Centre Name: Lawnswood School
Exam board: OCR
Course name: Level 3 Cambridge Technical Diploma in Sport and Physical activity.
Guided learning hours: 720 GLH equivalent to 2 A Levels
How you will achieve your grades:

Points range	Grade	
208 +	Distinction* Distinction*	D*D*
204- 207	Distinction* Distinction	D*D
200- 203	Distinction Distinction	DD
192- 199	Distinction Merit	DM
184- 191	Merit Merit	MM
176- 183	Merit Pass	MP
168- 175	Pass Pass	PP
Below 168	Unclassified	U

Recommended reading material: Cambridge Technicals Level 3 Sport and Physical Activity textbook by Authors: Suzanne Bointon, Helen Bray, Scott Chapman, James Martin, Alister Myatt, Annette Short. Publisher: Hodder Education.

Recommended websites:
https://www.bbc.co.uk/bitesize/examspecs/ztrcg82
https://www.sportengland.org/
https://www.brianmac.co.uk/

Link to specifications- Diploma/Sports coaching:
https://www.ocr.org.uk/qualifications/cambridge-technicals/sport-and-physical-activity/units/#level-3

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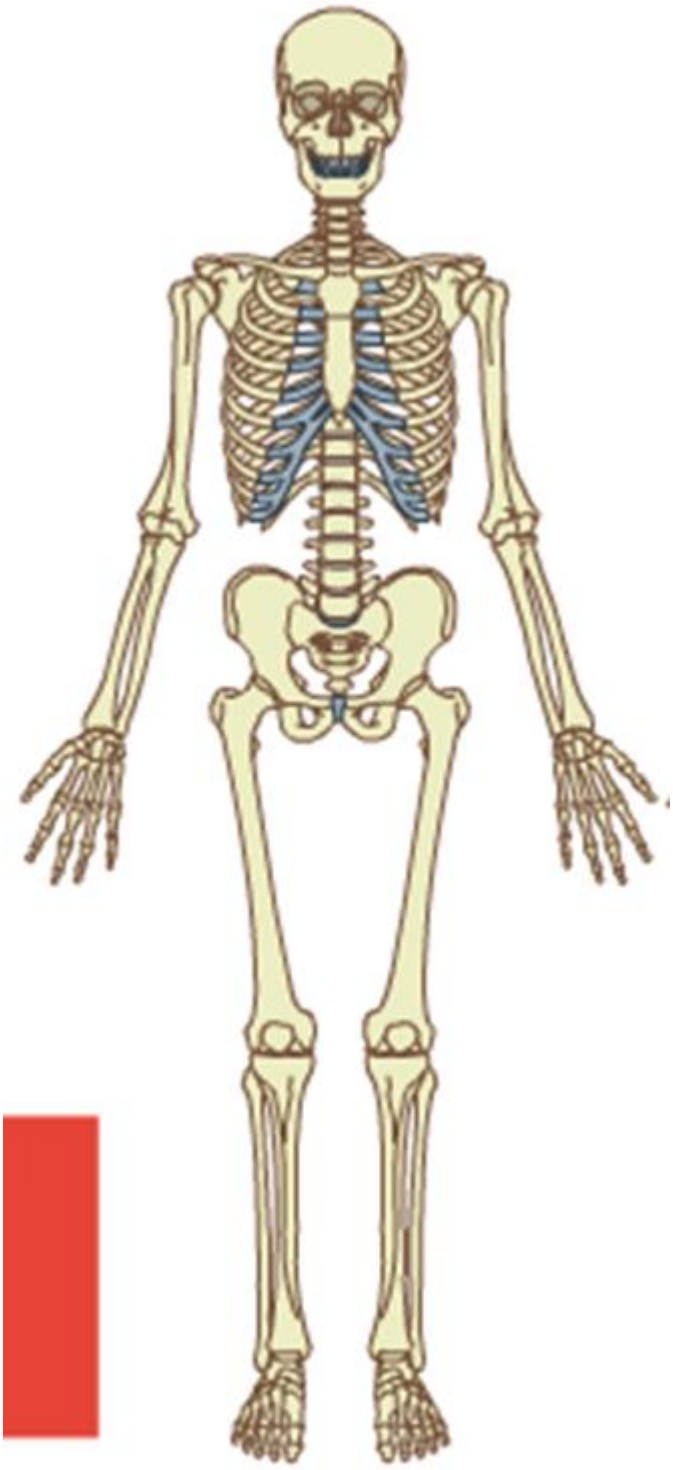
The Structure and Function of the Skeletal System

Location of Major Bones:



The Structure and Function of the Skeletal System

Axial and Appendicular Skeleton

Axial Skeleton – central core of the human body housing and protecting its vital organs e.g. cranium, ribs and vertebrate.

Appendicular Skeleton – the bones of the limbs e.g. femur

Functions of the Skeleton

The skeleton has five functions, each of which are described below:

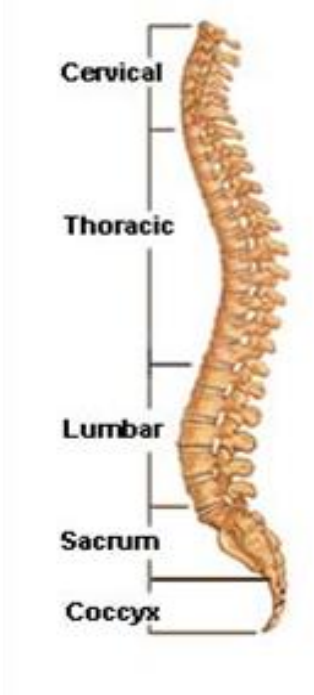
1. **Give shape and support to the body** – therefore keeping the body upright and giving the body posture.
2. **Allows movement** – provides areas for the muscles to attach to the skeleton via tendons, so that muscles can pull on the bones.
3. **Protects internal organs** – the axial skeleton protects vital organs, for example, the cranium protects the brain, the ribs protects the lungs, and the sternum protects the heart.
4. **Produces blood cells** – red and white blood cells are produced in the bone marrow. Red blood cells transport Oxygen around the body to the working muscles, and white blood cells help to fight infection.
5. **Stores minerals** – minerals are stored in the bones, such as iron, potassium and calcium, for example, iron helps to transport Oxygen to the working muscles in haemoglobin, and calcium is needed to help repair and build bone.

The Structure and Function of the Skeletal System

Types of bones

Type of bone	Description	Function	Examples
Flat	Strong, flat plates of bone	Protects vital organs	Cranium, Sternum, Ribs, Scapula
Short	As wide as they are long (cubic shaped)	Provide support and stability with little movement	Carpals, Tarsals
Long	Are longer that it is wide with growth plates at either end. Having a hard outer surface of compact bone and a spongy inner	Act as leavers by creating large movement	Clavicle, Humerus, Radius, Ulna, Meta-Tarsals, Meta Carpals, Phalanges, Tibia, Fibula, Femur
Irregular	Do not fall into any category, due to their non-uniform shape	Protection of the nervous tissue e.g. vertebrae protects the spinal cord)	Vertebrae
Sesamoid	Are usually short or irregular bones, embedded in a tendon	Serves to protect a tendon	Patella

Structure and function of the vertebral column



	Cervical	Thoracic	Lumbar	Sacral	Coccyx
Number of bones	7	12	5	5	4
Where in the body	Neck	Chest	Lower back	Pelvic area	Base of spine
Function	Help turn the neck and protect spinal cord.	Attached to the ribs and help with breathing: protect spinal cord	Provide greatest amount of movement occurs so bears a lot of weight. Protect spinal cord, the largest vertebrae in the body.	They are fused together and make up part of the pelvic girdle.	They are fused together to form the base of the spine
What is attached	Neck Muscles	Ribs	Back Muscles	Joins spine, pelvic & girdle	Base of spine attached only to sacral vertebrae

The Structure and Function of the Skeletal System

Classifications of joints

Fixed/fused joint is where two bones come together in the body but are unable to move e.g. cranium, pelvis

Slightly movable/ cartilaginous where there is a small amount movement permitted at these joints which are separate by cartilage e.g. vertebrate

Freely movable joint is also known as a synovial joint which allows a range of movement e.g. knee.

