PE.MA5 Movement Analysis: Agonist and Antagonist Muscle Roles

Total Marks

AQA 8582 · Calculators not allowed · about 50 minutes

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 Which term describes the muscle that contracts to cause a movement, working as the prime mover?

- [ ] A) The agonist
- [ ] B) The antagonist
- [ ] C) The fixator
- [ ] D) The tendon

(Total for Question 1 is 1 mark)

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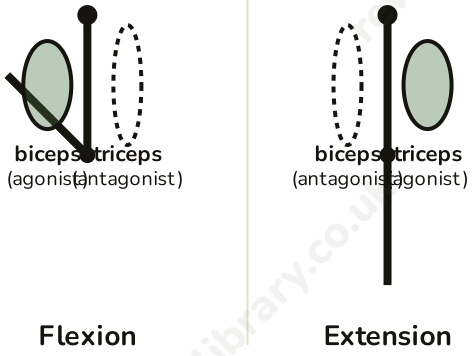
2 State what is meant by 'antagonistic muscle action', and explain why muscles need to work in pairs like this rather than alone.

(Total for Question 2 is 3 marks)

3 Diagram 1 shows the biceps brachii and triceps brachii during two phases of a bicep curl. In the 'Flexion' panel, the shaded muscle is shortening; the dashed-outline muscle is lengthening. In the 'Extension' panel, the roles are reversed.



Flexion Extension

(a) Name the agonist and the antagonist shown in the 'Flexion' panel. **(2)**

(b) Name the agonist and the antagonist shown in the 'Extension' panel. **(2)**

(c) Explain what this diagram shows about how the roles of the biceps and triceps change between the two panels. **(2)**

(Total for Question 3 is 6 marks)

4 During the drive phase of a squat jump, a basketball player extends their knee explosively to leave the ground.

(a) Name the agonist muscle group responsible for this knee extension. **(1)**

(b) Name the antagonist muscle group, and state what it does during this knee extension. **(2)**

(c) Explain how the lever class of the knee joint (a third class lever, with the quadriceps acting close to the knee) relates to the speed of this jumping action. **(2)**

(Total for Question 4 is 5 marks)

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5 During the recovery phase of a sprint stride, a runner drives their thigh forward and upward at the hip.

(a) Name the joint action taking place at the hip. **(1)**

(b) Name the agonist muscle for this movement, and its antagonist. **(2)**

(Total for Question 5 is 3 marks)

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6 As the same runner's foot then plants on the ground and the leg drives back and down behind the body to propel them forward, the hip extends.

(Total for Question 6 is 2 marks)

7 Table 1 names four joint actions and asks for the agonist muscle responsible for each.

Table 1

Row	Joint action
(a)	Plantarflexion of the ankle, as when rising onto the toes
(b)	Dorsiflexion of the ankle, as when pulling the toes up towards the shin
(c)	Flexion of the shoulder, as when raising a straight arm forward and up
(d)	Extension of the knee, as when straightening the leg to kick a ball

(a) Name the agonist for row (a). **(1)**

(b) Name the agonist for row (b). **(1)**

(c) Name the agonist for row (c). **(1)**

(d) Name the agonist for row (d). **(1)**

(Total for Question 7 is 4 marks)

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8 Which muscle is the antagonist to the deltoid during shoulder flexion?

- ☐ A) Latissimus dorsi
- ☐ B) Gastrocnemius
- ☐ C) Hamstrings
- ☐ D) Tibialis anterior

(Total for Question 8 is 1 mark)

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9 A gymnast performs a controlled, slow lowering of their body from a chin-up bar, straightening the elbow gradually rather than dropping suddenly.

(Total for Question 9 is 3 marks)

10 Explain why a swimmer's front crawl arm pull, which uses the latissimus dorsi as the agonist to pull the arm powerfully backward through the water (shoulder extension), needs the deltoid to act as the antagonist during this phase.

(Total for Question 10 is 2 marks)

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11 Explain, using the elbow as an example, why a muscle that is the agonist for one movement is always the antagonist for the exact opposite movement at the same joint.

(Total for Question 11 is 4 marks)

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12 Amara, a high jumper, drives off her take-off leg using a rapid sequence of joint actions: hip extension, knee extension and ankle plantarflexion, all occurring together to project her body upward and over the bar.

Discuss the agonist and antagonist muscles responsible for Amara's hip, knee and ankle actions during take-off, and evaluate why the antagonistic pairing at each of these joints is essential for her jump to be both powerful and controlled.

(Total for Question 12 is 9 marks)

13 During the downswing of a golf shot, a golfer's trailing elbow (the arm furthest from the target) extends rapidly through impact.

