



Oxford Cambridge and RSA

**GCE**

**Physical Education**

**H155/01: Physiological factors affecting performance**

AS Level

**Mark Scheme for June 2023**

OCR (Oxford Cambridge and RSA) is a leading UK awarding body, providing a wide range of qualifications to meet the needs of candidates of all ages and abilities. OCR qualifications include AS/A Levels, Diplomas, GCSEs, Cambridge Nationals, Cambridge Technicals, Functional Skills, Key Skills, Entry Level qualifications, NVQs and vocational qualifications in areas such as IT, business, languages, teaching/training, administration and secretarial skills.

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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****RM ASSESSOR**

1. Make sure that you have accessed and completed the relevant training packages for on-screen marking: *RM Assessor Assessor Online Training*; *OCR Essential Guide to Marking*.
2. 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>
3. Log-in to RM Assessor and mark the **required number** of practice responses (“scripts”) and the **number of required** 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 RM Assessor 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 RM Assessor 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.)*

### **Multiple Choice Question Responses**

When a multiple choice question has only a single, correct response and a candidate provides two responses (even if one of these responses is correct), then no mark should be awarded (as it is not possible to determine which was the first response selected by the candidate).

*When a question requires candidates to select more than one option/multiple options, then local marking arrangements need to ensure consistency of approach.*

### **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.

- The RM Assessor **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 RM Assessor messaging system, or e-mail.
- Assistant Examiners will send a brief report on the performance of candidates to their Team Leader (Supervisor) via email by the end of the marking period. The report should contain notes on particular strengths displayed as well as common errors or weaknesses. Constructive criticism of the question paper/mark scheme is also appreciated.
- For answers marked by levels of response:
  - To determine the level** – start at the highest level and work down until you reach the level that matches the answer
  - 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

Annotation	Meaning
	Tick
	Cross
	Benefit of doubt
	Too vague
	Repeat
	Indicates sub-max reached where relevant
	Noted but no credit given
	Significant amount of material which doesn't answer the question
	Knowledge and understanding / indicates AO1 on Q8
	Example/Reference / indicates AO2 on Q8
	Development / indicates AO3 on Q8
	Level 1 response on Q8
	Level 2 response on Q8
	Level 3 response on Q8

Annotation	Meaning
	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.

**12. Subject Specific Marking Instructions**



Question			Answer	Mark	Guidance
1	(a)	(i)	A	1 (AO1)	
1	(a)	(ii)	C	1 (AO1)	
1	(a)	(iii)	B	1 (AO1)	
1	(a)	(iv)	C	1 (AO1)	
1	(b)		<p><b>Submax 2 for each fibre type.</b></p> <ol style="list-style-type: none"> <li>1. (when SO recruited) Slow oxidative/SO/Type 1 fibres recruited for submaximal/aerobic work/ low intensity work/ eg marathon / long distance</li> <li>2. (explanation SO functional) <b>because</b> slow oxidative/SO/type 1 fibres have high fatigue resistance/high aerobic capacity / slow contraction speed / low force of contraction</li> <li>3. (explanation SO structural) <b>because</b> they have high density/number of mitochondria or many capillaries or high myoglobin content</li> <li>4. (when FOG recruited) Fast oxidative glycolytic/FOG/Type 2a fibres recruited during high intensity exercise/ eg team sports / 400m / 800m.</li> <li>5. (explanation FOG functional) <b>because</b> fast oxidative glycolytic/FOG/Type 2a fibres have high force of contraction/fast</li> </ol>	6 (AO2)	<p><b>Do not accept:</b> Purely descriptive points - must be part of an explanation of recruitment related to intensity.</p> <p><b>Accept opposites</b></p>