The Structure and Function of the Skeletal System

Type of synovial joints

Type of Synovial Joint	Location in Body	Articulating Bones
Hinge Joint	Elbow	Humerus Radius Ulna
	Knee	Femur Tibia
Ball & Socket Joint	Shoulder	Humerus Scapula
	Hip	Pelvis Femur
Pivot Joint	Neck	Cervical Thoracic
Gliding	Hands & Feet	Tarsals Carpals
Saddle	Fingers & Thumbs	Metatarsals Metacarpals
Condyloid	Wrist	Wrist Carpal

The Structure and Function of the Skeletal System

Types of Movement at a Hinge Joint

Type of Movement	Definition	Sporting Example
Flexion	Decreasing the angle at a joint	Preparing to kick a football
Extension	Increasing the angle at a joint	Overhead clear in badminton

The Structure and Function of the Skeletal System

Types of Movement at a Ball and Socket Joint

Type of Movement	Definition	Sporting Example
Flexion	Decreasing the angle at a joint	Arm action in backstroke
Extension	Increasing the angle at a joint	Shoulder action in a tennis serve
Abduction	Moving a limb ***away*** from the middle of the body	Arm action in butterfly stroke
Adduction	Moving a limb ***towards*** the middle of the body	'Squeeze' action in a rugby tackle
Rotation	Turn the bone around the longitudinal axis	Turning your foot out to control a football / Turning your wrist to add top spin in table tennis
Circumduction	A combination of abduction, adduction, flexion and extension	Front crawl action / cricket bowl

The Structure and Function of the Skeletal System

Types of Movement in other synovial Joints

Joint	Movements which can occur
Pivot	Rotation
Gliding	Flexion and extension
Saddle	Flexion, extension, adduction, adduction and circumduction but NO axial rotation
Condyloid	Flexion, extension, adduction, adduction and circumduction

The Structure and Function of the Skeletal System

Other Components of a Joint

There are three other components of a joint. You must know what these are, and what their function is:

- Cartilage:
  - Function: To reduce friction and act as a shock absorber

- Ligament:
  - Function: To join bone to bone, and to stabilise the joint to prevent dislocation

- Tendon:
  - Function: To join muscle to bone, and to produce the power needed to create movement

The Structure and Function of the Muscular System

Topics covered in this area:

- **Location of major muscles and their function**
- **Main muscle acting at synovial joint**
- **Types of muscle function**
- **Type muscle contraction**
- **Structure and function of muscle fibres**

The Structure and Function of the Muscular System

Location of Major Muscles and their Function

The Structure and Function of the Muscular System

Types of muscle functions

Key words that you need to know:

- **Antagonistic Pairs** – where **muscles work together** to produce movement, with one muscle contracting (agonist) and the other relaxing (antagonist)
- Agonist – the prime mover; the muscle that contracts and shortens
- Antagonist – the muscle that relaxes and lengthens
- Fixator – **stabilises** the joint and assists the agonist with movement

Movement	Agonist	Antagonist	Fixator
Flexion at elbow	Bicep	Tricep	Trapezius
Extension at elbow	Tricep	Bicep	Trapezius
Flexion at knee	Hamstring	Quadricep	Gluteal
Extension at knee	Quadricep	Hamstring	Gluteal
Abduction at shoulder	Deltoid	Latissimus Dorsi	Trapezius
Adduction at shoulder	Latissimus Dorsi	Deltoid	Trapezius
Plantarflexion	Gastrocnemius		
Extension at hip	Gluteus maximus		

The Structure and Function of the Muscular System

Muscle Contractions

Key words that you need to know

- Isotonic (meaning same tension) are those which cause the **muscle to change length** as it contracts and causes movement of a body part.

Two types of isotonic contacts

- Concentric: are those which cause the **muscle to shorten as it contracts**. An example is bending the elbow from straight to fully flexed, causing a concentric contraction of the Biceps Brachii muscle. Concentric contractions are the most common type of muscle contraction and occur frequently in daily and sporting activities.
- Eccentric: the opposite of concentric and occur when **the muscle lengthens as it contracts**. For example, when kicking a football, the Quadriceps muscle contracts concentrically to straighten the knee and the Hamstrings contract eccentrically to decelerate the motion of the lower limb. This type on contraction puts a lot of strain through the muscle and is commonly involved in muscle injuries
- Isometric: occur when there is **no change in the length** of the contracting muscle. This occurs when carrying an object in front of you as the weight of the object is pulling your arms down but your muscles are contracting to hold the object at the same level.
- Isokinetic: are similar to isotonic in that the muscle changes length during the contraction, where they differ is that Isokinetic contractions **produce movements of a constant speed.** Examples of using isokinetic contractions in day-to-day and sporting activities are rare. The best is breast stroke in swimming, where the water provides a constant, even resistance to the movement of adduction

The Structure and Function of the Muscular System

Structure and function of muscle fibres

	Slow Twitch (Type 1)	Fast Oxidative Glycolytic (FOG) (Type 2A)	Fast twitch glycolytic (FTG) (Type 2b)
Functional			
Speed of contraction	Slow	Fast	Very Fast
Force of contraction	Low	High	High
Resistance to fatigue	Very High	Moderate	Low
Activity use	Aerobic	Long term anaerobic	Short term anaerobic
Structural			
Mitochondrial density	High	Moderate	Low
Capillary density	High	Moderate	Low
Glycogen capacity	Low	High	High
Motor neuron size	Small	Large	Very Large
Major Storage fuel	Triglycerides	CP, Glycogen	CP, Glycogen
Activity suited	Marathon runner Tri athlete (Any endurance athlete)	Games Players Middle distances athletes	Sprinters Field Events (Any explosive movement)

Structure and Function of the Cardiovascular System

Topics covered in this area:

- **Structure of the heart and pathway of blood through it**
- **Double Circulatory System (including pulmonary and systemic circulation)**
- **Different types of blood vessels**
- **Key word definitions and the relationship between them**
- **Components and functions of blood**
- **Vascular shunt mechanism**

Structure and Function of the Cardiovascular System

Structure of the Heart and the Pathway of Blood through it

Pathway of Blood Through the Heart:

Deoxygenated Blood:

1. Deoxygenated blood enters the heart through the vena cava
2. The deoxygenated blood then enters the Right Atrium
3. The blood passes through the Tricuspid Valve
4. Into the Right Ventricle
5. Through the Semi-Lunar Valve
6. And out of the heart through the Pulmonary Artery to the lungs, where the blood will get oxygenated

Oxygenated Blood:

1. Oxygenated blood is returned to the heart in the Pulmonary Vein
2. The oxygenated blood enters the Left Atrium
3. The blood passes through the Bicuspid Valve
4. Into the Left Ventricle
5. Through the Semi-Lunar Valve
6. And out of the heart through the Aorta to the body, delivering oxygenated blood to the working muscles

Structure and Function of the Cardiovascular System

Double Circulatory System (including Pulmonary and Systemic Circulation)

Pulmonary Circulation:

This is the transport of blood between the heart and the lungs. It transports deoxygenated blood away from the heart to the lungs, so that it can be oxygenated.

Systemic Circulation:

This is the transport of blood between the heart and the rest of the body (working muscles). It transports oxygenated blood to the working muscles in order for them to function.

Structure and Function of the Cardiovascular System

Different Types of Blood Vessels

There are three different types of blood vessels that you must know. You must know their structure/features (these two words mean the same thing) and their function (job).

