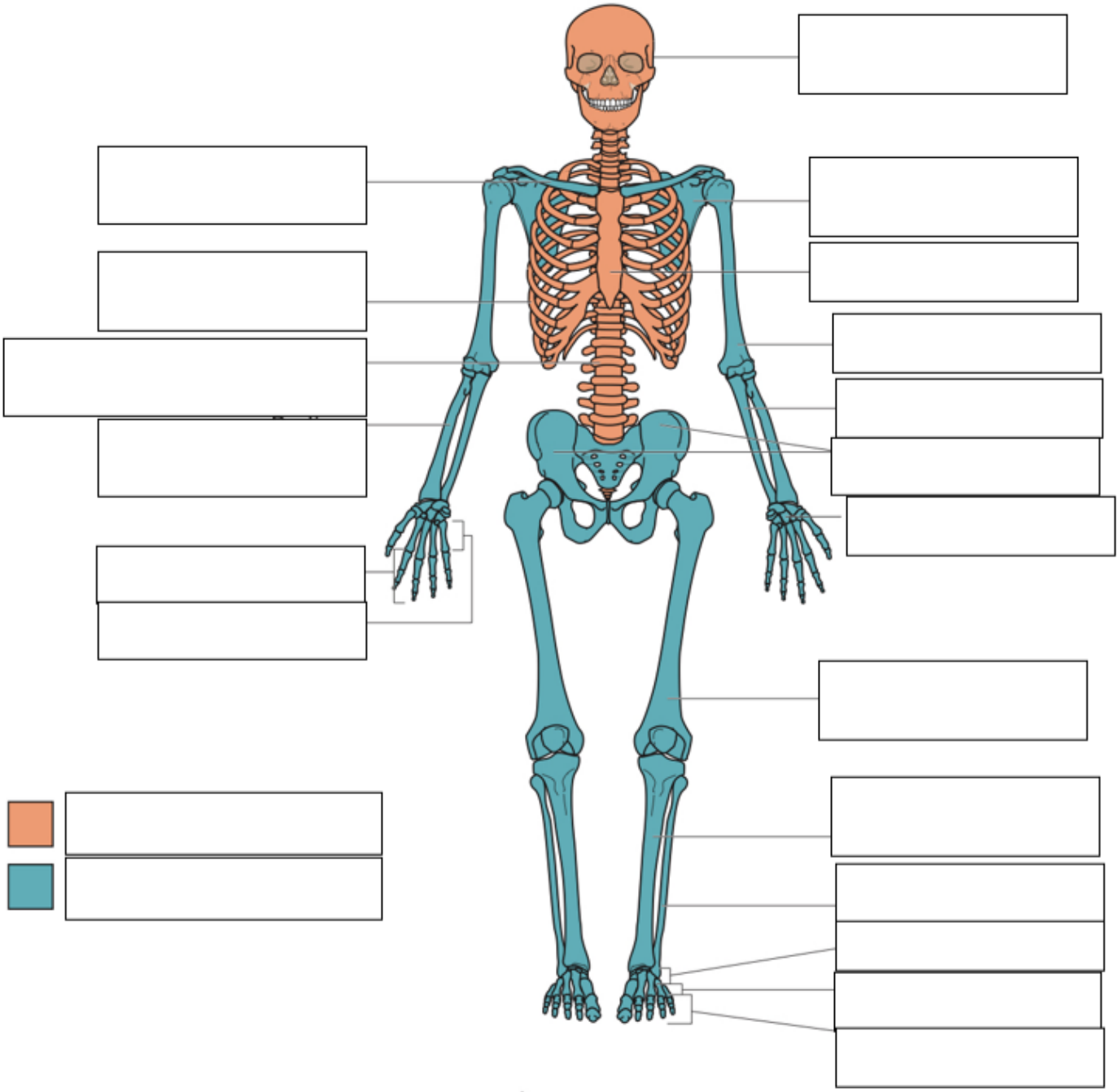
Name

IB SEHS Year 1 Summer Revision
Standard Level

Topic 1: Anatomy - 1.1 The skeletal system

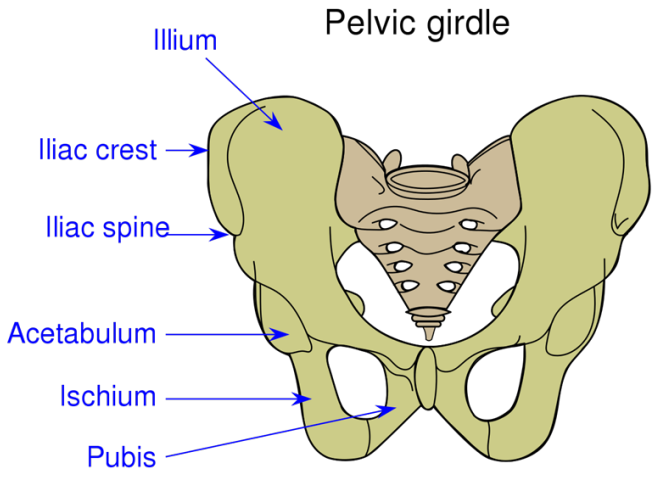
1.1.1 Distinguish anatomically between the *axial* and *appendicular* skeleton.

Label and learn the diagram of the skeleton below.



↑ Figure 1.2: Bones of the axial and appendicular skeleton

Remember you also need to know the parts of the pelvic girdle: *ilium, ischium and pubis.*



1.1.2 Distinguish between the *axial* and *appendicular* skeleton in terms of function.

State six functions of the skeleton.

_____

_____

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Give two examples of the axial skeleton's function - protection.

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State the main function of the appendicular skeleton and give an example.

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_____

Exam Question

Using examples, outline the function of the axial and appendicular skeleton during physical activity.

(4 marks)

_____

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1.1.3 State the four types of bone.

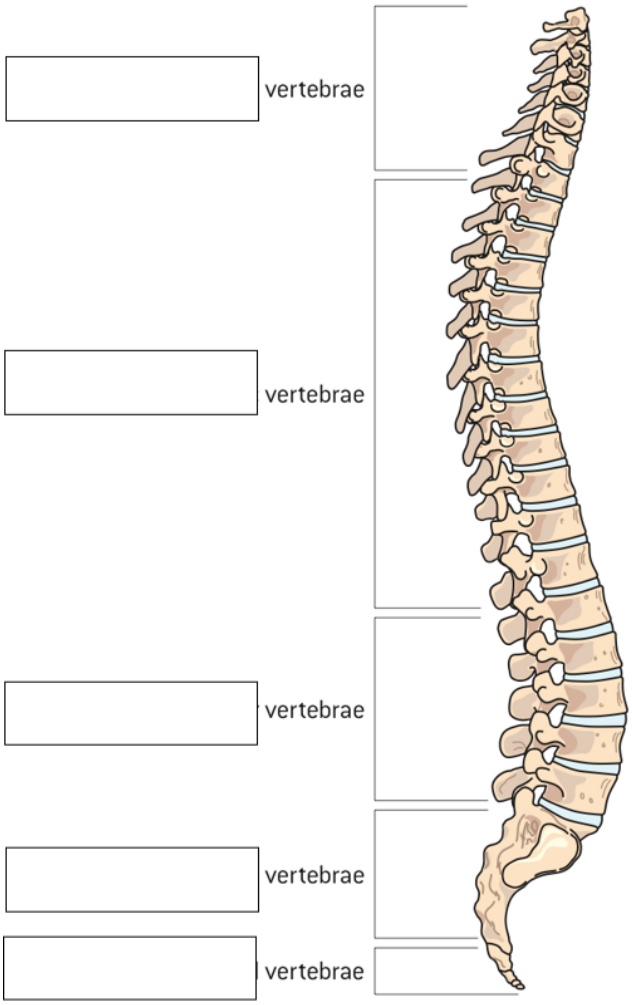
Complete the missing information in the table below.

_____ **-Long cylindrical shaft** **-Enlarged at both ends** **-Length is always greater than width** **-Most important for movement** **-e.g. _____**	_____ **-Small and cube shaped** **-Usually articulate with more than one other bone** **-e.g. _____** 

_____ **-Specialised shapes and functions** **-e.g. _____**	_____ **-Usually have curved surfaces** **-Vary from being quite thick to quite thin** **-Provide protection** **-Broad surface provides large area for muscle attachment** **-e.g. _____**

The vertebrae are _____ bones. The vertebral column protects the _____ and is strong and flexible to allow for _____ It is a part of the _____ skeleton.

Label and learn the diagram of the vertebrae below.



↑ Figure 1.4: Lateral view of the vertebral column

Which vertebrae are fused?

_____

_____

How many vertebrae make up the vertebral column? _____

Which vertebrae do the ribs attach to?

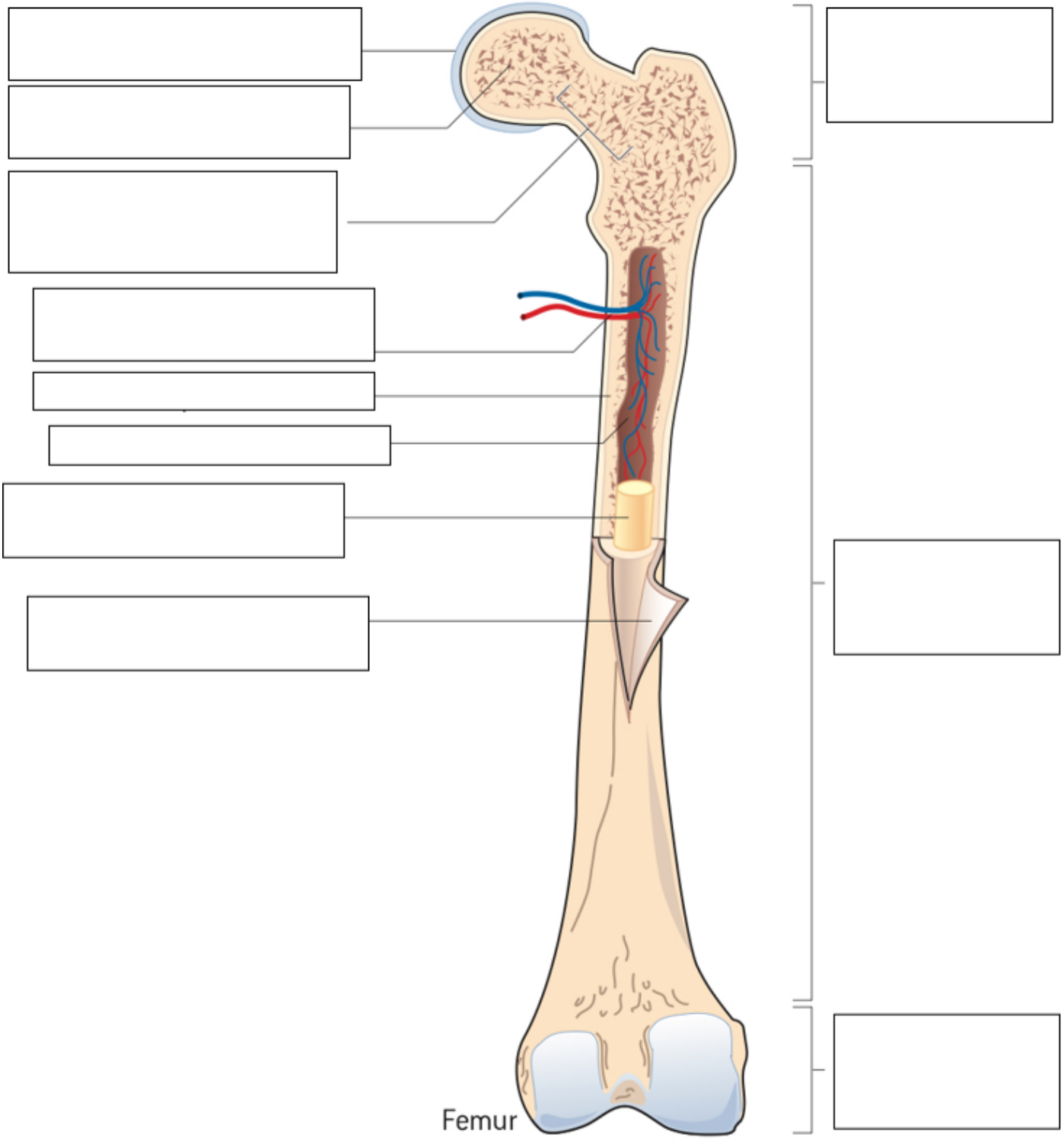
_____

Which vertebrae are the strongest and play a major role in weight bearing?

_____

1.1.4 Draw and annotate the structure of a long bone.

Label and learn the diagram of a long bone below.



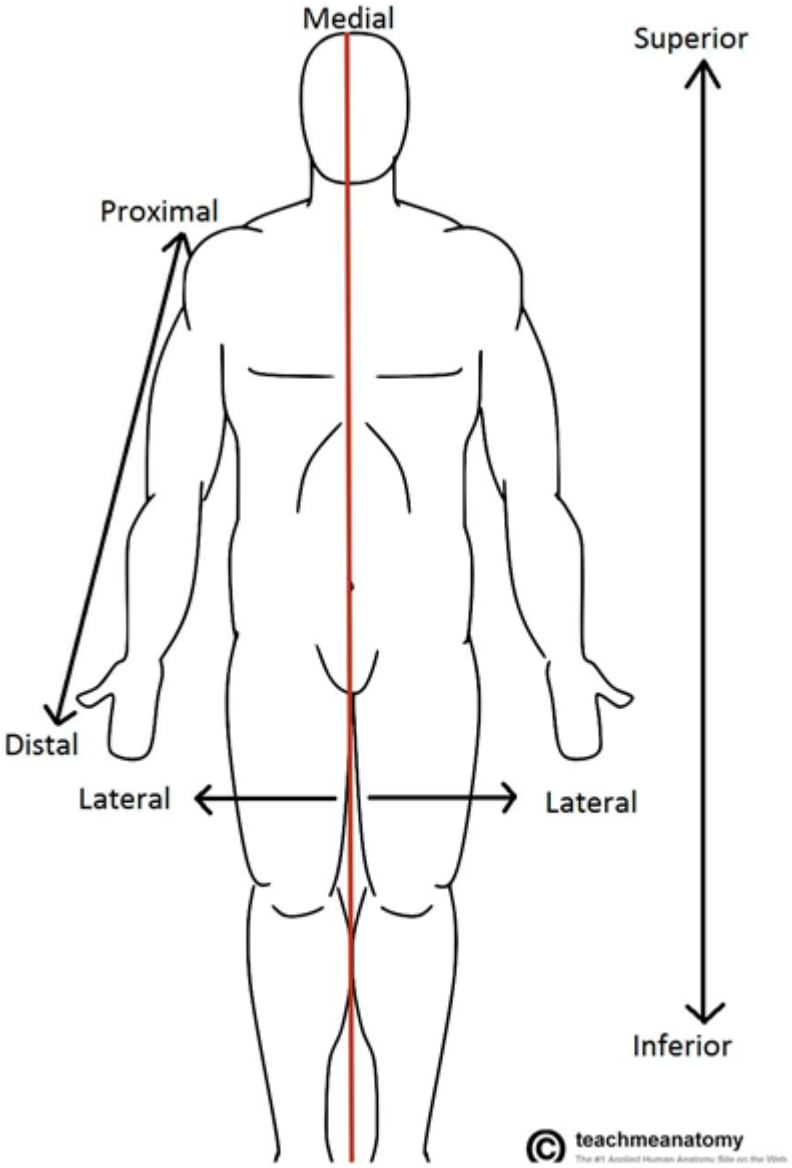
↑ Figure 1.6: Structure of a long bone

Complete the table below.