Question		Answer	Mark	Guidance
		<p>speed of contraction <b>or</b> moderate fatigue resistance/ aerobic capacity/ anaerobic capacity</p> <p>6. (explanation FOG structural) <b>because</b> large neuron/motor unit size or high capillary density or phosphocreatine store or moderate myoglobin store / high glycogen store / high anaerobic enzyme store</p> <p>7. (when FG recruited) Fast glycolytic/FG/Type 2b fibres recruited during very high intensity/explosive activities/ when maximum effort needed quickly or in the last 2-20 seconds of contraction / shot put / 100m / sprint for ball</p> <p>8. (explanation of FG functional) <b>because</b> fast glycolytic/FG/Type 2b fibres have fast speed of contraction/high force of contraction/high anaerobic capacity / low fatigue resistance</p> <p>9. (explanation of FG structural) <b>because</b> FG fibres have high phosphocreatine store or large neuron/motor units/ high glycogen stores / high anaerobic enzymes / few mitochondria / few myoglobin / low capillary density.</p> <p>10.(Ladder) Muscle fibres recruited in a 'ladder system' where slow oxidative/SO/Type 1 fibres recruited first then as intensity/required force increases, fast oxidative glycolytic/FOG/Type 2a and finally fast glycolytic/FG/Type 2b fibres are subsequently recruited.</p>		
1	(c)	<p>Five marks from:</p> <p>1. (role of arterioles and pre-capillary sphincters is) to return the distribution of blood/cardiac output to resting levels <b>OR</b> 20% of blood flow to muscles/80% to organs</p>	5 (AO2)	<p><b>Accept:</b> Named organs (but not brain) for points 3,4,8,9 'Blended' answers for points 1 and 2, 3 and 4 etc.</p>

Question		Answer	Mark	Guidance
		2. (Role of arterioles and/or PCS is) to limit/reduce blood flow to the muscles <b>that have been working</b> 3. Arterioles leading to muscles <b>that have been working</b> vasoconstrict 4. Pre-capillary sphincters at the muscles <b>that have been working</b> constrict/contract 5. (Role of arterioles and/or PCS is) to increase/restore blood flow to the organs (that have had reduced blood flow during exercise) 6. arterioles leading to organs vasodilate 7. pre-capillary sphincters at the organs relax/dilate		
1	(d)	Five marks from: 1. (passive/active) Expiration during exercise is active <b>whereas</b> expiration at rest is passive 2. (expiratory muscles) Internal intercostals/ Rectus abdominus/internal obliques / external obliques contract during exercise <b>but</b> not at rest 3. (rib cage) Rib cage/ribs come downwards <b>and</b> inwards <b>more quickly/further</b> during exercise than at rest 4. (diaphragm) Diaphragm (forced) into dome shape/relaxed shape <b>more quickly</b> in exercise than at rest 5. (volume) Volume in thoracic cavity/thorax/chest/lungs decreases <b>more</b> during exercise than at rest 6. (pressure) Pressure in thoracic cavity/thorax/chest/lungs increases <b>more</b> during exercise than at rest 7. (air) More air expired/forced expiration/air expired faster during exercise than at rest <b>OR</b> breathing rate increases during exercise compared to rest.	5 (AO3)	Answers must show a contrast between rest and exercise

