Answer Booklet

Component One – Applied Anatomy & Physiology

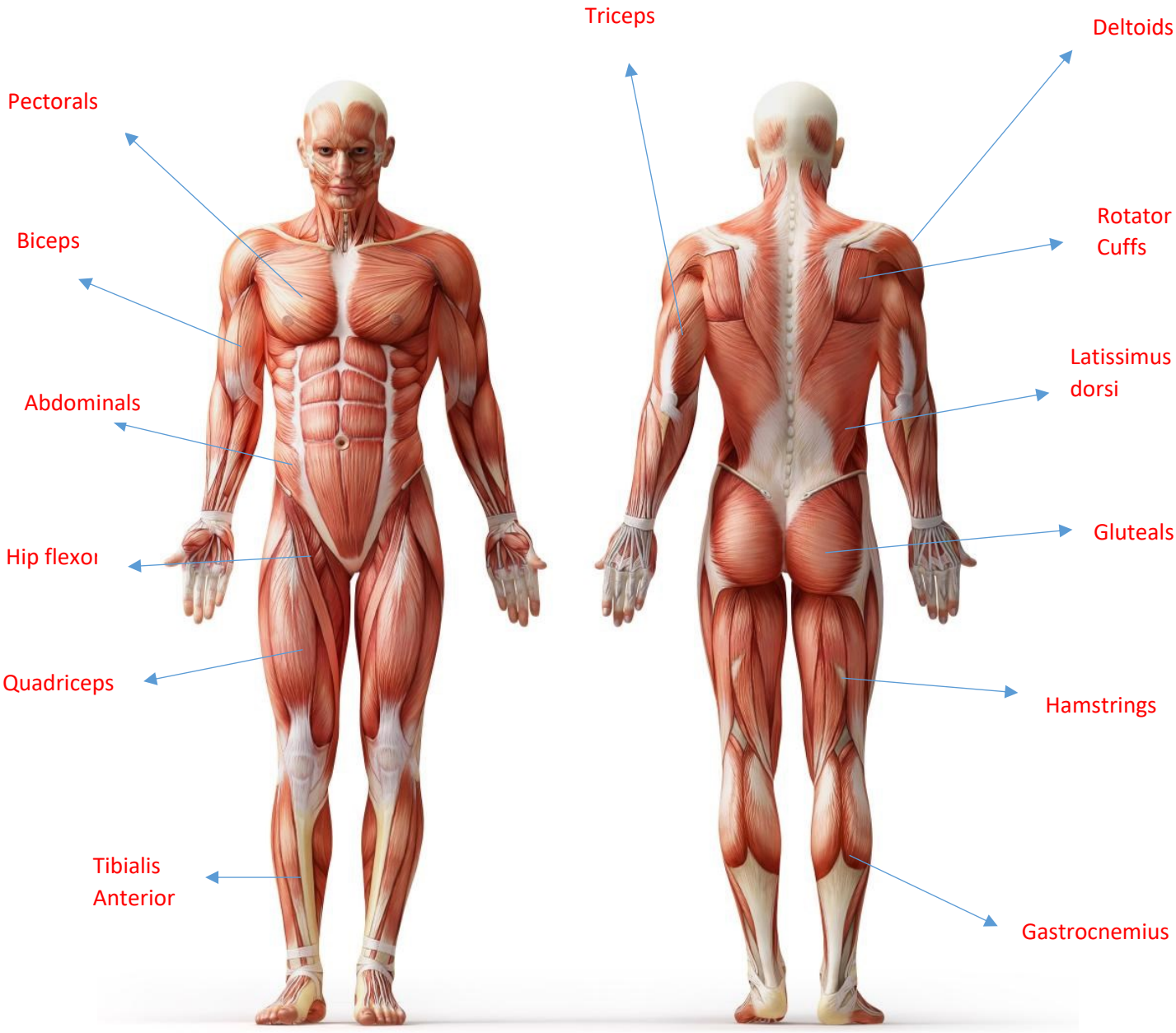
Name _____

Class _____

Topic	Description from Specification	Pupil comments – How confident do you feel on this topic?
Muscular System	How the major muscles and muscle groups of the body work antagonistically on the major joints of the skeleton to affect movement in physical activity at the major movable joints	
Cardio-Respiratory System	Blood vessels Mechanics of breathing – the interaction of the intercostal muscles, ribs and diaphragm in breathing Interpretation of a spirometer trace	
Aerobic & Anaerobic Exercise	The use of aerobic and anaerobic exercise in practical examples of differing intensities	
The Short & Long-term Effects of Exercise	Long-term effects of exercise (months and years of exercising)	

