



GCE

Physical Education

H555/01: Physiological factors affecting performance

A Level

Mark Scheme for June 2022

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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.

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MARKING INSTRUCTIONS

PREPARATION FOR MARKING SCORIS

3. Make sure that you have accessed and completed the relevant training packages for on-screen marking: Scoris Assessor Online Training; OCR Essential Guide to Marking.
4. Make sure that you have read and understood the mark scheme and the question paper for this unit. These are posted on the RM Cambridge Assessment Support Portal <http://www.rm.com/support/ca>
5. Log-in to scoris and mark the 10 practice responses (“scripts”) and the 10 standardisation responses

YOU MUST MARK 10 PRACTICE AND 10 STANDARDISATION RESPONSES BEFORE YOU CAN BE APPROVED TO MARK LIVE SCRIPTS.

MARKING

1. Mark strictly to the mark scheme.
2. Marks awarded must relate directly to the marking criteria.
3. The schedule of dates is very important. It is essential that you meet the Scoris 50% and 100% (traditional 40% Batch 1 and 100% Batch 2) deadlines. If you experience problems, you must contact your Team Leader (Supervisor) without delay.
4. If you are in any doubt about applying the mark scheme, consult your Team Leader by telephone or the Scoris messaging system, or by email.
5. **Crossed Out Responses**
Where a candidate has crossed out a response and provided a clear alternative then the crossed out response is not marked. Where no alternative response has been provided, examiners may give candidates the benefit of the doubt and mark the crossed out response where legible.

Rubric Error Responses – Optional Questions

Where candidates have a choice of question across a whole paper or a whole section and have provided more answers than required, then all responses are marked and the highest mark allowable within the rubric is given. Enter a mark for each question answered into RM assessor, which will select the highest mark from those awarded. *(The underlying assumption is that the candidate has penalised themselves by attempting more questions than necessary in the time allowed.)*

Contradictory Responses

When a candidate provides contradictory responses, then no mark should be awarded, even if one of the answers is correct.

Short Answer Questions (requiring only a list by way of a response, usually worth only **one mark per response**)

Where candidates are required to provide a set number of short answer responses then only the set number of responses should be marked. The response space should be marked from left to right on each line and then line by line until the required number of responses have been considered. The remaining responses should not then be marked. Examiners will have to apply judgement as to whether a 'second response' on a line is a development of the 'first response', rather than a separate, discrete response. *(The underlying assumption is that the candidate is attempting to hedge their bets and therefore getting undue benefit rather than engaging with the question and giving the most relevant/correct responses.)*

Short Answer Questions (requiring a more developed response, worth **two or more marks**)

If the candidates are required to provide a description of, say, three items or factors and four items or factors are provided, then mark on a similar basis – that is downwards (as it is unlikely in this situation that a candidate will provide more than one response in each section of the response space.)

Longer Answer Questions (requiring a developed response)

Where candidates have provided two (or more) responses to a medium or high tariff question which only required a single (developed) response and not crossed out the first response, then only the first response should be marked. Examiners will need to apply professional judgement as to whether the second (or a subsequent) response is a 'new start' or simply a poorly expressed continuation of the first response.

6. Always check the pages (and additional objects if present) at the end of the response in case any answers have been continued there. If the candidate has continued an answer there then add a tick to confirm that the work has been seen.

7. Award No Response (NR) if:

- there is nothing written in the answer space

Award Zero '0' if:

- anything is written in the answer space and is not worthy of credit (this includes text and symbols).

Team Leaders must confirm the correct use of the NR button with their markers before live marking commences and should check this when reviewing scripts.

8. The scoris **comments box** is used by your team leader to explain the marking of the practice responses. Please refer to these comments when checking your practice responses. **Do not use the comments box for any other reason.** If you have any questions or comments for your team leader, use the phone, the scoris messaging system, or e-mail.

