CHAPTER 3 - ANALYSIS OF MOVEMENT

Text between pages 52 and 68, answers to questions on page 66 to 68 of the text book.

Warm-up question 1)

Hockey involves movement at many joints in the body. Identify which bones articulate at each of the following joints: shoulder, elbow, radio-ulnar, hip, knee, and ankle. 6 marks

Answer

- *Shoulder:* *humerus and scapula.*
- *Elbow:* *humerus, radius and ulna.*
- *Radio-ulna:* *radius and ulna.*
- *Hip:* *femur and pelvis (acetabulum).*
- *Knee:* *femur and tibia.*
- *Ankle:* *talus, tibia and fibula.*

Warm-up question 2)

Complete the missing gaps in table 3.11 by naming the main agonist and antagonist muscles, body plane and body axis for each of the actions identified. 6 marks

Answer

Table 3.11 – **actions at various joints**

action	main agonist	main antagonist	body plane	body axis
elevating the shoulders	levator scapulae	pectoralis major	frontal plane	frontal axis
extending the elbow joint	triceps brachii	biceps brachii	sagittal plane	transverse axis
flexing the hip joint	iliopsoas	gluteus maximus	sagittal plane	transverse axis
flexing the knee joint	hamstring group: biceps femoris, semitendinosus, semimembranosus	quadriceps group: vastus medialis, vastus intermedius, vastus lateralis, rectus femoris	sagittal plane	transverse axis
dorsiflexing the ankle joint	tibialis anterior	tibialis posterior	sagittal plane	transverse axis
flexing the trunk	rectus abdominus	erector spinae group	sagittal plane	transverse axis

Warm-up question 3)

Describe the following movement terminology, and give a physical activity for each movement: abduction, circumduction, rotation and plantarflexion. In which plane(s) does each movement pattern occur? 12 marks

Answer

Abduction:

- *A movement pattern in which a body segment moves away from the midline of the body.*
- *Example: leg action going into a cartwheel.*
- *Frontal (or coronal) plane.*

Circumduction:

- *A body movement which consists of flexion, abduction, extension and adduction to create a cone shape in space.*
- *Example: a small circular hand dance gesture.*
- *Sagittal and frontal planes.*

Rotation:

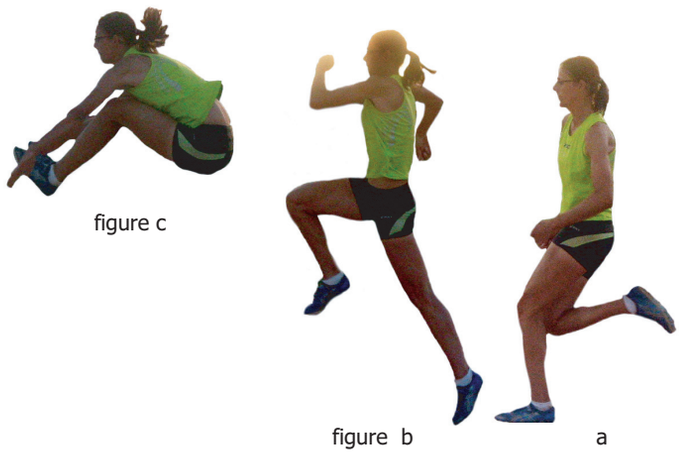
- *A limb movement around the axis down the centre of a long bone.*
- *Example: delivery phase of a discus throw.*
- *Transverse (or horizontal) plane.*

Plantarflexion:

- *A movement of the foot that results in the toe being pointed downwards.*
- *Example: diving off a springboard.*
- *Sagittal (or median) plane.*

4) Figures 3.21 a to c show the final stride, take-off and flight phase of a long jump. Use these three pictures to help you complete the following joint analysis.

figure 3.21 – long jump take-off and flight



a) Name the type of muscle contraction occurring in the leg whose foot is in contact with the ground in figure 3.21a, name the main agonist muscle responsible for this muscle contraction and explain why you have selected this muscle. 3 marks

Answer

- *Type of muscle contraction: isotonic, eccentric muscle contraction.*
- *Main agonist muscle: quadriceps group: rectus femoris, vastus medialis, vastus intermedius, vastus lateralis.*
- *Explanation: on this final stride prior to take-off, the hips and take-off leg sink into the board, during which time muscles of the quadriceps muscle group are lengthening under tension.*

b) Complete the following joint analysis below in table 3.12 for figure 3.21 b: 9 marks

Answer

Table 3.12 – **answer to question in table 3.12**

joint	joint type	articulating bones	agonist muscles
left ankle	*synovial hinge*	*talus, tibia, fibula*	*tibialis posterior, gastrocnemius, soleus*
left knee	*synovial hinge*	*tibia, femur*	*quadriceps group: rectus femoris, vastus lateralis, vastus medialis, vastus intermedius*
left hip	*synovial ball and socket*	*femur, acetabulum of pelvis*	*gluteus maximus, hamstring group: biceps femoris, semimembranosus, semitendinosus*

c) Describe the changes in movement patterns in the left ankle, knee, hip and trunk from figures 3.21 b to c. 4 marks

Answer

- *Left ankle changes from plantarflexion to dorsiflexion.*
- *Left knee changes from extension to flexion.*
- *Left hip changes from extension to flexion.*
- *Trunk changes from extension to flexion.*

d) Suggest **two** factors that affect the range of movement at the hip joint. 2 marks