Unit: The Musculo-Skeletal System

Voluntary Muscles of the Body:



12 of the 13 muscles labelled above, work as **antagonistic pairs.**

Biceps & Triceps

Pectoral & Deltoids

Quadriceps & Hamstrings

Latissimus Dorsi & Abdominals

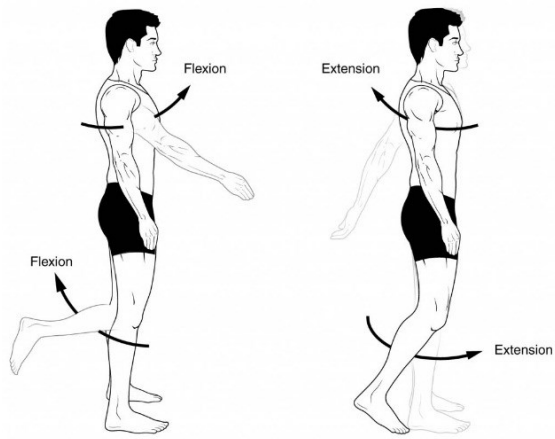
Gastrocnemius & Tibialis Anterior

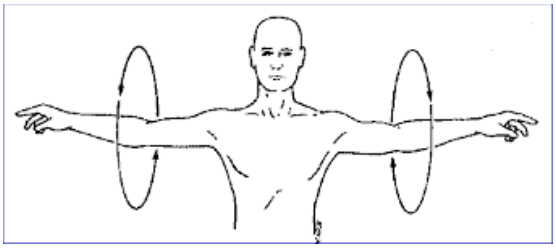
Hip Flexors & Gluteals

Movement:

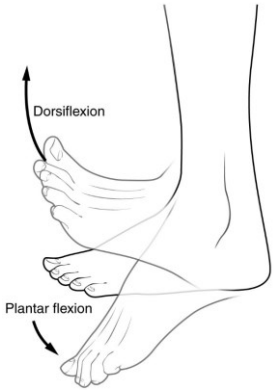
Joints are what make it possible to move our body in certain ways. Each type of joint allows for a different type of movement.

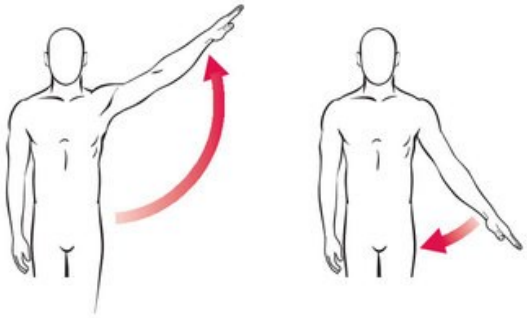
1. Flexion: Movement decreasing the angle between body parts (**bending**).
2. Extension: Movement increasing the angle between body parts (**straightening**).
3. Dorsi-Flexion: Flexing the ankle so that the toes move closer to the shin
4. Plantar-Flexion: Extending the ankle down, so that the toes move away from the shin
5. Adduction: Movement of a body part toward the body's midline
6. Abduction: Movement of a body part away from the body's midline
7. Rotation: the action of rotating around an axis or centre.





Rotation





Shoulder abduction Shoulder adduction

Useful Hint:

PLANTar-Flexion = Plant your toes on the ground

Useful Hint:

ADDuction = add to the body

Abduction = Take Away

The clean and jerk is a technique used in weightlifting. Explain the action of movement present at the knee joint at the start and finish of the lift.

As the weight lifter bends down to lift the weight, the hamstrings contract to cause flexion at the knee. As the weight is lifted the quadriceps contract to cause extension at the knee.

The image shows a cricketer preparing to throw a ball. Explain the action of movement present at the elbow in order to throw the ball.

Initially, flexion must occur at the elbow joint in order to bend the arm in preparation to throw the ball. As the throw takes place, extension will occur at the elbow joint in order to throw the ball with power and to follow through accordingly.

The image above shows a forehand shot in tennis. Explain the actions of movement present at the shoulder joint during the preparation and follow through of the shot.