9. Assistant Examiners will send a brief report on the performance of candidates to your Team Leader (Supervisor) by the end of the marking period. The Assistant Examiner's Report Form (AERF) can be found on the RM Cambridge Assessment Support Portal (and for traditional marking it is in the Instructions for Examiners). Your report should contain notes on particular strength displayed as well as common errors or weaknesses. Constructive criticism of the question paper/mark scheme is also appreciated.

10. For answers marked by levels of response:

- a. **To determine the level** – start at the highest level and work down until you reach the level that matches the answer
- b. **To determine the mark within the level**, consider the following:

Descriptor	Award mark
On the borderline of this level and the one below	At bottom of level
Just enough achievement on balance for this level	Above bottom and either below middle or at middle of level (depending on number of marks available)
Meets the criteria but with some slight inconsistency	Above middle and either below top of level or at middle of level (depending on number of marks available)
Consistently meets the criteria for this level	At top of level

11. 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	Marks	Guidance	
1			Two marks from		2 (AO1)	Do not accept: Reference to the heart Do not accept: reference to a delay of impulse to the AV node
			1. (Atria relax)	Atria/ventricles do not contract or atria/ventricles relax or atria/ventricles are filling/fill with blood		
			2. (No impulse)	(due to ...) No (electrical) impulse/signal		
2			Two marks from		2 (AO1)	
			1.(Oxygen)	Replenish/restore/re-link blood/haemoglobin/muscle/myoglobin with oxygen		
			2.(ATP)	Resynthesise/replenish ATP (in the muscle)		
			3.(PC)	Resynthesise/replenish phosphocreatine/PC or Restore (muscle) phosphagen		

Section A							
Question			Answer			Marks	Guidance
3			Two marks from			2 (AO1)	Description required for mark
			1.(BMR/RMR)	(Basal metabolic rate/resting metabolic rate) the minimum amount of energy/calories expended/required to sustain essential body function at rest			
			2.(TEF)	(Thermic effect of food) the energy expended/required to digest/absorb/process food			
			3. (Physical activity energy expenditure/MET)	(Physical activity energy expenditure) the energy/calories expended/required to perform tasks/(sports) activity or (Metabolic equivalent of task) is the working:resting metabolic ratio/a measure of the energy expenditure of different activities			
4			Two marks from: (Must have correct name and description)			2 (AO1)	Stamp KU for correctly named key term, then TICK for accompanying correct description. Must name and describe for each mark.
			1. (Line 3 in table)	Refer	Refer immediately to a qualified health care professional/specialist/medical attention		
			2. (Line 5 in table)	Recover	Players must be symptom free / fully recovered or 1-week adult/ 2 weeks U18's (before seeking an authorised return to play)		

8

Section B								
Question			Answer			Marks	Guidance	
6	(a)	(i)	Three marks from			3 (AO3)	Mark first answer only	
				Movement	Agonist muscle			Plane of movement
			1. Flexion	2. Biceps Femoris or semi-membranosus or semi-tendinosus	3. Sagittal			
		(ii)	Two marks from			2 (AO1)	Accept: Combined answer eg: “diaphragm and external intercostal muscles relax” = 2 marks	
		1.	Diaphragm relaxes/domes					
		2.	<u>External</u> intercostals relax					

(b)	Six marks		6 (AO1)	Sub-max 3 marks for exercise/recovery
	1.(ANS)	Heart rate regulated/controlled by the autonomic nervous system/ANS		
	2. (CCC)	Cardiac control centre receives information from the receptors		
	(Exercise – submax 3)			
	3.(Receptors)	Chemoreceptors detect increased (pp)CO ₂ /acidity/lactic acid or decreased (pp)O ₂ /pH or proprioceptors/mechanoreceptors detect (increased) motor activity/movement or baroreceptors detect increased blood pressure		
	4. (Sympathetic system)	sympathetic nervous system (to increase HR)		
	5.(Cardiac accelerator nerve)	(Cardiac) accelerator nerve (stimulated)		
	6.(SA node)	SA node increases firing rate/HR		
	(Recovery – submax 3)			
	7. (Receptors)	Chemoreceptors detect decreased (pp)CO ₂ /acidity/lactic acid or increased (pp)O ₂ /pH or proprioceptors/mechanoreceptors detect decreased motor activity/movement or baroreceptors detect decreased blood pressure		
	9. (Parasympathetic system)	parasympathetic nervous system (to decrease HR)		
	10. (Vagus nerve)	Vagus nerve (stimulated)		
	11. (SA node)	SA node decreases firing rate/HR		

