✓	*Award **[2 max]** for a list, **[3 max]** per factor.*	**5 max**

6.	**e**		during «approximately» the first minute all energy systems will be working ✓ during an 800m run, energy systems do not respond in a sequential manner ✓ ATP-CP system: ATP production is from the breakdown of phosphocreatine <anaerobically> during initial seconds of activity ✓ 1 PC = 1 ATP ✓ may contribute at other times of rapid change in energy demand <as long as a steady state is found where the athlete settles into a pace> such as at the end of the race ✓ can only last for 10-15 seconds/short burst ✓ Lactic Acid System: partial breakdown of glucose anaerobically to produce ATP ✓ 1 glucose molecule = <net> 2ATP ✓ will dominate after the ATP-PC system up to 1-2 minutes <while the aerobic system gets fully functional> ✓ The lactic acid system will dominate at other times where effort increases towards 100% such as during the final sprint ✓ Aerobic System: The aerobic system will dominate from approx. 1-2 minutes as the runner settles into their race pace ✓ 1 glucose molecule = 38 ATP with the aerobic system ✓ Complete breakdown of glucose molecule in the presence of oxygen ✓	*Award [3 max] for each energy system and [5 max] if only 2 energy systems are discussed*	**6 max**

7.	**a**		Cardiovascular drift is an increase in heart rate during prolonged exercise <despite effort remaining the same>✓ during prolonged exercise there is an increase in core temperature ✓ the rise in core temperature causes redistribution of blood to the periphery in order to cool ✓		**3 max**

			the blood volume redistribution causes the heart to work harder in order to maintain muscle blood flow / energy demands✓ blood flow to skin increases and water is lost via sweating ✓ prolonged cooling/sweating causes a decrease in blood volume / increase in viscosity✓ reduction in venous return/stroke volume causes the heart rate to increase to maintain cardiac output ✓		
7.	**b**		*Location:* located «in the brain» below the hypothalamus ✓ *Function:* <u>main</u> endocrine gland influencing other glands ✓ secretes hormones ***OR*** ADH/GH/TSH/ACTH/oxytocin secretion ✓ responsible for homeostasis ***OR*** regulates a wide range of bodily functions «growth», «water retention», «temperature» ✓		**3 max**
7.	**c**		ventilation is «chemically» regulated by blood acidity levels/low pH ✓ blood acidity levels increase/pH drops due to an increase in carbon dioxide levels ✓ blood acidity levels are detected by chemoreceptors ✓	*Accept appropriately labelled diagram.*	**3 max**

			medulla oblongata/ANS/respiratory control centre receive information from receptors ✓ increased blood acidity «and information from the proprioceptors» increases the depth / rate of ventilation ✓		
7.	**d**		depletion of muscle and liver glycogen reserves reduces energy source for ATP production ✓ reduction in Ca^{++} release reduces muscle ability to perform muscle contraction ✓ depletion of acetylcholine decreases effectiveness of muscle contraction ✓ «muscles contain approximately 70% water» dehydration decreases effectiveness of waste product removal ✓ electrolyte loss causes decreased nerve function and can cause cramping ✓ overheating causes decreased muscle function as enzymes work best at normal body temperature conditions ✓ increased peripheral fatigue takes place with unusually high intensity/lower VO_2max ✓	*Award **[2 max]** for a list.*	**5 max**

7.	**e**		*Post-exercise oxygen consumption/EPOC/oxygen debt takes place because there is a need for:* breathing remains elevated until recovery is complete ✓ EPOC is paying back the oxygen deficit during the initial energy demands achieved by the anaerobic systems ✓ reformation of phosphocreatine ✓ replenishment of myoglobin stores ✓ removal of lactic acid ✓ replenishment of glycogen stores «up to 24 hours» ✓ a highly trained aerobic athlete returns to a steady state quicker than untrained ***OR*** a highly trained aerobic athlete has a smaller EPOC than untrained ✓		**6 max**

8.	**a**		the model provides support to athletes and coaches to improve performance ✓ addresses mechanical factors that affect performance ✓ suggests that there is a hierarchy of factors on which successful performance is based ✓ factors that can be considered are speed principles/force principles/coordination principles/specific performance principles ✓		**3 max**

8.	b		fibrous/synarthrosis — no movement ✓ cartilaginous/amphiarthrosis — slight movement ✓ synovial/diarthrosis — freely movable ✓		**3**
8.	c	i	inflammatory reactions in muscle associated with structural muscle damage/overstretching/overtraining ✓ The pain felt in the muscle 24–72 hours after exercise due to vigorous training✓		**1**
8.	c	ii	undergo prior eccentric exercise ✓ start training at a low intensity ✓ gradual increase of the intensity ✓		**2 max**
8.	d		a tucked body position that decreases surface area/size while cycling decreases drag ✓ decreased opposing wind decreases drag ✓ clothing such as tight apparel will decrease drag ✓ equipment for cycling such as appropriately designed helmet and bicycle will decrease drag ✓ avoidance of turbulent air/drafting/being behind the athlete in front decreases drag ✓ shaving/waxing skin has a positive effect on reducing drag ✓ lower speed decreases drag ✓	*Award **[2 max]** for a list.*	**5 max**

