

Markscheme

November 2023

Sports, exercise and health science

Higher level

Paper 2

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Subject details: Sports, exercise and health science HL paper 2 markscheme

Mark Allocation

Candidates are required to answer **ALL** questions in Section A [**50 marks**] and **TWO** question in Section B [**40 marks**].
Maximum total = [**50 marks**].

Markscheme format example:

Question			Answers	Notes	Total
5	c	ii	this refers to the timing of the movements OR the extent to which the performer has control over the timing of the movement ✓ external paced skills are sailing/windsurfing/receiving a serve ✓ internal paced skills are javelin throw/gymnastics routine ✓		2 max

1. Each row in the “Question” column relates to the smallest subpart of the question.
2. The maximum mark for each question subpart is indicated in the “Total” column.
3. Each marking point in the “Answers” column is shown by means of a tick (✓) at the end of the marking point.
4. A question subpart may have more marking points than the total allows. This will be indicated by “**max**” written after the mark in the “Total” column. The related rubric, if necessary, will be outlined in the “Notes” column.
5. An alternative word is indicated in the “Answers” column by a slash (/). Either word can be accepted.
6. An alternative answer is indicated in the “Answers” column by “**OR**”. Either answer can be accepted.
7. An alternative markscheme is indicated in the “Answers” column under heading **ALTERNATIVE 1** etc. Either alternative can be accepted.

8. Words inside chevrons « » in the “Answers” column are not necessary to gain the mark.
9. Words that are underlined are essential for the mark.
10. The order of marking points does not have to be as in the “Answers” column, unless stated otherwise in the “Notes” column.
11. If the candidate’s answer has the same “meaning” or can be clearly interpreted as being of equivalent significance, detail and validity as that in the “Answers” column then award the mark. Where this point is considered to be particularly relevant in a question it is emphasized by **OWTTE** (or words to that effect) in the “Notes” column.
12. Remember that many candidates are writing in a second language. Effective communication is more important than grammatical accuracy.
13. Occasionally, a part of a question may require an answer that is required for subsequent marking points. If an error is made in the first marking point then it should be penalized. However, if the incorrect answer is used correctly in subsequent marking points then **follow through** marks should be awarded. When marking, indicate this by adding **ECF** (error carried forward) on the script. “ECF acceptable” will be displayed in the “Notes” column.
14. Do **not** penalize candidates for errors in units or significant figures, **unless** it is specifically referred to in the “Notes” column.

Question		Answers	Notes	Total
1	a	850 <W>✓		1
1	b	36-33 = 3 <ml kg ⁻¹ min ⁻¹ >✓		1
1	c	SD for (a)/VO ² max is very much lower than that for (b)/peak power or (c)/average power✓ as a percentage they are similar✓	<i>Do not accept reference to error bars, candidates need to refer to the scale of SD</i>	2
1	d	Contrast: SD for avg power is smaller than peak power therefore data is more reliable✓ EM avg/ peak power SD is smaller than for CON, therefore EM data is more reliable✓ Compare: both pre and post training peak power/ average power SD for EM/ CON is similar, therefore the reliability is similar✓ both peak power/ average power show low reliability as SDs are relatively large based on scale✓	<i>Max 1 for compare or contrast Accept in the converse Accept referencing to the graphs e.g., fig1b Only award a mark if there is a clear reason why the reliability is high/ low/ similar e.g., low reliability due to large error bars/ SD/ variation <about the mean></i>	2
1	e	EM appears to improve peak power✓ however, EM has no significant effect on peak power✓ EM has had no effect on VO ₂ Max <compared to control> ✓ EM has had no effect on average power <compared to control>✓ error bars are overlapping for peak power/ average power/ VO ₂ max therefore there is no significance✓	<i>For MP2 there must be a mention of statistical significance</i>	3

1	f	i	to minimize/ remove/ avoid bias✓ increases confidence in the conclusion/ the effect is caused by IV OR provides reliability/ validity of conclusion✓	<i>Do not accept to make the test fair</i>	1
1	f	ii	provides a baseline which the effects of the intervention/ IV can be measured/ compared✓ OR the use of a control group to isolate the effect of the independent variable✓ accounts for the placebo effect✓ provides <internal> validity/ confidence in conclusion of results✓		2