Answer

- *Shape of ball and socket joint, or the shape of bones.*
- *Extensibility of attached muscles or muscle tendons.*
- *Elasticity of attached ligaments.*
- *Length of muscle or bulk of muscle.*

5) Figure 3.22 shows a tennis player completing a forehand drive. Use the figure to help you complete the following joint analysis.

figure 3.22 – tennis forehand

a) For the shoulder joint during horizontal adduction, the type of joint, the articulating bones, the main agonist muscle and the type of contraction for the agonist. 4 marks

Answer
- *Type of joint: synovial, ball and socket.*
- *Articulating bones: scapula, humerus.*
- *Main agonist muscle: pectoralis major.*
- *Type of contraction at agonist: isotonic, concentric.*

b) Using the muscles that create elbow flexion during the forehand drive, explain what is meant by antagonistic muscle action. 4 marks

Answer
- *Muscles work in pairs to create movement across a joint - called antagonistic muscle action.*
- *Whilst one muscle is contracting (agonist muscle) the opposing muscle is relaxing (antagonist muscle).*
- *When the elbow flexes the biceps brachii (agonist muscle) contracts.*
- *And the triceps brachii (antagonist muscle) relaxes.*

c) Name the movement pattern produced on the right hand side of the trunk and the **main** agonist creating this movement. 2 marks

Answer
- *Movement pattern: lateral flexion.*
- *Main agonist muscle: external or internal abdominal obliques.*

d) In which body plane and around which axis does the tennis forehand occur at the flexed right elbow position shown in figure 3.22? 2 marks

Answer
- *Sagittal plane.*
- *Transverse axis.*

figure 3.23 – athlete holding a plank position

6) The athlete in figure 3.23 is holding a plank bridge position. Use the photograph to help you complete the following joint analysis.

a) Identify the joint type, articulating bones, the main agonist (prime mover) and type of muscle contraction at the hip joint. 4 marks

Answer
- *Type of joint: synovial, ball and socket.*
- *Articulating bones: femur, acetabulum of pelvis.*
- *Main agonist muscle: iliopsoas.*
- *Type of contraction at agonist: isometric muscle contraction.*

b) Explain why the muscle contraction is of this type. 1 mark

Answer
- *Since the muscle length does not change during the exercise.*

c) Explain the role of core muscles in relation to the plank bridge position. 2 marks

Answer
- *Core muscles are responsible for **stabilisation** of the trunk region to hold the plank bridge position.*
- *For example, transverse abdominus and multifidus muscle are acting as core stabilisers within the trunk region.*

6) d) There are four rotator cuff muscles that are inserted around the cuff or cap over the proximal humerus. Name **one** of these muscles and explain how these muscles provide range of movement and yet collectively protect the shoulder joint. 2 marks

Answer

One from the following muscles:

- *Teres minor.*
- *Infraspinatus.*
- *Supraspinatus.*
- *Subsacpularis.*

Explanation:

- *The function of the cuff rotators (depending on their position) is to enable to the shoulder joint to operate as a multiaxial joint i.e. 3 axes of movement.*
- *All these four muscles have their insertions on the bony protrusions (called tubercles) at the proximal head of the humerus.*
- *And therefore stabilise and protect the shallow rounded socket of the scapula from possible dislocation.*
- *By pulling the humerus bone into the scapula socket.*

figure 3.24 – sprint – a full stride

7) Figures 3.24 a – c show an elite sprinter completing a full running stride.

a) Analyse the action of the hip joint from the strike position of the left leg to the completion of a full running stride. 3 marks

Answer

- *Figure a - hip – extending beyond the straight line position.*
- *Figure b - hip - flexing.*
- *Figure c - hip – extending.*

b) Identify the main agonist muscles responsible for these movement patterns in figures a and b only. 2 marks

Answer

- *Figure a, main agonist muscle: gluteus maximus.*
- *Figure b, main agonist muscle: iliopsoas.*

c) At the completion of the full stride focus on the left foot plant. Identify the bones that form the ankle joint, the joint and the main agonist responsible for this movement pattern. 4 marks

Answer

- *Ankle joint bones: talus, tibia and fibula.*
- *Joint action: dorsiflexion.*
- *Main agonist muscle: tibialis anterior.*

d) Figure c shows the right knee in the recovery position. Identify the joint type, **main** agonist muscle group, its antagonist muscle group and the type of muscle contraction occurring at this joint. 4 marks

Answer

- *Joint type: synovial, hinge joint.*
- *Main agonist muscle group: hamstring group.*
- *Main antagonist muscle group: quadriceps group.*
- *Type of muscle contraction: isotonic, concentric.*

7) e) Explain the term 'body plane'. 2 marks

Answer

- *An imaginary flat surface.*
- *Running through the centre of gravity of the body.*

f) In which plane and around which axis does the sequence of movements of the sprint leg action take place? 2 marks

Answer

- *Sagittal (or median) plane.*
- *Transverse axis.*

8) Differentiate and give examples of concentric, static and eccentric work. 6 marks

Answer

- *Concentric work: muscle shortens whilst developing tension.*
  For example biceps muscle during an arm flexion movement. Known as a positive contraction.
- *Static work (isometric contraction): develops muscle tension without changing length.*
  For example rugby scrum.
- *Eccentric work: muscle lengthens whilst developing tension.*
  For example, biceps muscle during arm extension movement. Known as a negative contraction.