As the player prepares the shot he must use abduction to take is arm away from the mid-line of his body. As he then hits the ball he must show adduction in order to follow through and generate power.

The image above shows a person performing a calf raise exercise. Explain the action of movement present at the ankle joint in order to complete this exercise.

The ankle must show plantarflexion in order raise up onto the balls of the feet and perform the calf raise.

Antagonistic Pairs

A muscle is only capable of pulling during a contraction. Muscles cannot push. Therefore some muscles work in twos, known as **antagonistic pairs**. Whilst one muscle **contracts** (pulls), the other muscle in the pair will **relax**. The muscle contracting is known as the **agonist,** whereas the muscle relaxing is known as the **antagonist.**

Explain how an antagonistic pair of muscles work together to perform a press up.

Hint:

Think about the arms

The biceps and triceps are the antagonistic pair involved in the press up.

During the downward phase of a press up, the biceps contracts and shortens, (known as the agonist), whilst the triceps relaxes and lengthens (known as the antagonist).

This results in flexion occurring at the hinge joint as the body moves towards the floor. During the upward phase of the press up, the triceps contract and become the agonist, whilst the biceps relax and become the antagonist. This results in extension occurring at the hinge joint. The body moves away from the floor.

Explain how an antagonistic pair work together whilst performing a squat.

Hint:

Think about the legs

The antagonistic pair of muscles involved in the squat are the quadriceps and hamstrings. During the downward phase, the hamstrings contract (agonist) and the quadriceps relax (antagonist). This action creates flexion at the knee (hinge joint).

As the quadriceps contract (agonist) and the hamstrings relax (antagonist) the legs straighten and extension occurs at the knee (hinge joint).

Explain how an antagonistic pair work together during a hurdles race?

Hint:

Think about the feet

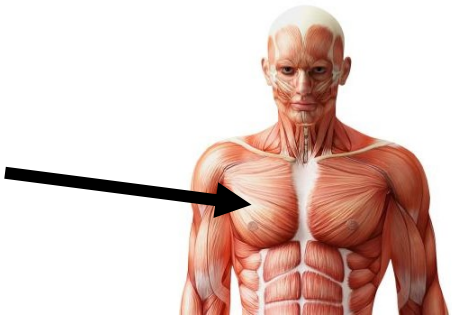
When the gastrocnemius contracts and shortens (agonist), the tibialis anterior relaxes and lengthens (antagonist). Plantar flexion takes place at the ankle (hinge joint). When the gastrocnemius relaxes and lengthens (antagonist) the tibialis anterior contracts and shortens (agonist). This causes dorsi- flexion to occurs at the ankle (hinge joint).

Musculo-Skeletal System Exam Questions

1. What is the name of the muscle shown in the image below? **(1 Mark)**

Mark One – Tibialis Anterior

2. What is the name of the muscle shown in the image below? **(1 Mark)**



Mark One – Pectorals

3. Analyse the antagonistic muscle action taking place at the elbow as the goalkeeper makes the save. **(3 marks).**

Mark One – The antagonistic muscle action is **extension at the elbow joint**

Mark Two – The tricep is the agonist/muscle contracting

Mark Three – The bicep is the antagonist/muscle relaxing

Unit: The Cardio-Respiratory System

Structure of the blood vessels:

	Size/Diameter	Wall Thickness	Valves
Arteries	Up to 10mm	Thick & Muscular	No
Veins	Up to 10mm	Thin	Yes
Capillaries	5-10 micrometers (Tiny!)	Thin	No

Why do the capillaries have a smaller diameter than the arteries and veins?

This is so that the capillaries can maximise the amount of oxygen that can diffuse into the blood stream and to the muscle tissues, and also maximise the amount of carbon dioxide that can diffused away from the muscles.

Why do the arteries have thicker walls than the veins and capillaries?

Arteries carry blood away from the heart which means that the blood is at high pressure. Therefore the walls of the arteries must be thick and muscular in order to withstand this pressure.

Why do the veins contain valves?

Unlike arteries, veins carry blood at a low pressure. This means that the blood has the potential to 'backflow' which would be dangerous for the body. Valves in veins prevent this from occurring.

Blood vessels are able to change in size in order to allow the redistribution of blood to happen during exercise.

Vasodilation means that the blood vessels become wider, enabling more blood to be delivered to active areas.

Vasoconstriction means that the blood vessels become narrower, restricting the amount of blood that is delivered to inactive areas.