Question		Answers	Notes	Total
2	a	protect the body from infectious disease/ pathogens/ harmful microbes OR tissue repair✓	<i>Accept removes/ fights as alternative to protects</i>	1
2	b	sustained increased levels of adrenaline/ cortisol <suppress the immune system>✓ reduced leucocyte/ WBC numbers, <reduce the ability to fight infection>✓ decreased mucosal secretions <due to increased ventilation during exercise/ exercise in the cold>✓ <pro>Inflammatory response to respiratory tract/ muscles✓		2

Question		Answers	Notes	Total
3	a	<p>Brain stem regulates ventilation/ HR/ blood flow/ eye movements/ chewing✓ relays sensory information/impulses from motor cortex to the thalamus/ cerebrum/ cerebellum✓ relays messages controlling balance/ coordination✓ produces reflexes <sneezing/ coughing/ vomiting/ swallowing>✓</p> <p>Diencephalon</p> <p>thalamus directs/ filters sensory/ motor signals to the cerebrum/ cerebral cortex✓ relays information between the brain stem and cerebral cortex/ cerebrum✓ maintains consciousness/ alertness/ <mental>awareness/ attention during the session✓</p> <p>hypothalamus responsible for temperature/ HR/ Blood pressure/ appetite/ thirst✓ regulates pituitary gland/ endocrine system to maintain homeostasis OR e.g., release ADH to conserve water/ release GHRH to stimulate release of GH✓</p>	<p><i>Award [1] Max brain stem</i></p> <p><i>Do not credit HR regulation twice</i></p> <p><i>Do not accept relays information on its own. Must refer to what information and where or from where to where</i></p> <p><i>Award [1] Max diencephalon</i></p> <p><i>Do not accept produces hormones unless there is a link to homeostasis/ example related to exercise</i></p>	2
3	b	external obliques✓		1

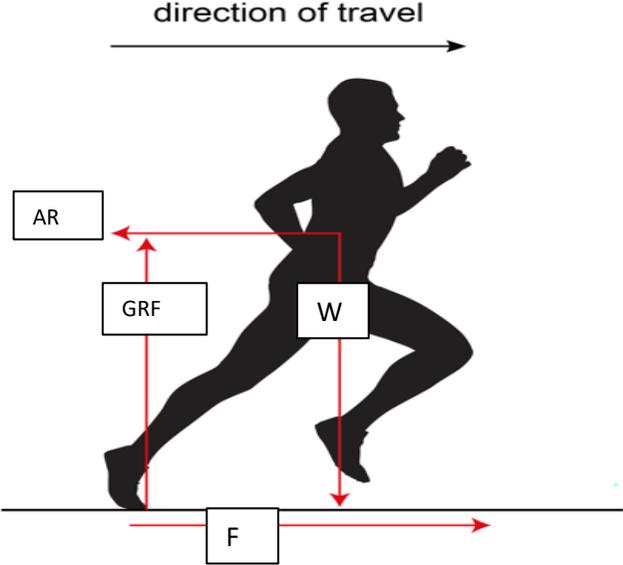
3	c	<p>diaphragm AND intercostal muscles contract <during inspiration>✓ the muscles contract more forcefully/ regularly <during running>✓ which moves the rib cage upwards AND outwards further than at rest✓</p> <p>increasing the thoracic cavity further than at rest OR decreasing thoracic pressure further than at rest✓</p> <p>accessory muscles increase the depth of breathing to maximal capacity during intense running✓</p>	<p><i>Accept chest cavity as an alternative to thoracic cavity</i></p> <p><i>Accessory muscles include sternocleidomastoid/ scalenes/ pectoralis minor</i></p>	4
3	d	<p>recommended higher carbohydrate intake for a trained runner than a sedentary individual✓</p>	<p><i>Accept in the converse</i></p> <p><i>Accept percentages as reference to higher/lower carbohydrate intake</i></p>	1

