Oxford Cambridge and RSA

GCE

Physical Education

H555/01: Physiological factors affecting performance

Advanced GCE

Mark Scheme for November 2020

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This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by examiners. It does not indicate the details of the discussions which took place at an examiners' meeting before marking commenced.

All examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the report on the examination.

Annotations used in the detailed Mark Scheme

Annotation	Description	Annotation	Description
	Tick	KU	Knowledge and understanding / indicates AO1 on Q9
	Cross	EG	Example/Reference / indicates AO2 on Q9
BOD	Benefit of doubt	DEV	Development / indicates AO3 on Q9
TV	Too vague	L1	Level 1 response on Q9
REP	Repeat	L2	Level 2 response on Q9
S	Indicates sub-max reached where relevant	L3	Level 3 response on Q9
SEEN	Noted but no credit given	L4	Level 4 response on Q9
IRRL	Significant amount of material which doesn't answer the question	BP	Blank page

- Sub-maxes are indicated with **S**; the guidance section of the mark scheme shows which questions these are relevant to.
- **KU/EG/DEV** used instead of ticks on the extended response question to indicate where knowledge or development points from the indicative content have been made.
- On this extended response question, one KU/EG/DEV does not necessarily equate to one mark being awarded; the marking is based on a levels of response mark scheme which awards a level and mark holistically based upon the quality of the response overall against the levels descriptors.

Section A					
Question			**Answer**	**Mark**	**Guidance**
1			Two marks for: 1. (explosive strength) rugby player sprinting down the wing 2. (aerobic capacity) to jog around in defence in football tracking the ball/ last full 90 minutes of football match without tiring	2 AO2 x 2)	DNA: examples from non-team games. 1 Evidence high intensity 2 Evidence sustained or continuous effort/ low intensity
2			Two marks for: 1. (exothermic) (ATP →) ADP + P + **energy** 2. (endothermic) **energy** + ADP + P (→ ATP)	2 AO1 x 2	DNA pt 1 or 2 without **energy**
3			Two marks for: **1.** (linear) movement of a body in a (straight or curved) line **and** all parts move the **same distance, in the same direction, in the same time** 2. (angular) movement of a body (or part of a body) in a circular path about an axis of rotation	2 AO1 x 2	Point 2: NB. Accept 'centre of mass' for axis of rotation as a **BOD** NB. Accept 'rotation about an axis' **BOD**
4			Two marks for: 1. (displacement) m / metres 2. (acceleration) metres/sec/sec **OR** ms^{-2} **OR** m/s^2	2 AO1 x 2	NB: mark 1st response only for each answer
5			Two marks for: **1.** (SV definition) volume / amount of blood pumped out of heart / ventricles / left ventricle **per beat** **2.** (value) (any value within the range) 80 – 120**ml**	2 AO1 x 1 AO2 x 1	DNS point 2 without correct units

Section B

Question			Answer	Mark	Guidance
6	(a)		Six marks for: Elbow: Phase of movement: Downward; Joint movement: **Extension**; Agonist: **Biceps brachii**; Type of contraction: **Eccentric** Elbow: Phase of movement: Upward; Joint movement: **Flexion**; Agonist: **Biceps brachii**; Type of contraction: **Concentric**	6 AO3 x 6	NB. Accept first answer only
6	(b)	(i)	Four marks from: 1. Anaerobic / without oxygen 2. Breakdown of glycogen / glucose **to** pyruvic acid / pyruvate 3. Pyruvic acid / pyruvate is converted **to** lactic acid / lactate 4. Enzyme GPP/glycogen phosphorylase / PFK / phosphofructokinase / LDH / lactate dehydrogenase 5. (net gain of) 2 ATP produced / 1:2 energy yield 6. Sarcoplasm / cytoplasm of a muscle cell	4 AO1 x 4	NB. DNA 'glycolysis' alone.
6	(b)	(ii)	Two marks from: 1. (.cf PC) Produces **more** ATP / energy / work at a lower intensity / longer duration than ATP-PC system 2. (.cf O_2) Produces **less** ATP / energy / work at a higher intensity / shorter duration than aerobic system 3. LA produced which inhibits performance / denatures enzymes **OR** no by-products from ATP-PC **OR** no **inhibiting** by-products from aerobic system	2 AO3 x 2	DNA more efficient than ATP-PC system – TV

