GORDON'S SCHOOL

BTEC SPORT SUMMER WORK

Introduction to Unit 1 & 2

Anatomy and Physiology &

Fitness Training and Programming

Name: _____

House: _____

BTEC Sport

Summer Work Instructions

Unit 2, Fitness Training and Programming is the first exam you will sit in January. Unit 1, Anatomy and Physiology is historically the Unit students find the most daunting and challenging. Here is a head start so you can hit the ground running in September!

Unit 2 (foundational knowledge)

1. Research **BTEC** components of fitness
2. Complete the table

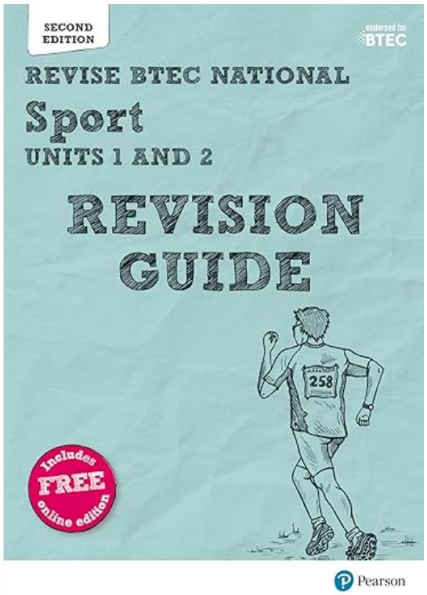
Beware, BTEC definitions may differ from GCSE or A-Level. Make sure you search BTEC specific definitions.

Unit 1 (first learning aim)

3. Make notes from pages 5-18
4. Answer Questions on pages 19-25
5. Mark

A resources you may wish to buy to help you this year.

Pearson REVISE BTEC National Sport Units 1 & 2 Revision Guide inc online edition - for 2025 exams : Hartigan, Sue, Sharp, Kelly: Amazon.co.uk: Books



Key Word	Definition	Sporting Example
Agility		
Balance		
Coordination		
Reaction time		
Power		

Aerobic endurance		
Strength		
Muscular endurance		
Flexibility		
Speed		
Body composition		

Structure of the skeletal system

Before we look at the functions of the skeletal system, it is important to understand which bones make up the skeleton and how they are used to perform the vast range of techniques and actions required in sport. Without bones, you would be a shapeless mass of muscle and tissue, unable to move. The skeletal system is made up of bones, cartilage and joints.

Your skeleton is made up of 206 bones which provide a framework that supports your muscles and skin and protects your internal organs.

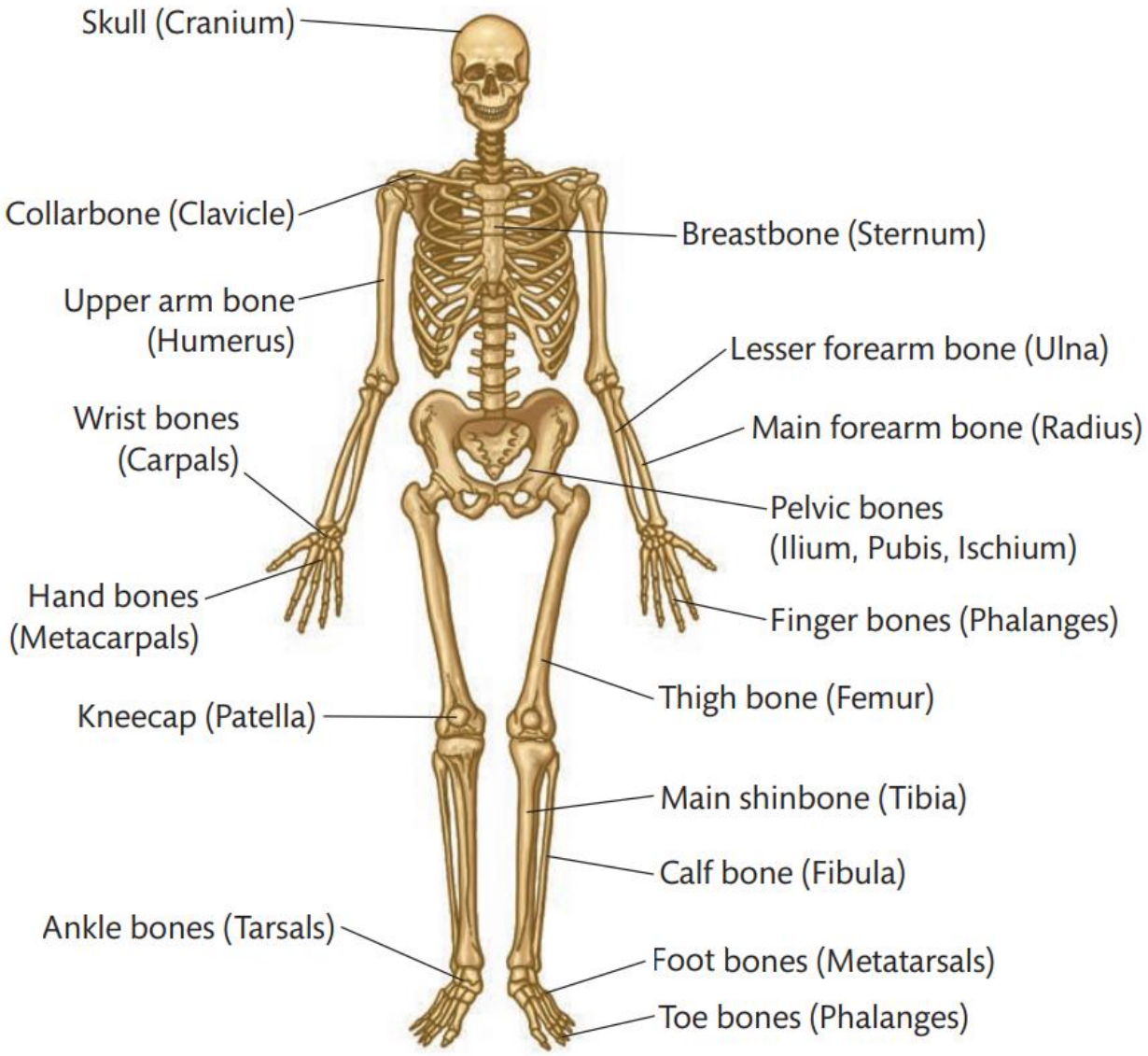


Table 1.2: Terms used to describe the location of bones

Term	Meaning
Anterior	To the front or in front
Posterior	To the rear or behind
Medial	Towards the midline or axis, an imaginary line down the centre of the body
Lateral	Away from the midline or axis
Proximal	Near to the root or origin (the proximal of the arm is towards the shoulder)
Distal	Away from the root or origin (the distal of the arm is towards the hand)
Superior	Above
Inferior	Below