This table below will help you to do this:

Blood Vessel	Structure/Feature	Function/Role
Artery	• Thick walls • Elastic walls • Small lumen • No valves • Smaller version of these are arterioles	• Transport blood ***A***way from the heart • Transport blood at high pressure
Ve***in***	• Thin walls • Large lumen • Valves to prevent the backflow of blood • Smaller version of these are venules	• Transport blood ***IN*** towards the heart • Transport blood at low pressure
Capillary	• One call thick wall • Single layer of cell in wall • Semi-permeable wall (allows some things, e.g. gas and nutrients to pass through)	• Allows gas exchange to occur in muscles and alveoli • Allows nutrients and waste products to pass through

Structure and Function of the Cardiovascular System

Key Word Definitions and the Relationship between Them

There are three key words that you must know in relation to the Cardiovascular System:

- Heart Rate (HR) – the number of times the heart beats per minute, measured in beats per minute (bpm)
- Stroke Volume (SV) – the volume of blood ejected from the heart per beat
- Cardiac Output (Q) – the volume of blood ejected from the heart per minute

If you are ever asked for the relationship between words, it is asking for an equation.

The relationship between these words is:

$$HR \times SV = Q$$

Extension:

A person, who has a resting heart rate of below 60 beats per minute, suffers from bradycardia. This is a good indication of fitness, with a lower resting heart rate demonstrating a higher level of fitness.

Structure and Function of the Cardiovascular System

Components and functions of blood

The Red Blood Cell

1. Contain Haemoglobin which carries oxygen
2. To transport Oxygen to the working muscles
3. To transport Carbon Dioxide to the lungs

The white blood cells

1. Are part of the immune system
2. Fight infections and diseases by using antibodies and anti-toxins
3. Found in bone marrow

Platelets

1. Clump together to forms clots
2. Protect the body by stopping bleeding

Plasma

1. Mainly made of water and surrounds blood cells
2. Carries carbon dioxide, hormones and waste
3. Maintains blood pressure
4. Regulates temperature

When exercising blood does the following things:

Transports nutrients and waste
Delivers **oxygen** to the working muscles
Removes heat (**temperature regulation**)
Dilutes/carries away lactic acid

Structure and Function of the Cardiovascular System

Vascular shunt system

- Vascular shunt mechanism – the arterioles that supply muscle tissue experience vasodilation and this increases the blood flow to the muscles, vasoconstriction of the arterioles that supply other organ such as the liver means that blood flow is lessened to these organs that do not require as much blood supply.
- The capillaries that supply the skeletal muscles the precapillary sphincters (valves) open up and blood flow is again increased.
-

This occurs when more blood is distributed to the working muscles and less to the non-essential organs

Structure and Function of the Respiratory System

Topics covered in this area:

- **The structure of the lungs and their roles**
- **The pathway of air through the Respiratory System**
- **The role of the respiratory muscles in breathing**
- **Key word definitions and the relationship between them**
- **Gas exchange in the alveoli**
- **Aerobic and Anaerobic exercise**

The Structure and Function of the Respiratory System

Structure	Roles
Nasal Cavity (Nose)	Is a hollow space within the nose that is lined with hair and mucus membrane. This allows it to warm, moisturise and filter air entering the body.
Epiglottis	Is to seal of the windpipe during eating, so that food is not inhaled.
Pharynx (Throat)	Acts as a passageway for food on its way to the stomach and for air en route to the lungs. The mucosal epithelium in the pharynx is thicker than elsewhere in the respiratory tract as it has to protect the tissues from any abrasive and chemical trauma caused by food.
Larynx (voice box)	It allows air to be directed into the respiratory organs for gas exchange
Trachea (Windpipe)	Provides air to flow to and from the lungs
Bronchi	Main passageway into
Bronchioles	Ensures that incoming air is supplied to each alveolus
Alveoli	Tiny air sacs at the end of bronchioles, where gaseous exchange happens

The pathway of air through the respiratory system is as follows:

1. Air enters through the Nose and Mouth
2. Into the Epiglottis
3. Into the Pharynx
4. Into the Larynx
5. Into the Trachea
6. Into the Bronchi
7. Into the Bronchioles
8. Into the Alveoli
9. Air diffuses from the Alveoli into the Red Blood Cells

There are two main Respiratory Muscles that you must know. You need to know their role in inspiration (breathing in) and expiration (breathing out), and how this helps us to inspire and expire.

The two Respiratory Muscles are:

1. The Diaphragm

2. The Intercostal Muscles

The Role of the Respiratory Muscles in Inspiration at Rest:

1. The intercostal muscles contract

2. This lifts the rib cage upwards and outwards

3. The diaphragm contracts and flattens

4. This increases the size of the thoracic cavity

5. Which decreases the pressure in the lungs, so that it is lower than the pressure outside of the body

6. This causes a diffusion gradient

7. Air diffuses into the lungs until an equilibrium is reached

The Role of the Respiratory Muscles in Expiration at Rest:

1. The intercostal muscles relax
2. This causes the rib cage to move inwards and downwards
3. The diaphragm relaxes and domes
4. This decreases the size of the thoracic cavity
5. Which increases the pressure in the lungs, so that it is higher than the pressure outside of the body
6. This causes a diffusion gradient
7. Air diffuses out of the lungs until an equilibrium is reached

Extension Information

Inspiration changes during exercise:

Additional muscles are involved in inspiration during exercise. These are the:

- Sternocleidomastoid
- Scalene
- Pectorals

These become involved to lift the rib cage further upwards and outwards. This increases the size of the thoracic cavity even further, which reduces the pressure in the lungs even further. This creates a larger diffusion gradient, so that more air can diffuse into the lungs.

The Structure and Function of the Respiratory System

Key Word Definitions and the Relationship between Them

There are three key words that you must know in relation to the Respiratory System:

- Breathing Rate (f) – the amount of times we breathe per minute
- Tidal Volume (TV) – the volume of air inspired or expired per breath
- Minute Ventilation (VE) – the volume of air inspired or expired per minute

If you are ever asked for the relationship between words, it is asking for an equation.

The relationship between these words is:

$$f \times TV = VE$$

The Structure and Function of the Respiratory System

Gas Exchange at the Alveoli

You need to know the following steps of gas exchange at the alveoli:

1. There is a high pressure of Oxygen in the Alveoli
2. There is a low pressure of Oxygen in the Capillary
3. There is a high pressure of Carbon Dioxide in the Capillary
4. There is a low pressure of Carbon Dioxide in the Alveoli
5. This causes a Diffusion Gradient

6. The Oxygen diffuses from the Alveoli to the Capillary

7. The Carbon Dioxide diffuses from the Capillary to the Alveoli

8. This diffusion occurs until an equilibrium is reached

9. Once the equilibrium is reached, the Carbon Dioxide is expired and the Oxygen enters the blood, joining with haemoglobin to form oxyhaemoglobin.

Extension Information:

The alveoli and lungs are a good place for gas exchange because:

- There is a large supply of blood
- They are surrounded by lots of capillaries
- There is a large surface area
- They only have thin walls to allow diffusion to occur

The Structure and Function of the Energy Systems

ATP

Key words

ATP/ Adenosine triphosphate, is the energy currency of life. ATP is a high-energy molecule found in every cell. Its job is to store and supply the cell with needed energy

ATP-PC System

The Structure and Function of the Energy Systems

Lactic acid system
Aerobic System (34-38 ATP)

Effects of Exercise on the Body Systems

Topics covered in this area:

- **The short term/immediate effects of exercise on the body systems**
- **The long term effects of exercise on the body systems**

Effects of Exercise on the Body Systems

The Short Term/Immediate Effects of Exercise on the Body Systems

Short Term/Immediate Effects of Exercise are the things that happen to your body as soon as you start exercising.