Term	Definition

	Blood cell production happens here
	Small opening in the middle of the external surface of the diaphysis, through which an artery enters the bone to provide nourishment (blood and nutrients).
	A dense fibrous membrane covering the surface of bones (except at their extremities) and serving as an attachment for tendons and muscles. Also important for bone growth, repair and nutrition.
	Covers end of bones to prevent friction.
	Between walls of diaphysis, containing yellow or fatty marrow
	The shaft, or middle section, of a long bone
	Hard, dense bone tissue that is beneath the outer membrane of a bone. Important for protection and support, and resists the stress of weight placed on long bones.
	The end of the bone located nearest to the midline of the body. Made of spongy bone.
	Mesh-like bone tissue found in the interior of bones. Red bone marrow is stored here.
	Stores fat.
	End of the bone located farthest away from the midline of the body. Made of spongy bone.

1.1.5 Apply anatomical terminology to the location of bones.



Inferior below or further away from the head

Superior above or nearer to the head

Proximal nearer to where a limb attaches to the body

Distal further away from where a limb attaches to the body

Posterior behind or nearer to the back

Anterior in front of or nearer to the front

Internal located inside or further away from the surface

External located on or near the surface

Lateral further away from the midline of the body

Medial closer to the midline of the body

Answer the questions below, using the information above.

Which bone is superior to the tibia? _____

What is the position of the clavicle relative to the ilium? _____

Using anatomical terminology, state the location of the fibula relative to the tibia. _____

Which bone is lateral to the sternum? _____

Which bone is medial to the fibula? _____

1.1.6 Outline the functions of the connective tissue.

Complete the summary table below.

	Attaches bone to bone; allow bones to articulate to form a joint; strong, fibrous tissue that firmly holds bones in place; allow certain movements at joints and restrict other movements; can be injured when force is applied in an opposite direction
	Attaches muscle to bone; muscles contract and change length, due to muscles attachment to bone, they are the driving force of movement; can be injured when overstretched or not warmed up sufficiently
	Firm and smooth connective tissue, adds protection to articulating bones and acts as a shock absorber within a joint

1.1.7 Define the term *joint.*

Complete and learn this definition.

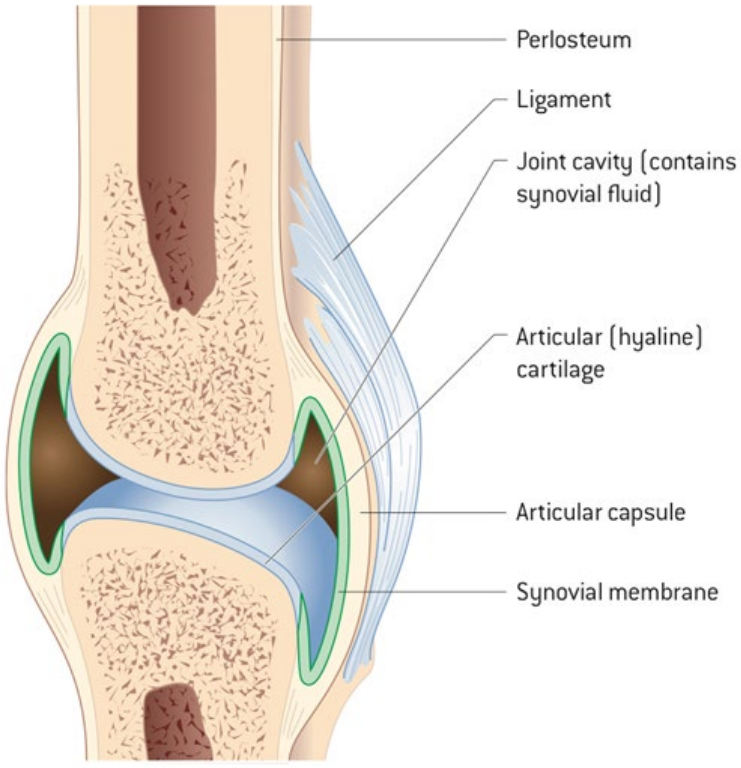
A joint occurs where two or more _____ articulate (join/meet).

1.1.8 Distinguish between the different types of joint in relation to movement permitted.

Add in the names of the types of joint described in each column below. Learn the facts!

_____	_____	_____
Bones are joined by a thin layer of **fibrous connective tissue**	Bones are separated by fibrocartilage disc or by a thick layer of **hyaline cartilage**.	Large number of parts: **synovial membrane, synovial fluid**, cartilage, joint cavity, ligaments.
FIXED/ IMMOVABLE	**SLIGHTLY MOVEABLE**	**FREELY MOVEABLE**
These bones cannot move at all	Bones in these joints can move a small amount	Joints allow a much greater range of movement
The cranium (skull)	The vertebrae (spine) and ribs	The elbow, shoulder, knee and hip

1.1.9 Outline the features of a synovial joint.

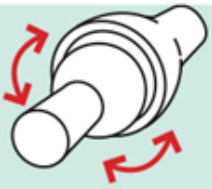


↑ Figure 1.7: Structure of a synovial joint

Complete and learn the table below to outline the features of a synovial joint.

Feature	Structure and Function
	Smooth and spongy protector for the ends of the bones; to prevent friction between articulating bones
	Tiny sacs filled with fluid, found between tendon and bone; reduces friction
	Outer (tough and fibrous) and inner (synovial membrane covered) layers; to strengthen joint and secrete synovial fluid
	A band of strong tissue that holds bones together, providing stability to the joint
	Tough, flexible discs of cartilage; allows bones to fit together, increases joint stability and reduces wear and tear within the joint
	Natural lubricant that fills joint capsule; reduces friction within the joint, eliminates waste from the joint
	Inner layer of joint capsule; all internal surfaces within the joint are covered so secretion of synovial fluid can reduce friction within the joint

1.1.10 List the different types of synovial joint.

JOINT	DESCRIPTION	DIAGRAM
Gliding joint e.g. between the tarsal bones and between the carpal bones	Usually flat or slightly curved bones	
Hinge joint e.g. elbow joint	A convex surface fits into a concave surface	
Pivot joint e.g. radioulnar joint	Rounded surface of one bone rolls around in a ring formed by bone and ligament	
Condyloid joint e.g. between the radius and carpal bones	Oval or egg shaped convex surface fits into a reciprocally shaped concave surface	
Saddle joint e.g. between the carpal bone and metacarpal of the thumb	A saddle shaped bone fits against another bone shaped like the legs of a rider sitting in the saddle	
Ball and socket joint e.g. shoulder joint	Sphere shaped head of one bone fits into a rounded cavity on the other bone	

↑ Figure 1.8: Types of synovial joint

Exam Questions

Distinguish the movement permitted between a fibrous and a cartilaginous joint. (1 mark)

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The articular capsule, meniscus and ligaments provide stability at the knee. Outline <u>two</u> other features of a synovial joint. (2 marks)

_____

_____

_____

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_____

_____

Describe the functions of ligaments and tendons in a joint such as the knee joint. (2 marks)

_____

_____

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_____

_____

_____

State the type of synovial joint that is found at the distal end of the femure (1 mark)

_____

_____

<u>Topic 1: Anatomy - 1.2 The muscular system</u>

1.2.1 Outline the general characteristics common to muscle tissue.

Complete and learn the table below.

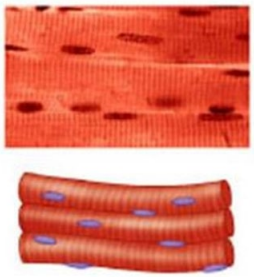
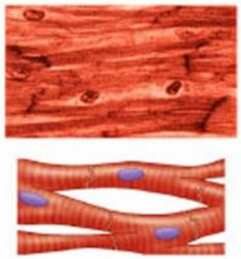
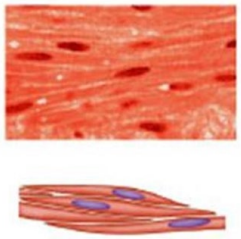
Characteristic	Description
	Muscles are able to contract to cause movement.

	Muscles can stretch and lengthen.
	Muscles can return to their previous length when stretched.
	Muscles will grow if you train them.
	Muscles will shrink if you do not train them - 'use it or lose it!'

*Muscles are also controlled by nerve stimuli and fed by capillaries.

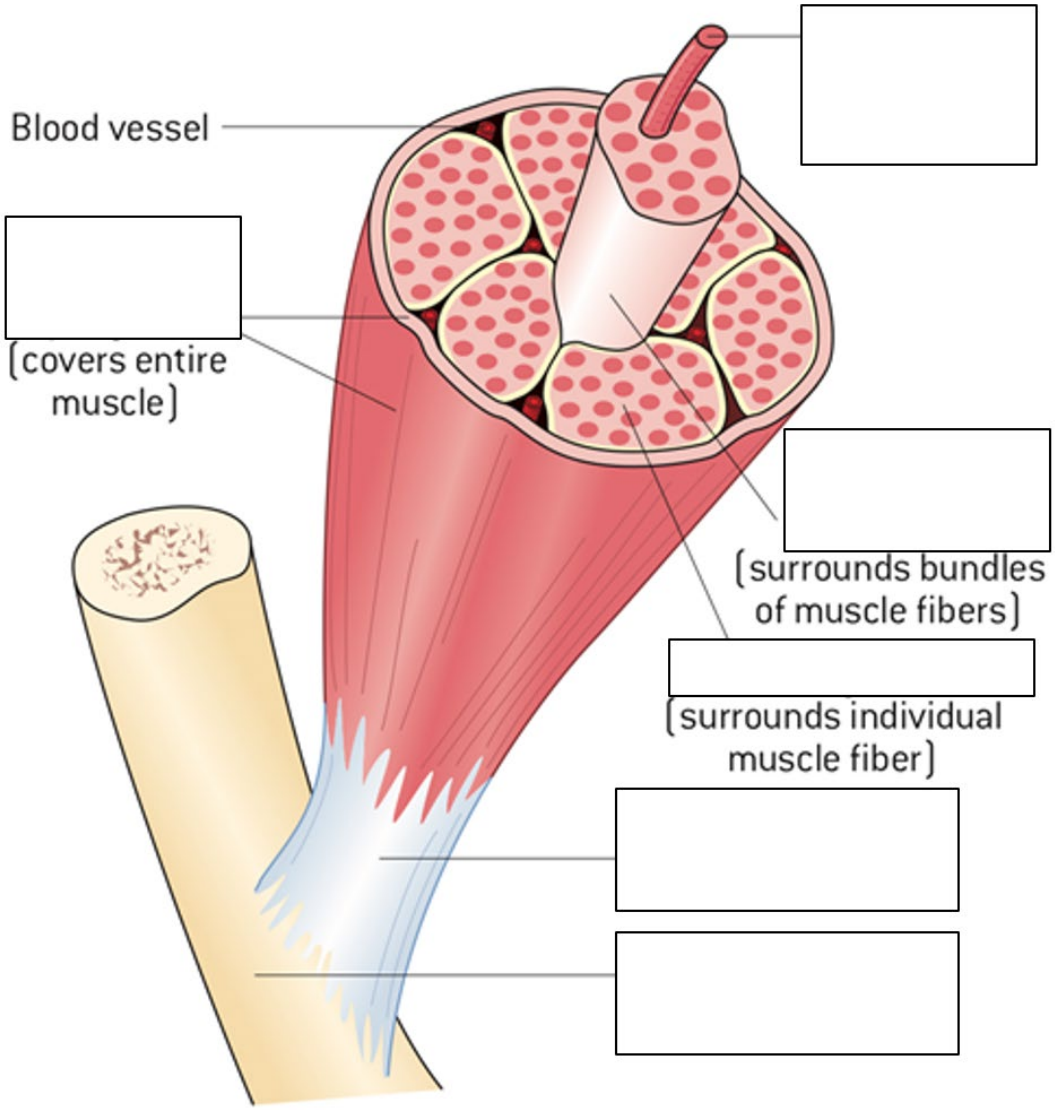
1.2.2. Distinguish between the different types of muscle.

Complete the missing table headers and gaps.

	_____	_____	_____
Location	**Attached to the skeleton via _____**	**In the walls of the _____**	**Walls of organs and blood _____**
Appearance	**Striated, multinucleated fibres**	**Striated, branched, uni-nucleated fibres**	**Narrow, non striated, uni-nucleated fibres**
Contraction	**_____**	**_____**	**Involuntary**
Image			

1.2.3 Annotate the structure of skeletal muscle.

Complete and learn the diagram of skeletal muscle below.