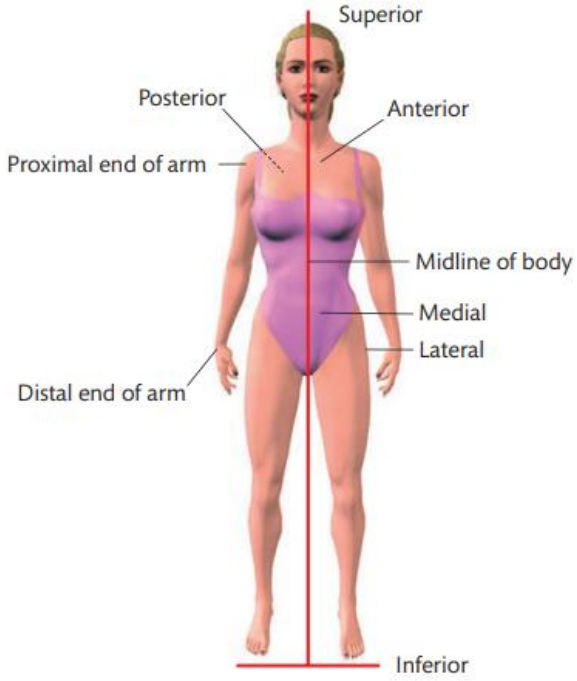


Figure 1.2: Anatomical positions

Types of bone

The skeleton has five main types of bone according to their shape and size. These can be classified as:

- **long bones** – the bones found in the limbs. They have a shaft known as the **diaphysis** and two expanded ends known as the **epiphysis**.
- **short bones** – small, light, strong, cube-shaped bones consisting of **cancellous bone** surrounded by a thin layer of compact bone. The carpals and tarsals of the wrists and ankles (introduced later in this section) are examples of short bones.
- **flat bones** – thin, flattened and slightly curved, with a large surface area. Examples include the scapulae, sternum and cranium.
- **irregular bones** – have complex shapes that fit none of the categories above. The bones of the spinal column are a good example.
- **sesamoid bones** – have a specialised function and are usually found within a tendon. These bones provide a smooth surface for the tendon to slide over. The largest sesamoid bone is the patella in the knee joint.

Key term

Cancellous bone – light and porous bone material that has a honeycomb or spongy appearance.

Areas of the skeleton

The skeleton can be divided into two parts: 80 bones form your **axial skeleton** – the long **axis** of your body; the other 126 bones form your **appendicular skeleton** – the bones that are attached to this axis.

Key term

Axis – a centre line through any body or object. The body or object to either side of the line should be symmetrical (a mirror image).

Axial skeleton

The axial skeleton is the main core or axis of your skeleton and consists of:

- the skull (including cranium and facial bones)
- the thoracic cage (sternum and ribs)
- the vertebral column.

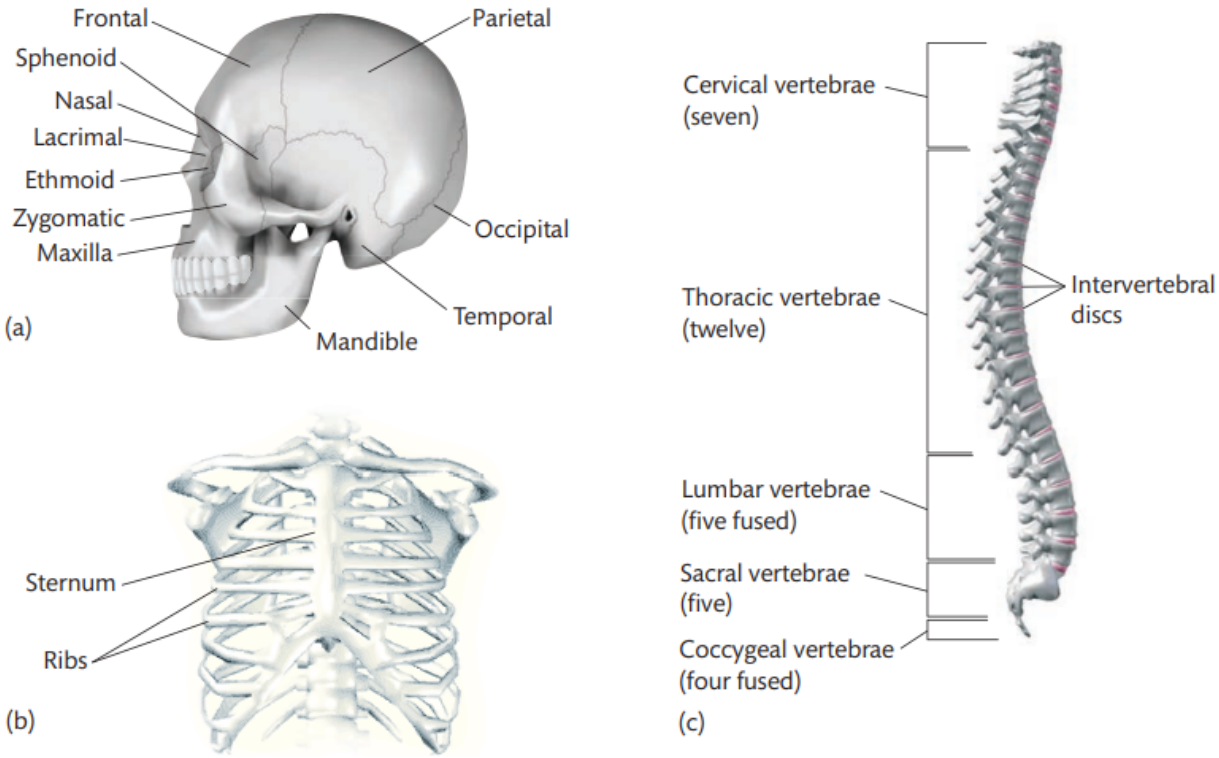


Figure 1.3: The axial skeleton: (a) the skull, (b) the thorax and (c) the vertebral column

Appendicular skeleton

The appendicular skeleton consists of the bones that are attached to the axial skeleton. These bones will be introduced in more detail later in this section, but the appendicular skeleton consists of the following parts.

- The upper limbs consist of 60 bones (30 in each arm) including the humerus, radius, ulna, carpals, metacarpals and phalanges.
- The lower limbs consist of 60 bones (30 in each leg) including the femur, tibia, fibula, patella, tarsals, metatarsals and phalanges.
- The shoulder girdle consists of four bones – two clavicles and two scapulae – which connect the limbs of the upper body to the thorax.
- The pelvic girdle is made of three bones: the ilium, pubis and ischium. These fuse together with age and are collectively known as the innominate bone. The main function of the pelvic girdle is to provide a solid base through which to transmit the weight of the upper body. It also provides attachment for the powerful muscles of the lower back and legs, and protects the digestive and reproductive organs.