Question			Answer	Mark	Guidance

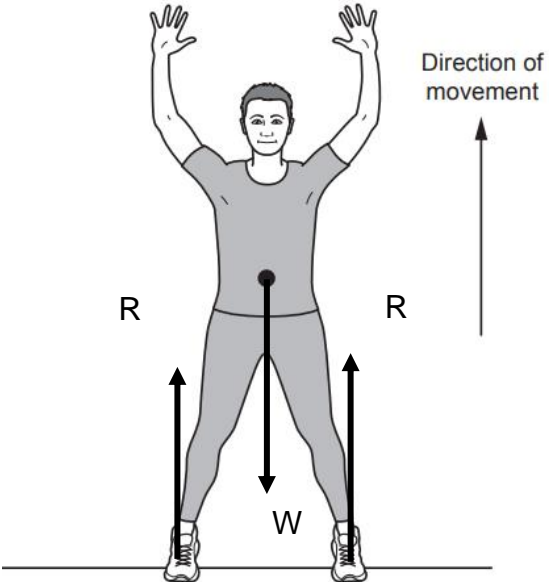
Question			Answer	Mark	Guidance
2	(a)	(i)	<p>Two marks for:</p> <ol style="list-style-type: none"> <li>(protein function) essential for growth and repair of tissues/ cells/ muscle/ haemoglobin/ enzymes</li> <li>(fat function) insulate nerves/ cushion organs/ form cell membranes/ energy store/ (fat soluble) vitamins/ essential fatty acids</li> </ol>	2 (AO1)	
		(ii)	<p>Two marks for:</p> <ol style="list-style-type: none"> <li>(protein importance) increase growth of muscle cells <u>during training</u> programme <b>OR</b> to repair muscles <u>following training</u> (fewer session missed) <b>OR</b> increase haemoglobin for O<sub>2</sub> carrying capacity</li> <li>(fat importance) marathon runner needs (unsaturated) fats for increased aerobic energy production <u>in each session</u>/increased endurance within each session /glycogen sparing/increased rate of recovery <u>between sessions</u> <b>OR</b> reduced joint inflammation/stiffness <u>after session</u></li> </ol>	2 (AO2)	

2	(b)	<p>Five marks for:</p> <table border="1" data-bbox="427 300 1429 1123"> <thead> <tr> <th data-bbox="427 300 786 395">Types of strength</th> <th data-bbox="786 300 1429 395">Definition</th> </tr> </thead> <tbody> <tr> <td data-bbox="427 395 786 523"><b>Static</b></td> <td data-bbox="786 395 1429 523">Force applied against a resistance with no movement or change in muscle length</td> </tr> <tr> <td data-bbox="427 523 786 651"><b><u>Dynamic</u></b></td> <td data-bbox="786 523 1429 651">Force applied with movement and a change in muscle length</td> </tr> <tr> <td data-bbox="427 651 786 810">Strength endurance</td> <td data-bbox="786 651 1429 810"><b>The ability to sustain repeated muscle contractions / apply a force over a period of time / withstanding fatigue</b></td> </tr> <tr> <td data-bbox="427 810 786 938">Maximum strength</td> <td data-bbox="786 810 1429 938"><b>The ability to produce a maximal /optimal amount of force in a single muscle contraction.</b></td> </tr> <tr> <td data-bbox="427 938 786 1123">Explosive strength</td> <td data-bbox="786 938 1429 1123"><b>The ability to produce a maximal amount of force in one or a series of rapid muscle contractions / fast contraction / high speed of contraction.</b></td> </tr> </tbody> </table>	Types of strength	Definition	<b>Static</b>	Force applied against a resistance with no movement or change in muscle length	<b><u>Dynamic</u></b>	Force applied with movement and a change in muscle length	Strength endurance	<b>The ability to sustain repeated muscle contractions / apply a force over a period of time / withstanding fatigue</b>	Maximum strength	<b>The ability to produce a maximal /optimal amount of force in a single muscle contraction.</b>	Explosive strength	<b>The ability to produce a maximal amount of force in one or a series of rapid muscle contractions / fast contraction / high speed of contraction.</b>	5 (AO1)	<p><b>Answers are in bold</b></p> <p><b>Accept:</b> isometric for static</p> <p><b>Do not accept:</b> power for dynamic / eg 1RM TV</p> <p><b>Accept:</b> Equivalent correct definitions for each strength type (review at SSU)</p>
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2	(c)		<table border="1"> <thead> <tr> <th>Test</th> <th>Converted test scores</th> <th>Performer's rating</th> </tr> </thead> <tbody> <tr> <td>(Sit and reach test)</td> <td>(15cm)</td> <td>(Excellent)</td> </tr> <tr> <td>(Queen's college step test)</td> <td><u>148 beats</u></td> <td><u>Above average</u></td> </tr> <tr> <td>(Cooper 12-minute run)</td> <td><u>2,600m</u></td> <td><u>Average</u></td> </tr> <tr> <td>(Vertical jump test)</td> <td><u>39cm</u></td> <td><u>Below average</u></td> </tr> </tbody> </table>	Test	Converted test scores	Performer's rating	(Sit and reach test)	(15cm)	(Excellent)	(Queen's college step test)	<u>148 beats</u>	<u>Above average</u>	(Cooper 12-minute run)	<u>2,600m</u>	<u>Average</u>	(Vertical jump test)	<u>39cm</u>	<u>Below average</u>	6 (AO3)	
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2	(d)	<p>Submax of 3 for advantages / disadvantages.</p> <p><u>Advantages:</u></p> <ol style="list-style-type: none"> <li>Increases range of motion at the joint</li> <li>Effective at <u>developmental</u> stretching</li> <li>(stretch reflex) (isometric) contraction overrides / desensitises the stretch reflex (allowing greater stretch)</li> <li>(Spindles) Muscle spindles adapt to new length</li> <li>(fast) Fastest method of increasing static (passive) flexibility</li> </ol> <p><u>Disadvantages</u></p> <ol style="list-style-type: none"> <li>(warm up) May be unsuitable for a warmup</li> <li>(contractility) Reduction in muscle contractility <b>OR</b> may decrease speed/power of contraction</li> <li>(injury) Risk of connective tissue damage</li> <li>(specificity) Static flexibility gains may not be most appropriate to the sport</li> <li>(reversibility) Gains quickly lost if not done regularly</li> <li>(uncomfortable) Can be uncomfortable</li> </ol>	5 (AO3)	<b>DNA increase flexibility. DNA opposites.</b>																