6	**(c)**		Four marks from: 1. Lactacid (debt) component 2. Extra / additional oxygen needed 3. Removal of lactic acid / CO_2 4. Transported in the blood / exhaled from the lungs 5. Aerobic respiration / energy system used (to aid recovery) 6. (Approx) 5 – 8 litres of oxygen used	4 AO2 x 4	 DNA: 'Lacticacid' component for point 1.
6	**(d)**		Four marks from: (Cardiovascular) (Sub-max 3) 1. Increase in heart rate 2. Decrease in stroke volume 3. Decrease in **maximal** cardiac output / heart rate 4. Decrease in blood / plasma volume 5. Reduced haemoglobin saturation (with oxygen) 6. Decrease in O_2 transport to muscle 7. Decrease in diffusion gradient (Respiratory) (Sub-max 3) 8. Increase in tidal volume / depth 9. Increase in breathing rate / frequency 10. Decrease in ppO_2 in **inspired** air 11. Decrease in oxygen diffusion / diffusion gradient from alveoli to (capillary) blood / lungs	4 AO1 x 4	Note: Sub-max of 3 marks per section of the question

Question			Answer	Mark	Guidance
7	(a)		Six marks from: (Hydration) (Sub-max 3) 1. (+ve) prevent dehydration / fluid loss **OR** maintain low / correct blood viscosity / improved cognitive function **OR** prevent headaches (or eq.) associated with dehydration 2. (+ve) prevent overheating / maintain correct body temperature 3. (-ve) reduced / low levels of sodium / salt / electrolytes / EAH / (exercise-associated) hyponatraemia 4. (-ve) nausea / vomiting / headache / muscle weakness / cramp / stomach discomfort (Caffeine) (Sub-max 3) 5. (+ve) increased fat breakdown **OR** preserved glycogen stores / glycogen sparing 6. (+ve) increased nerve stimulation **OR** increased focus / concentration / improved reaction time 7. (-ve) diuretic / dehydration / increased urine production 8. (-ve) insomnia / anxiety / gastrointestinal / digestive problems / high blood pressure / heart rate related complications	6 AO2 x 6	DNA: increased reaction time
7	(b)		Four marks from: 1. Performer cycles / runs on treadmill / performs continuous exercise 2. Progressive / increasing intensity 3. To exhaustion **OR** maximal test 4. Mask is worn to collect expired air 5. Expired air is analysed 6. (Relative) concentrations of O_2 **and** CO_2 are measured 7. (expired air) is compared to atmospheric / inhaled air One mark for: 8. Maximum volume of oxygen consumed per minute 9. VO2max is the accepted / accurate measure 10. VO2max presented on a graph / usage is compared to intensity (using graph) to give VO_2max (AO3)	5 AO1 x 4 AO3 x 1	Accept: any appropriate exercise for testing N.B. Sub-max 4 for description of test.

7	**(c)**		Four marks from : (CHD – sub-max 3) 1. Reduces cholesterol / LDL / (blood) lipids / fats 2. Prevents atherosclerosis / build up of fatty deposits / plaque on artery walls / atheroma 3. Prevents arteriosclerosis / hardening / loss of elasticity of artery walls 4. Decreases blood viscosity / resistance to flow / blood pressure **OR** less strain on heart 5. cardiac hypertrophy / increase size / strength of cardiac muscle **OR** cardiac efficiency **OR** decrease resting HR **OR** increase SV 6. Reduces risk of heart attacks / strokes (or equiv) (asthma – sub-max 3) 7. Increases strength of respiratory muscles 8. Maintain full use / elasticity of lung tissue 9. Increases surface area of alveoli / efficiency of gas exchange 10. Increase in **pulmonary** capillaries 11. Reduces risk of **chest / respiratory** infections	4 AO2 x 4	
7	**(d)**		Five marks from: 1. **Protect** the ankle by use bandages / splints / crutches / moving away from play **OR** from further damage 2. **Rest** the ankle by not applying weight / standing **OR** to allow healing **3. Ice** the ankle by applying cold therapy or eq. **OR** to reduce swelling / inflammation / pain 4. **Compression** of ankle using tape / bandage **OR** to reduce swelling 5. **Elevate** the ankle above heart level **OR** to reduce blood flow 6. Anti-inflammatories / pain meds / NSAIDs 7. Refer to hospital if concerned about severity **OR** if symptoms get worse 8. Be aware of the possibility of a fracture / broken bone	5 AO2 x 5	DNA PRICE on its own NB: marks awarded only if applied