↑ Figure 1.11: Structure of muscle

Part	Surrounded by/sub-part
Skeletal muscle	Surrounded by epimysium
Fascicle	Surrounded by perimysium
Single muscle fiber (cell)	Surrounded by endomysium, then sarcolemma (cell membrane). Inside is sarcoplasm (cytoplasm)
Myofibrils	Contains sarcomeres (made of actin and myosin)

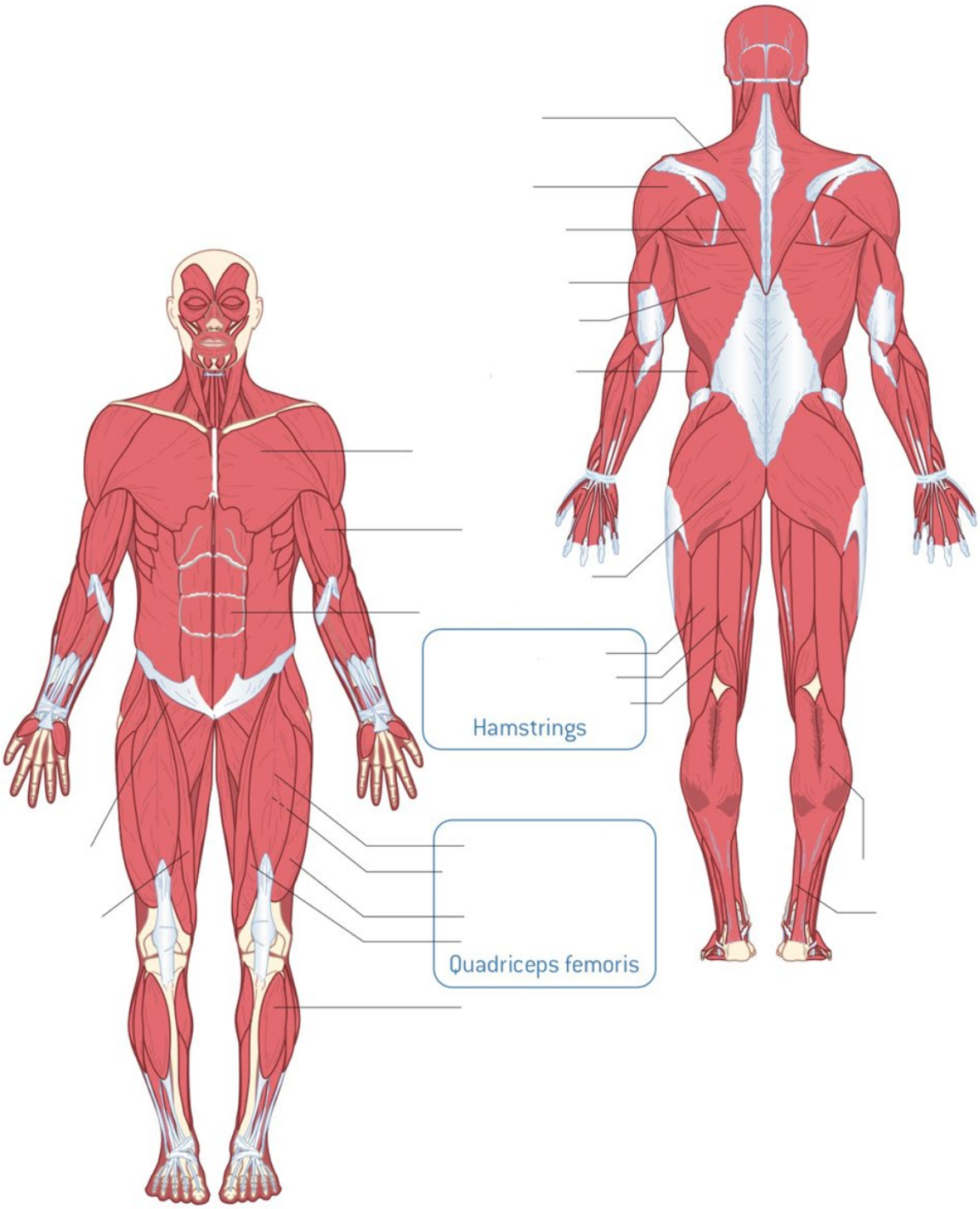
1.2.4 Define the terms *origin* and *insertion* of muscles.

Origin: the attachment of a muscle tendon to a **stationary bone**.

Insertion: the attachment of a muscle tendon to a **moveable bone**.

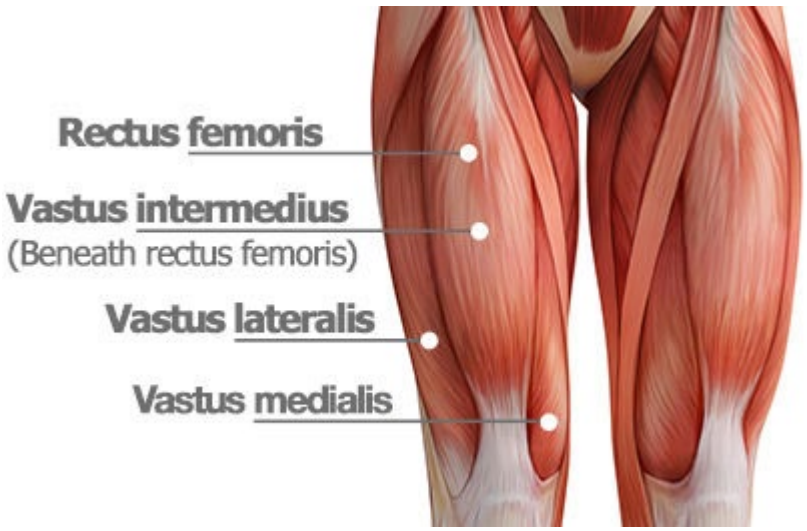
1.2.5 Identify the location of skeletal muscles in various regions of the body.

Label and learn the diagram of the skeletal muscles below.



↑ Figure 1.10: Superficial and deep muscles of the body

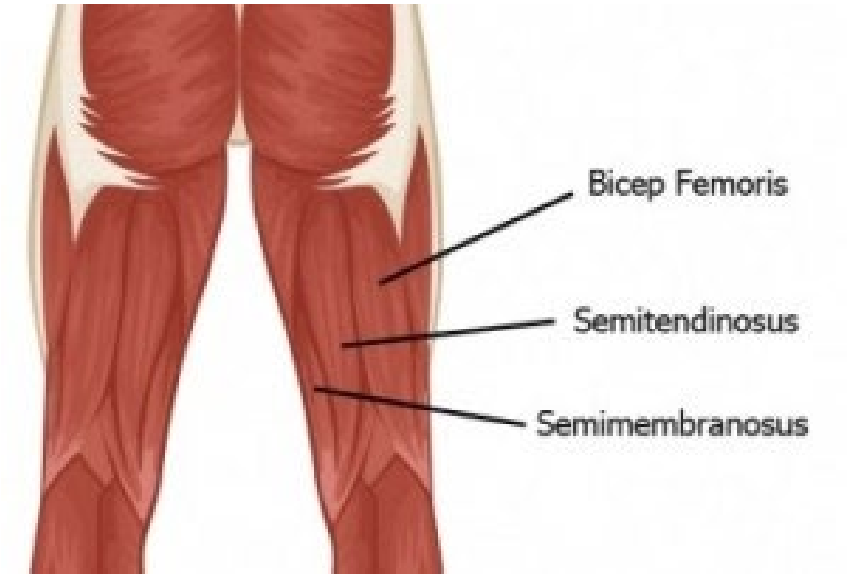
Muscles of the quadriceps (4) - Anterior of upper leg



Remember lateral means further away from the midline of the body, so vastus lateralis is on the outside (lateral) of the thigh.

Remember medial means closer to the midline of the body so it is on the inside (medial) of the thigh.

Muscles of the hamstrings (3) - Posterior of upper leg



Exam Questions

Identify the origin and insertion of the rectus femoris (2 marks)

Origin _____

Insertion _____

Identify the origin and insertion of the tricep brachii (2 marks)

Origin _____

Insertion _____

Identify the origin and insertion of the sartorius (2 marks)

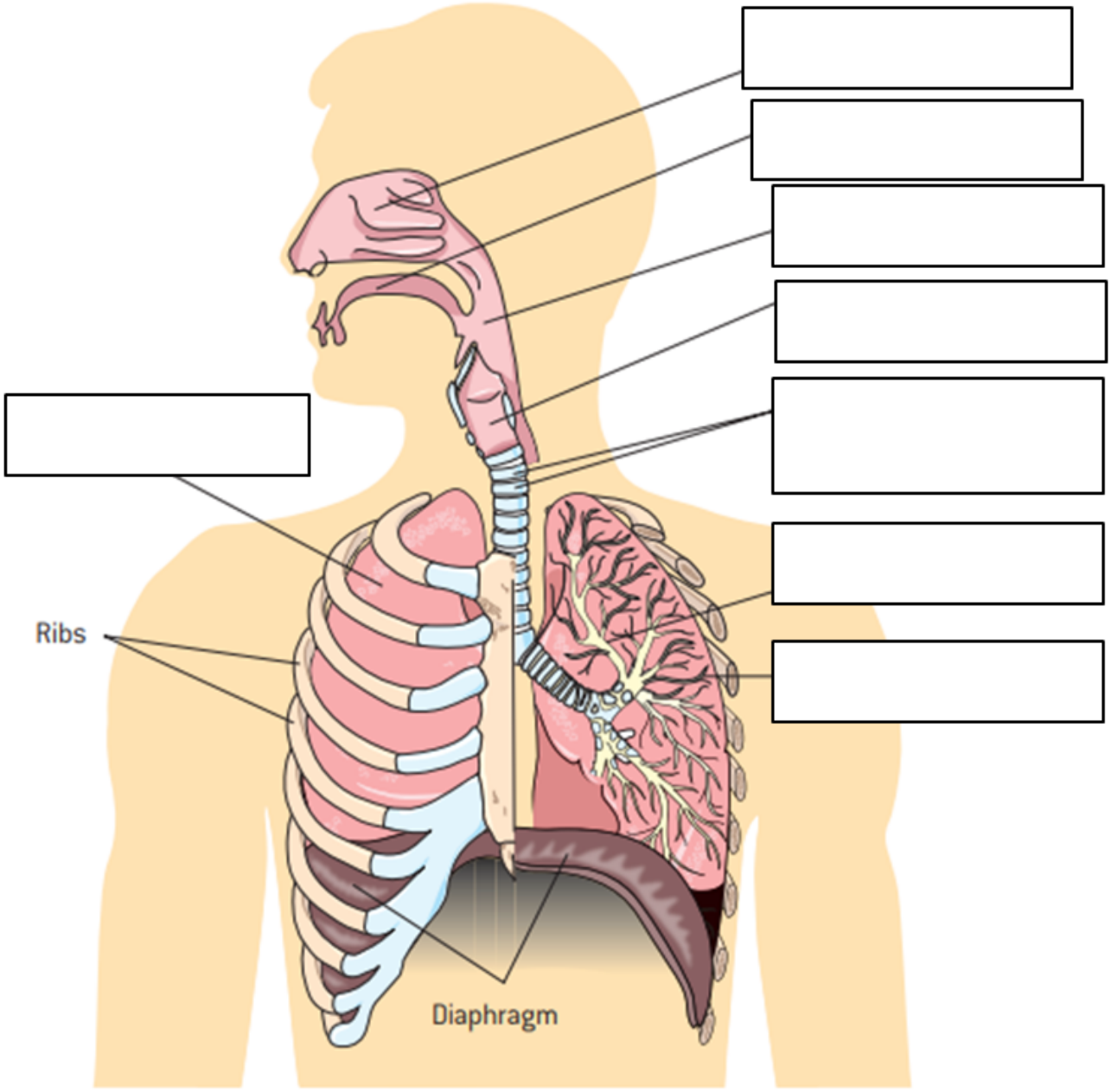
Origin _____

Insertion _____

Topic 2: Exercise Physiology - 2.1 Structure and function of the ventilatory system

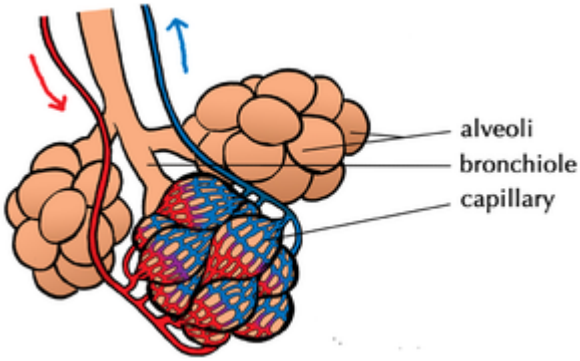
2.1.1 List the principle structures of the ventilatory system.

Label and learn the diagram of the ventilatory system.



↑ Figure 2.2: Anatomy of the ventilatory system

***At the end of each bronchiole, an alveoli can be found.**



2.1.2 Outline the functions of the conducting airways.

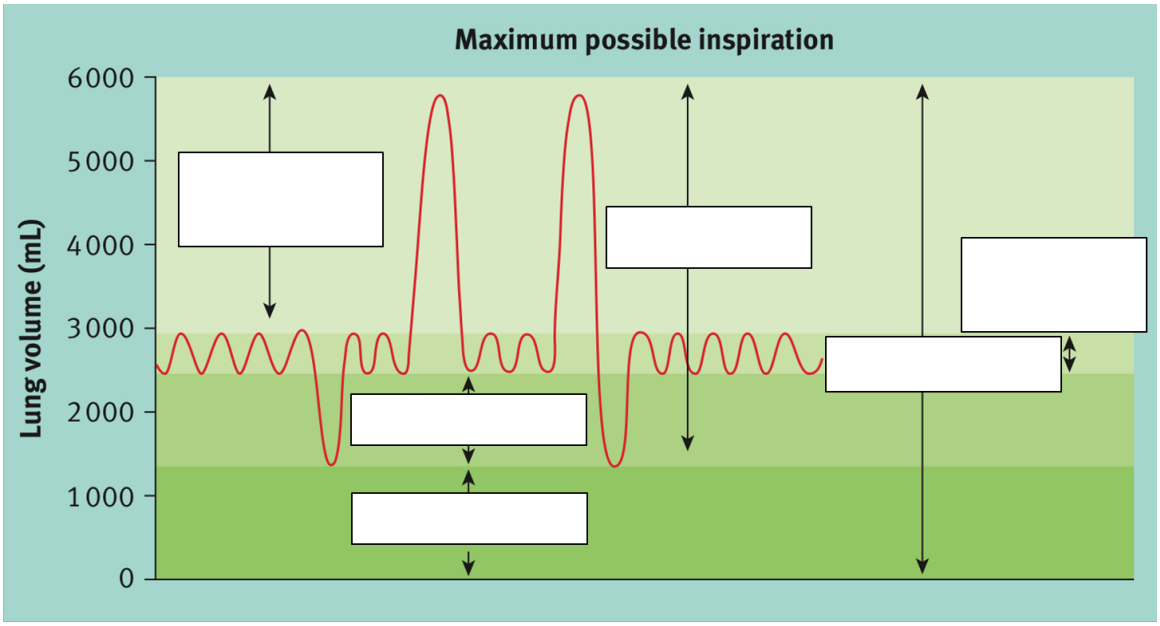
Match up the functions of the conducting airways with their further descriptions.

Complete any gaps.

They have a low resistance pathway for air to flow.	•_____ cells help to produce the _____ which protects from harmful or foreign substances _____ the ventilator system. •The ciliated epithelium also helps to move (_____) foreign bodies away.
They defend against chemicals and other harmful substances that are inhaled.	•The larynx provides a low resistance path for airflow. •This air then travels to the trachea, which is supported and kept open by C-Shaped _____ rings and smooth muscle. •These structures help us to swallow and _____.
They warm and moisten the inhaled air.	•Prevents damage to delicate tissues in the respiratory tract. •Increases the amount of water _____ entering the lungs, stopping the nose and others parts of the respiratory system from _____.