	Question	Answer	Mark	Guidance
3	(a)	<p>Seven marks from:</p> <ol style="list-style-type: none"> <li>(N1 definition) A body remains at rest or constant velocity until acted upon by an external (unbalanced) force/ reluctance or resistance of a body to change its state of motion.</li> <li>(N1 applied) e.g. the ball remains at rest until the force of the kick is applied to it</li> <li>(N2 definition) A body's rate of change of momentum/acceleration is proportional to the size of the force applied and acts in the direction in which the force acts / <math>\text{force} = \text{mass} \times \text{acceleration}</math>.</li> <li>(N2 magnitude applied) e.g. the rate of change of momentum/acceleration of the ball is proportional to the size of the force from the kick/foot of the performer. Or the bigger the force of the kick, the faster the ball will accelerate</li> <li>(N2 direction applied) e.g. the ball will accelerate/ start to move in the direction of the force of the kick</li> <li>(N3) For every force applied to a body there is an equal and opposite reaction <u>force</u> (exerted by the second body on the first)</li> <li>(N3 applied) e.g. when the foot applies a force to the ball, the ball applies a force that is equal (in size) and opposite (in direction) onto the foot.</li> </ol>	7 (AO1 x3 AO2 x4)	<p><b>Accept:</b> Alternative correct applications to a performer kicking a ball</p> <p><b>Do not accept</b> Definitions which are not very close to the wording in the ms</p>
3	(b)	<p>Four marks from:</p> <ol style="list-style-type: none"> <li>Velocity</li> <li>Shape/streamlining/aerodynamics</li> <li>Frontal cross - sectional area</li> <li>Surface characteristics/smoothness/wearing lycra</li> <li>Air density/altitude</li> </ol>	4 (AO1)	<p><b>Accept:</b> 1. Speed (BOD) 4. Surface friction (BOD)</p> <p><b>Do not accept:</b> 3. Surface area (TV) Cross sectional area (TV) Mass</p>