Question			Answer	Mark	Guidance
8	(a)	(i)	(flight path of B) 1. Diagram showing non-parabolic flight with dip on right hand side (unless arrow shows DOM from right to left).	1 AO3 x 1	(flight path of B) 
8	(a)	(ii)	Four marks from: 1. A is heavier / has higher mass than B (or opposite) 2. A - weight is greater than air resistance / W > AR / W dominant force 3. B has a greater AR / travelling at higher velocity than A 4. B - air resistance is greater than weight / AR > W / AR dominant force 5. E.g. A is medicine ball and B is a football	4 AO3 x 4	Accept suitable alternatives for pt. 5
8	(a)	(iii)	Four marks for: 1. (Velocity) as velocity increases AR increases 2. (Shape) the more aerodynamic / streamlined the lower the AR 3. (Frontal X-sectional area) the greater the f**rontal** cross-sectional area the higher the AR 4. (Surface) the smoother the surface the lower the AR 5. (Spin) (direction of) spin affects AR	4 AO1 x 4	Accept opposites where appropriate
8	(b)		Four marks for: (balanced force) 1. Two or more forces acting are equal in size **and** opposite in direction **OR** Net force = 0 **OR** W = R / AR = F **OR** no change in motion / stationary / constant velocity 2. E.g. rugby scrum / tug-of-war where there is no movement **OR** e.g. runner at constant velocity (Unbalanced force) 3. Two or more forces are not equal in size **OR** net force is present **OR** change in state of motion / acceleration / deceleration **OR** F > AR / R > W (or opposite) 4. E.g. tennis serve	4 AO1 x 2 AO2 x 2	NB. Accept resultant force for net force in point 3.

8	**(c)**		Three marks for: 1. (Definition) Rate of change in angular displacement **OR** rate / speed of rotation 2. (equation) Angular displacement ÷ time **OR** angular velocity = angular momentum / moment of inertia 3. (Units) radians per second **OR** rad/s **OR** $rads^{-1}$	3 AO1 x 3	
8	**(d)**		Four marks from: 1. Applies an off-centre / eccentric force / torque / moment 2. Causes side spin 3. Air flows faster / higher velocity on **left** side of ball 4. Creating lower pressure on **left** side 5. Air flows from a high to low pressure / pressure gradient 6. Causing magnus effect / magnus force	4 AO2 x 4	N.B. air flow diagrams must be annotated to gain credit N.B. accept opposites for points 3+4 NB. 'Spin' is TV for point 2

Section C		
Question	**Answer**	**Guidance**
9*	**Level 4 (17–20 marks)** • detailed knowledge and excellent understanding (AO1) • well-argued, independent opinion and judgements which are well supported by relevant practical examples (AO2) • detailed analysis and critical evaluation (AO3) • very accurate use of technical and specialist vocabulary • there is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.	**At Level 4 responses <u>are likely</u> to include:** • detailed knowledge of muscle fibre types, their recruitment and the factors affecting strength • detailed explanation of the use of each muscle fibre type by a marathon runner and a sprint hurdler • detailed evaluation of a range of factors affecting strength, applied to both athletes • at the top of this level the use of all three muscle fibre types for both athletes may have been explained, and evaluations of factors affecting strength are specific to both athletes. There may be reference to synchronisation to explain muscle fibre recruitment • AO1, AO2 and AO3 all covered well in this level.
	Level 3 (12–16 marks) • good knowledge and clear understanding (AO1) • independent opinions and judgements will be present but may not always be supported by relevant practical examples (AO2) • good analysis and critical evaluation (AO3) • generally accurate use of technical and specialist vocabulary • there is a line of reasoning presented with some structure. The information presented is in the most-part relevant and supported by some evidence.	**At Level 3 responses <u>are likely</u> to include:** • good knowledge of muscle fibre types, their recruitment and the factors affecting strength • the use of the predominant muscle fibre type has been explained clearly for both athletes, and at the top level the use of other fibre types may be addressed • a good range of factors affecting strength have been described and there is evidence of some evaluation of these factors • maximum of 7 marks to be awarded for AO1 and 7 marks for AO2; some AO3 required for top of this level.
	Level 2 (7-11 marks) • limited knowledge and understanding (AO1) • opinion and judgement given but often unsupported by relevant practical examples (AO2) • some evidence of analysis and critical evaluation (AO3) • technical and specialist vocabulary used with limited success • the information has some relevance and is presented with limited structure. The information is supported by limited evidence.	**At Level 2 responses <u>are likely</u> to include:** • limited knowledge of muscle fibre types, their recruitment and the factors affecting strength • the use of the predominant muscle fibre type may have been explained for each athlete • some factors affecting strength have been described but evaluations are limited • One part of the question may have been addressed more strongly than the others. • maximum of 7 marks to be awarded for AO1 with no application.

