CHAPTER 4: *The musculo-skeletal system*

Practice questions - text book pages 64 - 66

1) A prime mover of hip flexion is the:
   a. rectus femoris.
   b. Iliopsoas.
   c. vastus muscles.
   d. gluteus maximus.

Answer: *b.*
Explanation:
- *Key word here is prime and iliopsoas (consisting of psoas major and iliacus muscles) is the prime mover for hip flexion.*
- *Rectus femoris (within the quadriceps group) is a secondary agonist for hip flexion as well being the prime mover for knee flexion.*
- *Gluteus maximus is the prime mover for hip extension and lateral rotation.*

2) Which of the following movements occurs in the transverse (horizontal) plane?
   a. flexion and extension of the hip joints during sprinting.
   b. spinal rotation observed during a discus throw.
   c. abduction and adduction of the legs during a cartwheel.
   d. all of the above movements.

Answer: *b.*
Explanation:
- *The answer is b. as the transverse or horizontal plane divides the body into upper and lower sections and so any twisting or turning movements will occur within this plane.*
- *Sprinting occurs in the sagittal or median plane which divides the body into left and right sides.*
- *Abduction and adduction of the legs during a cartwheel occurs within the frontal or coronal plane which divides the body into front and back sections.*

3) Characteristics of isometric contractions include all but:
   a. shortening.
   b. increased muscle tension throughout the contraction phase.
   c. absence of shortening.
   d. used in resistance training.

Answer: *a.*
Explanation:
- *The answer must be shortening as isometric means same length, so no change in muscle length.*

4) In dorsi flexion of the foot about the ankle joint:
   a. the foot moves upwards towards the front of the calf.
   b. the foot moves upwards towards the rear of the calf.
   c. the foot moves sideways.
   d. none of the above.

Answer: *a.*
Explanation:
Dorsiflexion describes movement of the foot towards the shin. For example during the landing phase of a jump.

5) Abduction and adduction take place in which plane and axis?
   a. transverse plane about the longitudinal axis.
   b. frontal plane about the sagittal axis.
   c. sagittal plane about the transverse axis.
   d. none of these.

Answer: *b.*
Explanation:
- *Abduction is movement away from the midline, adduction is movement towards the midline and therefore takes place in the frontal plane about the sagittal axis.*
- *The sagittal axis runs horizontally from front to back and so includes the movement patterns abduction and adduction.*

6) Complete the missing gaps in table 4.11 naming the main agonist and antagonist muscles, body plane and body axis for each of the actions identified. 16 marks

Table 4.11 – **action at joints**

Answer::

action	main agonist	main antagonist
elevating the shoulder	*trapezius*	*latissimus dorsi*
extending the elbow joint	*triceps*	*biceps*
flexing the knee joint	*hamstrings group*	*quadriceps group*
dorsiflexing the ankle joint	*tibialis anterior*	*calf muscles - gastrocnemeus, soleus*
flexing the trunk	*rectus abdominus*	*erector spinae*

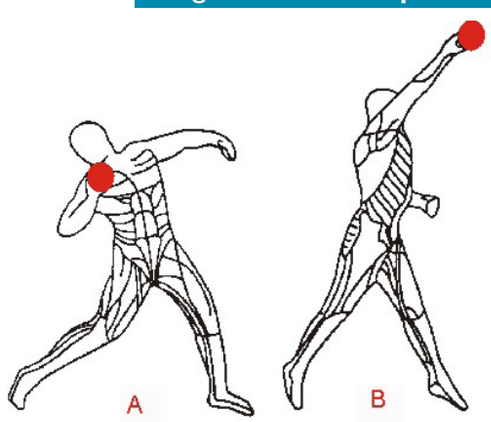
7) Describe the following movement terminology, and give a physical activity for each movement: abduction, circumduction, rotation and plantarflexion. 8 marks

Answer:

- *Abduction is a movement pattern in which a body segment moves away from the midline of the body.*
- *Example: leg action going into a cartwheel.*
- *Circumduction is a movement pattern which consists of flexion, abduction, extension and adduction to create a cone shape in space.*
- *Example: a small circular hand dance gesture.*
- *Rotation is a movement pattern around the axis down the centre of a long bone.*
- *Example: delivery phase of a discus throw.*
- *Plantarflexion is a movement pattern of the foot that results in the toe being pointed downwards.*
- *Example: diving off a springboard.*

8) a) The diagram in figure 4.25 shows a shot putter during the delivery phase of the technique. List the bones that articulate in the shoulder joint. 2 marks

figure 4.25 – a shotputter



Answer:

Bones which articulate at the shoulder:

- *Scapula.*
- *Humerus.*

8) b) Briefly explain the movement sequence of the right arm during the delivery phase of the shot put. 3 marks

Answer:

From diagram A:

- *Shoulder is extended and abducted, elbow is flexed, wrist is pronated and hyper-extended.*

From diagram B:

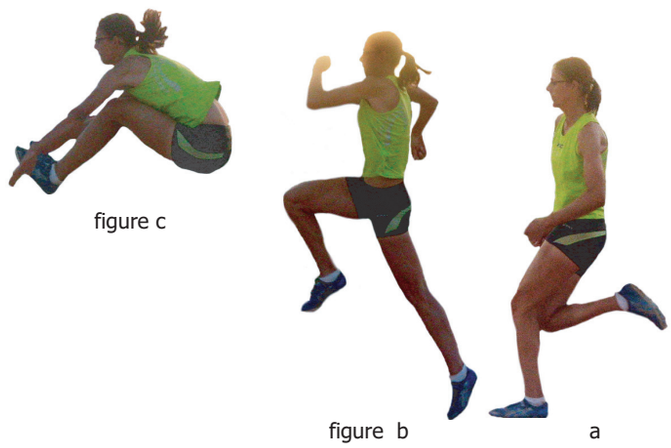
- *Shoulder is flexed and elevated, elbow extended,.*
- *Wrist is pronated and extended, and phalanges are extended.*

9) Figure 4.26 a-c shows an athlete during the final stride, take-off and flight phase of a long jump.