(c)	Six marks from:	6 (AO3)	Do not accept: Pt.2 ppO ₂ is lower in the muscles than the capillaries Do not accept: reference to CO ₂ (pt 1-5)	
	(Changes in the pressure gradient: submax 4)			
	1.(Pressure gradient)			Gradient is steeper/increased
	2.(ppO ₂ in muscles)			(pp)O ₂ in working muscles is reduced/lower
	3.(Reason)			Because the working muscles are using more O ₂ for <u>aerobic respiration/energy system</u>
	4.(O ₂ diffusion rate)			Diffusion/gaseous exchange (of O ₂ from capillary/blood) to muscle is faster/ rate increased/more efficient
	5.(O ₂ into muscle volume)			More O ₂ diffuses into the muscle
	(Changes in dissociation of oxyhaemoglobin: submax 4)			
	6.(Bohr shift)			The (oxy)haemoglobin dissociation curve shifts to the <u>right</u> or Bohr shift
	7. (ppCO ₂ /acidity/temperature)			there is an increase in CO ₂ /acidity/temperature or decrease in pH
	8. (Effect)			Causing reduced affinity of haemoglobin for O ₂ or causing increased dissociation of oxyhaemoglobin/O ₂ from haemoglobin or causing reduced saturation of haemoglobin with O ₂
	9. (O ₂ diffusion)			More oxygen available for diffusion to the muscle

	(d)	(i)	One mark from <table border="1"><tr><td>1.</td><td>14 days + / 2 weeks minimum</td></tr></table>	1.	14 days + / 2 weeks minimum	1 (AO2)	Mark first answer only Do not accept: any range that includes less than 14 days										
1.	14 days + / 2 weeks minimum																
		(ii)	Two marks from: <table border="1"><tr><td>1. (EPO)</td><td>Increased release (of the hormone) erythropoietin/EPO (by the kidneys)</td></tr><tr><td>2. (RBC)</td><td>Increased red blood cell/RBC/erythrocyte volume/haemoglobin</td></tr><tr><td>3. (Capillarisation)</td><td>Increased capillarisation (at alveoli/muscles) or increased capacity for gaseous exchange at the alveoli/muscles</td></tr><tr><td>4. (Ventilation)</td><td>Breathing rate/ventilation stabilise (at higher rate compared with sea level)</td></tr><tr><td>5. (SV/Q)</td><td>Decrease in stroke volume/cardiac output/Q (compared to arrival at altitude).</td></tr><tr><td>6. (Other effects)</td><td>Decrease in altitude sickness/headaches/poor sleep/lack of appetite.</td></tr></table>	1. (EPO)	Increased release (of the hormone) erythropoietin/EPO (by the kidneys)	2. (RBC)	Increased red blood cell/RBC/erythrocyte volume/haemoglobin	3. (Capillarisation)	Increased capillarisation (at alveoli/muscles) or increased capacity for gaseous exchange at the alveoli/muscles	4. (Ventilation)	Breathing rate/ventilation stabilise (at higher rate compared with sea level)	5. (SV/Q)	Decrease in stroke volume/cardiac output/Q (compared to arrival at altitude).	6. (Other effects)	Decrease in altitude sickness/headaches/poor sleep/lack of appetite.	2 (AO1)	
1. (EPO)	Increased release (of the hormone) erythropoietin/EPO (by the kidneys)																
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6. (Other effects)	Decrease in altitude sickness/headaches/poor sleep/lack of appetite.																