You need to know what these effects of exercise are, and which body system they belong to.

These are:

Cardiovascular System	• Cardiac Output (Q) increases • Heart Rate (HR) increases • Stroke Volume (SV) increases • Anticipatory Rise occurs • Vascular Shunt occurs (also known as redistribution of blood)
Respiratory System	• Minute Ventilation (VE) increases • Respiratory/Breathing Rate (f) increases • Tidal Volume (TV) increases
Muscular System	• Muscle Temperature increases • Lactic Acid is produced • Increased Oxygen delivery to the working muscles
Skeletal system	• Ligaments get warmer

To help you remember these Short Term/Immediate Effects of Exercise, get your Italian accents out, and say the following saying:

C – Cardiac Output (Q) increases

H – Heart Rate (HR) increases

A – Anticipatory Rise occurs

V – Vascular Shunt/Redistribution of Blood occurs

S – Stroke Volume (SV) increases

M – Minute Ventilation (VE) increases

I

T – Tidal Volume (TV) increases

R– Respiratory/Breathing Rate (f) increases

E

M – Muscle Temperature increases

E

L – Lactic Acid is produced

T

O – Oxygen delivery to the working muscles increases

Effects of Exercise on the Body Systems

The Long Term Effects of Exercise on the Body Systems

Long Term Effects of Exercise are the things that happen to your body, after you have been training for a long period of time, e.g. for 6 months or longer.

You need to know what these effects of exercise are, and which body system them below to.

These are:

Cardiovascular System	• Cardiac Hypertrophy • Resting Heart Rate decreases • Resting Stroke Volume increases • Resting Cardiac Output increases • Recovery Rate speeds up • Capillarisation occurs (increase in the number of capillaries)
Respiratory System	• Respiratory Muscles (Diaphragm and Intercostal Muscles) increase in strength • Aerobic Capacity (ability to use Oxygen to produce energy) increases • Tidal Volume increases • Minute Ventilation increases
Muscular System	• Muscle Hypertrophy • Muscular Strength increases • Muscular Endurance increases • Muscles become more resistant to fatigue
Skeletal System	• Bone Density increases • Reduced chance of osteoporosis • Increased mineral content • Increased range of movement at joints

Revision Complete?
Are you ready to test yourself with some exam questions?
Let's go!

1.

What type of bone is the femur?

Put a tick (✓) in the box next to the correct answer.

☐ Long bone

☐ Short bone

☐ Flat bone

☐ Irregular bone

[1]

2. **Fig. 11.1** shows a diagram of the bones of the lower leg.

Fig.11.1

Identify A, B and C on the diagram.

A ---------- **[1]**

B ---------- **[1]**

C ---------- **[1]**

3.

Fig. 11 shows a diagram of the skeleton.

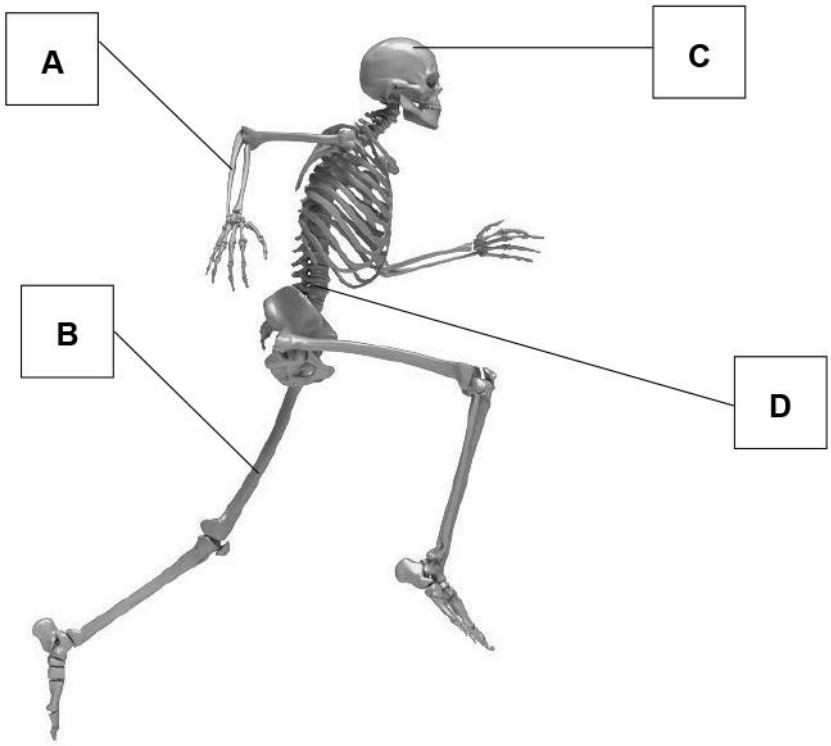


Fig. 11

State the type of bone and identify **one** function of each of B and D.

B .....

.....

D .....

.....

[4]

4. **Fig. 13.1** shows a diagram of a synovial joint.

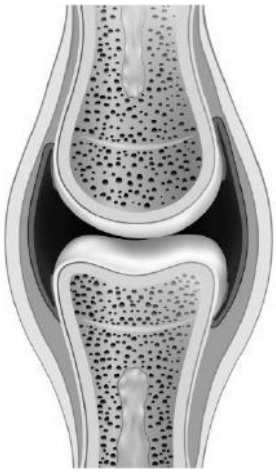


Fig. 13.1

Identify **two** structures of the joint and explain their functions.

---

[4]

5. Which one of the following is a characteristic of slow twitch muscle fibres?

(a) Few capillaries ☐

(b) High phosphocreatine stores ☐

(c) Low myoglobin stores ☐

(d) Many mitochondria ☐

[1]

6. A cyclist will use all three muscle fibre types at different times during a race.

State which muscle fibre type would be used in the following stages of a race:

During a long hill climb ----------

Maintaining a steady pace mid-race ----------

Sprinting for the finish line ----------

---

[3]

7. The following paragraph describes the structure and function of fast glycolytic fibres.

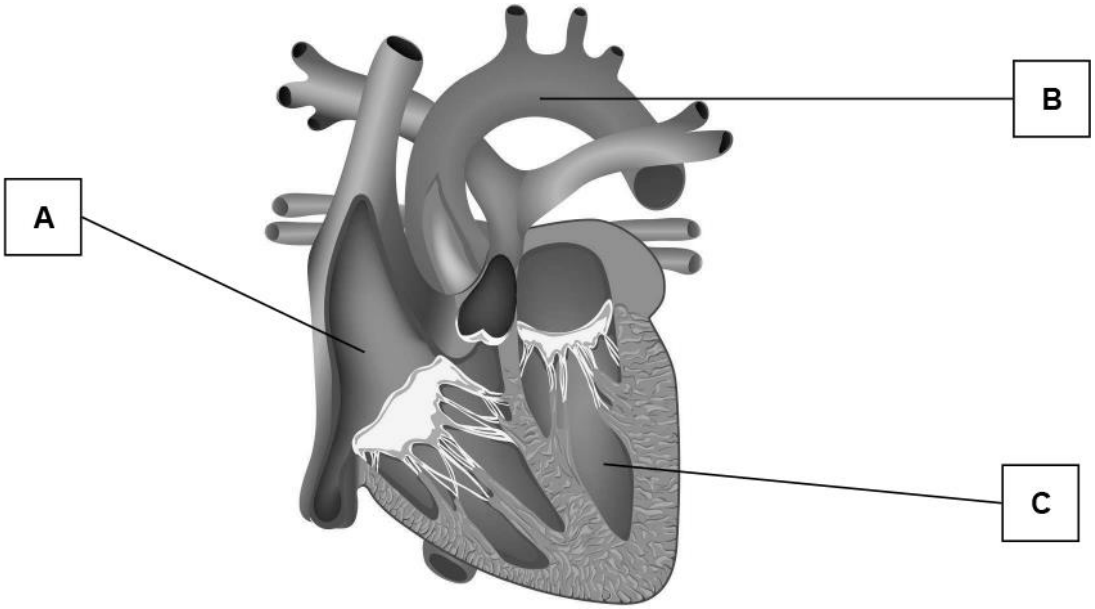
Complete the paragraph by selecting words from the box below.