Vasodilation and vasoconstriction also play an important role in regulating body temperature. Can you fill in the gaps below?

Vasodilation occurs when the body is too hot and it involves the blood vessels close to your skin dilating (getting bigger).The blood gets closer to the skin, enabling more heat to escape and the body cools down.

Vasoconstriction occurs when the body is too cold and it involves the blood vessels constricting (getting smaller). The blood gets further away from the surface of the skin and less heat is lost.

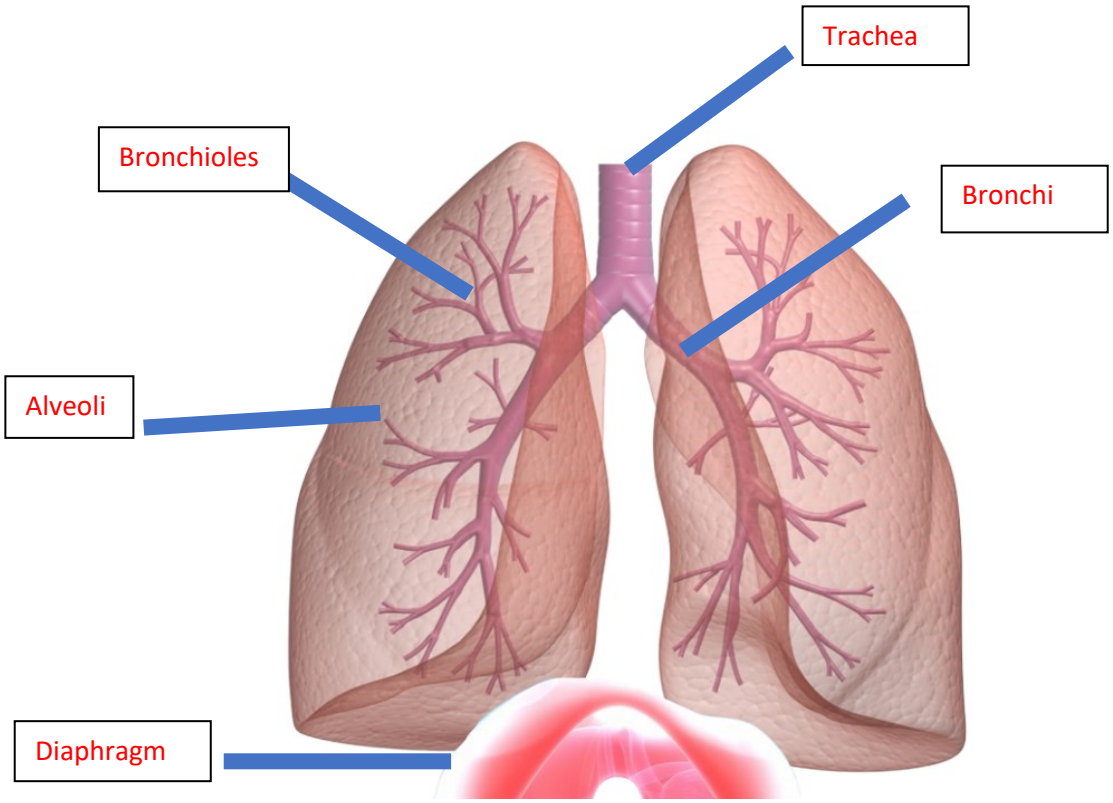
How could your cardiovascular system regulate your body temperature throughout a day of skiing?

In the early morning the temperature would be very cold and the body would also be cold due to the fact that no warm up has taken place. Therefore vasoconstriction would occur in order to take the blood vessels away from the surface of the skin and prevent heat being lost.

As the day progresses the outside temperature is likely to increase and the body temperature will also increase due to the physical exercise that has taken place throughout the day. Therefore vasodilation will occur with the blood vessels moving closer to the surface of the skin in order to lose more heat and cool down the body.

Label the diagram of the lungs with the key terms shown below.

Alveoli. Trachea. Bronchioles. Diaphragm. Bronchi.



<u>The Mechanics of Breathing:</u>

When exercising the pectorals help the lungs to expand during inhalation. When exhaling, the abdominals pull the rib cage down quicker in order to force out the air.

The **intercostal muscles** are internal muscles that lie between the ribs. They also play an important role in expanding and shrinking the chest so that breathing can occur.

