PE.MA6 Movement Analysis: Applying Levers, Planes, Joint Actions and Muscles to Sporting Movements

Total Marks

AQA 8582 · Calculators not allowed · about 55 minutes

Name: _____ Date: ____ / ____ / _____

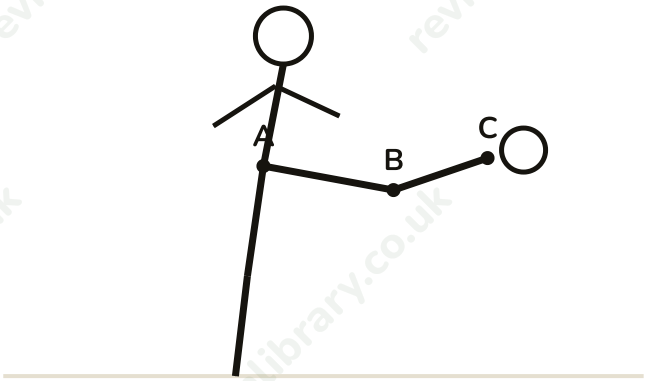
Answer ALL questions. Show all your working.

1 A complete movement analysis of a single joint action during a sporting skill should identify which of the following?

- ☐ A) The joint action and joint type, the plane and axis of movement, the lever class, and the agonist and antagonist muscles
- ☐ B) Only which muscle is contracting
- ☐ C) Only the plane of movement
- ☐ D) Only the class of lever involved

(Total for Question 1 is 1 mark)

2 Diagram 1 shows a footballer's kicking leg the moment before striking a penalty, with point A at the hip, point B at the knee and point C at the ankle. In the phase shown, the thigh has already swung forward, the knee is extending sharply, and the ankle is pointed to strike the ball.



= hip B = knee C = ankle (kicking leg, moment before conta

(a) Name the joint action at the hip (point A) and its agonist muscle. **(2)**

(b) Name the joint action at the knee (point B), its agonist muscle, and the class of lever this represents. **(3)**

(c) Name the joint action at the ankle (point C) and its agonist muscle. **(2)**

(d) State the plane of movement in which this whole kicking action takes place. **(1)**

(Total for Question 2 is 8 marks)

3 In the backswing phase, immediately before the kicking action shown in Diagram 1, the same footballer's kicking leg first swings backward and the knee bends, storing energy before the forward swing begins.

(a) Name the joint action at the hip during this backswing. **(1)**

(b) Name the agonist muscle for this hip extension. **(1)**

(c) Name the joint action at the knee during this backswing. **(1)**

(d) Name the agonist muscle for this knee flexion. **(1)**

(e) The knee is a third class lever for both flexion and extension. Explain how this lever arrangement benefits the speed of the whole kicking action, from backswing through to ball contact. **(2)**

(Total for Question 3 is 6 marks)

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4 At the start of a 100m race, a sprinter drives explosively out of the blocks, forcefully plantarflexing both ankles to push against the blocks.

(a) Name the joint action and the joint type at the ankle in this example. **(2)**

(b) Name the class of lever this ankle action represents. **(1)**

(c) Explain why this lever arrangement is well suited to driving powerfully out of the blocks. **(2)**

(Total for Question 4 is 5 marks)

5 A basketball player shoots a jump shot: the shooting shoulder flexes to raise the arm, the elbow then extends to push the ball upward, and finally the wrist flexes sharply in the follow-through ('wrist snap') as the ball leaves the hand.

(a) Name the joint action at the shoulder. **(1)**

(b) Name the joint action at the elbow, and the class of lever it represents. **(2)**

(c) Name the joint action at the wrist during the follow-through. **(1)**

(d) State the plane of movement this whole shooting action mainly takes place in. **(1)**

(Total for Question 5 is 5 marks)

6 Table 1 gives four short statements about analysing a sporting movement. For each, name which ONE of the four movement-analysis tools (joint action, plane/axis, lever class, or agonist/antagonist muscle) it is describing.