Fewer	**High**	**Weak**	**Strong**	**Many**	**Large**	**Small**	**Low**

Fast twitch glycolytic fibres are used in activities that are ..... intensity and require a very ..... force of contraction. This is because the size of the motor neurone is ..... and there are ..... fibres per motor unit. **[4]**

8.

Fig. 16.1 shows a diagram of the heart.



Identify A, B and C and describe the role of each in the circulation of blood.

A ----------

Description ----------

B ----------

Description ----------

C ----------

Description ----------

---

[6]

9. Below are listed four components of blood. Which component fights infections?

Put a tick (✓) in the box next to the correct answer.

- ☐ Red blood cells
- ☐ White blood cells
- ☐ Platelets
- ☐ Plasma

[1]

10.  Describe the path of a drop of blood as it travels from the right atrium through the heart and around the body until it returns to the right atrium.

Your answer should include:

- structures of the heart
- the different blood vessels the blood passes through
- the changes to the blood during its journey.

[10]

---

11. Complete the table below to show the components and functions of blood.

Component	Function
	Transport oxygen
Platelets	
White blood cells	
	Fluid that transports nutrients and blood cells

[4]

12. Which one of the following is the correct term for the volume of blood ejected from the left ventricle per beat?

(a) Tidal volume ☐

(b) Stroke volume ☐

(c) Stroke output ☐

(d) Cardiac output ☐

[1]

13. Which one of the following is the correct order of respiratory passages that air would pass through during expiration?

(a) Bronchi – trachea – nasal cavity – epiglottis ☐

(b) Bronchi – alveoli – bronchioles – epiglottis ☐

(c) Bronchioles – trachea – epiglottis – larynx ☐

(d) Bronchioles – bronchi – trachea – larynx ☐

[1]

14. Explain the mechanics of breathing during inspiration using the following terms:

External intercostals	**diaphragm**	**rib cage**	**thoracic cavity**	**pressure**

[5]

15. Describe gaseous exchange at the alveoli by filling in the missing words below:

In the alveoli the partial pressure of oxygen is ..... and the partial pressure of carbon dioxide is ..... , whereas in the blood capillaries at the alveoli the partial pressure of oxygen is ..... and the partial pressure of carbon dioxide is ..... . Gases move from areas of ..... to ..... pressure. Therefore ..... diffuses into the alveoli and ..... diffuses into the capillaries surrounding them.

[8]

16. **Fig. 19** shows a diagram of the lungs.

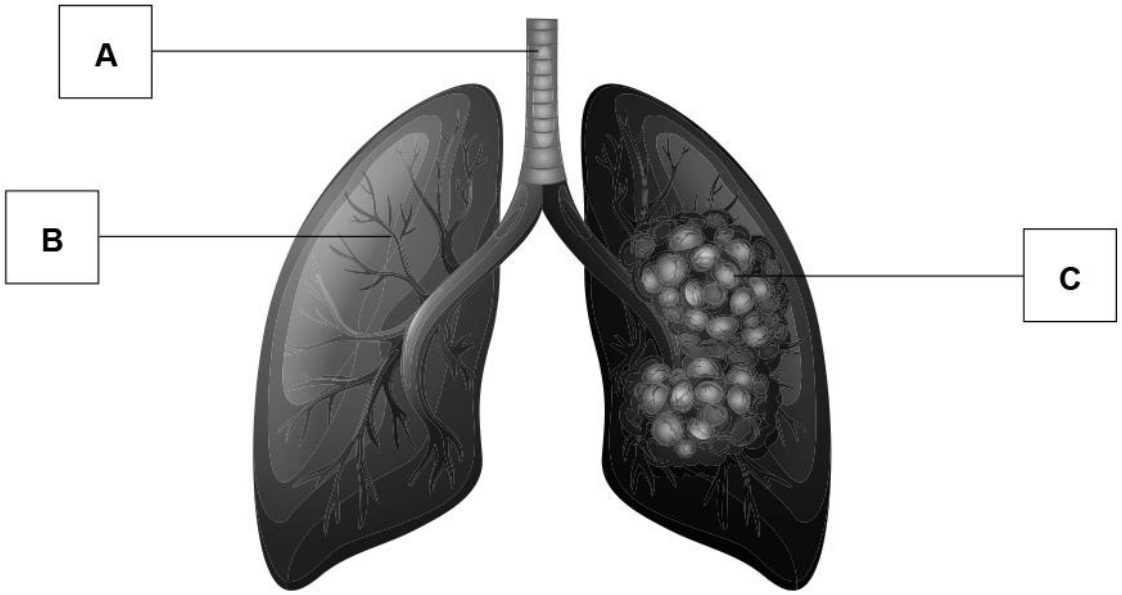


Fig. 19

Identify the structures labelled A, B and C.

A .....

B .....

C .....

[3]

17. Explain the role of the external intercostal muscles during the mechanics of breathing.

.....

.....

.....

.....

.....

.....

.....

[4]

18(a). Fig. 4 shows an example of the energy continuum with three sporting activities indicated.

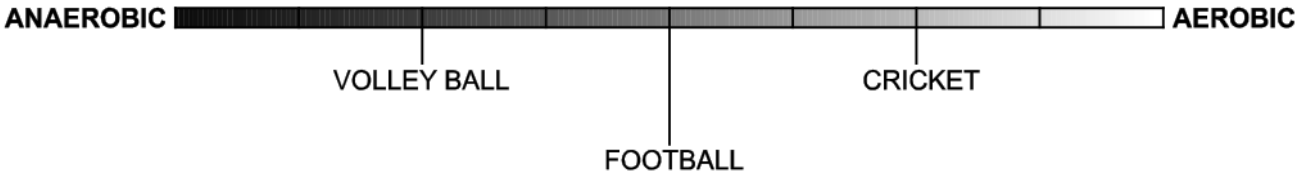


Fig. 4

Show your knowledge of energy systems by placing the following athletics events accurately on the continuum above.

A Marathon
B Shot put
C 1500 m race

[3]

(b). Justify your placement of each event on the continuum.

Marathon .....

.....

Shot put .....

.....

1500 m race .....

.....

[3]

19. Which one of the following is the correct definition of tidal volume?

(a) The volume of oxygen inspired per breath ☐

(b) The volume of carbon dioxide expired per breath ☐

(c) The volume of air inspired per breath ☐

(d) The volume of air inspired per minute

[1]

END OF QUESTION paper

Mark scheme

<table>
<tr><th colspan="3">Question</th><th>Answer/Indicative content</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>1</td><td></td><td></td><td>Long bone</td><td>1</td><td></td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>1</td><td></td></tr>
<tr><td>2</td><td></td><td></td><td>1. A = <u>Tibia</u>
2. B = <u>Talus</u>
3. C = <u>Metatarsal</u></td><td>3</td><td>Do not accept:
A = Fibia / tibula (NBD)
C = Metatarples (NBD)

<u>Examiner's Comments</u>

Very few candidates scored the full three marks available for this question. Many could identify the Tibia and Metatarsals but most struggled with labelling the Talus – with many simply writing 'ankle bone'.</td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>3</td><td></td></tr>
<tr><td>3</td><td></td><td></td><td>1. B = Long (bone)
2. (Function of femur) movement / support / blood (cell) production / mineral storage
3. D = Irregular (bone)
4. (Function of lumbar vertebra) movement / support / protection</td><td>4</td><td>Candidate can get function of each bone correct even if type or name of bone is wrong.
Mark the first function given for each bone
Do not accept stability = NBD

<u>Examiner's Comments</u>

A high percentage of candidates found success on this question, for both the type and function of the bone.</td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>4</td><td></td></tr>
<tr><td>4</td><td></td><td></td><td><table><tr><th>Structure</th><th>Function</th></tr><tr><td>1. Cartilage</td><td>2. Reduces friction between bones or stops bones rubbing together</td></tr><tr><td>3. Ligament</td><td>4. Attaches bone to bone or stabilise joint</td></tr><tr><td>5. Synovial membrane</td><td>6. Secretes/produces/ encases synovial fluid</td></tr><tr><td>7. Synovial fluid</td><td>8. Lubricates/cushions joint or synovial fluid absorbs / breaks down debris in joint.</td></tr></table></td><td>4</td><td>• Mark first two structures only.
• Function <u>must</u> relate to the named structure.