Section C		
Question	**Answer**	**Guidance**
	Level 1 (1–6 marks) • basic knowledge and little understanding (AO1) • little or no attempt to give opinion or judgement (AO2) • little relevant analysis or critical evaluation (AO3) • little or no attempt to use technical and specialist vocabulary • the information is basic and communicated in an unstructured way. The information is supported by limited evidence and the relationship to the evidence may not be clear.	**At Level 1 responses <u>are likely</u> to include:** • basic knowledge of muscle fibre types and factors affecting strength • limited attempt to apply knowledge to the marathon runner and hurdler • little or no attempt to evaluate factors affecting strength • some inaccurate or irrelevant information may be present • mainly AO1 content.
	(0 marks) No response or no response worthy of credit.	

9* 20 marks (AO1 x 7; AO2 x 7; AO3 x 6)

Indicative content:

AO1 - KU	AO2 – EG	AO3 - DEV
(marathon runner)		
1. (SO structural characteristics) o small neurons / few fibres per neuron o lots of mitochondria o High myoglobin content of oxygen o High capillary density	E.g. marathon runner must maintain have high levels of endurance / stamina E.g. to complete event in 2 hours + E.g. to run faster than opponents	High aerobic / low anaerobic capacity High fatigue resistance Low force of contraction Slow speed of contraction
3. (Fast oxidative) o Large neurons / many fibres per neuron o High stores of phosphocreatine o High capillary density o Moderate amount of mitochondria o Moderate myoglobin content of oxygen	E.g. good for muscular endurance E.g. to outpace opponents over prolonged period E.g. to increase pace to try and tire opponents who have a better sprint finish	Fast speed of contraction High force of contraction Moderate aerobic / anaerobic capacity Moderate fatigue resistance
4. (Fast glycolytic) o Large neurons / many fibres per neuron o High stores of phosphocreatine	E.g. for sprint finish E.g. sprint at start to get good position E.g. burst of speed for dynamic direction change	Fast speed of contraction High force of contraction High anaerobic / low aerobic capacity Low fatigue resistance
(hurdler) (NB. Learners may describe and evaluate general characteristics of fibres here rather than for marathon runner, but credit AO1s and AO3s only once)		
4. (FTG characteristics)	E.g. hurdler needs fast glycolytic fibres for explosive speed and power E.g. to sprint and clear hurdles as fast as possible E.g. to be faster than opponents	
5. (Fast oxidative)	E.g. fast oxidative to maintain speed at end of race/ maintain hurdle clearance E.g. for higher intensity training sessions	
6. (Slow oxidative)	E.g. for quicker recovery during training/ between heats	

(recruitment)		
7. At low intensity only slow oxidative fibres are used	E.g. aerobic / steady pace during marathon	Slow oxidative always used first Recover quickly / available for recruitment after just 90 seconds
8. At higher intensities fast oxidative fibres will be recruited (as well as SO fibres)	E.g. increase in pace during marathon	
9. At highest intensities fast glycolytic fibres recruited **OR** all 3 fibre types are recruited	E.g. sprinting during hurdle race / marathon finish	FG fibres only recruited in last 2 – 20 seconds of contraction / near muscle exhaustion / when max effort needed quickly FG fibres have a long recovery time

(factors affecting strength)		
10. Cross-sectional area	The greater the cross-sectional area the greater the strength	Both marathon and hurdler need to remain light / avoid large / heavy muscles to excel Hurdler may have greater XSA due to proportion of FG/FOG If X-sectional area is same in a male and female, strength will be equal
11. Gender	Males generally have higher muscle mass / faster times Males tend to have higher testosterone levels	Both events are split by gender so less of an impact Some marathons have women competing alongside men
12. Age	Peak strength between 20 – 30 years Females 16 – 25 years / males 18 – 30 years	Decline in strength due to less efficient neuromuscular system And lower testosterone / reduced elasticity / reduced muscle mass Greater demand for strength in hurdling so peak performance younger than marathon
13. Training / lifestyle		Hurdler will place greater focus on high explosive strength / power / speed Most of hurdler's training will focus on this Marathon runner will need strength endurance But training focus will be on aerobic capacity Marathon runner may do some sprint work
14. Genetics	Influence of parents on percentages of each fibre type / hormone levels	Athletes with high percentage of FT fibres may achieve early success in sprinting and be motivated to pursue this activity

OCR (Oxford Cambridge and RSA Examinations)
The Triangle Building
Shaftesbury Road
Cambridge
CB2 8EA

OCR Customer Contact Centre

Education and Learning
Telephone: 01223 553998
Facsimile: 01223 552627
Email: general.qualifications@ocr.org.uk

www.ocr.org.uk