2.1.3 Define the terms *pulmonary ventilation, total lung capacity (TLC), vital capacity (VC), tidal volume (TV), expiratory reserve volume (ERV), inspiratory reserve volume (IRV) and residual volume (RV).*

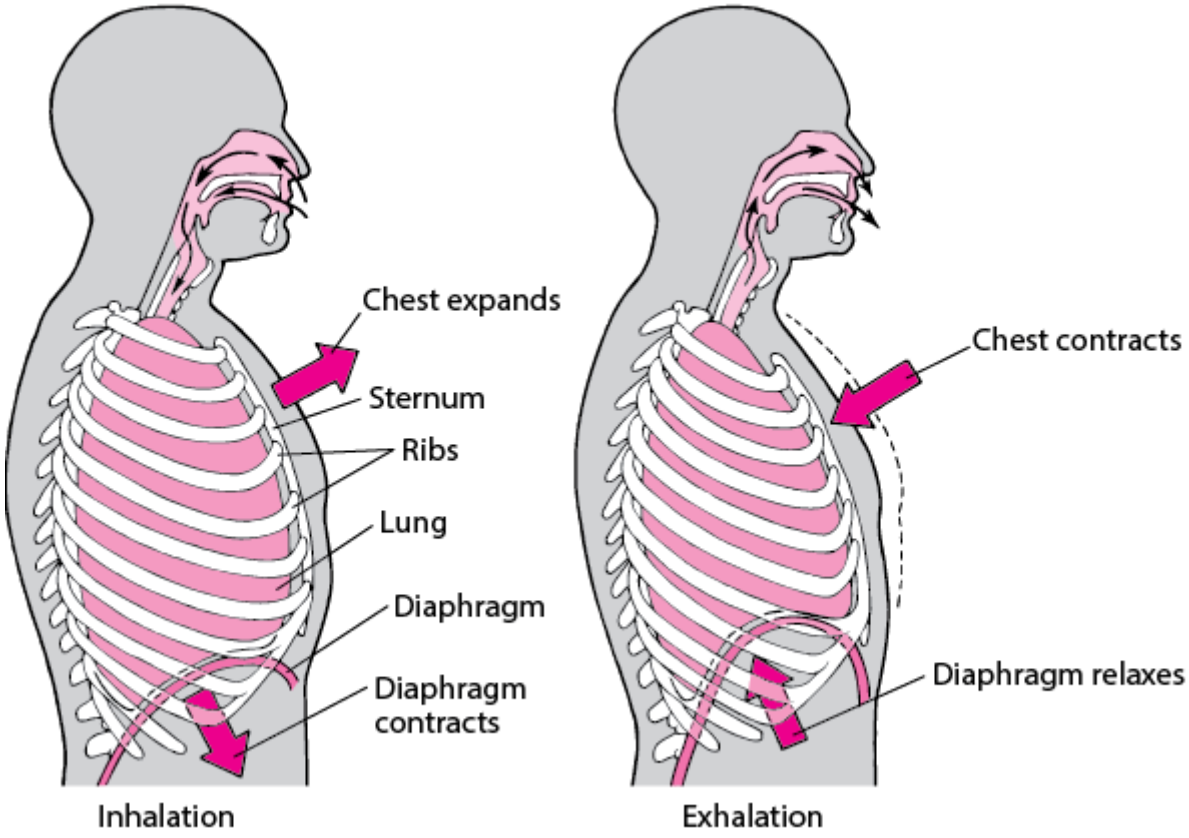
Use the terms to label the diagram below.



Complete the table below to define the terms found on a spirogram.

Volume Name	Description	Value at Rest (ml) (average male)	Change during Exercise
	Amount of air breathed in or out per breath	500	Increases
	Maximal amount of air forcibly inspired in addition to tidal volume	3100	Decreases
	Maximal amount of air forcibly expired in addition to tidal volume	1200	Decreases
	Maximal amount of air exhaled after a maximal inspiration (TV + IRV + ERV)	4800	Slight
	Amount of air left in the lungs after a maximal expiration	1200	None
	Vital Capacity plus residual volume (TV + IRV + ERV + RV)	6000	none

2.1.4 Explain the mechanics of ventilation in the human lungs.



Complete the paragraphs below to explain the mechanics of ventilation in human lungs.

Inhaling

Inhaling is when we breathe _____. The intercostal muscles between the _____ contract, causing the ribcage to move **up** and **out**. The diaphragm muscle _____. causing it to move _____. The volume within the chest _____ causing pressure, inside the thoracic cavity, to _____ so air is drawn into the _____.

Exhaling

Exhaling is when we breathe _____. The intercostal muscles _____ so the ribcage moves in and down. The diaphragm muscle _____ causing it to move _____. The volume within the chest _____ causing pressure, inside the thoracic cavity, to _____ so air is forced out of the _____.

Expiration is a passive process, at rest, the diaphragm and external intercostal muscles just _____.

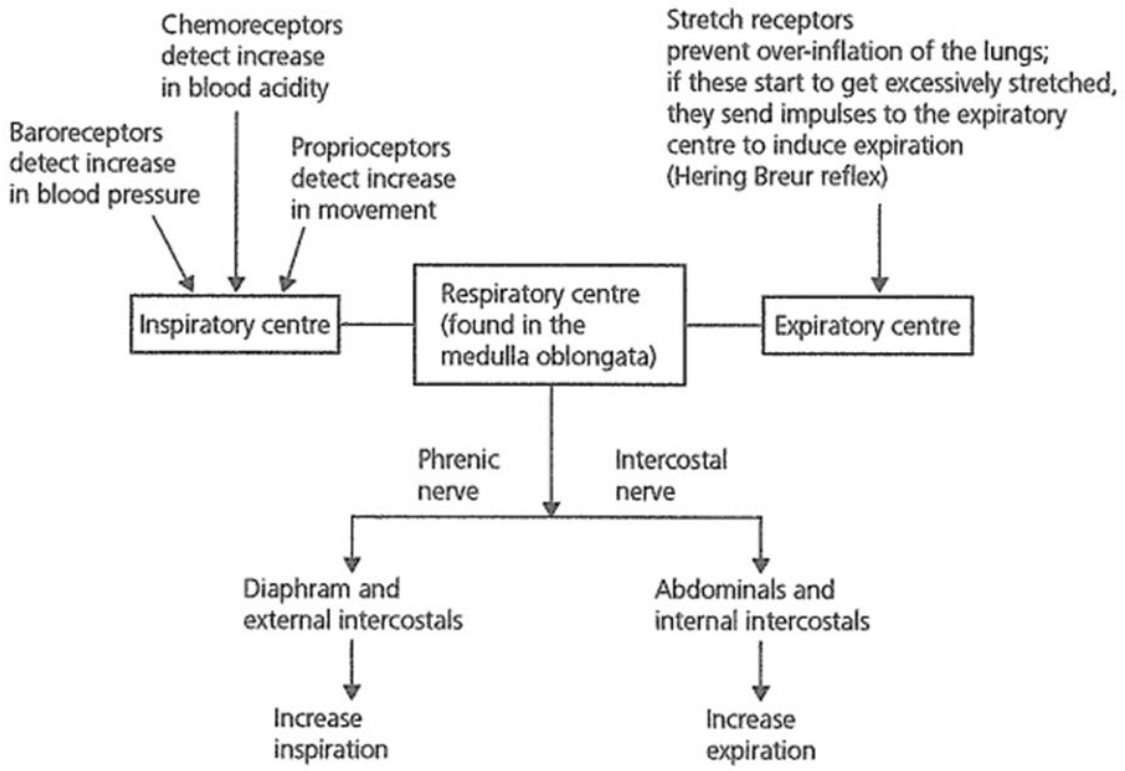
During exercise _____ muscles are recruited to increase breathing rate and depth. When exercising and inspiring, as well as the diaphragm and _____ intercostal muscles, the sternocleidomastoid, _____ and pectoralis minor support _____.

When expiring during exercise, the internal intercostal muscles, _____ and quadratus lumborum support _____ .

2.1.5 Describe nervous and chemical control of ventilation during exercise.

Study the diagram, then use it to complete the gap fill activity.

Breathing is controlled by the nervous system, which automatically increases or decreases the rate, depth and rhythm of breathing. The whole process is summarised in the diagram below.



Receptors are detectives in the body that report back to the brain (in this case the respiratory control centre in the _____).

Pulmonary ventilation is _____. The autonomic nervous system (ANS) controls this automatically through two systems;

Sympathetic Nervous system: Prepares your body for exercise _____ breathing rate (and heart rate).
Parasympathetic Nervous system: Opposite, decreases breathing rate (and heart rate), returning the body to resting level.

The respiratory centre located in the medulla oblongata of the brain controls the rate and depth of breathing. It uses both neural and _____ control to do this.

There are two parts to the respiratory control centre:
▪Inspiratory centre: responsible for inspiration and expiration
▪Expiratory centre: stimulates expiratory muscles during exercise.
When exercising more _____ is produced from respiration (also lactic acid is produced). This cause blood pH to drop (more acidic) as there is more carbon dioxide in the blood. _____ detect this and send a message to the brain. This causes the ventilation to increase. Allowing carbon dioxide to be _____ from the body more quickly, increasing blood pH (less acidic) to normal.

Proprioceptors are sensory receptors located in the joints and muscles. When they detect that muscle _____ is occurring they send a message to the brain. A message is then sent to the respiratory centre that _____ breathing during exercise. As more oxygen is needed in the muscles for _____.

Baroreceptors detect changes in blood _____. During exercise they detect a _____ in blood pressure. This message is sent to the brain. Which causes an increase in breathing rate during exercise.

Stretch receptors
During exercise the lungs are stretched more. Stretch receptors _____ over-inflation of the lungs. They do this by sending impulses to the expiratory muscles (abdominals and intercostal muscles) so that _____ occurs.

2.1.6 Outline the role of hemoglobin in oxygen transportation.

Most (98.5%) of oxygen in the blood is transported by hemoglobin as oxyhemoglobin within red blood cells.

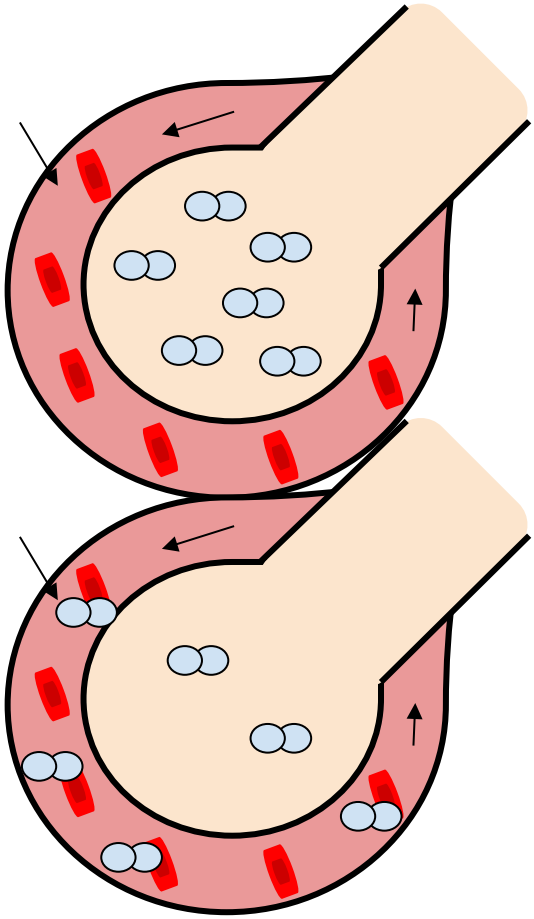
Hemoglobin is a protein rich in iron.

2.1.7 Explain the process of gaseous exchange at the alveoli.

Complete the gap fill activity to explain gaseous exchange.

Gaseous Exchange

Oxygen: Alveoli → Blood



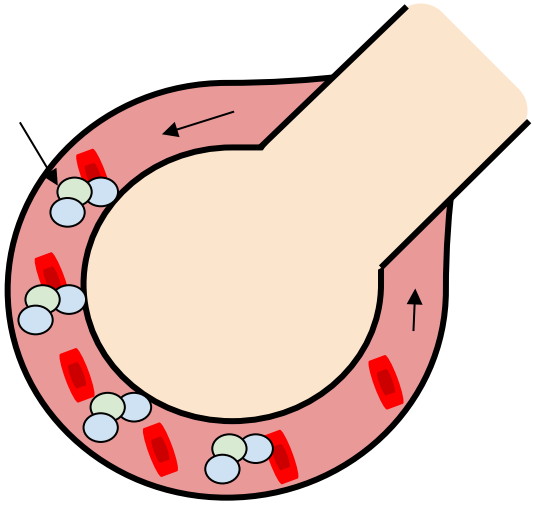
The air we breathe contains approximately _____% oxygen.

When we breathe in air, there is a high concentration of _____ (blue in the diagram) inside the _____.

There is a low concentration of oxygen in the blood _____ surrounding the alveoli.

Due to the concentration difference, oxygen _____ from the alveoli into the blood capillary and combines with _____ (red in the diagram), to be transported around the body..

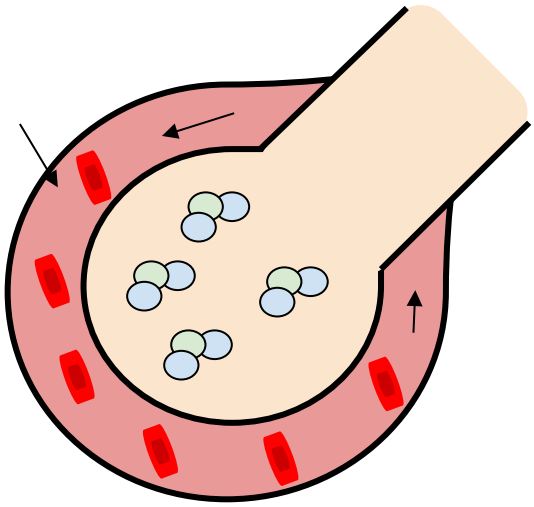
Carbon Dioxide: Blood → Alveoli



The body uses oxygen for _____ , this produces carbon dioxide. Carbon dioxide is a waste product and needs to be _____ from the body.

Carbon dioxide is carried in the blood to the alveoli. There is a high concentration of carbon dioxide in the blood capillary surrounding the _____ .

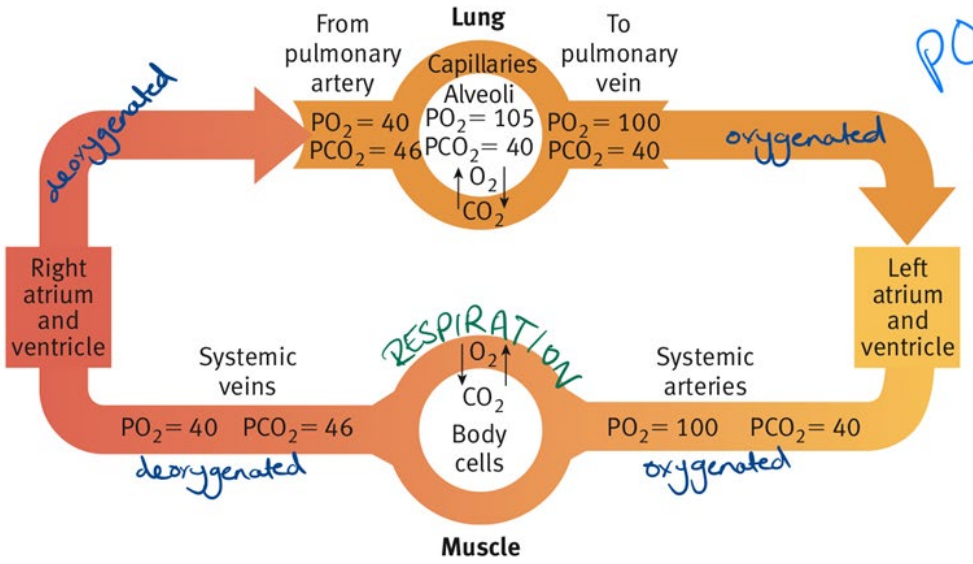
.There is a _____ concentration of carbon dioxide in the alveoli.