<u>Examiner's Comments</u>

This was generally a well–answered question. The diagram showed a synovial joint and learners were expected to identify two of the structures and explain their functions. The majority of learners were able to identify the synovial membrane and the synovial fluid, with some learners identifying other structures such as the cartilage or ligament. Most who gave the correct identification then went on to accurately explain the function of each. Some learners however did not give a function for each and therefore could not score full marks. Again, it is important for learners to address all aspects of each question to have access to all the marks available.</td></tr>
</table>

			9. Meniscus/menisci — 10. Additional cartilage to stabilise joint 11. Pads of fat — 12. Absorb shock or fill large spaces in joint 13. Bursa — 14. Reduce friction between tissues 15. Joint capsule — 16. Encloses joint		
			Total	**4**	
5			(d) Many mitochondria	**1**	**Examiner's Comments** A very small minority did not respond to one or more of these, with most answering them well. The most challenging part was that some learners unaware of the characteristics of slow twitch muscle fibres.
			Total	**1**	
6			1. Fast oxidative or Type 2a 2. Slow (oxidative) or Type 1 3. Fast glycolytic or Type 2b	3	**Do not accept:** Fast or fast twitch for 1 or 3 Slow glycolytic = BOD **Examiner's Comments** This question was to identify the appropriate muscle fibre type and it proved very difficult for many to score the full three marks available. Many were unable to identify fast oxidative or slow oxidative, but most were able to give fast glycolytic for the third answer. Simply writing fast twitch was not good enough to score marks for this Level 3 examination.
			Total	**3**	
7			Fast twitch glycolytic fibres are used in activities that are of (1) **high** intensity and require a very (2) **strong** force of contraction. This is because the size of the motor neurone is (3) **large** and there are (4) **many** fibres per motor unit.	**4**	**Examiner's Comments** Many learners scored the full four marks available for this question, showing a good understanding of the structure and function of the fast glycolytic fibres. There were a number of scripts where this question was left unanswered.
			Total	**4**	
8			1. A = Right atrium 2. Receives (de-oxygenated) blood from body or pumps/transports / sends (de-oxygenated) blood into right ventricle 3. B = Aorta 4. Carries (oxygenated) blood (from L ventricle) to tissues/body/muscle	6	**Identification must be correct for mark to be given for description. ie - If identification incorrect then mark cannot also be given for description** **Do not accept:** - Pumps blood (NBD Pt6)

			5. C = <u>Left ventricle</u> 6. Pumps/transports/sends (oxygenated) blood out of the heart/to body/into aorta		**<u>Examiner's Comments</u>** Although most could identify the structures of the heart, many were unable to back each up with an accurate description of the role of each structure. The role has to identify where the blood has come from or where it was going to and some left this important information out.
			Total	**6**	
9			White blood cells	**1**	
			Total	**1**	
10			1. Blood (enters right atrium) from **vena(e) cava(e)** • Blood is de–oxygenated • Blood is carrying CO_2 • Under low pressure or low speed 2. Blood moves into **right ventricle** • Through tricuspid valve • Opened by weight of blood • Right atrium contracts • Overfilling of right ventricle 3. Right ventricle contracts • Tricuspid valve closes to prevent backflow of blood 4. Blood moves into **pulmonary artery** • Through pulmonary valve • Valve closes to prevent backflow 5. Blood travels to **lungs/alveoli** • Through arterioles • To capillaries • Gaseous exchange/diffusion • Blood is (re–)oxygenated / oxygen enters blood • CO_2 is removed • External respiration • Oxygen picked up by red blood cells 6. Blood moves into **pulmonary vein** • Through venules/veins merge together 7. Blood enters **left atrium** • Very low pressure 8. Blood moves into **left ventricle** • Through bicuspid/mitral valve • Left atrium contracts • Stretching/overfilling left ventricle	**10**	**Level 3 (8–10 marks)** **A comprehensive answer:** Detailed knowledge & understanding. Effective analysis/critical evaluation and/or discussion/explanation/development. Clear and consistent practical application of knowledge. Accurate use of technical and specialist vocabulary. High standard of written communication. **At Level 3 responses <u>are likely</u> to include:** Detailed knowledge and understanding of the double circulatory system. Most points are developed. At the top of this level chambers, heart valves and most blood vessels are identified in the correct order. Changes to blood are covered. At the bottom of this level some heart valves may be omitted but blood vessels and chambers of heart are in correct order and changes in blood gases are probably considered. **Level 2 (5–7 marks)** **A competent answer:** Satisfactory knowledge & understanding. Analysis/critical evaluation and/or discussion/explanation/development attempted with some success. Some success in practical application of knowledge. Technical and specialist vocabulary used with some accuracy. Written communication generally fluent with few errors. **At Level 2 responses are likely to include:** Satisfactory knowledge and understanding of the movement of blood through the circulatory system. Points made but generally not developed. At the top of this level most chambers and blood vessels are covered in the correct order. An attempt to explain changes in blood gases may be made and at least one heart valve is correctly identified.

			9. Left ventricle contracts • Bicuspid/mitral valve closes to prevent backflow into left atrium 10. Blood is pumped into **aorta**/aortic arch • Through aortic valve • At very high pressure/speed 11. Blood travels to tissues/muscle (accept named muscle) • Through arteries • Into arterioles • Into capillaries • Blood pressure/speed is reduced • Gaseous exchange/diffusion • O_2 passes into tissues • CO_2 enters blood • Internal respiration 12. Blood passes into **veins** • Via venules • Blood is now de–oxygenated • Blood is at very low pressure/increasing speed • Valves prevent backflow 13. Blood re–enters right atrium via vena(e) cava(e) • Inferior/superior vena cava • For blood returning from below/above heart • Venous return mechanisms / skeletal muscle pump / respiratory pump 14. Double circulatory system • Pulmonary circuit (to lungs) • Systemic circuit (to muscles/tissues)		At the bottom of this level chambers and blood vessels are covered but there may be some errors. Oxygenated / deoxygenated blood / gaseous exchange has been mentioned at some point. **Level 1 (1–4 marks)** **A limited answer:** Basic knowledge & understanding. Little or no attempt to analyse/critically evaluate and/or discuss/explain/develop. Little or no attempt at practical application of knowledge. Technical and specialist vocabulary used with limited success. Written communication lacks fluency and there will be errors, some of which may be intrusive. **At Level 1 responses <u>are likely</u> to include:** Basic knowledge of the movement of blood through the circulatory system. At the top of this level at least 2 chambers of heart and arteries, capillaries and veins are mentioned, but if order of chambers/blood vessels are incorrect then max of 3 marks. To score 1 mark one blood vessel, gaseous exchange or a ventricle has been mentioned. **[0 marks]** No response or no response worthy of credit. **<u>Examiner's Comments</u>** This ten–mark question is marked using a levels response mark scheme; examiners use the levels descriptors and indicative content in the mark scheme to reach a holistic judgment about the level within which the response should sit and award a mark within that level accordingly. As with the January series, many learners partially answered this question well but did not fully address all aspects. Learners are again reminded that all the variables in the question are taken into consideration when awarding a mark for a particular response. As with the January series, many learners partially answered this question well but did not fully address all aspects. Learners are again reminded that all the variables in the question are taken into consideration when awarding a mark for a particular response. Those learners who took into consideration all these elements and accurately described the path of blood scored very well – with some able to score the full ten marks available. Those who were less accurate or were