13

	(b)	(i)	Three marks from	3 (AO1)	If a range is stated both lower and upper value must be within the accepted range stated			
			<table><tr><td>Resistance</td><td>Repetitions</td><td>Sets</td></tr><tr><td>1. 50 – 75% of <u>1rep max/1RM</u></td><td>2. 15-30</td><td>3. 3 - 6</td></tr></table>			Resistance	Repetitions	Sets
Resistance	Repetitions	Sets						
1. 50 – 75% of <u>1rep max/1RM</u>	2. 15-30	3. 3 - 6						
		(ii)	Four marks from:	4 (AO2)	Guidance: Must link explanation to the benefit to the marathon			
			<table><tr><td></td><td>KU</td><td>EG</td></tr></table>		KU	EG		
	KU	EG						

H555/01

Mark Scheme

June 2022

			<table><tr><td>1.(Muscular hypertrophy)</td><td>Muscular hypertrophy/muscle mass or increase in size of muscle fibres</td><td rowspan="3">Eg: enables increased force of contraction/power during run/sprint finish</td></tr><tr><td>2.(Hyperplasia)</td><td>Hyperplasia/increased number/splitting of muscle fibres</td></tr><tr><td>3. (Cross-bridges)</td><td>Increased actin/myosin filaments/cross-bridges</td></tr><tr><td>4. (Motor units)</td><td>Increased recruitment of muscle fibres/co-ordination of motor units</td><td>Eg: Increased efficiency of muscular contraction for running action</td></tr><tr><td>5. (Stretch reflex/ GTOs)</td><td>Delayed stretch reflex or delayed/decreased reciprocal inhibition or delayed threshold of Golgi tendon organs/GTOs</td><td>Eg: More force can be applied in the agonist for running action/stride length increases Eg: greater stretch of the antagonist/hamstrings allows higher knee lift in run/sprint finish</td></tr><tr><td>6. (Fuel stores)</td><td>Increased ATP/PC/glycogen stores in muscle</td><td rowspan="3">Eg: Runner can work at higher intensity for longer/ increased speed/anaerobic work/delay fatigue/OBLA/lactate threshold</td></tr><tr><td>7. (Buffering)</td><td>Increased buffering capacity/tolerance to lactic acid</td></tr><tr><td>8. (Aerobic)</td><td>Increased mitochondrial density/myoglobin content/capillary density</td></tr><tr><td>9. (Enzymes)</td><td>Increased enzyme/ATP-ase/creatine kinase/PFK activity/ activation</td><td>Eg: Increased intensity of all energy systems during the marathon</td></tr><tr><td>10. (Tendons/ ligaments)</td><td>Increased strength of ligaments/tendons</td><td rowspan="2">Eg: Reduce risk of runner's injury</td></tr><tr><td>11. (Bone density)</td><td>Increased bone density/mass</td></tr></table>	1.(Muscular hypertrophy)	Muscular hypertrophy/muscle mass or increase in size of muscle fibres	Eg: enables increased force of contraction/power during run/sprint finish	2.(Hyperplasia)	Hyperplasia/increased number/splitting of muscle fibres	3. (Cross-bridges)	Increased actin/myosin filaments/cross-bridges	4. (Motor units)	Increased recruitment of muscle fibres/co-ordination of motor units	Eg: Increased efficiency of muscular contraction for running action	5. (Stretch reflex/ GTOs)	Delayed stretch reflex or delayed/decreased reciprocal inhibition or delayed threshold of Golgi tendon organs/GTOs	Eg: More force can be applied in the agonist for running action/stride length increases Eg: greater stretch of the antagonist/hamstrings allows higher knee lift in run/sprint finish	6. (Fuel stores)	Increased ATP/PC/glycogen stores in muscle	Eg: Runner can work at higher intensity for longer/ increased speed/anaerobic work/delay fatigue/OBLA/lactate threshold	7. (Buffering)	Increased buffering capacity/tolerance to lactic acid	8. (Aerobic)	Increased mitochondrial density/myoglobin content/capillary density	9. (Enzymes)	Increased enzyme/ATP-ase/creatine kinase/PFK activity/ activation	Eg: Increased intensity of all energy systems during the marathon	10. (Tendons/ ligaments)	Increased strength of ligaments/tendons	Eg: Reduce risk of runner's injury	11. (Bone density)	Increased bone density/mass	runner (eg) for mark for AO2 credit. KU for adaptation, TICK for correct accompanying e.g. Accept: one relevant example for multiple relevant KU points
1.(Muscular hypertrophy)	Muscular hypertrophy/muscle mass or increase in size of muscle fibres	Eg: enables increased force of contraction/power during run/sprint finish																														
2.(Hyperplasia)	Hyperplasia/increased number/splitting of muscle fibres																															
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10. (Tendons/ ligaments)	Increased strength of ligaments/tendons	Eg: Reduce risk of runner's injury																														
11. (Bone density)	Increased bone density/mass																															
	(c)	(i)	One mark from:	1 (AO2)																												