(Total for Question 13 is 2 marks)

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14 State two reasons why it would not be possible to produce controlled joint movement using only one muscle at a joint, rather than an antagonistic pair.

(Total for Question 14 is 2 marks)

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15 A rugby player pulls an opponent's arm downward and inward during a tackle, adducting their own shoulder.

(Total for Question 15 is 2 marks)

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16 Explain why identifying the correct agonist muscle for a joint action is useful information for a coach designing a strength training programme for a specific sporting movement.

(Total for Question 16 is 2 marks)

Mark scheme · PE.MA5 Movement Analysis: Agonist and Antagonist Muscle Roles

Question 1

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

Question 2

- **B1** antagonistic muscle action is where one muscle, the agonist, contracts to cause a movement while the other, the antagonist, relaxes and lengthens to allow it, oe
- **B1** muscles can only actively pull, not push, oe
- **B1** so a single muscle can only move a joint in one direction; a paired, opposing muscle is needed to move the joint back the other way, oe
- **Answer: Antagonistic muscle action is where one muscle, the agonist, contracts to cause a movement while the other, the antagonist, relaxes and lengthens to allow it. Muscles can only actively pull, not push, so a single muscle can only move a joint in one direction; a paired, opposing muscle is needed to move the joint back the other way.**

Question 3

- (a) **B1** agonist: biceps brachii
- (a) **B1** antagonist: triceps brachii
- **(a) Answer: Agonist: biceps brachii. Antagonist: triceps brachii.**
- (b) **B1** agonist: triceps brachii
- (b) **B1** antagonist: biceps brachii
- **(b) Answer: Agonist: triceps brachii. Antagonist: biceps brachii.**
- (c) **B1** the same muscle can be the agonist for one movement and the antagonist for the opposite movement at the same joint, oe
- (c) **B1** which muscle is which role depends on the direction of movement being produced, not on the muscle's identity alone, oe
- **(c) Answer: The same muscle can be the agonist for one movement and the antagonist for the opposite movement at the same joint; which role a muscle plays depends on the direction of movement being produced, not on the muscle's identity alone.**

Question 4

- (a) **B1** quadriceps
- **(a) Answer: Quadriceps.**
- (b) **B1** hamstrings
- (b) **B1** the hamstrings relax and lengthen to allow the knee to extend, oe
- **(b) Answer: The hamstrings, which relax and lengthen to allow the knee to extend.**
- (c) **B1** the quadriceps inserts close to the knee (fulcrum), giving a short effort arm compared with the load arm (to the foot), so the mechanical advantage is below 1, oe
- (c) **B1** this means a fast, powerful contraction of the quadriceps close to the joint produces a much larger, faster extension movement at the foot, which helps drive the explosive jump, oe
- **(c) Answer: The quadriceps inserts close to the knee (the fulcrum), giving a short effort arm compared with the load arm to the foot, so the mechanical advantage is below 1; this means a fast, powerful contraction of the quadriceps close to the joint produces a much larger, faster extension movement at the foot, which helps drive the explosive jump.**

Question 5

- (a) **B1** hip flexion
- **(a) Answer: Hip flexion.**
- (b) **B1** agonist: hip flexors/iliopsoas
- (b) **B1** antagonist: gluteus maximus
- **(b) Answer: Agonist: the hip flexors (iliopsoas). Antagonist: gluteus maximus.**

Question 6

- **B1** agonist: gluteus maximus
- **B1** antagonist: hip flexors/iliopsoas
- **Answer: Agonist: gluteus maximus. Antagonist: the hip flexors (iliopsoas).**

Question 7

- (a) **B1** gastrocnemius (calf muscle)
- **(a) Answer: Gastrocnemius (the calf muscle).**
- (b) **B1** tibialis anterior
- **(b) Answer: Tibialis anterior.**
- (c) **B1** deltoid (anterior deltoid)
- **(c) Answer: Deltoid (anterior deltoid).**
- (d) **B1** quadriceps
- **(d) Answer: Quadriceps.**

Question 8

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

Question 9

- **B1** as the elbow extends (straightens), the triceps is the agonist for the movement, oe
- **B1** but the biceps brachii, the antagonist, does not simply go slack; it lengthens gradually under tension rather than relaxing suddenly, oe
- **B1** this controls the speed of the lowering movement, preventing the body from dropping suddenly out of control, oe
- **Answer: As the elbow extends, the triceps is the agonist for the movement, but the antagonist, the biceps brachii, does not simply go slack; it lengthens gradually under tension rather than relaxing suddenly, which controls the speed of the lowering movement and prevents the body from dropping suddenly out of control.**

