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Answers

Exam-style questions

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Check your answers to the questions in this issue.

The biomechanical principle of stability (pp. 10–12)

1 Area of base of support, height of centre of mass, position of the line of gravity through the base of support (aiming through the middle), mass of the performer.

2 AO1 – the raw facts and definitions

Stability is the ability to maintain equilibrium or balance. A floor routine will require elements of static (stationary) balance and dynamic (moving) balance. The area of the base of support, height of centre of mass, position of the line of gravity and mass of the performer are all factors that affect/influence stability.

AO2 – apply each factor to the sporting example given (in this case, gymnastics)

- Area of base of support: the larger the area, the more stable the performer.
- Height of centre of mass: the lower to the ground, the more stable the performer.
- Position of the line of gravity: the performer will be most stable when the line of gravity passes through the centre of the base of support.
- Mass of the performer: the greater the mass of the performer, the greater their stability. It acts like inertia (reluctance to change position or momentum). Note that a performer's mass affects their stability when moving as well as when stationary.

AO3 – add the extra details and analysis

To increase stability when landing, the gymnast will try to ensure their knees flex, which lowers their centre of mass. They will also try to position their line of gravity between their base of support. The gymnast can increase the area of the base of support by adding more points of contact with the ground, such as two feet or two hands. This will create a large base of support but may lose them points for aesthetics.

In fact, a gymnast must demonstrate their ability to move smoothly and under control (co-ordination) with fewer points of contact on the ground. The gymnast may decrease their points of contact mid performance, such as by moving from a headstand into a handstand. This may lead to greater technical marks being awarded. The floor routine should comprise elements of static and dynamic balance. Moving between each will demonstrate their strength in transitioning smoothly through the routine.

The gymnast may elongate themselves by bringing their arms up overhead or standing on their toes to draw their centre of mass further away from their base of support. This may look aesthetically pleasing

and score technical marks. Other things like friction may play a part. The gymnast is bare-footed so has less grip with the floor. They may use chalk or taping to marginally increase adhesion with the surface, which in turn enables them to feel more stable.

3 AO1 – the raw facts and definitions

A racket sports player such as a tennis player will aim to be as stable as possible on the court in order to win points and not fault. The greater their balance, the greater their stability. This is achieved through biomechanical principles such as friction (the grip provided by tennis-specific footwear), body mass, area of the base of support, position of the line of gravity and the height of their centre of mass away from the base of support.

The musculoskeletal system provides movement – all movement occurs at joints. Movement is provided by one of three classes of lever systems (first, second or third). Muscles will contract and pull on a bone, via a tendon, to generate movement.

The type of muscular contraction is brought about via the neuromuscular system. When the player is static, an isometric muscle contraction is taking place. When moving, an isotonic muscle contraction occurs. Nerves stimulate skeletal muscles to contract under voluntary control.

AO2 – apply each factor to the sporting example given (in this case, any racket sport)

The player is often moving, so must use dynamic balance. When receiving a return of serve, they may be more static. In this case, they can lower their centre of mass, achieved by squatting closer to the ground, to become more stable. The knee flexion will be caused by the shortening action of the hamstring muscle group (and its antagonistic pair, the quadriceps, will relax and lengthen). This is an example of a third-class lever system. Flexion also occurs at the hip joints and dorsiflexion at the ankles.

When lunging to return a shot mid-rally, the musculoskeletal system will be generating isotonic contractions within muscles, brought about by the action of antagonistic muscle pairs. If contracting to move towards the ball, muscle contractions are likely to be concentric. Decelerating when reaching the ball is likely to be caused by eccentric muscle action.

When serving, players are often on their toes. This is plantarflexion at the ankle, caused by a concentric (shortening) contraction of the agonist, the gastrocnemius and the relaxing and lengthening of the tibialis anterior muscle, the antagonist. This is an example of a second-class lever system.

AO3 – add the extra details and analysis

The performer may increase their stability through conducting sport-specific, functional training. This will strengthen the performer's muscles and reduce the possibility of injury. It may also have the effect of increasing co-ordination and agility. Examples include proprioception exercises to strengthen the ankle joints so that they may move into position more safely. It may include core training exercises such as planks and back extensions, so they will have a stronger core, leading to greater stability. This will also develop the neuromuscular system, resulting in faster conduction of nerve stimulation and faster contraction of muscles.

When moving on the court, the performer will use spatial and wave stimulation to generate greater forces. They will use large motor units for more powerful actions such as serving. The 'all or none law' states that when a motor unit contracts, either all of the muscle fibres within the unit will contract, or none at all.

Hamstring injuries (pp. 26–29)

1 For example:

Physiotherapy:

- is useful for rehabilitation from injury through progressive exercises to strengthen relevant tissues
- requires a qualified physiotherapist, which can be expensive.

Anti-inflammatory drugs:

- can be effective in reducing pain and inflammation
- can lead to stomach complaints, mask and therefore aggravate an injury, and are possibly addictive.

2 Intrinsic risk factors relate to the individual athlete. Examples include:

- age – older sprinters are more likely to suffer hamstring injuries due to reduced flexibility
- gender – female footballers and rugby players are more likely to suffer ACL injuries and concussions than men
- medical history – athletes with a history of hamstring injury are more likely to suffer the same injury again.

Extrinsic risk factors relate to external factors, such as the coaches or club. Examples include:

- insufficient or excessive training loads
- lack of recovery time
- limited medical expertise.

3 An acute, soft tissue injury. Steps to treat it:

- protect – remove from play to avoid worsening damage
- rest – to enable healing
- ice – to reduce inflammation via vasoconstriction
- compress – to reduce blood flow and swelling
- elevate – to reduce blood flow and swelling.

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