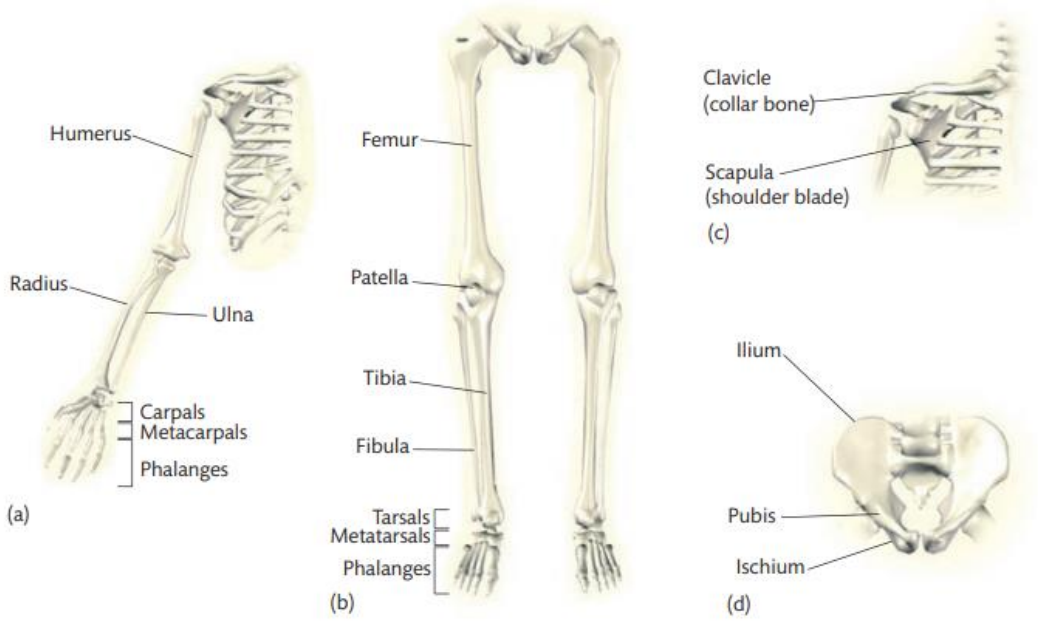


Figure 1.4: The appendicular skeleton: (a) the upper limbs, (b) the lower limbs, (c) the shoulder girdle and (d) the pelvic girdle

The spine or vertebral column

The vertebral column is commonly known as the spine or backbone and extends from the base of the cranium to the pelvis, providing a central axis for the body. It is made up of 33 irregular bones called **vertebrae**.

The vertebral column accounts for around 40 per cent of a person's overall height. The vertebrae are held together by powerful **ligaments**. These allow little movement between adjacent vertebrae but a considerable degree of flexibility along the spine as a whole.

The vertebral column can be classified into five sections or regions (see Figure 1.3(c)):

- **cervical vertebrae** – the seven vertebrae of the neck. The first two are known as the atlas (C1) and the axis (C2). They form a pivot joint that allows the head and neck to move freely. They are the smallest and most vulnerable vertebrae of the vertebral column.
- **thoracic vertebrae** – the 12 vertebrae of the mid-spine, which articulate with the ribs. They lie in the thorax, a dome-shaped structure that protects the heart and lungs.
- **lumbar vertebrae** – the five largest of the movable vertebrae, situated in the lower back. They support more weight than other vertebrae and provide attachment for many of the muscles of the back. The discs between these vertebrae produce a **concave** curve in the back.
- **sacral vertebrae** – the five sacral vertebrae are fused together to form the **sacrum**, a triangular bone located below the lumbar vertebrae. It forms the back wall of the pelvic girdle, sitting between the two hip bones. The upper part connects with the last lumbar vertebra and the bottom part with the coccyx.
- **coccygeal vertebrae** – at the bottom of the vertebral column there are four coccygeal vertebrae, which are fused together to form the **coccyx** or tail bone.

Key terms

Ligaments – short bands of tough and fibrous flexible tissue that hold bones together.

Concave – having an outline or surface that curves inwards.

Key term

Intervertebral discs – fibrocartilaginous cushions that act as the spine's shock absorbing system and prevent injury to the vertebrae and brain.

The vertebral column has many functions. It protects the spinal cord and supports the ribcage. The larger vertebrae of the lumbar region support a large amount of body weight. The flatter thoracic vertebrae offer attachment for the large muscles of the back. These, along with the **intervertebral discs**, receive and distribute impact associated with sporting performance, reducing shock.

Postural deviations

The 33 vertebrae of the spine have a distinctive shape when stacked on top of one another. The normal shape consists of a curve in the cervical (neck), thoracic (mid back) and lumbar (low back) regions when viewed from the side. A **neutral spine** refers to a good posture with the correct position of the three natural curves. When viewing the spine from the front (anterior), it should be completely vertical. Occasionally the spine may suffer from disorders which can cause the natural curves to change.

- **Kyphosis** – the excessive outward curve of the thoracic region of the spine resulting in a 'hunchback' appearance. This is often caused by poor posture but can be caused by deformities of the vertebrae.
- **Scoliosis** – the abnormal curvature of the spine either to the left or to the right (lateral curvature). Most likely to occur in the thoracic region. Often found in children but can be found in adults. This condition is not thought to be linked to bad posture and the exact reasons for it are unknown, although it seems to be inheritable.

Major bones of the skeletal system

The skeletal system includes the following bones.

- **Cranium** – this box-like cavity (space) consists of interlinking segments of bone that are fused together. The cranium contains and protects the brain.
- **Clavicles** – these are commonly known as the collar bones and are the long, slim bones that form the anterior part of the shoulder girdle. This provides a strong attachment for the arms.
- **Ribs** – there are 12 pairs of ribs and they form part of the **thoracic cage**. The first seven pairs are attached to the sternum (see below) and are known as true ribs; the remaining five pairs are known as false ribs as they do not attach to the sternum. The ribs are long, flat bones.
- **Sternum (breast bone)** – this is the elongated, flat bone that runs down the centre of the chest and forms the front of the thoracic cage. Seven pairs of ribs are attached to the sternum, which provides protection and muscular attachment.
- **Scapula** (plural: scapulae) – commonly known as the **shoulder blades**, these large, triangular, flat bones form the posterior part of the shoulder girdle.
- **Humerus** – this is the long bone of the upper arm and is the largest bone of the upper limbs. The head of the humerus articulates (joins) with the scapula to form the shoulder joint. The distal end articulates with the radius and ulna to form the elbow joint.
- **Radius and ulna** – the ulna is the longer of the two bones of the forearm. The ulna and radius articulate distally (see Table 1.2) with the wrist.
- **Carpals** – these are the eight small bones that make up the wrist. They are irregular, small bones arranged in two rows of four. They fit closely together and are kept in place by ligaments.

