Diploma Programme
Programme du diplôme
Programa del Diploma

Markscheme

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Sports, exercise and health science

Standard level

Paper 2

22 pages

Section A

Question			Answers	Notes	Total
1.	a		Group 2/trained participants ✓		1
	b		0.3 «g min^{-1}» ✓	*Units not required.*	1
	c		a high r value «0.86» is a strong positive correlation ***OR*** there is a positive trend between VO_2max and fat oxidation «rate» ***OR*** as VO_2 max increases so does fat oxidation «rate» ✓ group 2/trained participants are running faster «therefore require more energy» ✓ fats provide energy for the participants ***OR*** respiration involves fat oxidation ✓ the highest VO_2max is not the highest fat oxidation «rate» value ✓ the existence of a correlation does not establish that there is a causal relationship «between the two variables» ✓		3 max

1.	**d**		ensuring the safety/decreasing risk of the participant before/during the exercise testing procedure ***OR*** information provided in the questionnaire will allow the test administrator to identify any factors or contraindications / health status prior to participating in the study ✓ to meet the criteria for ethical approval of the study ✓		**2 max**
	e		increase ✓ «by» 0.6 «W kg^{-1}»✓ from 11.8 to 12.4 «W kg^{-1}» ✓	*Units not required.* *Accept the subtraction in a different order.*	**1 max**
	f	**i**	«all methods» have demonstrated a positive impact / an increase in peak power output ✓		**1**
		ii	«all methods» have demonstrated a positive impact / an increase in VO_2max ✓		**1**

1.	**g**		an increase in left ventricular volume ***OR*** increased stroke volume ✓ lower resting heart rate ✓ lower heart rate during submaximal exercise at the same relative exercise intensity ✓ increased cardiac output during maximal exercise ✓ increased capillarisation ✓ higher arterio-venous difference ✓ hypertrophy ✓		**2 max**
	h		arm ergometry involves less muscle mass compared to cycling ✓ arm ergometry has a lower VO_2max compared to cycling ✓ dependent on previous training the difference between VO_2max between the two modes could be very large ✓	*Must state the relative relationship between cycling and arm ergometry for MP.*	**2 max**

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

Question			Answers	Notes	Total
3.	a		adipose tissue ✓ skeletal muscle ✓		1 max
	b		fats are broken down during beta (β) oxidation ✓ fatty acids are broken down into acetyl CoA ✓ 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✓ «motor skill development» depends on building each new skill upon those learned previously ✓ triple jump adds the stage of hop & step to the long jump ✓	*Accept other applicable explanations.*	2 max
	b		pose less risk to the performer ✓ can be used by a wide range of the population/children/elderly/untrained ✓ do not require high levels of motivation ✓ allow estimation of an individual's maximal capacity ✓ 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		*Axial skeleton:* provides protection of vital organs ✓ *eg*, skull protects the brain «during a tackle in rugby» ✓ supports the weight of the upper body ✓ *eg*, vertebral column supports the weight of the upper body «while balancing on a beam in gymnastics» ✓ *Appendicular skeleton:* provides attachment for muscles ✓ *eg*, scapula provides attachment for rotator cuff muscles «which support the shoulders during the rings and vaulting» ✓ provides levers to allow movement ✓ *eg*, humerus and ulna articulate to form a lever «that allows for a more effective release of a javelin» ✓	*Award **[2 max]** per skeleton type for both function and example.* *Award **[1 max]** if either an outline or example has not been provided.* *Accept any other suitable examples.*	**4 max**
	b		diaphragm contracts ***OR*** flattens ✓ «external» intercostal muscles contract ✓ raising the rib cage upwards and outwards ✓ this increases the thoracic volume ✓ this decreases the thoracic pressure ✓ final stages of the race accessory muscles contract (*eg, pectoralis* minor, sternocleidomastoid and scalenes) increase (thoracic) volume further ✓	*Award **[4 max]** if there is no reference to accessory muscles.*	**5 max**

5.	**c**		all energy systems work in a continuum during physical activity depending on the intensity / duration / fuel availability / oxygen availability ✓ *ATP-CP System/PC system/alactic system:* resynthesizes ATP during brief high intensity exercise «for more than 3 seconds to less than 10 seconds» ✓ *eg,* in hockey/soccer when performing a sprint/explosive movement for the ball at speed 20-60 m ✓ *The lactic acid system / anaerobic glycolysis:* resynthesizes ATP during short/medium high intensity exercise «between 10s–2 mins range» ✓ *eg,* in hockey/soccer during transition of play such as a counter attack from defense ✓ *Aerobic system:* hockey/soccer requires moderate/high intensity movements but is ongoing «more than 2 minutes» ✓ used during recovery between high intensity bouts or during lower intensity periods ✓ *eg,* returning to the half way line after a goal is scored ✓	*Accept any reasonable ranges for duration. Accept other suitable examples.* *Award **[5 max]** if all three systems are not mentioned.* *Award **[3 max]** without applied examples.* ***[2 max].***	**6 max**

5.	**d**		greater fibres per motor neuron therefore more fibre recruitment per contraction ✓ fast motor neuron conduction transports action potential quickly ✓ a highly developed sarcoplasmic reticulum helps spread the action potential across the muscle fibre quickly ✓ «therefore» delivery of calcium is increased to the muscle cell ✓ «therefore» the contractile speed is fast ✓ high PC and ATP stores provide immediate source of energy for fast muscle contraction ✓ high glycogen stores provide energy for high intensity movements ✓ have a high anaerobic capacity «which is important for sprinters» ✓ can produce an explosive performance «which is required at the start of the event» ✓		**5 max**

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

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

6.	**d**		*BMI (body mass index):* Body mass index is a measure of an adult's weight in relation to height/weight in kg divided by their height in metres squared ✓ *Strengths:* more accurate than standard height and weight tables ✓ easy to administer ✓ non invasive ✓ *Limitations:* BMI is not a direct measure of body fat ✓ not suitable for certain populations *eg*, children, pregnant women, elderly or athletes ✓ despite its inaccuracy it is still used as a medical standard to assess obesity ✓ *Anthropometry:* most common field technique is skinfold calipers ✓ where skin fat thickness is measured at a number of sites and the sum of these sites used in an equation estimates percentage body fat ✓ *Strengths:* accuracy is greater than BMI ✓ more detailed protocol and equations are used to focus on gender specific differences ✓ widely used due to its accessibility ✓	*Award **[3 max]** per test.* *At least **one** strength and **one** limitation per test. Accept other suitable examples of strengths and limitations.* ***[3 max].*** *At least **one** strength and **one** limitation per test. Accept other suitable examples of strengths and limitations.*	**6 max**

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

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

7.	**b**					*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.*	**5 max**

Skill profile continuum	*Javelin throw*	*Table tennis forehand*	
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»	✓

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

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