Using these three figures, analyse the action of the left leg (foot in contact with the ground) to include joint type, movement patterns, type of muscle contraction, acting muscles and plane of movement.

Identify factors that affect the maximal force required for long jump take-off. 8 marks

figure 4.26 – long jump take-off and flight



Answer:

- *Joint type: hinge.*
- *Movement pattern: dorsiflexion*
- *Type of muscle contraction: isotonic, eccentric muscle contraction.*
- *Main agonist muscle: quadriceps group: rectus femoris, vastus medialis, vastus intermedius, vastus lateralis.*
- *Plane of movement: sagittal or median plane.*
- *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.*

Factors affecting maximal force (strength):

- *Muscle fibre type: Explosive athletes have a greater percentage of fast twitch glycolytic (FG typ IIa) muscle fibres when compared with endurance athletes or sedentary people. This is observed in large powerful leg and bottom musculature.*
- *The synchronous firing of fast twitch motor units (i.e. many motor units recruited simultaneously) enables the long jumper to generate high force quickly.*
- *The faster speed of contraction due to an increased speed of nerve transmission to numerous muscle fibres associated with each fast twitch motor unit.*
- *Preparing the athlete for speed and strength required for take-off.*
- *Increased speed of strength of contraction is also due to an improvement in coordination between antagonistic muscle pairs – known as reciprocal innervation.*
- *Muscle cross sectional area: The greater the cross sectional area the stronger the muscle.*
- *Type and length of body lever: The ankle joint is a 2nd class lever and its mechanical advantage is to move a large load with a small amount of effort. In this example the ball of the take-off foot strikes the take-off board slightly ahead of the athlete's body mass and provides the vertical acceleration into the flight phase of the jump.*
- *The length of lever affects the load exerted by the lever and hence the speed at which the foot can move since longer levers generate greater forces.*

10) Figure 4.27 shows a tennis player completing a forehand drive. Use the figure to help you complete the following joint analysis.

figure 4.27 – tennis forehand

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

Answer:

- *Type of joint: synovial, ball and socket.*
- *Articulating bones: scapula, humerus.*
- *Agonist from one of the following muscles: pectoralis major, anterior deltoid.*
- *Type of contraction at agonist: isotonic, concentric.*

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

Answer:

- *The agonist is the active muscle, the muscle under tension or doing work and functioning as the prime mover of a joint during the desired movement.*
- *The antagonist muscle relaxes to allow the agonist muscle to work as movement occurs.*
- *When the elbow is flexing during the forehand drive, the agonist = biceps brachii muscle, and the antagonist = triceps brachii muscle.*

11) Differentiate between concentric, eccentric and isometric muscle contraction, using practical examples to support your answer. 6 marks

Answer:

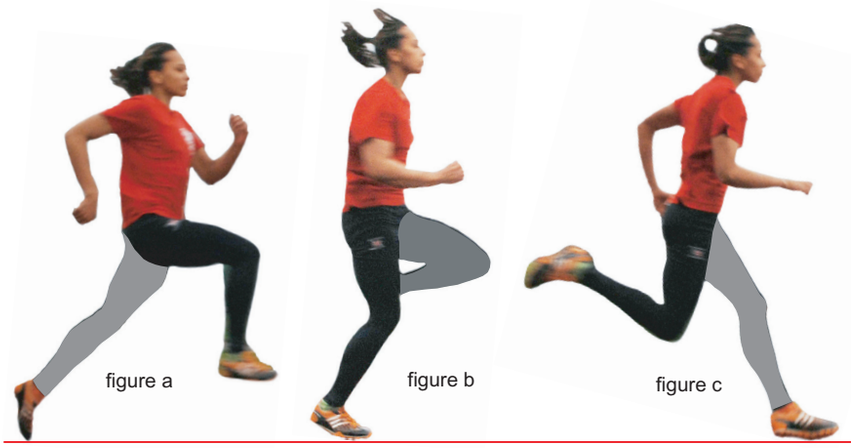
- *Concentric muscle contraction: a muscular contraction which shortens whilst producing tension.*
- *Example: driving upward phase in a jump or squat.*

- *Eccentric muscle contraction: a muscular contraction which lengthens whilst producing tension.*
- *Example: landing from a jump off a box.*

- *Isometric muscle contraction: a muscle contraction which stays the same length whilst producing tension.*
- *Example: holding a plank position.*

12) Figures 4.28 a to c show an elite sprinter completing a full running stride.

figure 4.28 – sprint – a full 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 action 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.*

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

Answer:

- *An imaginary flat surface/line.*
- *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.*