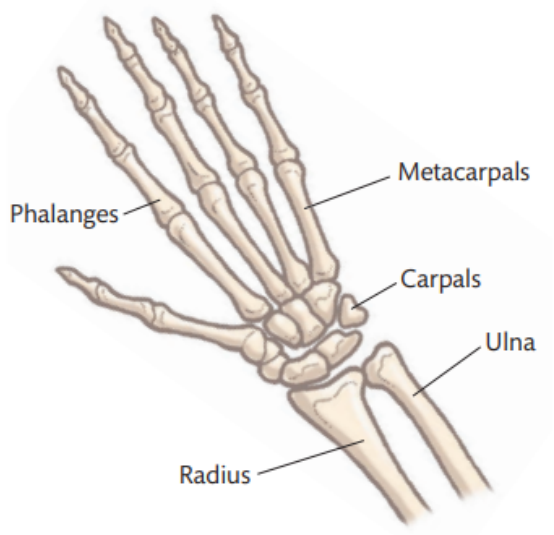


Figure 1.5: The bones of the wrist and hand

- **Metacarpals** – five long bones in the palm of the hand, one corresponding to each digit (finger or thumb). These run from the carpal bones of the wrist to the base of each digit in the hand.
- **Phalanges** – the bones that make up the thumbs, fingers and toes. Most fingers and toes have three phalanges, but the thumbs and big toes have two.
- **Pelvis** – the pelvis is made up of two hip bones which in turn consist of three sections (**ilium**, **ischium** and **pubis**) which fuse together during puberty to form one bone. The ilium structure provides the socket for the ball and socket joint (see Figure 1.8) of the femur, allowing the legs to be attached to the main skeleton.
- **Femur** – the longest and strongest bone in the body, sometimes referred to as the **thigh bone**. The head fits into the socket of the pelvis to form the hip joint; the lower end joins the tibia to form the knee joint.
- **Patella (kneecap)** – the large, triangular sesamoid bone found in the quadriceps femoris **tendon**. It protects the knee joint.
- **Tibia and fibula** – the long bones that form the lower leg. The tibia is the inner and thicker bone, also known as the **shin bone**. The upper end of the tibia joins the femur to form the knee joint, while the lower end forms part of the ankle joint. The fibula is the outer, thinner bone of the lower leg; it does not reach the knee, but its lower end does form part of the ankle joint.
- **Tarsals** – along with the tibia and fibula, seven bones known collectively as the tarsals form the ankle joint including the heel. The calcaneus, or heel bone, is the largest tarsal bone. It helps to support the weight of the body and provides attachment for the calf muscles via the Achilles tendon. The tarsals are short and irregular bones.
- **Metatarsals** – there are five metatarsals in each foot; they are located between the tarsals and the phalanges (toes). Each metatarsal has a similar structure, with a distal and proximal head joined by a thin shaft (body). The metatarsals are responsible for bearing a great deal of weight, and they balance pressure through the balls of the feet. The metatarsals are a common site of fracture in sport.

Key term

Tendon – strong fibrous tissue that attaches muscle to bone.

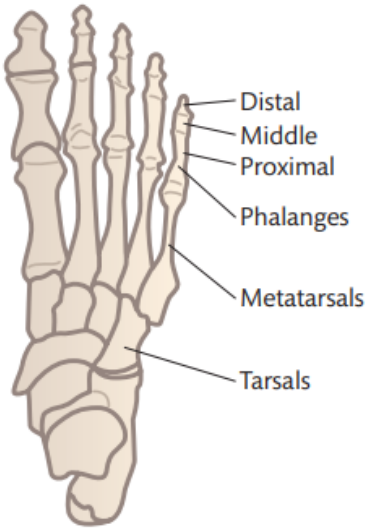


Figure 1.6: The bones of the foot

Key term

Calcium – a mineral essential for bone growth and found in a wide range of foods including milk, cheese, yoghurt, nuts, broccoli and beans.

Process of bone growth

Bone is a living organ that is continuously being reshaped through a process called remodelling. **Ossification** is the process in which bones are formed. Throughout this process parts of the bone are reabsorbed so that unnecessary **calcium** is removed (via cells called **osteoclasts**) while new layers of bone tissue are created.

The cells that bring the calcium to your bones are known as **osteoblasts** and are responsible for creating bone matter. Osteoblast activity increases when you exercise, so your bones will become stronger the more exercise you do. This means your bone calcium stores increase to cope with the demand for calcium, so exercising also reduces the risk of osteoporosis. Activities that can build stronger bones include tennis, netball, basketball, aerobics, walking and running.

The ends of each long bone contain growing areas – or plates – which allow the bone to grow longer. This continues throughout childhood until they reach full maturity. These areas are called the **epiphyseal plates** and allow the long bones to extend. Once a long bone is fully formed, the head – or end of each bone – fuses with the main shaft (diaphysis) to create the **epiphyseal line**.

Function of the skeletal system

Your skeleton has a number of important functions both in sport and in everyday life. When performing sport or exercise there are eight main functions.

- **Support** – collectively, your bones give your body shape and provide the supporting framework for the soft tissues of your body.
- **Protection** – the bones of your skeleton surround and protect vital tissues and organs in your body. Your skull protects your brain, your heart and lungs are protected by your thorax, your vertebral column protects your delicate spinal cord, and your pelvis protects your abdominal and reproductive organs.
- **Attachment for skeletal muscle** – parts of your skeleton provide a surface for your skeletal muscles to attach to, allowing you to move. Tendons attach muscles to bone, providing leverage. Muscles pulling on bones act as levers, and movement occurs at the joints so that you can walk, run, jump, kick, throw etc. Type of joint (see page 12) determines the type of movement possible.
- **Source of blood cell production** – your bones are not completely solid, as this would make your skeleton heavy and difficult to move. Blood vessels feed the centre of your bones, and stored within the bones is **bone marrow**. The marrow of your long bones is continually producing red and white blood cells. This is an essential function as large numbers of blood cells, particularly red cells, die every minute.
- **Store of minerals** – bone is a reservoir for minerals such as calcium and phosphorus, which are essential for bone growth and the maintenance of bone health. These minerals are stored and released into the bloodstream as required, balancing the minerals in your body.