	Question	Answer	Mark	Guidance
				4. Drag <b>Friction alone (TV)</b>
3	(c)	<p>(i) Five marks from:</p>  <p>1. <u>(W)</u> Arrow vertically downwards from centre of mass <b>and</b> labelled <u>Weight/W</u></p> <p>2. <u>(R)</u> Arrow vertically upwards from <u>both</u> points of contact with the ground <b>and</b> combined length <math>&gt;W</math> <b>and</b> labelled <u>(Ground) reaction force/R/RF/R1 and R2/Normal reaction</u></p>	<b>2</b> (AO2)	<p><b>Accept:</b></p> <ol style="list-style-type: none"> <li>1. Arrow of any length provided it is vertically downwards from centre of mass.</li> <li>2. Reaction arrows that are not the same size as each other, provided their combined length is clearly longer than the weight arrow given.</li> </ol> <p><b>Do not accept:</b></p> <ol style="list-style-type: none"> <li>1. If arrow not from centre of mass</li> <li>1 or 2. If arrows not very close to vertical</li> <li>3. If only one arrow drawn</li> <li><b>4. Gravity for weight</b></li> </ol>

	Question		Answer	Mark	Guidance
3	(c)	(ii)	<p>Three marks from:</p> <ol style="list-style-type: none"> <li>1. The (combined) reaction forces are greater than the weight force/ <math>R1 + R2 &gt; W</math></li> <li>2. There is a net /unbalanced/resultant force <u>acting upwards</u></li> <li>3. Acceleration/change in momentum occurs in the direction of the net force/<u>upwards</u></li> <li>4. Performer jumps <u>upwards</u>/takes off / leaves the ground</li> <li>5. (Takes off if) If the net upwards force is large enough to overcome the inertia/mass of the performer/ gravity</li> <li>6. The larger the net force upwards, the greater the acceleration upwards.</li> </ol>	3 (AO2)	<b>Only award point 4 if the candidate has accessed points 1,2 or3.</b>
3	(d)		<p>Submax of 3 for points 1-4 / 5-8</p> <ol style="list-style-type: none"> <li>1. Reflective markers/ sensors placed <u>on bony landmarks/joints</u> of the performer</li> <li>2. Performance of the technique (in the lab) is recorded using multiple video/infra-red cameras</li> <li>3. Information is downloaded to computer</li> <li>4. Gives a record of the motion in time and (3D) space / in digital format</li> <li>5. Used to assess gait/ movement efficiency/joint angles/</li> <li>6. Used to calculate velocity/acceleration</li> <li>7. Used to analyse sports technique/ compare to the technical model/elite performer/ to adjust technique to improve performance</li> <li>8. Used (by coaches/sports scientists) to adjust technique to reduce risk of (repetitive strain or joint) injury / Used to monitor rehabilitation from injury</li> </ol>	4 (AO1)	<b>Accept:</b> 1. Markers (BOD) 2. Cameras (BOD)