			(increased range of motion) Swimmer can apply force over an increased distance/time (during the arm pull/propulsive phase) or swimmer moves a greater distance through the water (with each arm pull/propulsive phase) or swimmer is more efficient/requires less strokes to travel the same distance/achieves faster times/swims quicker or decreased risk of injury			
		(ii)	Four marks from: (Advantages – submax 3)		4 (AO3)	

17

H555/01

Mark Scheme

June 2022

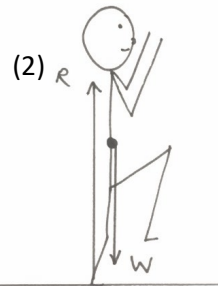
	(d)	(i)	One mark from: <table><tr><td>1.(Cause and bone)</td><td>Caused by sudden event/impact/trauma and affects <u>bone</u></td></tr></table>	1.(Cause and bone)	Caused by sudden event/impact/trauma and affects <u>bone</u>	1 (AO2)	Guidance: Must have both cause and reference to bone for mark										
1.(Cause and bone)	Caused by sudden event/impact/trauma and affects <u>bone</u>																
		(ii)	Four marks from <table><tr><td>1.(Open surgery)</td><td>Incision made to open a joint to access injury</td></tr><tr><td>2.(Realign bones)</td><td>Realign fractured/dislocated bones</td></tr><tr><td>3.(Stabilise)</td><td>Use of plates/pins/rods/wires to stabilise fractures/dislocation</td></tr><tr><td>4.(Arthroscopy)</td><td>Arthroscopy/keyhole surgery to access injury/small incisions/camera to access injury/be less invasive</td></tr><tr><td>5.(Knee/Meniscus)</td><td>Repair/trim/resurface meniscus/cartilage in (knee) joint</td></tr><tr><td>6.(Shoulder/Labrum)</td><td>Used to repair Bankart lesion/damaged labrum/cartilage in shoulder/treat repeated shoulder dislocations</td></tr></table>	1.(Open surgery)	Incision made to open a joint to access injury	2.(Realign bones)	Realign fractured/dislocated bones	3.(Stabilise)	Use of plates/pins/rods/wires to stabilise fractures/dislocation	4.(Arthroscopy)	Arthroscopy/keyhole surgery to access injury/small incisions/camera to access injury/be less invasive	5.(Knee/Meniscus)	Repair/trim/resurface meniscus/cartilage in (knee) joint	6.(Shoulder/Labrum)	Used to repair Bankart lesion/damaged labrum/cartilage in shoulder/treat repeated shoulder dislocations	4 (AO2)	Do not accept: reference to soft tissue repairs e.g. ACL reconstruction etc.
1.(Open surgery)	Incision made to open a joint to access injury																
2.(Realign bones)	Realign fractured/dislocated bones																
3.(Stabilise)	Use of plates/pins/rods/wires to stabilise fractures/dislocation																
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H555/01