- **Leverage** – the bones provide a lever system against which muscles can pull to create movement.
- **Weight bearing** – your bones are very strong and will support the weight of your tissue including muscles. During sport large forces are applied to your body, and your skeleton provides the structural strength to prevent injury.
- **Reducing friction across joints** – the skeleton has many joints of different types. Synovial joints secrete fluid that prevents bones from rubbing together, reducing friction between the bones.

Main function of different bone types

The bones in your body have many different functions, depending on their shape and location. Consider the bones of the arms and legs and how they are used in sport. In conjunction with your muscles, these long bones can produce large movements such as kicking or throwing as the long bones act like levers. The flat bones of the body are also important in sport as they can provide protection from impact, ensuring your vital organs remain functioning. Look at Table 1.3 for examples of the different bones and their main functions.

Table 1.3: Function of different bones types

Type of bone	Function	Examples
Long	Movement, support, red blood cell production	Femur, humerus, tibia, radius, ulna
Short	Fine or small movements; shock absorption, stability, weight bearing	Carpals, tarsals
Flat	Attachment for muscles; protection	Sternum, scapula, pelvis, cranium
Sesamoid	Protection; reduction of friction across a joint	Patella, pisiform (wrist)
Irregular	Protection (spinal cord); movement	Vertebrae

All synovial joints contain the following features.

- A **joint capsule** or fibrous capsule - an outer sleeve to help to hold the bones in place and protect the joint. This capsule will also contain the main structure of the synovial joint.

- A **bursa** – a small fluid-filled sac which provides a cushion between the tendons and the bones, preventing friction. Bursae are filled with synovial fluid.
- **Articular cartilage** on the ends of the bones – provides a smooth and slippery covering to stop the bones rubbing or grinding together.
- A **synovial membrane** – the capsule lining that releases synovial fluid.
- **Synovial fluid** – a viscous (thick) liquid that lubricates the joint and reduces the friction between the bones, preventing them from rubbing together. Synovial fluid also provides nutrients to the articular cartilage.
- **Ligaments** – hold the bones together and keep them in place.

Joints

You have seen that your skeleton is made up of bones that support and protect your body. For movement to occur, the bones must be linked. A joint is formed where two or more bones meet. This is known as an **articulation**. The adult human body contains around 350 joints, which can be classified in different ways depending on their structure.

The bones of the shoulder are shown in Figure 1.4(c) on page 7 and the bones of the hip, knee and ankle are shown in Figure 1.4(b). The structure and movement of the vertebrae are described on pages 7–8 under the heading 'The spine or vertebral column'.

Key term

Articulation – where two or more bones meet.

Classification of joints

There are three types of joint, classified according to the degree of movement they allow:

- fixed
- slightly movable
- synovial.

Fixed joints

Fixed joints, or **fibrous** or **immovable joints**, do not move. Fixed joints form when the bones interlock and overlap during early childhood. These joints are held together by bands of tough, fibrous tissue and are strong with no movement between the bones. An example is between the bone plates in your cranium, which are fixed together to provide protection for your brain.

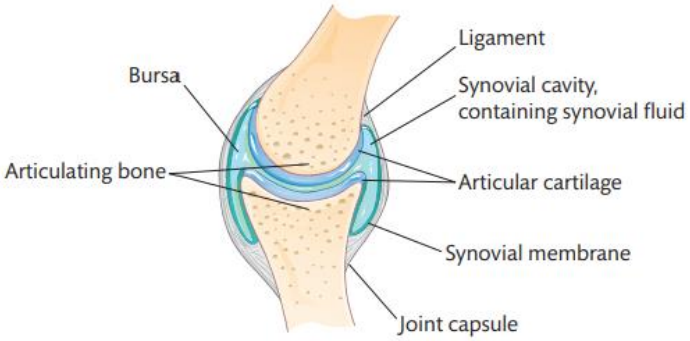
Slightly movable joints

Slightly movable or **cartilaginous joints** allow slight movement. The ends of the bone are covered in a smooth, shiny covering, known as articular or hyaline cartilage, which reduces friction between the bones. The bones are separated by pads of white fibrocartilage (a tough cartilage that is capable of absorbing considerable loads). Slight movement at these joining surfaces is made possible because the pads of cartilage compress, for example between most vertebrae.

Synovial joints

Synovial joints or **freely movable joints** offer the highest level of mobility at a joint and are vital to all sporting movements. Most of the joints in your limbs are synovial.

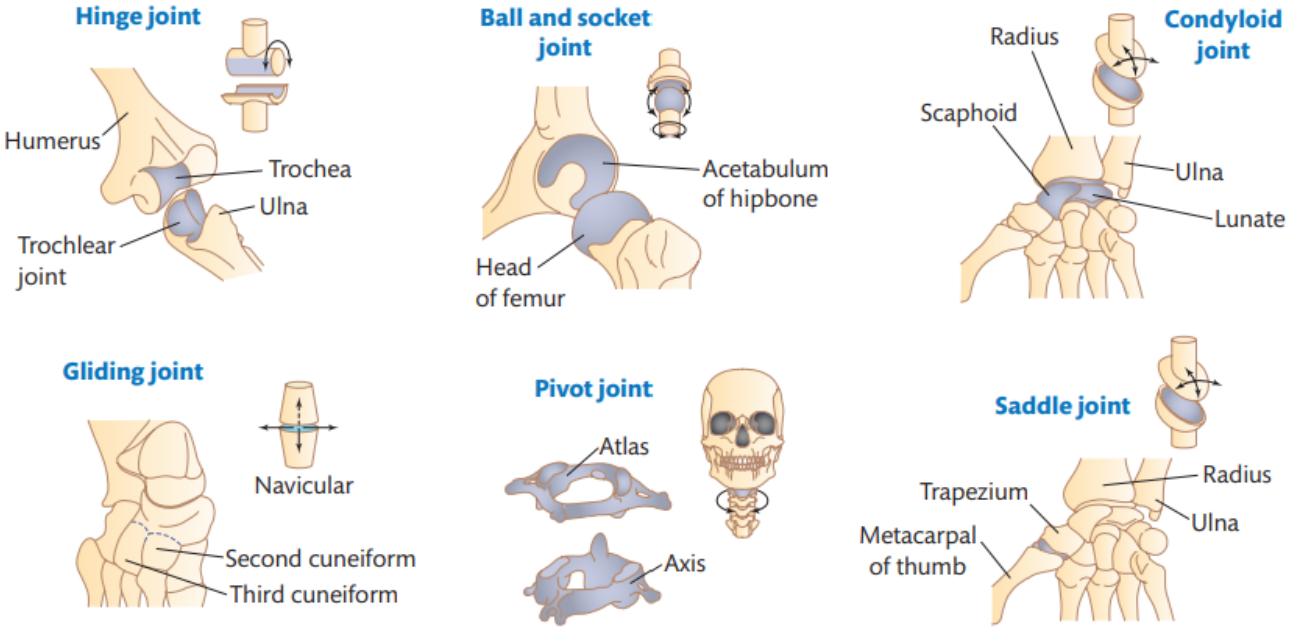
A synovial joint (see Figure 1.7) consists of two or more bones, the ends of which are covered with articular cartilage, which allows the bones to move over each other with minimum friction. Synovial joints always have a synovial cavity or space between the bones. This cavity is completely surrounded by a fibrous capsule, lined with a synovial membrane, whose purpose is to release or secrete fluid known as synovial fluid into the joint cavity. This lubricates and nourishes the joint. The joint capsule is held together by tough bands of connective tissue known as ligaments. These ligaments provide the strength to avoid dislocation, while being flexible enough to allow a wide range of movement.