Interpretation of a Spirometer Trace:

A **spirometer** is an implement that can be used to show the amount of air inhaled and exhaled.

A **spirometer trace** is the data reading being shown as part of a graph.

In order to understand a spirometer trace, you must first be able to define the following terms:

Tidal Volume - The amount of air inspired and expired with each normal breath

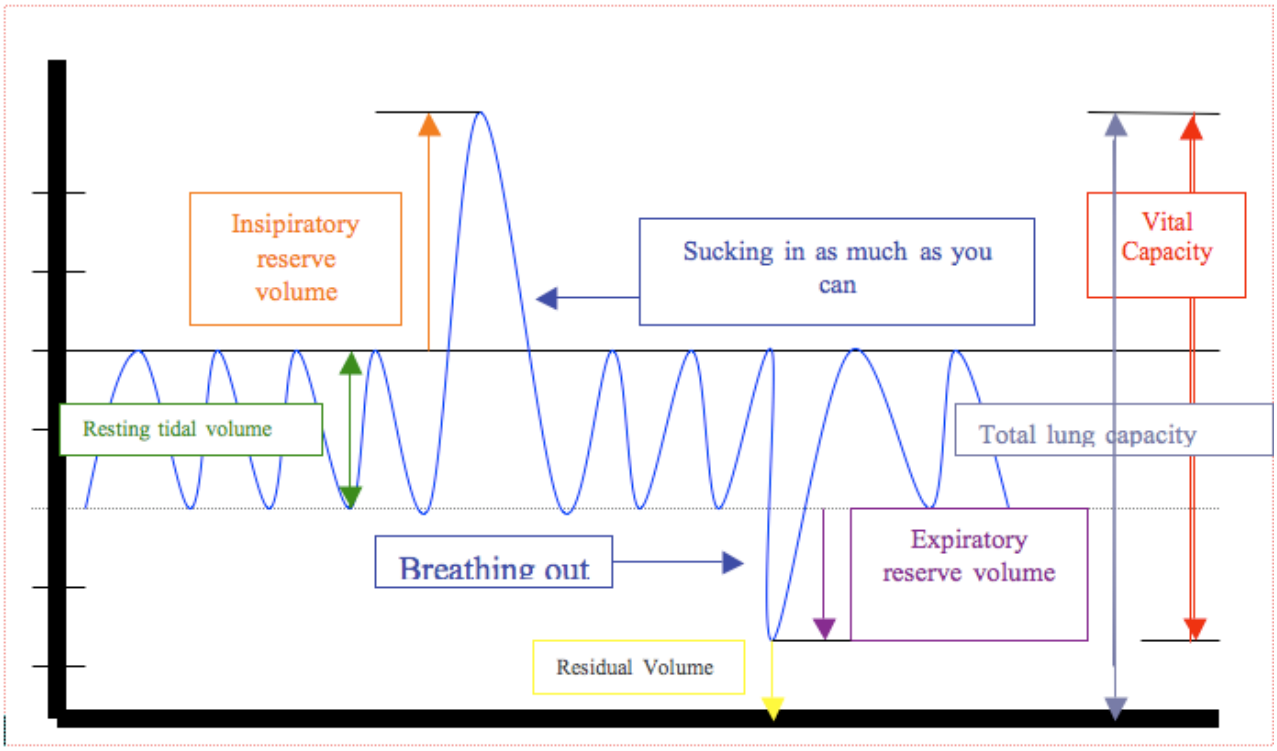
Expiratory Reserve Volume - the additional amount of air that can be expired from the lungs by determined effort after normal expiration

Inspiratory Reserve Volume - the maximal amount of additional air that can be drawn into the lungs by determined effort after normal inspiration

Residual Volume - the amount of air that remains in a person's lungs after fully exhaling.

Vital Capacity – The maximum amount of air that can be forcibly inhaled and exhaled

The image below shows how each of these terms can be displayed on a graph. This graph is showing the values for a person **at rest.** Take some times to understand this graph before having a go at the questions below.



Tidal volume increases during exercise. Why does this occur?

This is because **breathing rate** and **breathing depth** both increase in order to supply the working muscles with the oxygen they require in order to produce energy whilst exercising.

Does your **vital capacity** increase during exercise?

Vital capacity does not increase due whilst exercising as the amount you can **forcibly** breathe in and out does not suddenly change.