Table 1

Row	Statement
(a)	'The elbow joint bends, decreasing the angle between the upper arm and forearm'
(b)	'The biceps brachii shortens while the triceps brachii lengthens'
(c)	'The movement takes place with the effort acting between the fulcrum and the load'
(d)	'The rotation happens with the body turning around a vertical line running from head to toe'

(a) Name the tool described in row (a). **(1)**

(b) Name the tool described in row (b). **(1)**

(c) Name the tool described in row (c). **(1)**

(d) Name the tool described in row (d). **(1)**

(Total for Question 6 is 4 marks)

7 During the pull phase of front crawl swimming, a swimmer's shoulder extends powerfully to pull the arm backward through the water. During the recovery phase that follows, the same shoulder lifts the arm up and swings it forward through a wide circular path back to the starting position.

(a) Name the joint action at the shoulder during the pull phase. **(1)**

(b) Name the agonist muscle for this pull-phase movement. **(1)**

(c) State the plane of movement the pull phase mainly takes place in. **(1)**

(d) The recovery phase moves the arm through a wide circular path, described as circumduction. Explain why the shoulder's joint type is essential for this recovery phase, and what would happen if the shoulder were a hinge joint instead. **(3)**

(Total for Question 7 is 6 marks)

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8 During the underwater 'catch' phase of the same front crawl arm pull, the swimmer's elbow bends (flexes) to hold the water before the powerful pull phase begins.

(Total for Question 8 is 2 marks)

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9 Which class of lever is represented by a calf raise, as used to push off the ground during a jump?

- ☐ A) First class lever
- ☐ B) Second class lever
- ☐ C) Third class lever
- ☐ D) Fourth class lever

(Total for Question 9 is 1 mark)

10 A coach tells a young performer that 'the biceps causes elbow flexion' and stops the analysis there. Explain why this single fact is an incomplete movement analysis, referring to what else a full analysis should include.

(Total for Question 10 is 3 marks)

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11 Tariq is a long jumper. During take-off, his take-off leg's hip and knee extend explosively while the ankle plantarflexes, all driving him upward and forward off the board; in the air, his lead leg then flexes at the hip and knee in a running-style action to prepare for landing.

Using at least three different joints from Tariq's take-off and flight, discuss how lever class, plane of movement, joint action/type and agonist/antagonist muscles together explain his technique, and evaluate why a coach analysing his jump needs all four of these tools rather than just one.

(Total for Question 11 is 9 marks)

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12 During the cocking (preparation) phase of a tennis serve, a player's throwing shoulder abducts to raise the racquet arm out to the side and up, while the elbow flexes.

(Total for Question 12 is 2 marks)

13 During a low rugby tackle, a defender drops their hips and bends both knees to lower their body height before making contact.

(Total for Question 13 is 2 marks)

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14 During a cricket bowling action, a bowler's whole bowling arm rotates rapidly around its own long axis as the ball is released.

(Total for Question 14 is 2 marks)

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15 During a netball chest pass, a player extends both elbows sharply to push the ball away from the chest towards a team-mate.

(Total for Question 15 is 2 marks)

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16 During a badminton smash, a player's wrist flicks forward rapidly just before contact, adding extra racquet-head speed. State the class of lever this represents, and explain why this arrangement is suited to adding speed rather than force.

(Total for Question 16 is 2 marks)

Mark scheme · PE.MA6 Movement Analysis: Applying Levers, Planes, Joint Actions and Muscles to Sporting Movements

Question 1

- **B1** A
- **Answer: A**

Question 2

- (a) **B1** flexion
- (a) **B1** hip flexors/iliopsoas
- **(a) Answer: Hip flexion; agonist: the hip flexors (iliopsoas).**
- (b) **B1** extension
- (b) **B1** quadriceps
- (b) **B1** third class lever
- **(b) Answer: Knee extension; agonist: quadriceps; a third class lever.**
- (c) **B1** plantarflexion
- (c) **B1** gastrocnemius
- **(c) Answer: Plantarflexion; agonist: gastrocnemius.**
- (d) **B1** sagittal plane
- **(d) Answer: Sagittal plane.**