<p>3</p>	<p>e</p>	<p>glucose pathway into cells is different to that by insulin✓ increase blood flow to muscles during exercise increases delivery of glucose OR exercise increases muscular contraction and stimulates an increase in muscle glucose uptake OR exercise improves cell membrane permeability to glucose✓ muscle contraction moves GLUT4 to surface to allow glucose to enter cell✓ muscle contraction leads to reduced production of insulin/ glycogen OR blood glucose levels lower due to muscle uptake, reducing insulin levels✓ calcium signalling in the muscle/ mechanical stretch receptors in the lungs also increase glucose uptake✓ local factors in the muscle play the major role in glucose uptake e.g., increased sarcolemma transport of glucose✓ magnitude of muscle glucose uptake is related to both the intensity and duration of the exercise✓</p>		<p>4</p>
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Question			Answers	Notes	Total
4	a	i	<p><the sprinter is> accelerating✓ <the sprinter is> increasing speed/ velocity✓</p>	Accept non uniform change in speed/ velocity	1
4	a	ii	<p><the sprinter is> moving at constant/ uniform speed/ velocity✓</p>		1
4	b		<p>Compare both gymnasts would be able to perform fast/ unconscious skills <e.g. jumping onto a beam> with little perceptual trace/ using open loop feedback✓ both gymnasts would use closed loop feedback <mechanism>✓</p> <p>Contrast novice gymnast will rely on external feedback, whereas experienced gymnast will use internal feedback <and external feedback>✓</p> <p>OR novice gymnast will rely on closed loop level 3, whereas experienced gymnast will mainly use closed loop 2✓ novice gymnasts control the skill through the brain, whereas experienced gymnasts control the skill through their muscles✓ feedback loop is shorter/ quicker for experienced gymnast compared to novice gymnast✓</p>	Accept in the converse	3
4	c		<p>Whilst exercising outside the skin is exposed to sunlight✓ UV radiation <from sunlight> penetrates/ absorbed by the epidermis/ skin</p> <p>OR UV radiation <from sunlight> activates previtamin D in the skin✓ in the presence of UV radiation, vitamin D is synthesized/ produced✓</p>	Accept ultraviolet/ UV rays MP3 candidates must refer to UV radiation (not sun) to allow the synthesis/ production of vitamin D	2

Question		Answers				Notes	Total	
5	a	X	ligament	✓	<p>For ligament tough/ fibrous/ elastic tissue OR connects bone to bone OR stabilizes the joint</p>	✓	<p>Award [1] for ECF for accurate matching annotation to an incorrect label e.g., tendon-attaches muscle to bone</p> <p>Award [1] for ECF for accurate annotation X(ligament/ muscle) Y(cartilage) despite incorrect label</p>	4
		Y	<articular> cartilage	✓	<p>smooth/ connective tissue covering ends of bones <at joint> OR Provides protection/ shock absorption <to bones></p>	✓		
5	b	<p>muscles can only pull therefore must work in pairs OR muscles act through reciprocal inhibition OR as one muscle contracts the other muscle relaxes to enable movement✓ contracting muscle/ agonist is the quadriceps✓ relaxing muscle/ antagonist is the hamstrings✓</p>				<p>MP1.1 candidates must reference pull or WTTE Accept any individual quadricep/ hamstring muscle Allow MP1.3 if candidates give incorrect muscles in example. e.g., hamstrings contract whilst the quadriceps relax Do not credit hamstring antagonist if they refer to eccentric contraction</p>		2

Question			Answers	Notes	Total
6	a	i	the ability of a joint < series of joints> to move through an unrestricted, pain free range of motion. e.g., a gymnast requires high levels of flexibility to complete the splits during a floor routine✓	<i>Component of fitness must be fully applied to a suitable sporting skill/ activity Identification of a sport is insufficient</i>	1
6	a	ii	the ability to move all or part of the body as quickly as possible.e.g., a soccer player moving their whole body quickly towards the opponent's goal to score✓	<i>Component of fitness must be fully applied to a suitable sporting skill/ activity Identification of a sport is insufficient</i>	1
6	a	iii	the ability to continue contracting a muscle, or group of muscles, against resistance over a period of time. e.g., a rower repeatedly using their oar to propel the boat without tiring✓	<i>Component of fitness must be fully applied to a suitable sporting skill/ activity Identification of a sport is insufficient Must refer to the muscles working repeatedly without tiring/fatiguing or holding a contraction for a long period of time</i>	1