<table>
<tr><td>8.</td><td>e</td><td></td><td>sodium ions/Na^+ enter the muscle and change the polarization in the myofibril ✓
the sarcoplasmic reticulum releases calcium ions ✓
calcium ions bind to troponin ✓
Tropomyosin/troponin complex exposes the binding site «on actin» ✓
myosin «head» creates a cross-bridge with the actin ✓
power stroke takes place ✓
myosin releases actin if new ATP appears ✓
myosin head reattached further down the actin filament repeating the cycle < called the ratchet mechanism>✓
process goes on until acetylcholine-esterase breaks the acetylcholine down ✓</td><td></td><td>6 max</td></tr>
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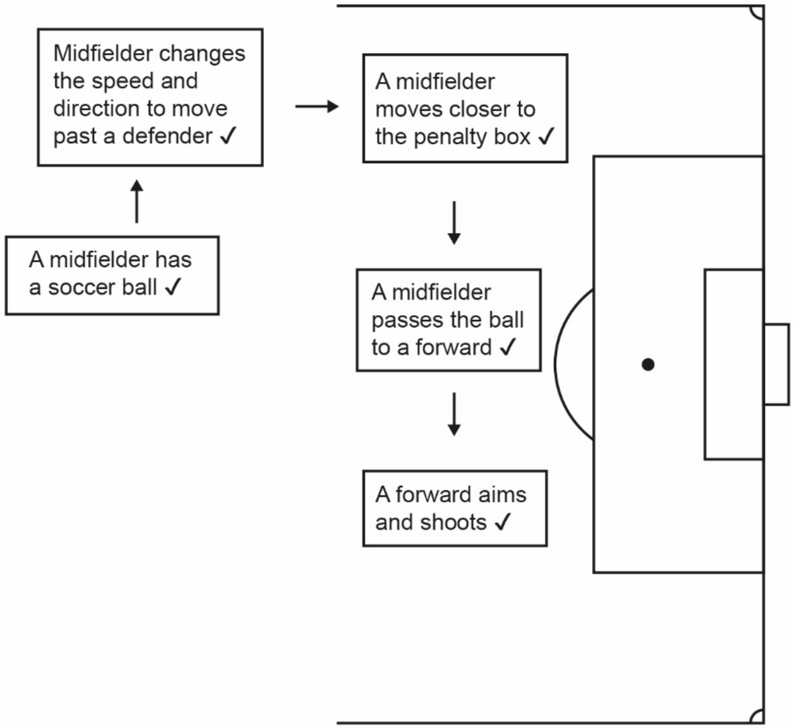
<tr><td>9.</td><td>a</td><td></td><td>from the right ventricle blood travels «through pulmonary valve» into <u>pulmonary artery</u> ✓
from pulmonary artery blood travels to the lungs «gets oxygenated» and back to the heart via <u>pulmonary vein</u> ✓
from pulmonary vein blood enters the <u>left atrium</u> ✓
from left atrium blood travels to <u>left ventricle</u> «via bicuspid valve» ✓</td><td>Accept a labelled diagram.</td><td>3 max</td></tr>
<tr><td>9.</td><td>b</td><td></td><td><table><tr><td></td><td>untrained</td><td>trained</td><td></td></tr><tr><td>stroke volume</td><td>lower</td><td>higher</td><td>✓</td></tr><tr><td>resting heart rate</td><td>higher</td><td>lower</td><td>✓</td></tr><tr><td><Maximal>cardiac output</td><td>lower</td><td>higher</td><td>✓</td></tr></table>For a set task at submaximal level Q will be the same but SV will be higher in trained✓
and HR will be higher in untrained✓</td><td></td><td>3</td></tr>
</table>

9.	**c**		the player who has possession ✓ the location (in the field of play) for a change in possession ✓ the player who gains possession ✓ the method of change in possession (for example, tackle or interception) ✓ *eg* 	*Award* ***[1 max]*** *if not drawn.* *Award* ***[1 max]*** *if not in sequential order.* *Accept any appropriate example.*	**3 max**

9.	**d**		the relationship can be seen as a J curve ✓ highly-trained athletes are more susceptible to infections than their sedentary peers ✓ highly-trained athletes have lower leucocyte numbers caused by the stress of the exercise ✓ highly trained athletes can experience inflammation caused by muscle damage ✓ athletes have greater exposure to airborne bacteria and viruses because of an increased rate and depth of breathing ✓ moderate exercise, however, is associated with reduced susceptibility to infection ✓	*Award **[2 max]** for a list.*	**5 max**

9.	**e**		psychological refractory period/PRP is the increase in reaction time to a second stimulus caused when the second stimulus has been delivered while the performer is responding to the first stimulus OR it is the time delay in reaction time caused by the arrival of a second stimulus before the first is processed ✓ this is believed to take place due to brain processing information on a single track/using the single channel mechanism ✓ in sports you can use PRP as an advantage by introducing a dummy stimulus before the real movement ✓ strengths: can be used to help a performer have greater chances of success eg pretending to pass / run one direction then quickly changing to pass / run the other way ✓ provides a performer with a greater range of options in their play ✓ external noise eg: other players calling, or crowd noise can enhance the effectiveness of the PRP ✓ the more options that a player has will increase the reaction time to the stimulus <Hick's law> ✓ limitations: if a performer uses it too often, they will become predictable and this limits success✓ PRP may be reduced by anticipation/early cue detection / effective coach analysis / practicing «open» skills ✓ anxiety might make the performer get the timing wrong and thus the PRP is not effective ✓	*Award **[2 max]** for an annotated diagram of the single channel hypothesis for mark points 1 and 2.* Award 4 [max] if only strengths or limitations provided Award [4 max] if no example given	**6 max**