Hint: Think carefully before answering this question

Cardio-Respiratory System Exam Questions

1. What type of blood vessel carries blood away from the heart? **(1 Mark)**

Mark One - Artery

1. Define the term residual volume and explain what will happen to residual volume during exercise. **(2 Marks)**

Mark One – Residual volume is the amount of air left in the lungs following forceful expiration

Mark Two – Residual volume will stay the same during exercise

Accept other appropriate answers

2. Define tidal volume and explain what will happen to tidal volume during exercise. **(2 marks).**

Mark One – Tidal volume is the amount of air inspired or expired with each normal breath (at rest or during exercise)

Mark Two – During exercise tidal volume will increase due to an increase in breathing rate/increase in demand for oxygen

Unit: Aerobic & Anaerobic Exercise

Aerobic Respiration:

This is the usual process for releasing energy for your muscles. **Aerobic** means with oxygen.

The equation for aerobic respiration is:

The equation for aerobic respiration is: glucose + oxygen → energy + CO_2 + water

Anaerobic Respiration:

When your muscles have to work at a very intense level, **Anaerobic respiration** takes place. **Anaerobic** refers to producing energy without Oxygen. Glucose is still used but now there is a waste product called lactic acid.

The equation for anaerobic respiration is: glucose → energy + lactic acid

Would the following activities require aerobic or anaerobic respiration?

Aerobic

Aerobic/ Anaerobic

Aerobic/ Anaerobic

Anaerobic

Aerobic/ Anaerobic

Anaerobic

Aerobic & Anaerobic Exercise Exam Questions

1. Write out the equation for anaerobic respiration. **(1 mark)**

Mark One – Glucose = Energy + Lactic Acid

2. Give an example of a sport which requires aerobic respiration. Justify your answer. **(2 Marks)**

Mark One – Marathon runner

Mark Two – A marathon takes place over a long period of time (low intensity) so the performer has time to create energy with oxygen present

Accept other appropriate answers

3. 'Football is a sport that requires both aerobic and anaerobic respiration.'

   Use examples to justify this statement. **(2 marks)**

Mark One – Aerobic respiration is required in football. A match lasts for 90mins and throughout this time there is a large amount of low intensity exercise e.g. jogging

Mark Two – Anaerobic respiration is required in football. Throughout a match a player will need to produce short bursts of explosive energy e.g. when sprinting onto a through ball

Accept other appropriate answers and examples

Unit: The Effects of Exercise

The long-term effects of exercise (months and years):

The table below outlines the long-term effects of exercise. Explain each long-term effect in more detail.

Effect	Explanation
Body Shape may change	Muscles will become more toned and weight loss can occur
Improvements in specific components of fitness	Such as speed, agility and strength – you will learn more about these in future topics
Build Muscle Strength	Weight training in particular will build muscle strength over a long period of time
Improve Muscular Endurance	Muscles will be able to work for longer without getting tired
Improve Speed	Move the body at quicker speeds, which is great for individual and team sports
Improve Suppleness	Meaning that performers can stretch further and are less likely to get injured
Build cardiovascular endurance	The body will become better at using the oxygen that is brought into the body
Improve stamina	The whole body will be able to work for longer without getting fatigued
Cardiac Hypertrophy (Increase in size of the heart)	A bigger heart means that stroke volume increases and more blood will be sent to the active muscles
Lower resting heart rate	Due to an increase in the size of the heart, it does not need to work as hard at rest

Effects of Exercise Exam Questions

1. Cardiac Hypertrophy is a long-term effect of exercise. Explain what Cardiac Hypertrophy is and evaluate how this long-term effect can benefit performance in a sport of your choice. **(3 Marks)**

Mark One – Cardiac Hypertrophy is when the heart increases in strength and size

Mark Two – This will benefit performance in marathon running **(accept any other aerobic activity)**

Mark Three – As the heart is bigger in size it will be capable of pumping out more blood per beat (stroke volume) to the working muscles during a race. Therefore the marathon runner will be able to run at a quicker pace for a longer period without becoming tired

Accept other appropriate answers

2. Naomi is a long-distance swimmer. She has taken part in a six-week training programme in order to improve her performance.

   Other than Cardiac Hypertrophy, state two long-term effects of exercise that Naomi will have experienced. **(2 marks)**

Mark One – Lower resting heart rate

Mark Two – Increased muscular endurance

Accept other appropriate answers (related to long distance swimming/endurance/cv fitness)