Mark Scheme

June 2022

8	(a)	(i)	One mark from		1 (AO2)	
			(increasing friction)	allows greater acceleration/deceleration/change of direction/speed/velocity/drive force or to improve grip/decrease the chance of their foot/feet slipping/increase stability		
		(ii)	Three marks from		3 (AO2)	Guidance: must give sporting example for mark accept any suitable example Mark KU for explanation and TICK accompanying correct example Accept: pt.4 increased stickiness (BOD)
			KU	EG		
			1. Increased roughness of footwear/tyres	athletes wear spikes or hockey players wear astro shoes or rugby players wear boots/studs or tyres of mountain bikes have deep tread or gymnasts chalking/taping hands		
			2. Increased softness of contact surface	rubber soles on training shoes or adjust tyre pressure on bike		
			3. Increased roughness of ground surface	cross country runner choosing to run a line on rougher ground/rubber/tartan track		
			4. Increased temperature	heating tyres /warm up laps in motor sports		
			5. Increased reaction/normal force generated	spoiler on F1 car generates downforce high/long/triple jumpers dip at take off or heavy rugby players/shot putters		

	(b)	Five marks from: (Free body diagram) <table><tr><td>1.(Weight – see pic below)</td><td>Weight force acting vertically downwards from C of M</td></tr><tr><td>2.(Reaction – see pic below)</td><td>(Ground) Reaction force/Normal reaction acting vertically upwards from the point of contact with the ground and longer than weight force</td></tr></table>  (1) (Explanation) <table><tr><td>3.($R>W$)</td><td>$R>W$/ Reaction force is greater than weight</td></tr><tr><td>4.(Net force)</td><td>(Positive) net force Or (external) unbalanced force</td></tr><tr><td>5.(Acceleration)</td><td>There is acceleration (upwards)</td></tr><tr><td>6.(Take off)</td><td>The basketball player leaves the ground</td></tr></table>	1.(Weight – see pic below)	Weight force acting vertically downwards from C of M	2.(Reaction – see pic below)	(Ground) Reaction force/Normal reaction acting vertically upwards from the point of contact with the ground and longer than weight force	3.($R>W$)	$R>W$ / Reaction force is greater than weight	4.(Net force)	(Positive) net force Or (external) unbalanced force	5.(Acceleration)	There is acceleration (upwards)	6.(Take off)	The basketball player leaves the ground	5 (AO2)	Pt. 2 if there is no ground indicated BOD <i>Pt. 6 'jumps upwards'/'takes off' - TV</i>
1.(Weight – see pic below)	Weight force acting vertically downwards from C of M															
2.(Reaction – see pic below)	(Ground) Reaction force/Normal reaction acting vertically upwards from the point of contact with the ground and longer than weight force															
3.($R>W$)	$R>W$ / Reaction force is greater than weight															
4.(Net force)	(Positive) net force Or (external) unbalanced force															
5.(Acceleration)	There is acceleration (upwards)															
6.(Take off)	The basketball player leaves the ground															

(c)	Five marks from	Weight of rugby player:	
		1.(Use of formula/workings)	Weight = mass x acceleration due to gravity / W = mg or W = 96 x 10
		2. (Answer with units)	960N or 960Newtons or 960kgm/s ²
		Acceleration between 0s and 2.5s:	
		3.(Use of formula/workings)	acceleration = $\frac{\text{Final velocity} - \text{initial velocity}}{\text{Time}} \quad / \frac{v-u}{t}$ or $\frac{\text{change in velocity}}{\text{time}}$ or $\frac{8-0}{2.5}$ or $\frac{8}{2.5}$
		4.(Answer with units)	3.2m/s/s or 3.2 m/s ² or 3.2 ms ⁻²
		Momentum at maximum velocity:	
		5.(Use of formula/workings)	Momentum = mv or mass x velocity or 96 x 8
		6.(Answer with units)	768 kgm/s or 768 kgms ⁻¹