<p>6</p>	<p>b</p>	 <p>The diagram shows a silhouette of a runner moving to the right, as indicated by a horizontal arrow labeled 'direction of travel'. Four force vectors are shown as red arrows with labels in boxes: 'AR' (Air Resistance) is a horizontal arrow pointing left from the runner's chest; 'GRF' (Ground Reaction Force) is a vertical arrow pointing up from the runner's back foot; 'W' (Weight) is a vertical arrow pointing down from the runner's center of mass; and 'F' (Friction) is a horizontal arrow pointing right from the runner's back foot. The runner is on a horizontal ground line.</p>	<p><i>Lines of force must have label and arrowheads for each mark</i></p> <p><i>Arrows must go in the correct direction</i></p> <p><i>Arrows must originate from the correct point of application.</i></p> <p><i>Friction Arrow needs to be from the point where the toes of the back foot contact the floor. Like where GRF originates.</i></p> <p><i>Do not accept Mass or Gravity for weight.</i></p>	<p>4</p>
<p>6</p>	<p>c</p>	<p>used to identify life-threatening conditions/ genetic diseases✓ used to predict the susceptibility to injury and the need to adjustment training✓ provides opportunity for gene doping to enhance athletic performance✓ early identification of athletic genes/ potential which can be enhanced with training OR early pre-selection for suitable sporting activities based on genetic potential✓</p>		<p>3</p>

Question		Answers	Notes	Total
7	a	<p>preparation phase: approach/ run up/ stance✓</p> <p>retraction phase: backswing/ retraction of kicking leg✓</p> <p>action phase: forward swing of kicking leg and contact with ball✓</p> <p>follow through: action of leg moving forward after connection✓</p>	<p><i>Phases need to be stated in the correct order or numbered</i> <i>Phases don't need to be named</i></p> <p><i>Credit may be given if a phase is missing but candidates have responded in chronological order</i></p>	4
7	b	<p>environmental factors influencing performance include climate/ technological aids / training/ nutrition✓</p> <p>athletes have a greater history of training/ use of technological aids/ optimal nutrition which improves their performance</p> <p>OR</p> <p>e.g., a weightlifter who engages in strength training will be able to increase the effectiveness of their fast twitch fibres✓</p> <p>however, contribution of these factors on performance are restricted by inherited characteristics/ genetically controlled ceiling✓</p> <p>environmental factors can switch on/ off human characteristics therefore athletic performance may change during a weightlifter's lifetime✓</p>		4

7	c	<p>cycling increases the rate of O₂/ CO₂/ gaseous exchange✓</p> <p>CO₂ PP at pulmonary capillaries is higher than at the alveoli/ lungs✓ therefore net movement of CO₂ from the blood to the lungs✓ cycling increases CO₂ levels within the body✓</p> <p>O₂ PP in the pulmonary capillaries is lower than the alveoli/ lungs✓ therefore net movement of O₂ from the lungs to the blood✓ cycling causes an increase in O₂ uptake from the capillaries at working tissues✓</p>	<p><i>Accept exercise as alternative to cycling</i></p>	<p>6</p>
7	d	<p>red blood cell travels from pulmonary capillaries into the pulmonary vein✓ through the pulmonary vein into the left atrium✓ through the bicuspid/ mitral valve✓ into the left ventricle✓ then travels through the aortic/ semi-lunar valve✓ into the aorta✓ travels through the arteries/ arterioles to the systemic capillary bed✓</p>	<p><i>Accept an appropriately labelled/ annotated diagram</i></p>	<p>6</p>

Question		Answers	Notes	Total
8	a	<p>the brain has a high energy requirement✓ the brain has limited capacity to store carbohydrates/ energy✓ blood–brain barrier only allows small molecules to move from the blood to the brain cells OR due to their size, glucose and oxygen are able to pass quickly through the blood–brain barrier✓ therefore glucose <and oxygen> need to be supplied regularly OR a regular supply of nutrient rich blood is essential to meet the energy needs of the brain✓</p>		3
8	b	<p>hypothalamus receives feedback from the body✓ pituitary gland is located below the hypothalamus for efficiency of regulation✓ hypothalamus and pituitary gland maintain homeostasis/ growth/ water balance/ reproduction/ temperature✓ neurohormones/ GHRH/ somatostatin from the hypothalamus directly influence the pituitary gland✓ nerve impulses from the hypothalamus stimulate the pituitary gland✓ neurohormones are delivered through the portal/blood vessel✓ pituitary gland <posterior>secretes hormones e.g., antidiuretic hormone/ ADH OR pituitary gland <anterior>secretes hormones e.g., growth hormone/ GH/ luteinizing hormone/ LH✓</p>	<p><i>Both MP7.1 and Mp7.2 can be awarded separately if reference is made to the specific pituitary lobe and the correct hormones</i></p>	6