Types of synovial joint

There are six types of synovial joint, categorised according to their structure and the movements they allow. These joints will permit specific movements and, combined, will allow you to perform complex techniques such as a somersault or a tennis serve.

- **Hinge** – These allow movement in one direction only (similar to the hinge of a door). Elbow and knee joints are typical examples and only allow movements forwards and backwards. Exercise examples include running with the knee bending or a bicep curl.
- **Ball and socket** – The round end of one bone fits into a cup-shaped socket in the other bone, allowing movement in all directions. Examples include hip and shoulder joints, used in running and in throwing an object such as a javelin.
- **Condyloid** – Also known as ellipsoidal joints. These are similar to ball and socket joints, in which a bump (condyle) on one bone sits in the hollow formed by another. Movement is backwards and forwards and from side to side. Ligaments often prevent rotation. An example of a condyloid joint in action is during a basketball game when a player is dribbling or bouncing the ball, with the wrist being used to create this action.
- **Gliding** – These joints allow movement over a flat surface in all directions, but this movement is restricted by ligaments or a bony prominence, for example in the carpals and tarsals of wrists and ankles. This can be seen in a netball jump with the foot pointing downwards.



- **Pivot** – A circular bone fits over a peg of another bone, allowing controlled rotational movement, such as the joint of the atlas and axis in the neck. This joint allows you to turn your head from side to side. When you turn your head in sport you will be using a pivot joint.
- **Saddle** – These are similar to condyloid joints but the surfaces are **concave** and **convex**. The joint is shaped like a saddle with the other bone resting on it like a rider on a horse. Movement occurs backwards and forwards and from side to side, such as at the base of the thumb. You would use a saddle joint when gripping a racket in tennis or squash.

Key terms

Flexibility – the range of movement around a joint or group of joints.

Soft tissue – the tissue that connects, supports and surrounds structures such as joints or organs. It includes tendons, ligaments, skin, fat and muscles.

The range of movements at synovial joints

The type of movement that each synovial joint allows is determined by its structure and shape. Sporting techniques usually use a combination of different joints to allow a wide range of movement or techniques. For example, a cricketer bowling a ball will use joints in the fingers (phalanges), wrist, elbow and shoulder. They will also use the joints of the foot, ankle, knee and hip when running.

It is important when studying sports performers in action that you are able to break down these techniques and identify the specific movements at each joint. A coach will often analyse the movements produced by an athlete in order to improve technique, and it is common to see movements filmed and analysed in detail using computer software.

The range of motion is the amount of movement at a joint and is often referred to as joint **flexibility**. Flexibility will also depend on a number of factors including age, the tension of the supporting connective tissues (tendons) and muscles that surround the joint, and the amount of **soft tissue** surrounding the joint.

Cricketers use a large number of joints and movements when bowling

The following movements are common across a wide range of sports and are important when performing sport and exercise techniques.

- **Flexion** – reducing the angle between the bones of a limb at a joint: muscles contract, moving the joint into a bent position. Examples include bending your arm in a bicep curl action or bending the knee when preparing to kick a football.
- **Extension** – straightening a limb to increase the angle at the joint, such as straightening your arm to return to your starting position in a bicep curl action or the kicking action when taking a penalty in football with the knee straightening.
- **Dorsiflexion** – an upward movement, as in moving the foot to pull the toes towards the knee in walking.
- **Plantar flexion** – a movement that points the toes downwards by straightening the ankle. This occurs when jumping to shoot in netball.
- **Lateral flexion** – the movement of bending sideways, for example at the waist.
- **Horizontal flexion** and **horizontal extension** – bending the elbow (flexion) while the arm is in front of your body; straightening the arm at the elbow is **extension**.

- **Hyper-extension** – involves movement beyond the normal anatomical position in a direction opposite to flexion. This occurs at the spine when a cricketer arches his or her back when approaching the crease to bowl.
- **Abduction** – movement away from the body's vertical midline, such as at the hip in a side-step in gymnastics.
- **Adduction** – movement towards the body's vertical midline, such as pulling on the oars while rowing.
- **Horizontal abduction and adduction** – this is the movement of bringing your arm across your body (flexion) and then back again (extension).
- **Circumduction** – this is a circular movement that results in a conical action.
- **Rotation** – circular movement of a limb. Rotation occurs at the shoulder joint during a tennis serve.

Reflect

Think about a common sporting movement such as a javelin throw. Consider the movement at each joint and identify the type of action that is occurring.

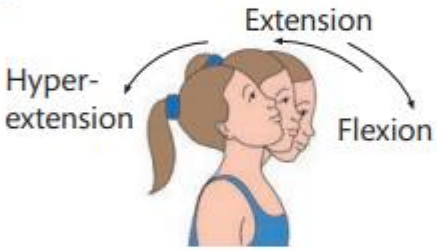
Flexion

Extension

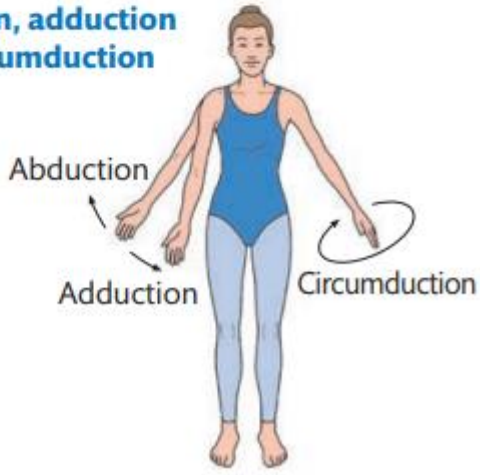
Plantar flexion and dorsiflexion

Lateral flexion

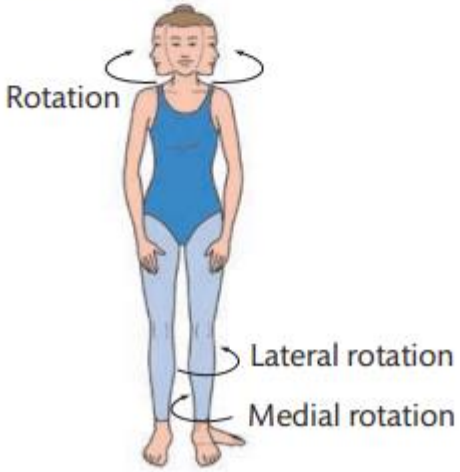
Hyper-extension



Abduction, adduction and circumduction



Rotation



Responses of the skeletal system to a single sport or exercise session

You are probably aware that during exercise your heart rate and breathing rate increase, but did you know that your skeletal system will also respond to exercise? This is sometimes overlooked as the changes are small and out of sight. When you exercise or take part in sport your body's systems will adapt almost instantaneously so that your body is prepared for the additional stresses that will be put on it. This is one of the reasons why you should always complete a well-planned and performed warm-up before starting any physical activity.