Question 10

- **B1** the deltoid is the muscle that would flex the shoulder (the opposite movement), so during shoulder extension it must relax and lengthen, oe
- **B1** this allows the latissimus dorsi to pull the arm backward through the water without the deltoid resisting the movement, oe
- **Answer: The deltoid is the muscle that would flex the shoulder, the opposite movement, so during shoulder extension it must relax and lengthen, allowing the latissimus dorsi to pull the arm backward through the water without the deltoid resisting the movement.**

Question 11

- **B1** the biceps brachii is the agonist for elbow flexion, contracting to bend the elbow, oe
- **B1** for the opposite movement, elbow extension, the biceps must instead relax and lengthen to allow the triceps to straighten the arm, which makes the biceps the antagonist, oe
- **B1** a muscle can only pull in one direction (towards its own contraction), so it cannot actively cause the opposite movement itself, oe
- **B1** this means at any joint with two opposing movements, each muscle in the pair must always be agonist for one direction and antagonist for the other, never both agonist at the same time, oe
- **Answer: The biceps brachii is the agonist for elbow flexion, contracting to bend the elbow; for the opposite movement, elbow extension, the biceps must instead relax and lengthen to allow the triceps to straighten the arm, which makes the biceps the antagonist. A muscle can only pull in one direction, so it cannot actively cause the opposite movement itself, meaning at any joint with two opposing movements, each muscle in the pair must always be agonist for one direction and antagonist for the other, never both at the same time.**

Question 12

- **Level 3** (7-9): A detailed and coherent response that accurately names the agonist and antagonist muscles at Amara's hip, knee and ankle, explains their roles during take-off, and gives a well-justified evaluation of why antagonistic pairing is essential for both power and control. Sustained, accurate use of muscle and joint-action terminology throughout.
- **Level 2** (4-6): Some accurate naming of agonist/antagonist muscles at two or more of Amara's joints, with some explanation of their roles, but coverage may be incomplete or the evaluative point about power and control underdeveloped.
- **Level 1** (1-3): Basic or generic statements about muscles with little or no application to Amara's specific take-off action, and little or no evaluation.
- **Level 0** (0): No relevant content.
- **Indicative content:**
  - Hip: gluteus maximus is the agonist for hip extension, contracting to drive the thigh back and down; the hip flexors (iliopsoas) act as the antagonist, relaxing and lengthening to allow this.
  - Knee: quadriceps is the agonist for knee extension, straightening the leg explosively; the hamstrings act as the antagonist, relaxing and lengthening to allow this.
  - Ankle: gastrocnemius is the agonist for plantarflexion, driving the foot down and off the ground; tibialis anterior acts as the antagonist, relaxing and lengthening to allow this.
  - Power point: at each joint the agonist must fully contract, quickly and forcefully, to generate the drive needed to project the body upward, so the antagonist must relax fully and promptly rather than resisting the movement.
  - Control point: if the antagonist did not relax appropriately, it would resist the agonist's contraction, reducing the force and speed of the movement and potentially straining the joint.
  - Evaluative point: the coordinated relaxation of three separate antagonist muscles (hip flexors, hamstrings, tibialis anterior), timed correctly with the contraction of their agonists, is what allows all three joints to extend together smoothly rather than fighting against each other.
  - Evaluative point: without correct antagonistic pairing at even one of these joints, the whole kinetic chain of the jump would be less powerful and less coordinated, showing that all three joints depend on the same underlying muscular principle.
  - Balanced conclusion: antagonistic muscle action is not just about producing movement, but about producing it powerfully, in the correct sequence, and without the joint being damaged by opposing muscular resistance.

Question 13

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

Question 14

- **B1** a single muscle can only pull the joint in one direction, so it could not return the joint to its original position or move it the opposite way, oe
- **B1** without an opposing muscle to control the movement (e.g. by lengthening gradually), the joint could not be slowed or controlled, risking a sudden, uncontrolled or damaging movement, oe
- **Answer: A single muscle can only pull the joint in one direction, so it could not return the joint to its original position or move it the other way; and without an opposing muscle to control the movement by lengthening gradually, the joint could not be slowed or controlled, risking a sudden, uncontrolled or damaging movement.**

Question 15

- **B1** agonist: latissimus dorsi
- **B1** antagonist: deltoid
- **Answer: Agonist: latissimus dorsi. Antagonist: deltoid.**

Question 16

- **B1** knowing the agonist muscle for a movement lets the coach select exercises that specifically strengthen that muscle, oe
- **B1** so the training directly targets the muscle responsible for producing power in the sporting movement, rather than training muscles that are less relevant to that specific action, oe
- **Answer: Knowing the agonist muscle for a movement lets a coach select exercises that specifically strengthen that muscle, so the training directly targets the muscle responsible for producing power in the sporting movement, rather than training muscles that are less relevant to that specific action.**