Due to the concentration difference, carbon dioxide (blue & green in the diagram) _____ from the blood capillary into the alveoli and is _____ .

Gas	% in inhaled air	% in exhaled air
Oxygen	21	17
Carbon dioxide	0.04	4
Nitrogen	78	78
Water	0.9	3

During exercise, the pressure gradient at the tissues and lungs becomes greater as more oxygen is being used up and more carbon dioxide is being produced (Figure 2.3). The challenge for the lungs is to maintain resting partial pressures in the alveoli. This is achieved by breathing out the air with less oxygen and more carbon dioxide and then breathing in fresh air to maintain the pressure gradients for diffusion to occur. Otherwise the exercise could not be sustained for long.



↑ Figure 2.3: Simplified version of partial pressure differences between lungs, blood and tissues (all partial pressures are in the units of mmHg)

PO_2: Partial Pressure of oxygen

PCO_2: Partial pressure of carbon dioxide.

Partial pressure - the force exerted by a gas.

The diagram above explains gaseous exchange with reference to partial pressure.

Partial pressure is similar to concentration, but represents the pressure exerted by a single gas (e.g. oxygen) within a mixture (e.g. air, blood or tissue fluid).

At rest, differences in the partial pressures of the gases in the alveoli and blood create a pressure diffusion gradient across the respiratory membrane. This causes gases to move from an area of higher pressure to one of lower pressure. The amount and rate of gas exchange that occurs across the membrane depends on the partial pressure of each gas.

For example, in the diagram, PO_2 at the alveoli is 105 mmHg which is much higher than PO_2 in the pulmonary capillaries (40 mmHg), therefore oxygen diffuses into the capillary. The opposite occurs with the PCO_2.

At exercise, oxygen diffusion capacity increases. There is a greater arterio-venous difference facilitating O_2 exchange. Exercise also increases the CO_2 production and facilitates CO_2 removal.

Exam Questions

Explain the process of oxygen exchange at the alveoli. (3 marks)

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Describe how breathing is controlled during exercise. (3 marks)

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Explain how the mechanics of exhalation change from rest to exercise. (6 marks)

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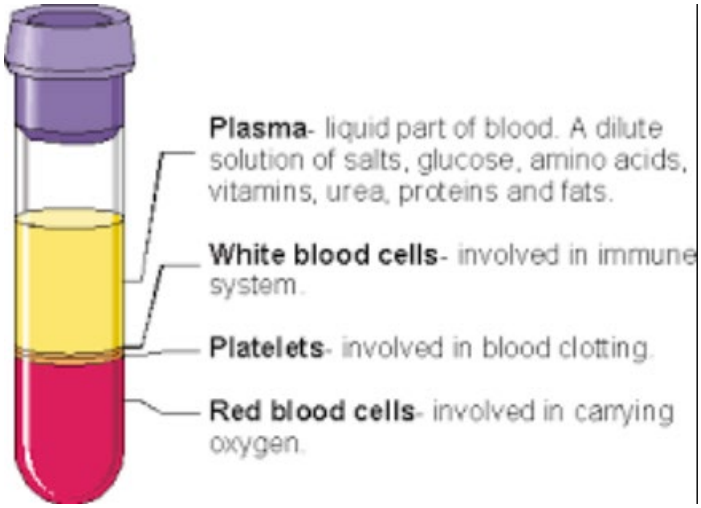
Topic 2: Exercise Physiology - 2.2 Structure and function of the cardiovascular system

2.2.1 State the composition of blood.



Answer the questions.

What percentage of the blood is composed of red blood cells (erythrocytes)? _____

What percentage of the blood is composed of white blood cells (leucocytes)? _____

What percentage of the blood is composed of platelets (thrombocytes)? _____

What percentage of the blood is composed of plasma? _____

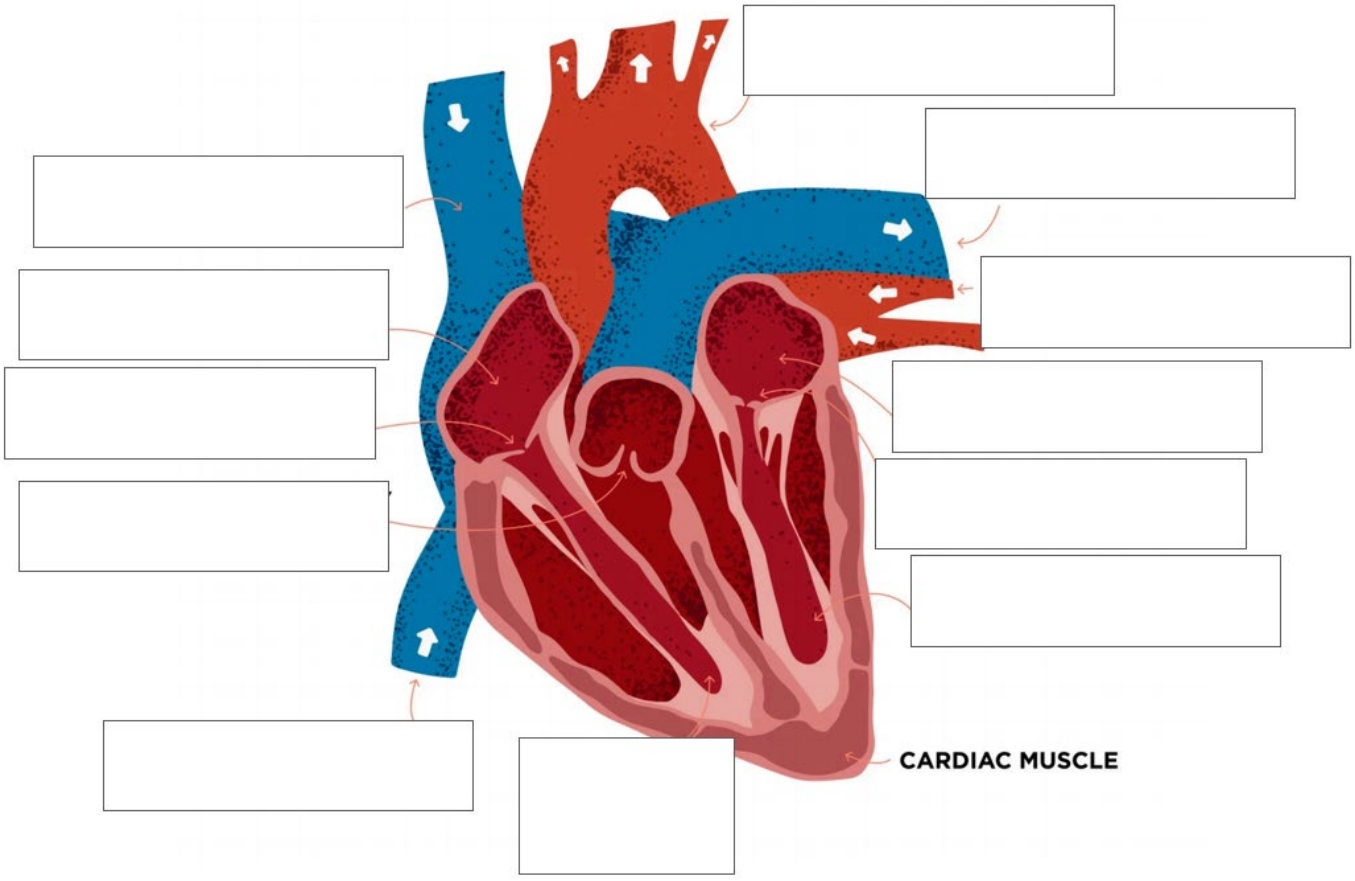
2.2.2 Distinguish between the functions of *erythrocytes, leucocytes and platelets.*

Complete and learn the table below.

Part of the blood	**% of blood**	**Function**
_____	____	**Provides the liquid substance that allows the transportation of other cells and nutrients.** **Controls body _____ and hydration.**
_____	____	**Help fight _____ and disease by engulfing the pathogen or attacking the pathogen with _____**

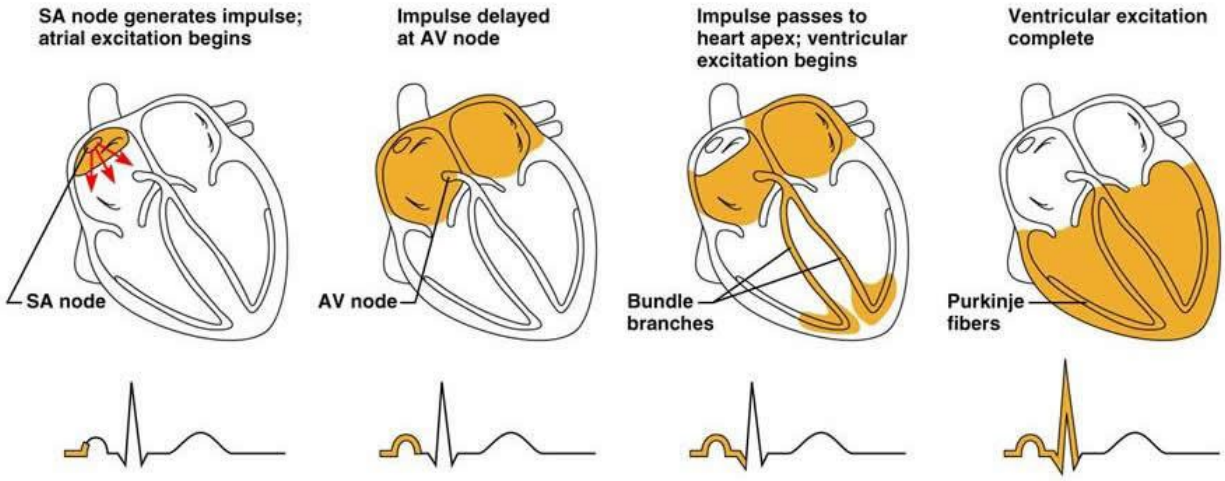
_____	____	**Protects us from disease entering through a cut as well as bleeding to death, via _____**
_____	____	**Transports oxygen and carbon dioxide around the body within the _____**

2.2.3 Describe the anatomy of the heart with reference to the heart chambers, valves and major blood vessels.
Label and learn the diagram of the heart below.



2.2.4 Describe the intrinsic and extrinsic regulation of heart rate and the sequence of excitation of the heart muscle.

INTRINSIC CONTROL



Put these statements into order by adding numbers to the first column. Then learn the steps in order.

	The heart is myogenic, meaning it makes itself contract. The heart starts its cardiac cycle, by an electrical impulse which is initiated within the heart.
	The initial electrical impulse comes from the sinoatrial node aka primary pacemaker.
	This sends an impulse through the walls of the atria (both right and left sides) to a secondary group of specialist cells called the atrioventricular (AV) node.
	This causes the muscles in the walls of the atria to contract simultaneously (at the same time). This reduces the volume of the atria chambers.
	This increases the pressure inside the atria, forcing blood from the atria, through the atrioventricular (AV) valves *(tricuspid valve in right side and mitral valve in the left side).*
	Blood enters the ventricles and the AV valves close preventing backflow of blood (ensures blood travels in the right direction).
	There is a VERY brief delay. Allows the atria to empty, filling the ventricles and ensuring the order of contraction is atria then ventricles.
	The electrical impulse is then conducted rapidly via a bundle of specialist cells called the *Bundle of His*.

	These cells rapidly conduct the impulse along the very fast conducting *Purkinje fibers*, that spread the impulse along the ventricle walls.
	The impulse causes the ventricle walls to contract simultaneously, reducing the volume of the ventricles and increasing the pressure inside them.
	Blood is forced up and out through the main arteries (aorta and pulmonary artery) leaving the heart.
	The semi-lunar valves (aortic and pulmonary valves) close and while the ventricles relax, the next cycle has already started again.

EXTRINSIC CONTROL

Fill in the gaps.

The heart has its own _____, but heart rate is also influenced by;
▪the sympathetic and;
▪parasympathetic branches of the _____ nervous system and;
▪by _____.

Extrinsic Regulation of the heart rate: Autonomic Nervous System (ANS)

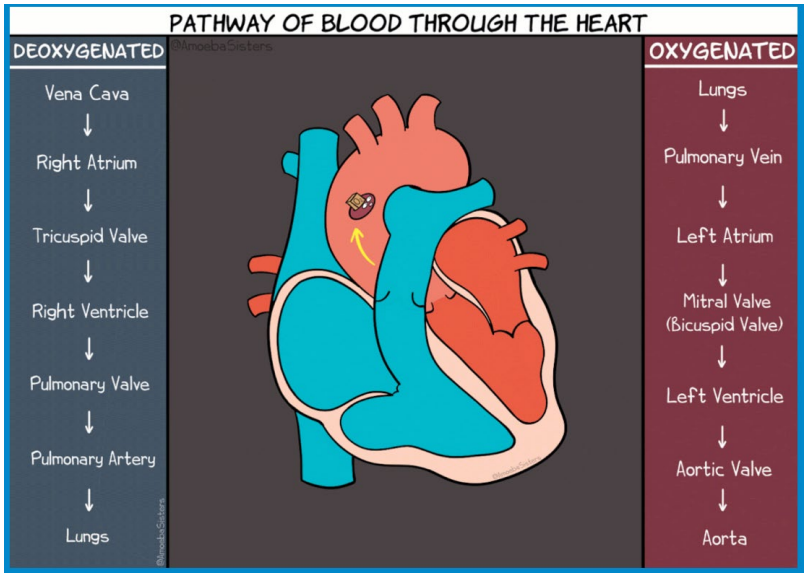
Sympathetic Nervous System (AKA Fight or flight)
▪When faced with a problem (fight, exam, penalty in sport, before a race) our SNS stimulates the release of a hormone called _____ which directly affects the SA Node, thus _____ HR
▪SNS also dilates pupils, dilates bronchi, inhibits digestive organs – increasing alertness, allowing more oxygen into our blood and circulating the blood faster
▪Adrenaline (hormone) also stimulates the breakdown of glycogen and lipids.