8	c	<p>A rugby player ensures their line of gravity remains within their base of support✓ player needs to widen their base of support OR spread their legs further apart OR bind to other players to increase the base of support✓ can lean forwards/ move COM towards a tackle✓ widening base/ leaning into tackle/ therefore increases the distance the line of gravity has to move to fall outside the base of support✓ lower the COM✓ bending their knees/ lower their body/ crouching <lowers COM>✓ can increase points of contact with the ground to lower COM/ increase base of support/ increase ability to resist movement of line of gravity out of the base of support✓</p>	<p>COM = Centre of mass</p>	<p>5</p>
8	d	<p>ATP is re-synthesized anaerobically/ without presence of oxygen✓ first few seconds ATP is re-synthesized using the CP system✓ creatine phosphate is broken down into Cr, P and energy✓ ADP + P + energy = ATP OR 1 CP molecule: 1 ATP✓ creatine kinase is the controlling enzyme✓ the predominant energy system is the lactic acid system/anaerobic glycolysis✓ glucose is broken down into pyruvate✓ pyruvate is converted to lactic acid✓ by lactate dehydrogenase✓ 1 glucose molecule: 2 ATP <net>✓</p>	<p><i>Award max [3] for CP system MP2 accept no more than 20 secs</i></p> <p><i>Do not credit anaerobic glycolysis as MP1 and MP7. There must make two separate points</i></p>	<p>6</p>

Question		Answers	Notes	Total
9	a	<p>maintain personal/oral hygiene e.g., washing/sanitizing hands to remove pathogens✓</p> <p>maintain an optimum balanced diet/hydration status to provide sufficient nutrients to fight infection✓</p> <p>Consume pathogen free water/food to reduce risk of infection/ illness✓</p> <p>ensure they get sufficient sleep/ recovery between training sessions to maintain a healthy immune system✓</p> <p>isolating from other family members/infected individuals to reduce transmission of disease</p> <p>OR</p> <p>Social distancing/wearing a face mask to reduce transmission of disease✓</p>		4