Level descriptors	Discriminators
<p><b>Level 3 (8–10 marks)</b></p> <ul style="list-style-type: none"> <li>• detailed knowledge &amp; understanding (AO1)</li> <li>• clear and consistent practical application of knowledge &amp; understanding (AO2)</li> <li>• effective analysis/evaluation and/or discussion/explanation/development (AO3)</li> <li>• accurate use of technical and specialist vocabulary</li> <li>• there is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.</li> </ul>	<p><b>At Level 3 responses <u>are likely</u> to include:</b></p> <ul style="list-style-type: none"> <li>• detailed and accurate movement analysis</li> <li>• comprehensive understanding of centre of mass and stability</li> <li>• accurate links between centre of mass and stability, applied to all phases of the sprint.</li> <li>• correct technical language is used throughout</li> </ul> <p>AO1, AO2 all covered well in this level with some reference to AO3</p> <p><b>At the top of this level candidates have attempted to include AO3 in both parts of the question.</b></p>
<p><b>Level 2 (5–7 marks)</b></p> <ul style="list-style-type: none"> <li>• satisfactory knowledge &amp; understanding (AO1)</li> <li>• some success in practical application of knowledge (AO2)</li> <li>• analysis/evaluation and/or discussion/explanation/development attempted with some success (AO3)</li> <li>• technical and specialist vocabulary used with some accuracy</li> <li>• there is a line of reasoning presented with some structure. The information presented is in the most-part relevant and supported by some evidence.</li> </ul>	<p><b>At Level 2 responses <u>are likely</u> to include:</b></p> <ul style="list-style-type: none"> <li>• both movement analysis and centre of mass/stability are covered, but one may be in more detail and there may be some inaccuracies.</li> <li>• competent movement analysis, but factors affecting stability may only linked to some phases of the sprint start</li> <li>• there may be some inaccuracies in the use of technical vocabulary</li> <li>• application to at least 2 phases of the sprint start may be attempted</li> </ul>
<p><b>Level 1 (1–4 marks)</b></p> <ul style="list-style-type: none"> <li>• basic knowledge &amp; understanding (AO1)</li> <li>• little or no attempt at practical application of knowledge (AO2)</li> <li>• little or no attempt to analyse/evaluate and/or discuss/explain/develop (AO3)</li> <li>• technical and specialist vocabulary used with limited success</li> <li>• 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.</li> </ul>	<p><b>At Level 1 responses <u>are likely</u> to include:</b></p> <ul style="list-style-type: none"> <li>• some knowledge and understanding is shown in either the movement analysis and/or the relationship between centre of mass and stability</li> <li>• gaps and inaccuracies may be a feature of the movement analysis</li> <li>• maximum of 3 marks to be awarded for AO1 with no application.</li> <li>• Only 1 phase applied to the sprint start.</li> </ul>
<p><b>(0 marks)</b> No response or no response worthy of credit.</p>	

**4\* 10 Marks.** Max. 3 marks to be awarded for AO1. Max. of 3 marks to be awarded for AO2. Maximum of 4 marks to be awarded for AO3.

AO1	AO2	AO3
Centre of mass and stability applied to the sprint start		
1. (definition c of m) Centre of mass is the point at which a body is balanced in all directions	<ul style="list-style-type: none"> <li>In the anatomical position the centre of mass is around the height of the navel</li> </ul>	<ul style="list-style-type: none"> <li>Position of centre of mass depends on distribution of mass or density of body parts</li> </ul>
2. It is the point at which weight is considered to act	<ul style="list-style-type: none"> <li>If a performer crouches in a sprint start position the c of m will move lower to the ground</li> <li>C of m will move forwards/towards the front of their body</li> </ul>	<ul style="list-style-type: none"> <li>Position of the centre of mass can be manipulated by changing body shape</li> </ul>
3. (definition stability) Stability is the ability of a body to resist motion/remain balanced/at equilibrium	<ul style="list-style-type: none"> <li>Increased mass increases stability, e.g. a sprinter with large muscle mass is more stable than a lighter athlete</li> </ul>	<ul style="list-style-type: none"> <li>More force is required to make the heavier athlete unstable because they have greater inertia</li> </ul>
4. The height of the centre of mass affects stability	<ul style="list-style-type: none"> <li>The higher the centre of mass the less stable the athlete is</li> <li>In Diagram A of the sprint start the centre of mass is lowest, so the athlete is most stable</li> <li>In Diagram B the hips are raised so the centre of mass raises, reducing stability</li> <li>In Diagram C the centre of mass is at its highest and so the athlete is at their least stable</li> </ul>	<ul style="list-style-type: none"> <li>because a smaller torque/turning force is required to move the line of gravity outside the base of support</li> <li>The athlete needs to create instability to leave the blocks</li> </ul>
5. (line of gravity) The line of gravity is an imaginary line vertically downwards from the c of m	<ul style="list-style-type: none"> <li>In Diagram A of the sprint start the line of gravity falls to the centre of the base of support, so the athlete is most stable</li> <li>In Diagram B the athlete moves their shoulders in front of their hands/ weight is more onto the hands so the line of gravity moves towards the edge of the base of support, reducing stability</li> </ul>	<ul style="list-style-type: none"> <li>The more central the line of gravity falls within the base of support, the more stable the body is</li> </ul>