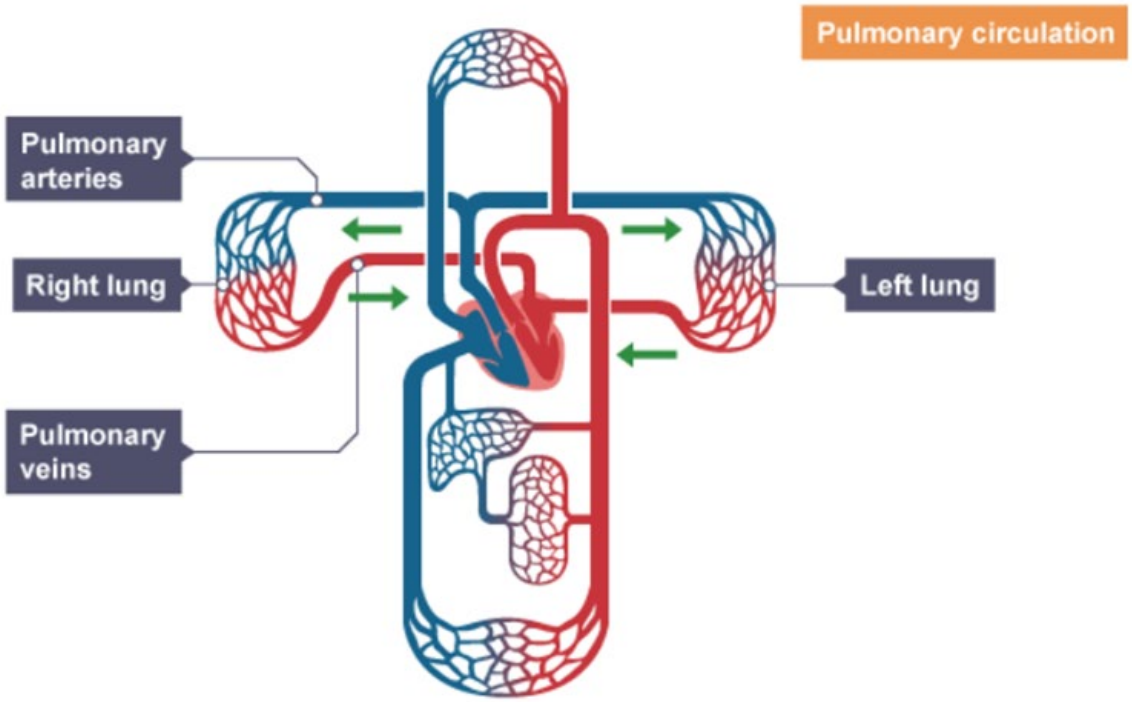
Extrinsic Regulation of the heart rate: Autonomic Nervous System (ANS)

Parasympathetic Nervous System (AKA Rest or Digest)
▪PNS releases the neurotransmitter _____ and has the reverse affect on the body; reducing HR, constricting bronchi, stimulating the activity of the digestive organs
▪Stimulates the pacemaker to _____ (reducing heart rate)

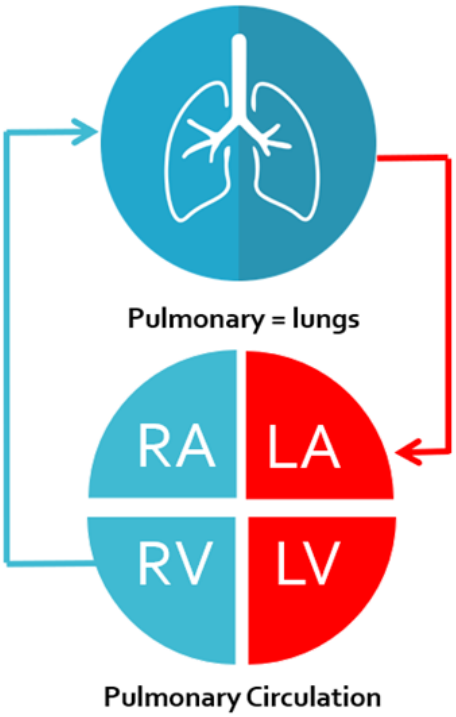
This links back to receptors:
Sensors in the body detect the status of the body e.g. chemoreceptors, baroreceptors.
Which is monitored by the central nervous system and the body responds.

2.2.5 Outline the relationship between the pulmonary and systemic circulation.





Pulmonary circulation takes place between the heart and the lungs



Complete the text below to outline the pulmonary circulation.

The **pulmonary circuit** transports blood to the _____.

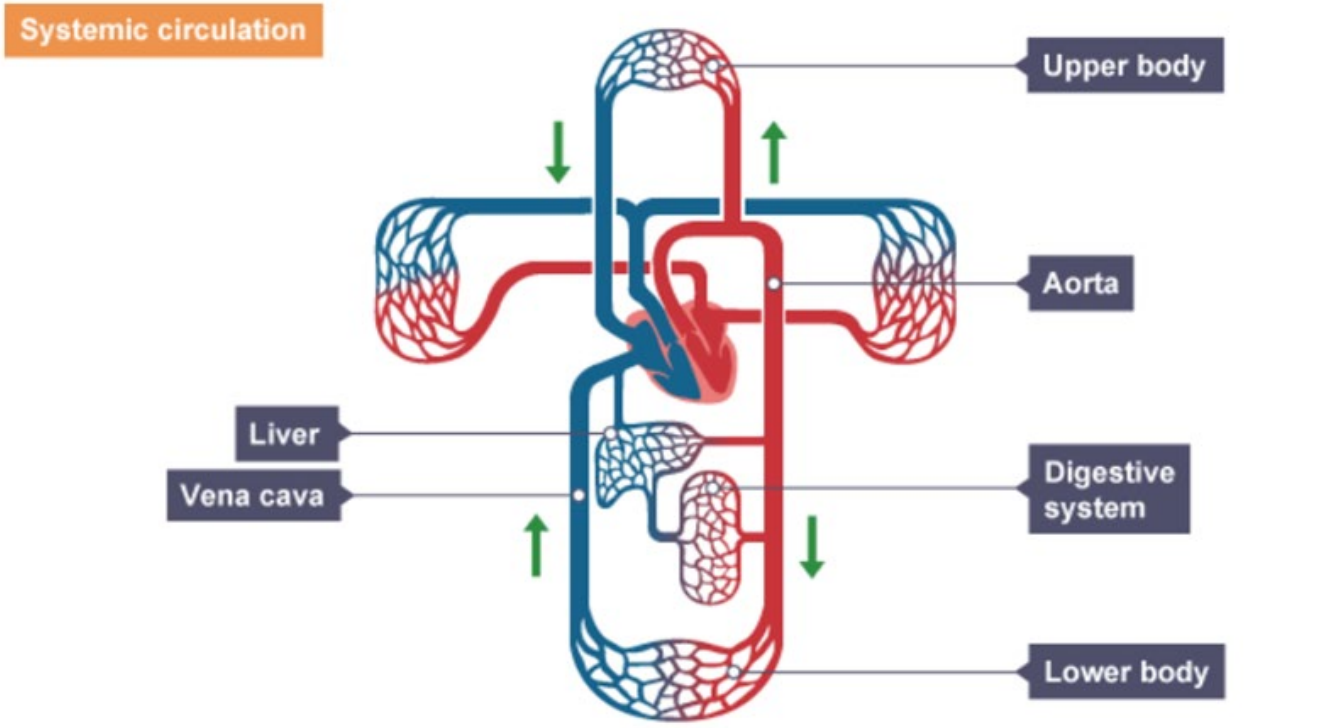
Blood leaves the heart from the right _____ of the heart through the pulmonary _____.

Pulmonary blood leaving the heart is _____ in oxygen (deoxygenated).

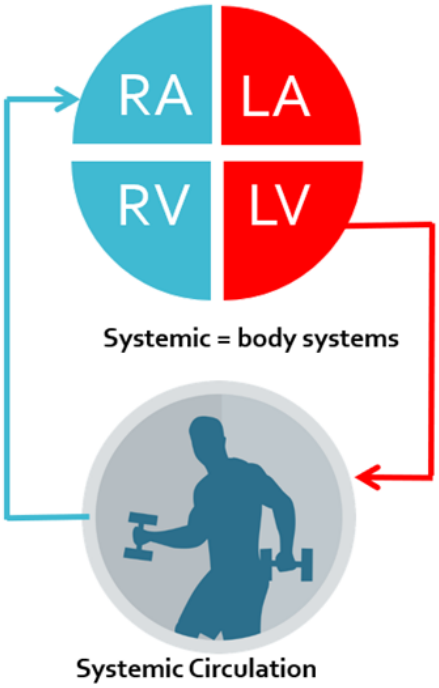
The blood is oxygenated at the lungs (via gaseous exchange) and then carried back to the heart, through the pulmonary _____ into the _____ atrium.

Pulmonary blood returning to the heart is _____ in oxygen (oxygenated).

Unlike other arteries and veins, the pulmonary artery carries deoxygenated blood and the pulmonary vein carries _____ blood.



Systemic circulation takes place between the heart and other organs



Complete the text below to outline the pulmonary circulation.

The **systemic circuit** transports blood around the _____. Transporting oxygen and nutrients to the body tissues.

Systemic blood leaves the heart from the left _____ via the _____ to the the organs of the body.

Systemic blood leaving the heart is high in oxygen (_____).

Systemic blood returns from the body via the vena cava into the right _____.

Systemic blood returning to the heart is _____ in oxygen (deoxygenated) and also carries carbon dioxide and other waste materials.

Systemic circulation is under _____ pressure than pulmonary circulation.

2.2.6 Describe the relationship between heart rate, cardiac output and stroke volume at rest and during exercise.

Cardiac Output (Q) = Heart Rate (HR) x Stroke Volume (SV)

- Heart rate is the number of times the ventricles contract in one minute. Measured in bpm.
- Stroke volume is the volume of blood ejected from the (left) ventricle after contraction. Measured in ml or l.
- Cardiac output is the amount of blood ejected by the ventricles in one minute. Measured in ml/minute or l/min.

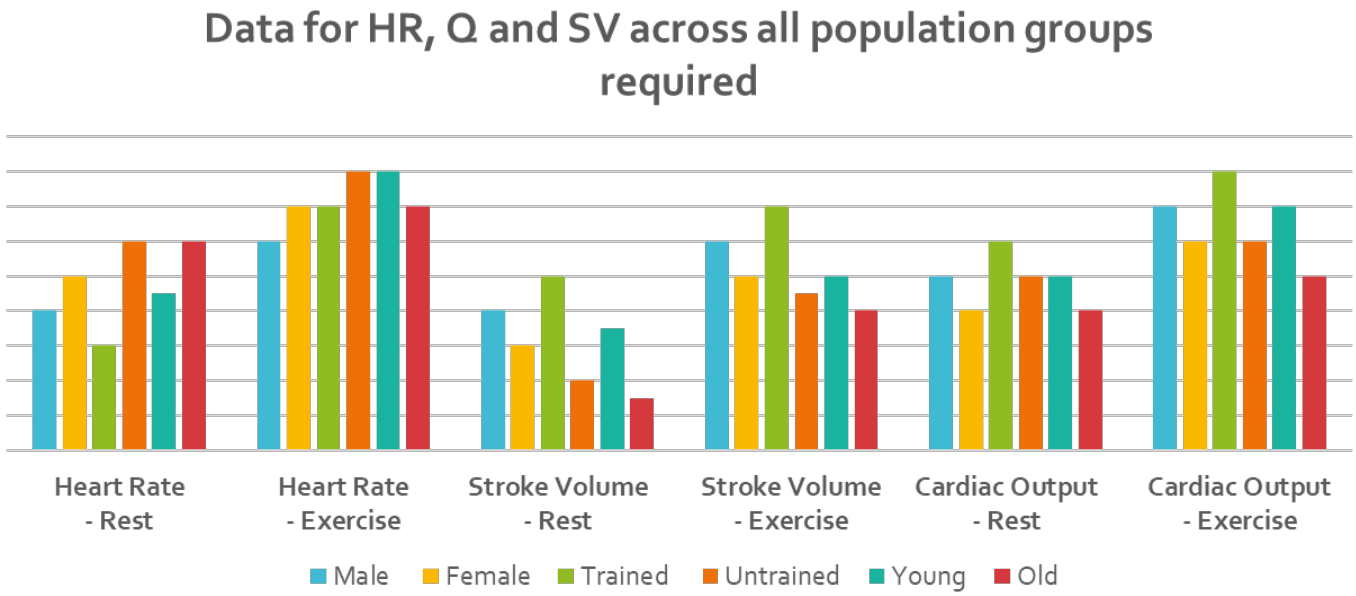
Calculate the following. Make sure you show your working and use the correct units!

The Cardiac Output for a 25-year-old male with a heart rate of 60 bpm and a stroke volume of 90 ml.

The stroke volume for a 16-year-old girl with a heart rate of 72 bpm and a Cardiac output of 4.2 l/min.

The heart rate for a 67 year-old-male a Cardiac output of 3.9 l/min and a stroke volume of 50 ml.

2.2.7 Analyse cardiac output, stroke volume and heart rate data for different populations at rest and during exercise.



Use the graph to answer the following.

Exam Questions

Distinguish how cardiac output, stroke volume and resting heart rate would differ between trained and untrained women during exercise. (3 marks)

_____

_____

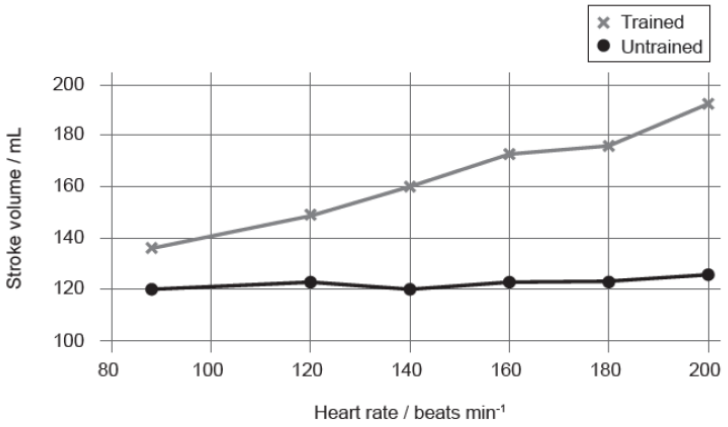
_____

_____

_____

_____

The graph shows the stroke volume and heart rate for trained and untrained athletes. What is the reason for the difference in stroke volume? (1 mark)



_____

_____

_____

_____

_____

_____

2.2.8 Explain cardiovascular drift.

Cardiovascular drift is an increase in heart rate during prolonged exercise, despite effort remaining the same. It occurs because;

▪Exercise causes a rise in body temperature

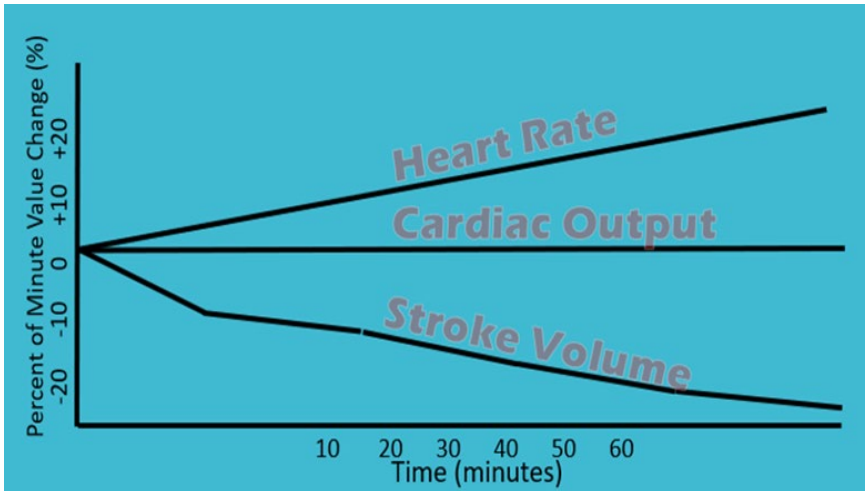
▪Vasodilation occurs at the skin (to encourage heat loss) so the blood now has to go to skin as well as muscles (and other parts of the body)

▪Sweating occurs to lose heat which reduces blood plasma

▪Blood gets more viscous which increases blood pressure

▪Less blood gets back to the heart so stroke volume decreases.