					confused in their description or who left out one or more of the aspects scored less well. Some learners started with a short plan or diagram to help them focus in on the path of the blood and this seemed to help then in describing the path of blood more accurately. Some marks were given to learners even where the path of blood was incorrect if they had shown knowledge of structures, but they could rarely access more than three marks unless most of the path of the blood was accurately described. Some learners who showed the very best answers went into fantastic detail concerning gas exchange and the structures of blood vessels. This extended question is also assessed on the quality of written communication and the better responses showed a fluent and accurate response with few spelling errors and with good use of clear sentences and paragraphs. More limited responses showed weaker accuracy in spelling, used technical terminology less effectively and rarely structured their answer. Centres are advised that learners should be given more guidance and feedback on the quality of their written communication so that they are better able to write clearly and fluently for this extended question.
			Total	**10**	
11			<table><tr><th>Component</th><th>Function</th></tr><tr><td><u>Red blood cells</u></td><td>Transport oxygen</td></tr><tr><td>Platelets</td><td><u>Help blood to clot</u></td></tr></table>	4	Correct answers are in bold and underlined (WBC) Produces antibodies = BOD (Platelets) Stops bleeding / heals the wound= NBD (WBC) Helps infections/ fights illness = NBD (WBC) Ingest pathogens / engulfs pathogens/ fights

			<table><tr><td>White blood cells</td><td><u>Protect against/fight disease/infection</u></td></tr><tr><td><u>Plasma</u></td><td>Fluid that transports nutrients and blood cells</td></tr></table>		pathogens = BOD **<u>Examiner's Comments</u>** A high number of candidates successfully completed the table shown in the question, normally attracting 3-4 marks. Red blood cells and plasma were more consistently correct with points generally being dropped due to poor wording or incorrect functions that could not be awarded a mark, normally for the function of platelets.
			Total	**4**	
12			**(b)** - Stroke volume	1	
			Total	**1**	
13			(d) Bronchioles – bronchi – trachea - larynx	1	**<u>Examiner's Comments</u>** A very small minority did not respond to one or more of these, with most answering them well. Candidates advised to read question and all answers carefully before committing to a particular answer. Candidates are advised to look for and/or highlight key words in each question. Candidates should beware of a negative question e.g. which is not a ... and lung volumes relate to air, not oxygen. Candidates are also reminded to be aware of and to recognise the specific muscles within the quadriceps and hamstrings. Candidates are also advised to re-visit these multi-choice questions again if they have time. Very few scored 10/10 for the multi-choice section.
			Total	**1**	
14			1. External intercostals contract 2. Diaphragm contracts/flattens 3. Rib cage moves up/out 4. Volume of thoracic cavity increases 5. Pressure in lungs is reduced	5	Candidates may write a sentence using more than one word. E.g. external intercostals and diaphragm contract = 2 marks. E.g. Rib cage moves up, increasing volume of thoracic cavity and decreasing pressure inside lungs = 3 marks. **Do not accept:** - Diaphragm moves up - Makes lungs larger

					Examiner's Comments Candidates that fully explained the mechanics of breathing during inspiration, using all the terms available in the 'word bank, scored well. Too many candidates got themselves confused with the mechanics of inspiration with the mechanics of expiration and so scored few marks. Those that scored marks explained the roles of the diaphragm, external intercostals and the ribs and it was only the most able candidates who were able to effectively explain the role of the thoracic cavity and pressure.
			Total	**5**	
15			In the alveoli the partial pressure of oxygen is **high** and the partial pressure of carbon dioxide is **low**, whereas in the blood capillaries at the alveoli the partial pressure of oxygen is **low** and the partial pressure of carbon dioxide is **high**. Gases move from areas of **high** to **low** pressure. Therefore, **carbon dioxide** diffuses into the alveoli and **oxygen** diffuses into the capillaries surrounding them.	8	Answers are in bold and underlined. Order of answers is: **High - low – low – high – high – low – CO2 – O2** Accept alternative valid words for high/low e.g. great/small, increased/decreased **Examiner's Comments** This was generally well-answered, with most candidates scoring at least two marks. Those that did not score full marks often got the last sentence wrong with the actions of carbon dioxide and oxygen the wrong way around.
			Total	**8**	
16			A = trachea B = bronchiole C = alveolus/alveoli/alveolar sac	3	**Examiner's Comments** The majority of candidates successfully labelled all 3 structures. Trachea was generally correct for A. B was often highlighted as bronchus or bronchi instead of bronchioles. C was generally correct.
			Total	**3**	
17			1. Contract during inspiration/breathing in 2. Causing ribs to move up/out 3. To increase volume/size of lungs/thoracic cavity 4. To reduce pressure in lungs/thoracic cavity 5. Relax during expiration/breathing out 6. Causing ribs to move down/in 7. To decrease volume/size of lungs/thoracic cavity 8. To increase pressure in lungs/thoracic cavity	4	**Sub-max 3** for inspiration **Sub-max 3** for expiration Increase / decrease size of chest = NBD **Examiner's Comments** The mechanics of breathing has traditionally been the 'Achilles heel' for candidates who have often tied themselves up into knots trying to explain this topic area.

					Answers this examination series brought a breath of fresh air – with many scoring the full 4 marks. There are still too many candidates mixing up the mechanics for inspiration with expiration and vice versa. Some gave answers which made it unclear whether the mechanics belonged to inspiration or expiration. It is important that candidates identify for the examiner which explanation refers to inspiration and which for expiration.
			Total	**4**	
18	a		A Marathon must be near to aerobic end of continuum B Shot put must be at the anaerobic end of continuum C 1500m must be in central third of continuum	**3**	Marathon does have some anaerobic elements.
	b		A Marathon an endurance event/low intensity/long duration B Shot put involves (explosive) strength/power/speed/high intensity/short duration C 1500 m race has elements of speed/muscular endurance <u>and</u> lower intensity/lasts more than three minutes	**3**	For 1500 m answer must cover both aerobic and anaerobic elements. NB. Do not accept use of 'aerobic/anaerobic' for justification, e.g. Marathon is an aerobic event.
			Total	**6**	
19			(c) The volume of air inspired per breath	1	**<u>Examiner's Comments</u>** A very small minority did not respond to one or more of these, with most answering them well. This question proved to be a most challenging question. Candidates advised to read question and all answers carefully before committing to a particular answer. Candidates are advised to look for and/or highlight key words in each question. Candidates should beware of a negative question e.g. which is not a ... and lung volumes relate to air, not oxygen. Candidates are also reminded to be aware of and to recognise the specific muscles within the quadriceps and hamstrings. Candidates are also advised to re-visit these multi-choice questions again if they have time. Very few scored 10/10 for the multi-choice section.
			Total	**1**	

Movement analysis

Using the diagram identify as many major muscles as you can. There are 11 here but can you challenge yourself and label more?