<p>9</p>	<p>b</p>	<p>Modify rules e.g., not allow tackling to provide players more time on the ball to allow them to find a pass/ dribble with the ball increasing success✓</p> <p>Modify equipment e.g., using a larger/ lighter ball to help players manipulate the ball more easily increasing confidence/ motivation✓</p> <p>Modify the goal e.g., award a point for completing 5 forehand passes to allow specific focus on the core skill and help speed up learning✓</p> <p>Modify the time e.g., play 5-minute periods with breaks in between to allow young performers time to recover✓</p> <p>Modify the playing area e.g., increase the space from half a pitch to three quarters of a pitch to reduce pressure/ increase time on ball✓</p> <p>Modify playing surface e.g., play on astro rather than hard court to allow the ball to move more slowly increasing success✓</p> <p>Modify the performers e.g., play 4 v 4 in a small area rather than 7 v 7 game to allow more touches/ develop key skills✓</p>	<p><i>Award [1] Max for Modification of equipment</i></p> <p><i>Accept any suitable example of a potential modification, but there needs to be reference to how it might support a novice performer</i></p> <p><i>Do not penalise lack of knowledge of field hockey. Award mark if they meet the criteria above</i></p>	<p>5</p>										
<p>9</p>	<p>c</p>	<table border="1"> <tr> <td><i>gross-fine continuum</i></td> <td><i>fine</i>✓</td> </tr> <tr> <td><i>open-closed continuum</i></td> <td><i>closed</i>✓</td> </tr> <tr> <td><i>discrete-serial-continuous continuum</i></td> <td><i>discrete</i>✓</td> </tr> <tr> <td><i>pacing continuum</i></td> <td><i>internally paced</i>✓</td> </tr> <tr> <td><i>interaction continuum</i></td> <td><i>coactive</i>✓</td> </tr> </table>	<i>gross-fine continuum</i>	<i>fine</i> ✓	<i>open-closed continuum</i>	<i>closed</i> ✓	<i>discrete-serial-continuous continuum</i>	<i>discrete</i> ✓	<i>pacing continuum</i>	<i>internally paced</i> ✓	<i>interaction continuum</i>	<i>coactive</i> ✓		<p>5</p>
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<p>9</p>	<p>d</p>	<p>Strengths a valid/ reliable test for aerobic capacity✓ Testing aerobic capacity is specific to soccer as they require aerobic capacity for success✓ multiple athletes can be tested simultaneously✓ no specialist/ expensive equipment/ training/ facility is required to conduct the test✓ can be conducted on the pitch used in competition providing ecological validity✓</p> <p>Weaknesses it doesn't replicate the type of running performed in soccer e.g., sharp changes in direction✓ the test is affected by the motivation of the athlete✓ the test requires practice in pacing✓ the test is a prediction/ estimate of VO₂ max and therefore not as accurate as direct analysis/ measurement✓</p> <p>Conclusion e.g., it will provide valid results but there are other tests that would be more suitable<e.g., leger test/ MSFT>✓</p>	<p><i>Award max [4] for either strengths or weaknesses</i></p> <p><i>Do not accept just lab is more accurate than field</i></p>	<p>6</p>
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Question		Answers				Notes	Total
10	a		Marathon runner	100m sprinter			5
		predominant muscle fibre type	slow twitch/ type I	fast twitch/ type II			
		aerobic/oxidative capacity	high	low	✓		
		anaerobic capacity	low	high	✓		
		speed of contraction	low	high	✓		
		force of contraction/ power production	low	high	✓		
		resistance to fatigue	high	low	✓		
10	b	<p>Surface drag water catches on the outer layer of the skin/ hat/ swimsuit and opposes the swimmer's motion✓ by wearing smooth clothing/ shaving to make the body smooth, this will reduce the effect of surface drag✓</p> <p>Wave drag drag force acting on the body at the interface between two fluids, movement by swimmer creates waves/ displaces water and the reaction force opposes motion✓ to reduce the additional forces swimmers swim beneath the surface of the water for as long as permitted✓ use lane ropes to reduce the effect of wave drag✓</p>				<p><i>Award [2] max per type of drag</i> <i>Must refer to water/ fluid causing friction/ catching the surface for credit</i></p> <p><i>Must refer to the reaction force opposing motion due to displacement of water/ creation of waves</i></p>	4
10	c	<p>duration/ intensity of sprint training will determine the rate of <peripheral> fatigue✓ training will cause a depletion of energy stores e.g., ATP/ CP✓ a reduction in energy source availability will increase the rate of fatigue✓ training will cause a depletion in muscle calcium stores✓ sprint training will increase the levels of fatiguing by-products/ lactate/ lactic acid/ hydrogen ions/ Pi✓ training history will affect the individual's tolerance to this by-product/ their ability to buffer these by-products and therefore affect the rate of fatigue✓</p>				<p><i>Ignore any reference to central fatigue</i></p>	5

			fatigue due to the training can be affected by age/ genetics✓		
10	d		<p>whole-part-whole learner first tries the whole skill to get a feel of movement✓ then practice individual parts before integrating back into whole skill✓ Allows performers to focus on more challenging/ difficult aspects of the skill✓ e.g., complete the long jump in full, then break down the run, the take off and then complete the full long jump routine✓</p> <p>progressive part learner experiences initial movement and then adds a new movement to the previous part building a sequence✓ used when a skill is too complex/ difficult for the learner allowing each part to be mastered✓ e.g., start with the run up, then add the take off, then add focus on the flight, then add focus on the landing✓</p> <p>part parts/ challenging/ dangerous elements of a skill are practised in isolation✓ allows performers to develop master of each element✓ used when the learning the skill in sequence is not vital✓ e.g., isolate parts of the skill, such as the run up only, take-off and landing only✓</p> <p>whole skill is practised in its entirety✓ e.g., complete the jump as one whole movement, run, take off, flight, landing✓ fast and explosive movement, must be practised specific to the required movement, therefore can't be broken down into component parts✓</p>	<p><i>Award max [3] for each method</i></p> <p><i>Only credit reference to two methods</i></p>	6