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Section C		
Question	Answer	Guidance
9*	Level 4 (17–20 marks) • detailed knowledge and excellent understanding (AO1) • well-argued 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: • accurate interpretation of the velocity/time graph • detailed understanding to explain the shape of the graph with reference to positive and negative sections • detailed analysis of the interplay of the energy systems relating to several factors affecting the interplay. • a range of practical examples illustrate the predominant energy systems within the team game • AO1, AO2 and AO3 all covered in detail in this level. At the top of this level, responses are likely to: • demonstrate a detailed knowledge of forces • make reference to Newton’s laws of motion • and factors affecting the predominant energy system have been logically applied to the relevant examples.
	Level 3 (12–16 marks) • good knowledge and clear understanding (AO1) • 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: • mainly accurate interpretation of the velocity time graph with minor errors only • application of the hockey shot to most stages of the graph • good analysis of the interplay of energy systems and knowledge demonstrated of more than one factor affecting the interplay • a practical example is used to illustrate when each of the three energy systems are predominant within the team game • If AO1 and AO2 are detailed, significant AO3 is required for top of this level

Section C		
Question	Answer	Guidance
	Level 2 (7-11 marks) - limited knowledge and understanding (AO1) - 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: - interpretation of the velocity time graph will be attempted but contain errors - application of the hockey shot to some parts of the graph is attempted but may be inaccurate - a practical example is used to illustrate when two of the three energy systems is predominant within the team game - analysis of the interplay of energy systems is attempted and a factor affecting the interplay will be identified. - Responses that are very unbalanced between each part or between each AO may be in this level.
	Level 1 (1–6 marks) - basic knowledge and little understanding (AO1) - little or no attempt to give 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: - interpretation of the velocity time graph may not include all stages and are likely to contain significant errors. - application of the hockey shot to a part of the graph may be attempted - a practical example of when one energy system is predominant may be attempted - basic knowledge of all three energy systems may be shown at the top of this level - mainly AO1 content, some AO2 at the top of this level.
	(0 marks) No response or no response worthy of credit.	

Marks: 20 (AO1 x 6, AO2 x 7, AO3 x 7)

Guidance: Maximum of 6 marks to be awarded for AO1
Maximum of 7 marks to be awarded for AO2

Maximum of 7 marks to be awarded for AO3

Indicative Content:

	AO1 - KU	AO2 - EG	AO3 - DEV
Explanation of v/t graph :			
(A to B)	1.Acceleration/ increasing velocity/increasing momentum	• Ball is hit • Stick applies force to the ball	• (reference to Newton 1) Player/stick applies a large (external) force to cause a change in the state of motion of the ball • (reference to Newton 2) the larger the force applied (by the player/stick) on the ball, the greater the acceleration/ in the direction of the hit / towards the goal
(B to C)	2.Maximum/ constant/uniform velocity	• Maximum velocity reached as ball leaves the stick	• (reference to Newton 1) opposing forces are balanced/ net force = 0/ there is no net force acting on the ball (as the ball leaves the stick)
(C to D)	3. (quick/rapid) Deceleration/ decreasing velocity/ decreasing momentum 4. At D velocity = 0	• The ball hits the post. • the ball becomes stationary at point D.	• (reference to Newton 3) the ball applies a (action) force on the post/ the post applies an equal and opposite force on the ball • Post applies (reaction) force to cause a change in the state of motion of the ball/velocity
(D to E)	5.Acceleration/ increasing velocity/increasing momentum <u>in opposite direction</u>	• Ball changes direction during the rebound. • post applies a force to the ball • the ball accelerates in the new direction between points D-E • At point E the ball has maximum velocity/momentum in the new direction.	• (reference to Newton 3) Post applies (reaction) force to cause a change in the state of motion of the ball/velocity in the opposite direction