▪HR increases to maintain Q (cardiac output).



2.2.9 Define the terms *systolic* and *diastolic blood pressure.*

Complete the definitions.

Systolic = the force exerted by blood on arterial walls during _____.

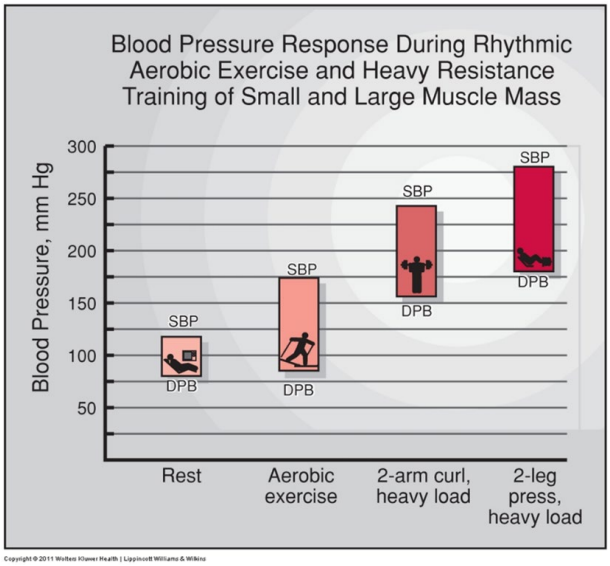
CONTRACT & SPILL

Diastolic = the force exerted by blood on arterial walls during _____.

RELAX & FILL

2.2.10 Analyse systolic and diastolic blood pressure data at rest and during exercise.

2.2.11 Discuss how systolic and diastolic blood pressure respond to dynamic and static exercise.

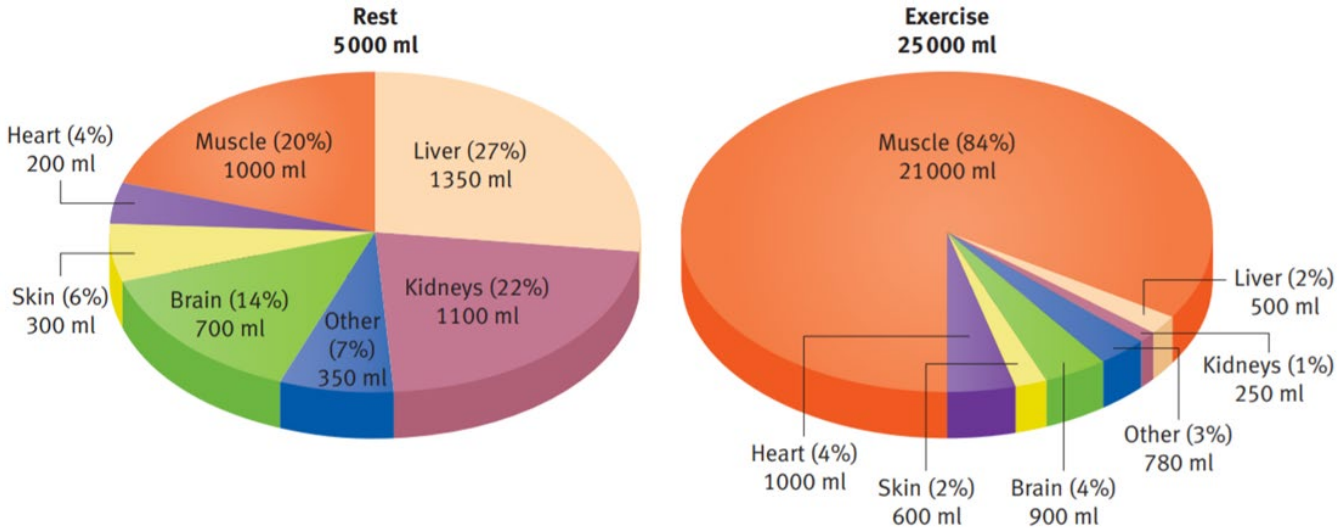


Complete the table below to explain changes in blood pressure during exercise.

	Diastolic Blood Pressure	**Systolic Blood Pressure**
Static Exercise **(isometric)** **Lifting heavy load**	**Increase in diastolic BP:** ▪_____ occurs increasing pressure ▪Muscles squeeze veins to promote venous return which increases _____ ▪Muscles exert continuous pressure on vascular system ▪Breathing is more constricted, less oxygen and more carbon dioxide so heart has to work harder to supply muscles with enough oxygen and get rid of carbon dioxide	**Increase in systolic BP:** ▪Larger _____ of blood is being pumped through arteries with each ventricular contraction ▪Heart trying to meet _____ of exercise
Dynamic Exercise **(isotonic)** **Running**	**Constant diastolic BP (stays the same):** ▪Muscles are still moving so no added pressure of muscles _____ veins ▪Constantly breathing so carbon dioxide can be	**Increase in systolic BP (but lower than static exercise):** ▪Breathing rate is _____ than in static exercising so not as much pressure as static

	_____ ▪_____ occurs (reduces total peripheral resistance) reducing pressure	exercise ▪Stroke volume _____ to meet demands of body, increasing pressure

2.2.12 Compare the distribution of blood at rest and the redistribution of blood during exercise.



Complete the explanations of the pie charts above.

.

During exercise blood is redistributed around the body. Blood moves to working _____ as the need for _____ and nutrients increases and the need to get rid of wastes from these regions _____.

Blood moves to working muscles because of _____ and blood distribution to regions such as stomach / liver / kidneys decreases because of _____.

Blood flow will increase to the heart and lungs as they are vital for _____ blood around the body and getting rid of wastes and getting oxygen into the blood and around the body.

Increased blood acidity and body temperature are detected by the _____ triggering vasodilation and vasoconstriction.

2.2.13 Describe the cardiovascular adaptations resulting from endurance exercise training.

Complete the table to explain the adaptations caused by endurance training.

Adaptation to the body	**Why does this happen?**
Increased left ventricular volume resulting in increased stroke volume.	
Increased left ventricular volume resulting in lower resting and exercise heart rate.	
Increased capillarization and arterio-venous oxygen difference.	

2.2.14 Explain maximal oxygen consumption.

Read and check you understand before moving on.

Maximal oxygen consumption (VO_2max) represents the functional capacity of the oxygen transport system and is sometimes referred to as maximal aerobic power or aerobic capacity.

It is the maximum volume of oxygen inhaled and used per minute by the body.

Basically, how much oxygen a person can take in from the atmosphere; the more oxygen you can take, the more ATP will be generated within the cells, thus a greater fitness level

If you have a greater VO2 MAX then you are able to perform at a higher intensity, for longer periods of time improving you chances of success within any sport.

Really important for endurance events.

2.2.15 Discuss the variability of maximal oxygen consumption in selected groups.

Complete the table to show who has the highest VO_2 Max in each of the groups.

Trained Vs untrained	**Males Vs females**
_____ have the highest VO_2 Max Because they have experienced cardiovascular adaptations that enhance the uptake of oxygen	_____ have the highest VO_2 Max Because they tend to have bigger lungs and higher hemoglobin stores
Young Vs old	**Athlete Vs non-athlete**
_____ have the highest VO_2 Max Because as you age your MAX HR decreases alongside the strength of your heart muscles; these aging declines will have a negative impact on your VO_2 MAX as you age	_____ have the highest VO_2 Max Because similar to trained athlete but an elite version; on top of a strong dedication to training, they more than likely possess naturally greater VO_2 MAX too

2.2.16 Discuss the variability of maximal oxygen consumption with different modes of exercise.

The greater the number of muscles you use, the higher the VO2 max. Running is a whole body workout, it is a weight bearing exercise and requires the recruitment of major muscles in both the arms and the legs. Cross country skiers regularly come out tops in $V0_2$ max tests because of this.

Cyclists have a lower Vo_2 Max as it is non-weight bearing, but still the major leg muscles are needed.

Arm ergometry (bicycle for the arms) testing will yield a lower VO_2 max than normal cycling because of the size differences of the arm and leg muscles.

Exam Questions

Distinguish between the pulmonary and systemic circulatory systems. (3 marks)

_____

_____

_____

_____

_____

_____

Describe the intrinsic and extrinsic regulation of the heart. (6 marks)

_____

_____

_____

_____

_____

_____

_____

Explain the difference between adult males and females in maximal oxygen consumption. (2 marks)

_____

_____

_____

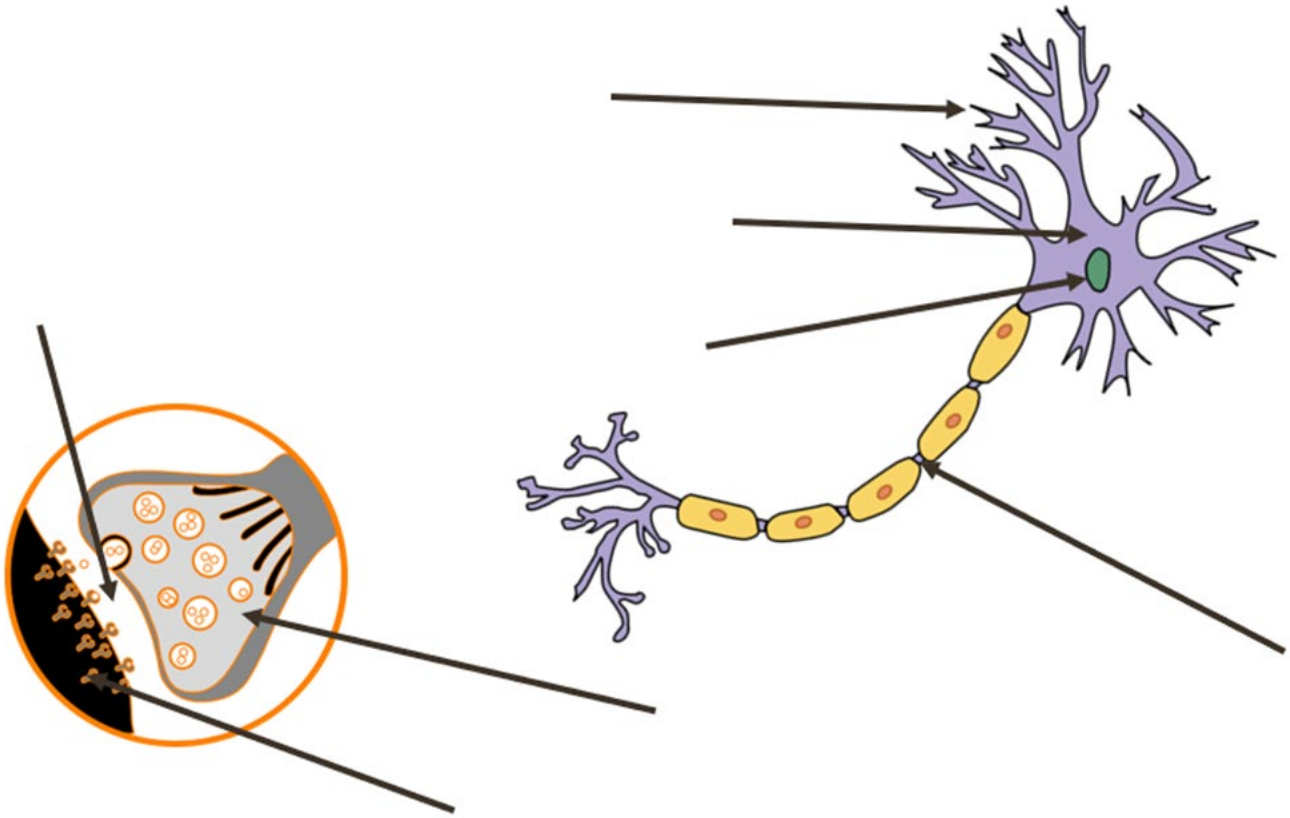
_____

_____

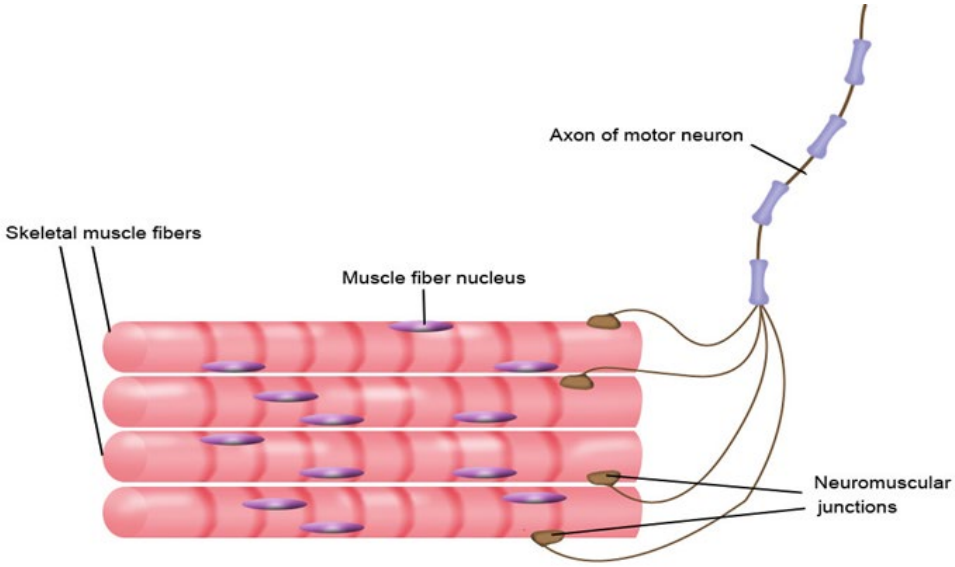
Topic 4: Movement Analysis - 4.1 Neuromuscular Function

4.1.1 Label a diagram of a motor unit.

Label and learn the diagram below.