Your skeletal system will respond to exercise in the short term by producing more synovial fluid in the synovial joints. This is so that the joints are lubricated and can protect the bones during the increased demands that exercise puts on the skeleton and joints. The fluid will also become less **viscous** and the range of movement at the joint will increase. The release of synovial fluid from the synovial membrane will also provide increased nutrients to the articular cartilage.

Another **acute response** to exercise is the increased uptake of minerals within the bones. Just as muscles become stronger the more you use them, a bone becomes stronger and denser when you regularly place exercise demands upon it. The body will absorb minerals such as calcium which will increase your bone mineral density. This is especially important for weight bearing exercises such as bench pressing. When more stress and force is applied to the bones they must be strong enough to cope with these increased demands.

Additional factors affecting the skeletal system

The benefits of taking part in regular exercise or physical activity are huge. People who take part in regular exercise are more likely to live longer and are less likely to develop serious diseases. Exercise should be part of a healthy lifestyle and it is common to hear about the benefits of physical activity in preventing heart disease and controlling weight. Regular exercise can also help common skeletal diseases such as arthritis and osteoporosis.

Arthritis

Arthritis is a condition where there is an inflammation within a synovial joint, causing pain and stiffness in the joint. The most common type of arthritis is osteoarthritis. This is caused by general wear and tear over a long period of time. This reduces the normal amount of cartilage tissue, which may result in the ends of the bones rubbing together. This natural breakdown of cartilage tissue can be made worse by injury to the joint.

However, regular exercise can prevent arthritis. During physical activity your joints will produce more synovial fluid which will not only improve the joint lubrication, reducing friction between the bones, but will also provide important minerals to the cartilage. Exercises such as stretching will also improve the joint range of motion, lengthen the ligaments holding the bones in place and improve flexibility.

Osteoporosis

Osteoporosis is the weakening of bones caused by a loss in calcium or a lack of **vitamin D**. As you get older your bones slowly lose their mineral density and naturally become brittle, fragile and more likely to break under stress. However, physical activity and exercise can help prevent osteoporosis by promoting increased uptake of minerals within the bones, resulting in an increase in bone mineral density. Resistance training is a good method of preventing osteoporosis, as overloading the skeleton will increase bone density.

Age

The skeletal system is a living tissue that is constantly growing and repairing itself so that it can provide support and protection. Generally, exercise and sports will benefit you. The exception to this is resistance training (weight training) in children, as this can cause more harm than good. The reason for this is that a child's bones are still growing and putting too much force on them can damage the epiphyseal plates which are found at each end of the long bones. Damage to these plates during childhood and puberty can result in stunted bone growth.

Questions

Q1.

Ted is a tennis player. **Figure 7** shows the preparation (position A) and the hitting (position B) phases of his serve.

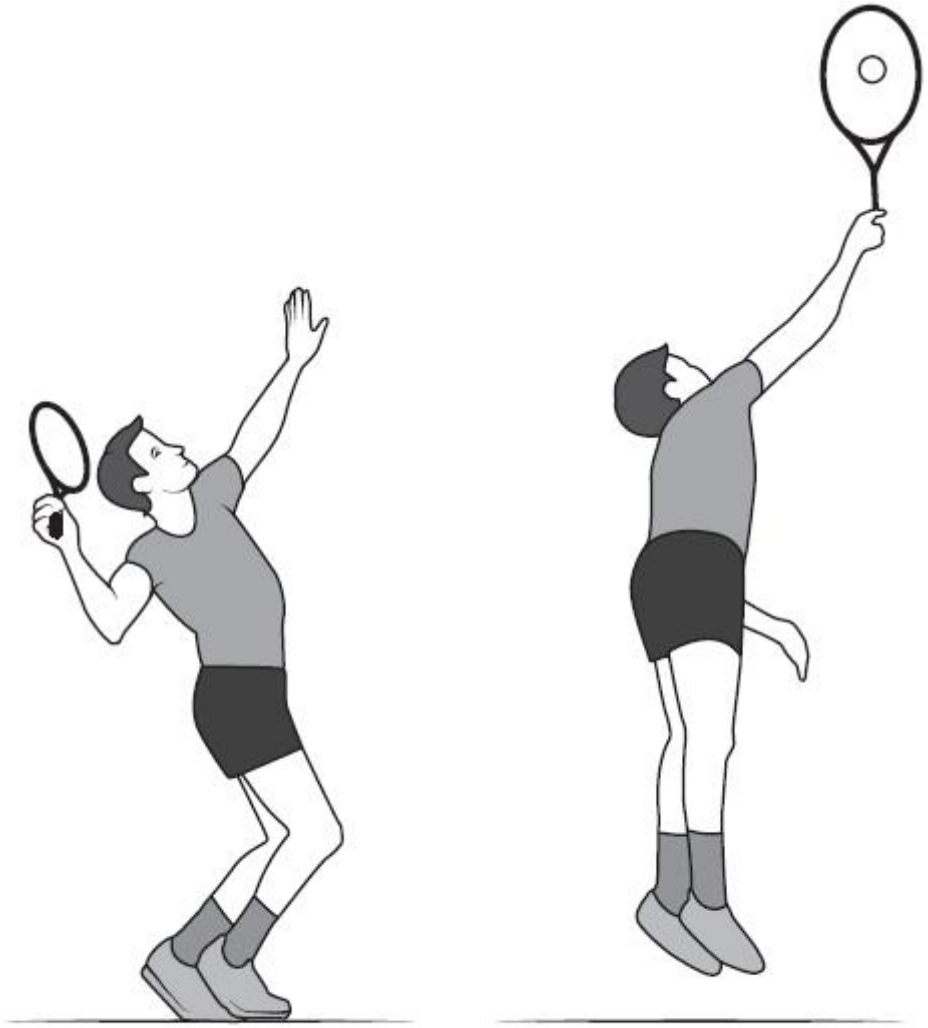


Figure 7

Analyse how the skeletal and muscular systems interact to enable the movement of the shoulder, elbow and wrist of Ted's racquet arm from position A to position B in **Figure 7**.