	AO1 - KU	AO2 - EG	AO3 - DEV
	Interplay of energy systems		
(Intermittent exercise)	6. Activity where the intensity alternates either between work and relief intervals	during a game with breaks of play and changes in intensity	
(Interplay – Energy Continuum)	7. The relative contribution of each energy system to overall energy production 8. A performer can move between any of the 3 energy systems		• When factors change, predominant system changes/ interplay of systems
(Threshold)	9. An energy system threshold is the point at which a performer’s predominant energy production moves from one energy system to another		• Anaerobic / ATP-PC:glycolytic threshold • Aerobic / glycolytic:aerobic threshold
(ATP-PC)	10. ATP-PC system predominant during very	Credit relevant practical examples of v.high	• ATP/energy is resynthesised/ provided quickly as short/few reactions • No delay for Oxygen (system is anaerobic)

	high/maximal intensity exercise 11. ATP/PC system predominant during short duration exercise/up to 10 seconds	intensity/<10s duration <u>from a team game</u> : - eg (Very high) Making a tackle in hockey/rugby - eg (short) Sprint to receive a centre pass in netball	- PC/fuel readily available in the sarcoplasm/ muscle cytoplasm - PC fuel stores deplete after 10 secs
(Glycolytic)	12. Glycolytic system predominant during high intensity exercise 13. Glycolytic system predominant up to 3 minutes duration	Credit relevant practical examples of high intensity/ 10s-3min duration <u>from a team game</u> : - eg (High) A rugby forward pack making repeated drives for the try line - eg (mid) counter attack in netball	- ATP/energy is resynthesised/ provided quite quickly as relatively short/few reactions - No delay for Oxygen (system is anaerobic) - Glucose (fuel) readily available in the bloodstream - Glycogen (fuel) is readily available in the muscle cell/ large fuel store - Lactic acid is produced as a by-product/ higher the intensity the more lactic acid is accumulated - Lactic acid causes fatigue/OBLA
(Aerobic)	14. Aerobic energy system predominant during low/moderate intensity exercise 15. The aerobic system is predominant during exercise longer than 3 minutes duration	Credit relevant practical examples of mod/low intensity/ >3min duration <u>from a team game</u> : - eg (low) A cricketer when fielding (when ball not coming to him) - eg (long) Tracking play in football defense - Unusual for long periods of low intensity exercise to occur in a team game	- Steady state exercise - Oxygen demand high/ oxygen required/ oxygen available - Glycogen (fuel) is readily available in the muscle cell/ large fuel store - Large FFA stores available
Other factors	16. Level	(eg U14C v 1st VII Netball match)	- Length of game/half/quarter - Length of time before recovery periods

	17. Position 18. Type of game 19. Tactics	• (eg GK v Midfield football player) • (eg invasion or eg size of pitch) • (eg zonal v man to man)	
(Recovery periods)	20. Recovery periods affect the interplay of energy systems	• During half time in football • Time out in basketball • Rolling substitutes in hockey/basketball • Tactical plays to allow periods of rest for some players	• Aerobic system predominant during recovery • Maintain elevated respiratory and circulatory rates to enable recovery processes • The performer may begin recovery/fast stage of EPOC • Resynthesis of PC stores/phosphogen recovery • 30seconds for 50%/2-3 minutes for 100% • Performer may then use the ATP-PC system for high intensity work • Myoglobin stores replenished/oxy-myoglobin link restored (in 3 minutes) • Performer may begin to remove lactic acid depending on recovery time/W:R ratio
(Fitness)	21. High levels of (cardio-vascular fitness) affect the interplay of energy systems	• Accept any 1 relevant cardio-vascular adaptation, eg cardiac hypertrophy • Accept any 1 relevant strength-based adaptation, eg muscular hypertrophy	(Physically fitter performers ...) • can use the aerobic system sooner during exercise due to more efficient oxygen delivery • can use the aerobic system predominantly during higher intensity exercise/higher % VO2 max (than an unfit performer) • ..which reduces fatigue as glycolytic system not used predominantly • can use fat as a fuel at higher intensity exercise which conserves glycogen for the glycolytic system • can work for longer at high intensity using glycolytic system as OBLA is delayed (due to buffering) • can recover more quickly from using anaerobic systems • can re-use anaerobic systems more quickly. (accept opposites for unfit performers)

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