Question 3

- (a) **B1** extension
- **(a) Answer: Hip extension.**
- (b) **B1** gluteus maximus
- **(b) Answer: Gluteus maximus.**
- (c) **B1** flexion
- **(c) Answer: Knee flexion.**
- (d) **B1** hamstrings
- **(d) Answer: Hamstrings.**
- (e) **B1** in a third class lever the effort (hamstrings/quadriceps) acts close to the knee (fulcrum), giving a short effort arm compared with the long load arm to the foot, oe
- (e) **B1** so small, fast contractions of the hamstrings and quadriceps close to the knee produce a much larger and faster movement of the foot, both during the backswing and the forward kick, which is ideal for generating high ball speed, oe
- **(e) Answer: In a third class lever the effort (hamstrings or quadriceps) acts close to the knee, giving a short effort arm compared with the long load arm to the foot; small, fast muscle contractions close to the knee therefore produce a much larger, faster movement of the foot during both the backswing and the forward kick, which is ideal for generating high ball speed.**

Question 4

- (a) **B1** plantarflexion
- (a) **B1** hinge joint
- **(a) Answer: Plantarflexion, at a hinge joint.**
- (b) **B1** second class lever
- **(b) Answer: Second class lever.**
- (c) **B1** a second class lever has the effort arm longer than the load arm, giving a mechanical advantage above 1, oe
- (c) **B1** this favours force, allowing the calf muscles to drive against the blocks and move the sprinter's full body weight without needing to generate more force than that body weight, oe
- **(c) Answer: A second class lever has the effort arm longer than the load arm, giving a mechanical advantage above 1, which favours force: the calf muscles can drive against the blocks and move the sprinter's full body weight without needing to generate more force than that body weight.**

Question 5

- (a) **B1** flexion
- **(a) Answer: Shoulder flexion.**
- (b) **B1** extension
- (b) **B1** first class lever
- **(b) Answer: Elbow extension; a first class lever.**
- (c) **B1** flexion
- **(c) Answer: Wrist flexion.**
- (d) **B1** sagittal plane
- **(d) Answer: Sagittal plane.**

Question 6

- (a) **B1** joint action (flexion)
- **(a) Answer: Joint action (flexion).**
- (b) **B1** agonist and antagonist muscles
- **(b) Answer: Agonist and antagonist muscles.**
- (c) **B1** lever class (third class)
- **(c) Answer: Lever class (third class).**
- (d) **B1** axis of rotation (longitudinal axis)
- **(d) Answer: Axis of rotation (longitudinal axis).**

Question 7

- (a) **B1** extension
- **(a) Answer: Shoulder extension.**
- (b) **B1** latissimus dorsi
- **(b) Answer: Latissimus dorsi.**
- (c) **B1** sagittal plane
- **(c) Answer: Sagittal plane.**
- (d) **B1** the shoulder is a ball and socket joint, which allows circumduction, a full circular movement combining flexion, extension, abduction and adduction, oe
- (d) **B1** if the shoulder were a hinge joint, it would only allow flexion and extension in a single plane, oe
- (d) **B1** so the arm could not be swept out to the side and around in the wide circular recovery path shown by a front crawl swimmer; it could only swing forward and back in one plane, oe
- **(d) Answer: The shoulder is a ball and socket joint, which allows circumduction, a full circular movement combining flexion, extension, abduction and adduction. If the shoulder were a hinge joint instead, it would only allow flexion and extension in a single plane, so the arm could not be swept out to the side and around in the wide circular recovery path a front crawl swimmer actually uses; it could only swing forward and back in one plane.**

Question 8

- **B1** third class lever
- **B1** the biceps brachii (effort) acts close to the elbow (fulcrum), between the fulcrum and the hand/water resistance (load), oe
- **Answer: Third class lever, because the biceps brachii (effort) acts close to the elbow (fulcrum), between the fulcrum and the hand/water resistance (load).**