(Total for question = 8 marks)

Q2.

A flat bone is one type of bone. One function of a flat bone is to protect vital organs of the body.

Complete **Table 1** by:

(a) giving **two** other types of bone in Column A

(b) giving **one** function of each type of bone in Column B.

An example has been provided.

	Column A	Column B
	(a) Type of bone	**(b) Function of the bone given in Column A**
Example	Flat bone	Protect vital organs
1	(1)	(1)
2	(1)	(1)

Table 1

(Total for question = 4 marks)

Q3.

One of the additional factors that can affect the skeletal system is arthritis.

Explain how arthritis affects the skeletal system.

(3)

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(Total for question = 3 marks)

Q4.

Warren is a rugby player. He uses different bone types to perform successfully in a match.
Two of these bone types are flat bones and long bones.

Explain why flat bones **and** long bones help Warren when playing a match.

(4)

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(Total for question = 4 marks)

Q5.

Zara is a badminton player. During a game she regularly runs, jumps and changes direction.

Explain why regular participation in weight-bearing activities helps to reduce the likelihood of osteoporosis.

(3)

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(Total for question = 3 marks)

Q6.

Synovial fluid is a thick liquid found in synovial joints.

Give **three** functions of synovial fluid.

(3)

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(Total for question = 3 marks)

Q7.

Figure 2 shows Claire performing a squat.

Figure 2

Complete **Table 1** by:

(a) identifying the joint type at the knee and hip

(2)

(b) identifying the movement from standing to the position shown in **Figure 2**.

(2)

	(a) Joint type	(b) Movement
Knee		
Hip		

Table 1

(Total for question = 4 marks)

Mark Scheme

Q1.

Question Number	Answer	Mark
	Answers will be credited according to the learner's demonstration of knowledge and understanding of the material, using the indicative content and level descriptors below. The indicative content that follows is not prescriptive. Answers may cover some/all of the indicative content but should be rewarded for other relevant answers. **Movement from position A to B** • Wrist joint is a hinge joint, • Movement taking place is wrist extension to flexion/held neutral • The agonist muscle is the wrist flexors and the antagonist the wrist extensors • The wrist flexors are contracting concentrically, and the wrist extensors are relaxing • Elbow is a hinge joint • The movement taking place is elbow flexion to extension • The agonist muscle is the triceps and the antagonist is the biceps • The triceps is contracting concentrically, and the biceps is relaxing • Shoulder is a ball and socket joint • The movement taking place is abduction to adduction/extension to flexion • The agonist muscle is the pectorals/deltoid and the antagonist is the latissimus dorsi/deltoid • The pectorals/deltoid are contracting concentrically, and the latissimus dorsi/deltoid are relaxing • eccentrically/relaxing • Skeletal muscles attach to bones via tendons and when they contract, they pull on the bone causing movement to take place when Ted serves	8
	Accept any other appropriate answer.	

Mark scheme (award up to 8 marks)		
Level	**Mark**	**Descriptor**
Level 0	0	No rewardable material.
Level 1	1–3	• Demonstrates isolated elements of knowledge and understanding. • Breaks the situation down into component parts and a few of the points made will be relevant to the context in the question.
		• Limited analysis which contains generic assertions rather than interrelationships or linkages.
Level 2	4-6	• Demonstrates some accurate knowledge and understanding. • Breaks the situation down into component parts and some of the points made will be relevant to the context in the question. • Displays a partially developed analysis which considers some interrelationships or linkages but not always sustained.
Level 3	7-8	• Demonstrates mostly accurate knowledge and understanding. • Breaks the situation down into component parts and most of the points made will be relevant to the context in the question. • Displays a developed and logical analysis which clearly considers interrelationships or linkages in a sustained manner.

Q2.

<table>
<tr><th>Question Number</th><th>Answer</th><th>Mark</th></tr>
<tr><td>(a)
(b)
Clip together</td><td>Award one mark for each identification of a type of bone, up to a total of two marks.

Award one mark for each associated function, up to a total of two marks.

<table>
<tr><th>Column A</th><th>Column B</th></tr>
<tr><th>(a) Type of bone</th><th>(b) Function of the bone given in Column A</th></tr>
<tr><td>Long</td><td>Movement/blood cell production</td></tr>
<tr><td>Short</td><td>Weight-bearing</td></tr>
<tr><td>Sesamoid</td><td>Reduce friction across a joint</td></tr>
</table>

Accept phonetic spelling.
Accept any other appropriate response.</td><td>2+2</td></tr>
</table>

Q3.

Question Number	Answer	Mark
	Award up to **three** marks for explaining arthritis. Arthritis is when there is an inflammation (in the joint) (1) due to the breakdown/wearing away of cartilage (1) causing pain/stiffness/friction (1) Accept any other appropriate answer.	3

Q4.

Question Number	Answer	Mark
Expert	Award **one** mark for identifying why flat bones and **one** mark for identifying why long bones will help when playing in the match and **one** mark for justifying each reason. Flat bones protect the vital organs (1) reducing the risk of injuries when being tackled. (1) Long bones enable leverage/movement to take place (1) to enable Warren to run with the ball. (1) Accept any other appropriate answer.	4

Q5.

Question Number	Answer	Mark
Expert	Award **one** mark for identifying that bones become stronger/denser and up to **two** marks for justifying that reason. The weight-bearing activities cause additional stress or damage to the bone/help make the bones stronger/denser. (1) The process happens through ossification (1) osteoclasts clear away old bone (1) increasing osteoblast activity to build new bone (1) allowing the bones to take up more calcium/minerals (1) and making them less likely to break/fracture in later life. (1) Accept any other appropriate answer.	3

Q6.

Question Number	Answer	Mark
	Award **one** mark for each function of synovial fluid identified to a maximum **three** marks. • Provides lubrication for the joint (1) • Provides nutrients/nourishes the cartilage (1) • Reduces friction between the bones / preventing bones from rubbing together (1) • Used as a shock absorber (1) • Increases the range of movement of a joint(1) Accept any other appropriate answer.	3

Q7.

Question Number	Answer	Mark
(a) & (b)	Award **one** mark for each identification of a joint type, up to a total of **two** marks. Award **one** mark for each associated movement, up to a total of **two** marks. Accept phonetic spelling.	2+2

	(a) joint type	(b) movement
Knee	Hinge	Flexion
Hip	Ball and socket	Flexion