AO1	AO2	AO3
	<ul style="list-style-type: none"> <li>In Diagram C the athlete takes their hands/one foot off the ground, so the line of gravity moves outside the edge of the base of support, making them unstable</li> </ul>	<ul style="list-style-type: none"> <li>Because the centre of mass has further to move until it falls outside of the base of support</li> <li>If the line of gravity falls outside of the base of support, the body is unstable/will topple</li> <li>This instability, combined with large (reaction) forces on the athlete enables an effective sprint start</li> </ul>
<p>6. (base of support) The base of support is the area contained by all points of contact with the ground.</p>	<ul style="list-style-type: none"> <li>The sprinter has their hands and feet/knees (at least) shoulder width apart to increase stability</li> <li>In Diagrams A &amp; B of the sprint start the base of support is largest, which increases stability (compared to 'go')</li> <li>In Diagram C the athlete takes their hands/one foot off the ground, so the base of support is much smaller (one foot), making them (much) less stable</li> </ul>	<ul style="list-style-type: none"> <li>The smaller the base of support the less stable the body because the line of gravity has less distance to move until it is outside of the base (or opposite)</li> </ul>
Movement analysis		
<p>7. (joint type) Hip is a ball and socket joint</p>	<ul style="list-style-type: none"> <li>3 planes of/ larger range of motion than condyloid/hinge joints</li> </ul>	
<p>8. (movements) Sprint start involves flexion and extension at the hip</p>	<ul style="list-style-type: none"> <li>In Diagrams A &amp; B of the sprint start both hips are flexed</li> <li>In Diagram C the lead/right hip flexes/there is flexion</li> <li>In Diagram C the rear/driving/left hip extends/there is extension</li> </ul>	<ul style="list-style-type: none"> <li>In the sagittal plane</li> <li>The greater the force downwards and backwards on the block during the hip extension, the greater the acceleration upwards and forwards</li> </ul>

AO1	AO2	AO3
9. (muscles) The iliopsoas and the gluteus maximus are the muscles involved in hip flexion and extension	<ul style="list-style-type: none"> <li>• In Diagram C of the sprint start, the iliopsoas contracts to cause flexion/ is the agonist at the lead/right hip</li> <li>• The gluteus maximus at the right hip relaxes/ is the antagonist</li> <li>• In Diagram C of the sprint start the gluteus maximus contracts to cause extension/is the agonist at the rear/drive/left hip</li> <li>• The iliopsoas at the right hip is the antagonist</li> </ul>	<ul style="list-style-type: none"> <li>• Hamstring group (extension) and quadriceps group (flexion) of muscles also contribute to hip action</li> <li>• Reciprocal inhibition prevents both muscles contracting at the same time</li> </ul>
10 (types of contraction) Isometric contraction involves tension in the muscle but no movement	<ul style="list-style-type: none"> <li>• In Diagrams A &amp; B of the sprint start the hip muscles are contracting isometrically to maintain balance/posture/correct technique</li> </ul>	<ul style="list-style-type: none"> <li>• Postural/upper body muscles also contract isometrically to increase efficiency of movement at the start</li> </ul>
11 (types of contraction) Concentric isotonic contraction involves the muscle contracting/shortening under tension to cause movement	<ul style="list-style-type: none"> <li>• In Diagram C of the sprint start the agonist muscles/ iliopsoas for right hip/gluteus maximus for left hip contract concentrically to cause the flexion/extension</li> </ul>	<ul style="list-style-type: none"> <li>• The more powerful the contraction, the faster the start.</li> </ul>

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