The Structure and Function of the Muscular System

Types of muscle functions

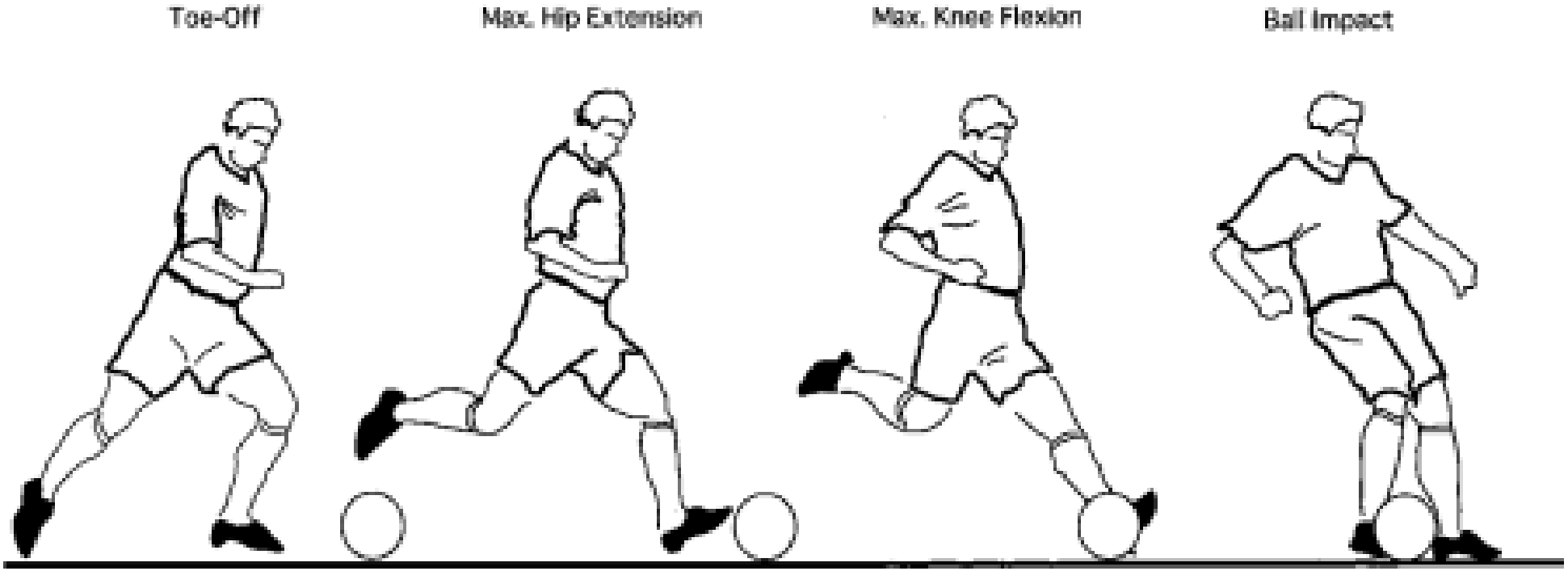
Key words that you need to know:

- **Antagonistic Pairs** – where **muscles work together** to produce movement, with one muscle contracting (agonist) and the other relaxing (antagonist)
- Agonist – the prime mover; the muscle that contracts and shortens
- Antagonist – the muscle that relaxes and lengthens
- Fixator – **stabilises** the joint and assists the agonist with movement

Fill in the missing words

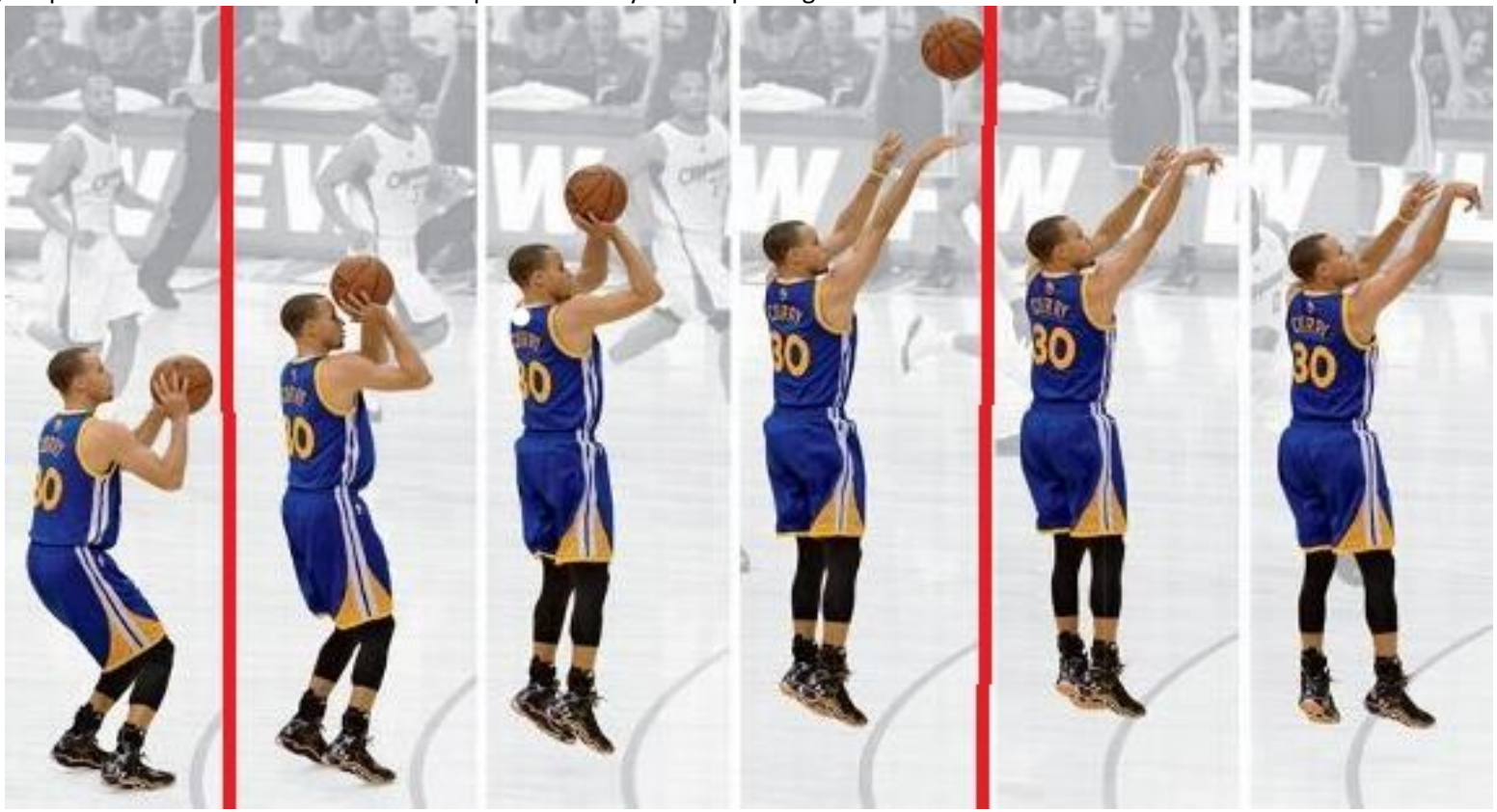
Movement	Agonist	Antagonist	Fixator
Flexion at elbow	Bicep		Trapezius
Extension at elbow			Trapezius
Flexion at knee	Hamstring		Gluteal
Extension at knee			Gluteal
Abduction at shoulder		Latissimus Dorsi	Trapezius
Adduction at shoulder		Deltoid	Trapezius
Plantarflexion	Gastrocnemius	Tibialis Anterior	
Extension at hip	Gluteals	Illiopsoas	

Annotate each of the diagrams analysing each movement phase for a sporting action. Explain in as much detail as possible for each movement.



What type of movement is occurring at each joint? E.g Phase 1 Hip joint is extended as the performer takes their leg back to strike the ball. -Phase 2 Flexion at the knee takes their lower leg back to generate power. Can you name any of the muscles involved?

Steph Curry shooting a 3 pointer in basketball. Annotate each phase to analyse this sporting action.



A fast bowler in cricket. Annotate each phase to analyse this sporting action.