Question 9

- **B1** B
- **Answer: B**

Question 10

- **B1** naming only the agonist muscle does not state the joint type, so it does not explain what range of movement is actually possible at that joint, oe
- **B1** it also does not state the plane of movement, so it does not explain which direction, or in combination with which other movements, the action takes place, oe
- **B1** it also does not state the lever class or mechanical advantage, so it does not explain whether the movement favours force or speed and range of movement, oe
- **Answer: Naming only the agonist muscle does not state the joint type, so it does not explain what range of movement is actually possible at that joint; it also does not state the plane of movement, so it does not explain the direction of the action; and it does not state the lever class, so it does not explain whether the movement favours force or speed and range of movement.**

Question 11

- **Level 3** (7-9): A detailed and coherent response that accurately applies lever class, plane of movement, joint action/type and agonist/antagonist muscles to at least three of Tariq's joints across take-off and flight, and gives a well-justified evaluation of why all four analytical tools are needed together. Sustained, accurate use of movement-analysis terminology throughout.
- **Level 2** (4-6): Some accurate application of two or more of the four analytical tools to at least two of Tariq's joints, but coverage may be incomplete, limited to fewer than three joints, or the evaluative point about needing all four tools may be underdeveloped.
- **Level 1** (1-3): Basic or generic statements about movement analysis with little or no specific application to Tariq's take-off or flight, and little or no evaluation.
- **Level 0** (0): No relevant content.
- **Indicative content:**
  - Hip (take-off): extension, sagittal plane, agonist gluteus maximus, antagonist hip flexors; a ball and socket joint, allowing this extension as well as the earlier approach-run flexion/extension cycle.
  - Knee (take-off): extension, sagittal plane, agonist quadriceps, antagonist hamstrings, third class lever (short effort arm, mechanical advantage below 1), favouring the speed needed to drive off the board quickly.
  - Ankle (take-off): plantarflexion, sagittal plane, agonist gastrocnemius, antagonist tibialis anterior, second class lever (mechanical advantage above 1), favouring the force needed to push off the ground.
  - Lead leg in flight: hip and knee flexion, sagittal plane, agonists hip flexors and hamstrings respectively, preparing the leg for landing in a running-style action.
  - Evaluative point: the joint action alone (e.g. 'the knee extends') does not explain whether the movement favours force or speed; the lever class adds that information (here, favouring speed at the knee but force at the ankle, within the very same take-off).
  - Evaluative point: the muscle names alone do not explain the direction or plane of the resulting movement; the joint action and plane are needed to connect the muscle contraction to the actual body movement produced.
  - Evaluative point: the joint type explains why some joints (hip, a ball and socket joint) can combine several different actions across the approach and take-off, while others (knee, ankle, hinge joints) are limited to flexion/extension-type actions only.
  - Balanced conclusion: only by combining all four tools, joint action/type, plane/axis, lever class and agonist/antagonist muscles, can a coach fully explain both WHAT is moving, WHERE it is moving, HOW MUCH force or speed it produces, and WHICH muscles are responsible, across the whole jump.

Question 12

- **B1** agonist for shoulder abduction: deltoid
- **B1** lever class for elbow flexion: third class
- **Answer: Agonist for shoulder abduction: deltoid. Lever class for elbow flexion: third class.**

Question 13

- **B1** hip flexion
- **B1** ball and socket joint
- **Answer: Hip flexion, at a ball and socket joint.**

Question 14

- **B1** transverse plane
- **B1** longitudinal axis
- **Answer: Transverse plane, rotating about the longitudinal axis.**

Question 15

- **B1** agonist: triceps brachii
- **B1** antagonist: biceps brachii
- **Answer: Agonist: triceps brachii. Antagonist: biceps brachii.**

Question 16

- **B1** third class lever
- **B1** the wrist flexor effort acts close to the wrist joint (fulcrum), giving a short effort arm relative to the long load arm to the racquet head, so a small, fast muscle contraction produces a much larger, faster movement at the racquet head, oe
- **Answer: A third class lever, because the wrist flexor effort acts close to the wrist joint, giving a short effort arm relative to the long load arm to the racquet head, so a small, fast muscle contraction produces a much larger, faster movement at the racquet head.**