Extra clarity



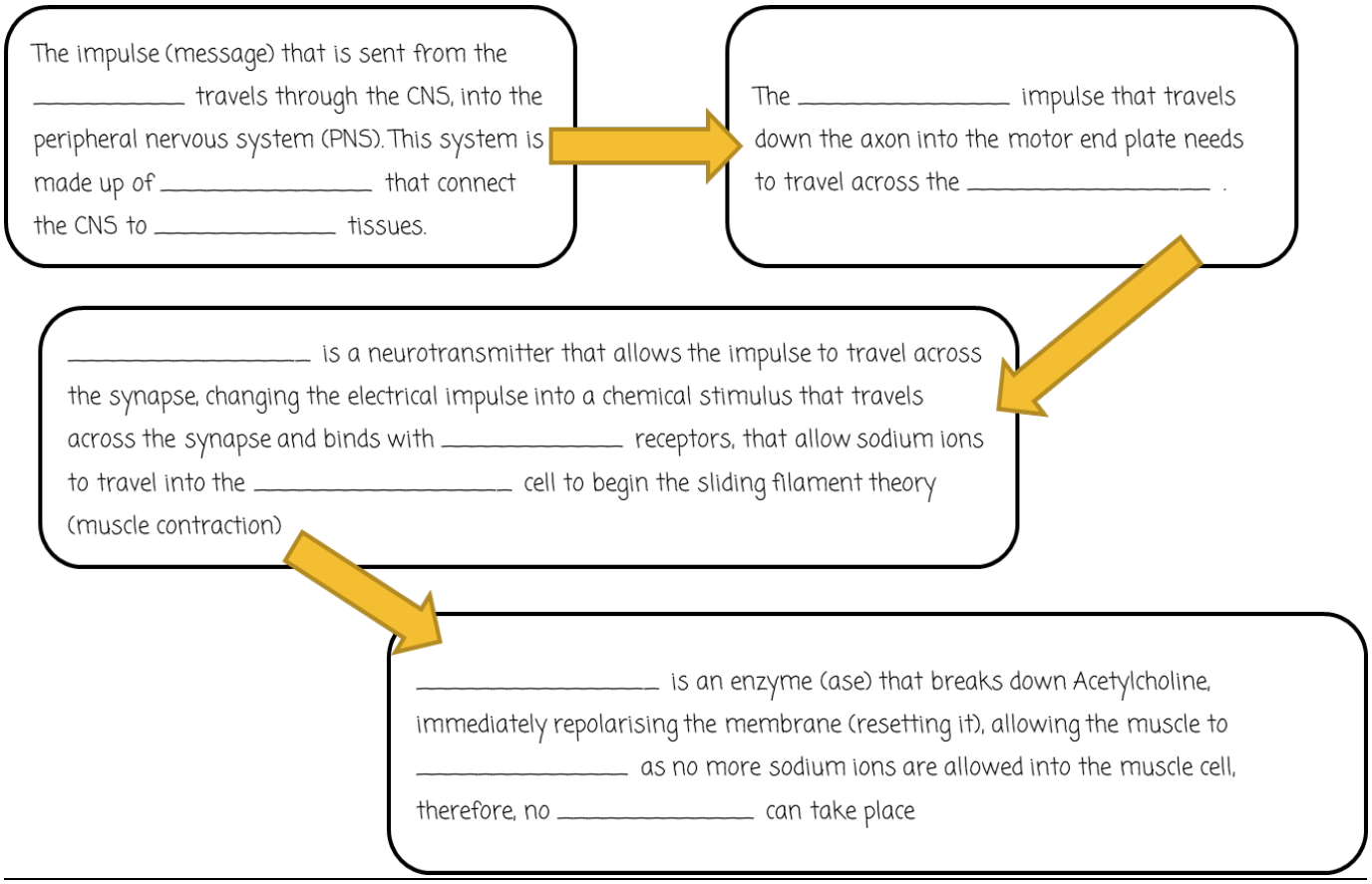
4.1.2 Explain the role of neurotransmitters in stimulating skeletal muscle contraction.

Fill in the gaps below.

1. An electrical nerve impulse travels along the _____ of the first neuron (presynaptic neuron).

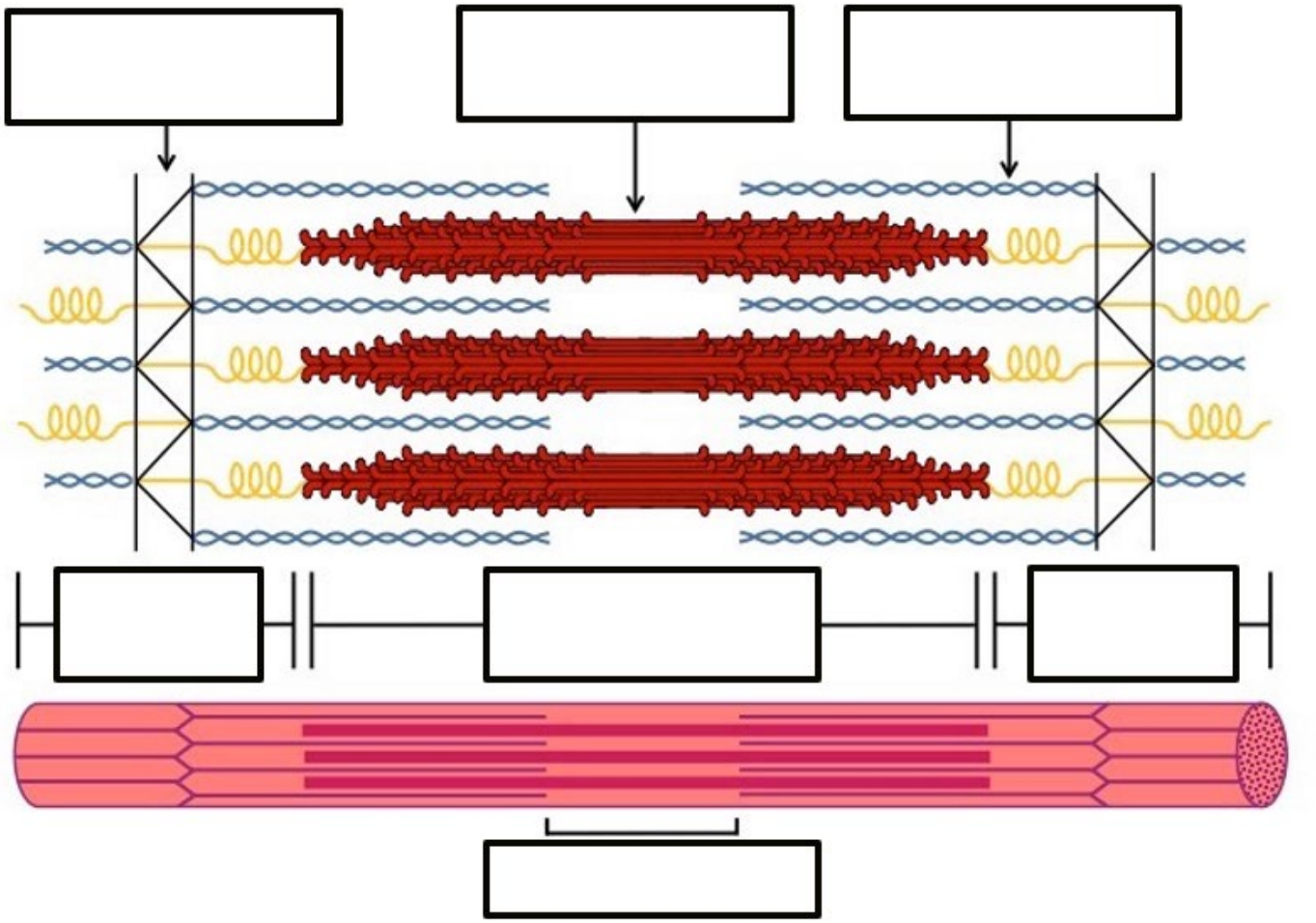
2. When the nerve impulse reaches the _____ at the end of the axon, chemical messengers called _____ are released.
3. These chemicals _____ across the synaptic cleft. The chemicals bind with receptor molecules on the membrane of the second neuron (postsynaptic neuron).
4. The receptor molecules on the second neuron can only bind to the _____ neurotransmitters released from the first neuron.
5. The binding of the neurotransmitter to the receptors stimulates the second neuron to transmit an electrical impulse along its axon. The signal therefore has been carried from one neuron to the next.

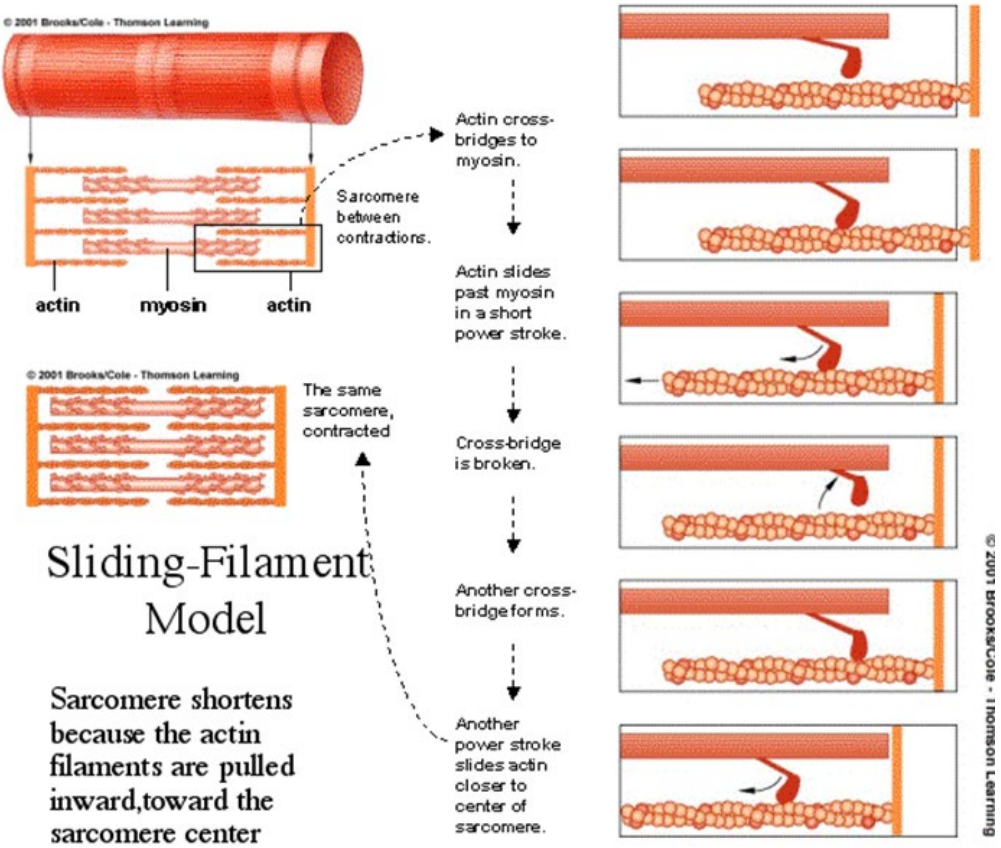
Acetylcholine	Cholinesterase
A neurotransmitter. Used at neuromuscular junctions to cause muscle contractions.	Cholinesterase is an enzyme that is responsible for the breakdown of acetylcholine into acetate and choline. These products are then reabsorbed into the presynaptic membrane where ACh can be resynthesised and reused. Cholinesterase is important to enable muscle relaxation as it removes the acetylcholine in the synaptic cleft.



4.1.3 Explain how skeletal muscle contracts by sliding filament theory.

Label the diagram of a sarcomere below.




© 2001 Brooks/Cole - Thomson Learning
Actin cross-bridges to myosin.
Sarcomere between contractions.
actin
myosin
actin
Actin slides past myosin in a short power stroke.
© 2001 Brooks/Cole - Thomson Learning
The same sarcomere, contracted
Cross-bridge is broken.
Another cross-bridge forms.
Another power stroke slides actin closer to center of sarcomere.
Sliding-Filament Model
Sarcomere shortens because the actin filaments are pulled inward,toward the sarcomere center
© 2001 Brooks/Cole - Thomson Learning

Complete the missing words below to describe sliding filament theory

1. A nerve impulse arrives at the _____ junction, which causes a release of a chemical called _____. The presence of Acetylcholine causes the depolarisation of the motor endplate which travels throughout the muscle by the transverse tubules, causing _____ (Ca+) to be released from the _____ _____.
2. In the presence of high concentrations of Ca+, the Ca+ binds to _____ , changing its shape and so moving _____ from the active site of the Actin. The Myosin filaments can now _____ to the Actin, forming a cross-bridge.
3. The breakdown of ATP releases _____ which enables the Myosin to pull the Actin filaments inwards and so _____ the muscle. This occurs along the entire length of every myofibril in the muscle cell.
4. The Myosin detaches from the Actin and the cross-bridge is broken when an ATP molecule binds to the Myosin head. When the ATP is then broken down the Myosin head can again attach to an Actin binding site further along the Actin filament and repeat the '_____ _____'. This repeated pulling of the Actin over the myosin is often known as the ratchet mechanism.
5. This process of muscular contraction can last for as long as there are adequate ATP and Ca+ stores. Once the impulse stops the Ca+ is pumped back to the Sarcoplasmic Reticulum and the Actin returns to its resting position causing the muscle to lengthen and _____.

Add numbers to the first column to put the descriptions of sliding filament theory in order.

	When the electrical impulse reaches the synapse the neurotransmitter, acetylcholine, is released.
	At the neuromuscular junction (or motor end plate) there is a space between the end of the neuron and the muscle fibres, called a synapse.
	The action potential travels through the muscle fibres down the T-tubules, which stimulates the sarcoplasmic reticulum to release calcium ions (Ca^{2+}).
	The heads of the myosin molecules move out towards these active sites and attach to the actin. This forms a cross bridge.
	Calcium ions bind to troponin, changing its shape and moving tropomyosin from the active site of the actin, which exposes active sites on actin.
	Electrical impulse travels along motor neuron to the neuromuscular junction of the motor unit.
	An ATP molecule binds to the myosin, the myosin head is released from the actin. When the ATP is then broken down the Myosin head can again attach to an Actin binding site further along the Actin filament and repeat the 'power stroke'

	Thus the actin has been pulled along parallel to the myosin.
	This changes the electrical state of the muscle and causes a signal called an action potential to travel along the muscle fibres.
	To start the contraction, ATP is split chemically to form ADP and a phosphate (Pi). This causes the myosin head to bend and pull the actin along a little (power stroke).
	This happens repeatedly while the neural signal is active, thus the muscle contracts by the sliding of the actin relative to the myosin.

4.1.4 Explain how slow and fast twitch fibre types differ in structure and function.

Complete the table to show the similarities and differences between slow and fast twitch muscle fibres.

	Slow:	Fast:
force production	low	
contraction speed		fast
fatigue resistance / aerobic capacity		low
glycogen content	low	
mitochondrial density		
capillary density	high	
myoglobin	high	low
oxidative enzyme capacity	high	low
colour		white
fibre diameter	small	large
primary function		high intensity rapid activities

Complete the table to show the similarities and differences between Type IIa and Type IIb fast twitch muscle fibres.

Contrast	*Type IIa fast oxidative glycolytic*	*Type IIb fast glycolytic*
myoglobin content		low
capillary density	medium	
fibre diameter	medium	
mitochondria		low
sample activity		*eg.* 100 m sprint
Compare	*Type IIa fast oxidative glycolytic*	*Type IIb fast glycolytic*
glycogen	high	
PC stores		high
sarcoplasmic recticulum	high	high

Exam Questions

Explain how skeletal muscle contracts (8 marks).

_____

_____

_____

_____

_____

_____

_____

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_____

_____

_____

_____

Compare and contrast slow and fast twitch muscle fibre types. (5 marks)

_____

_____

_____

Describe how the characteristics of slow-twitch muscle fibres are suited to a rower.. (4 marks)

Topic 4: Movement Analysis - 4.2 Joint and movement type

4.2.1 Outline the types of movement of synovial joints.

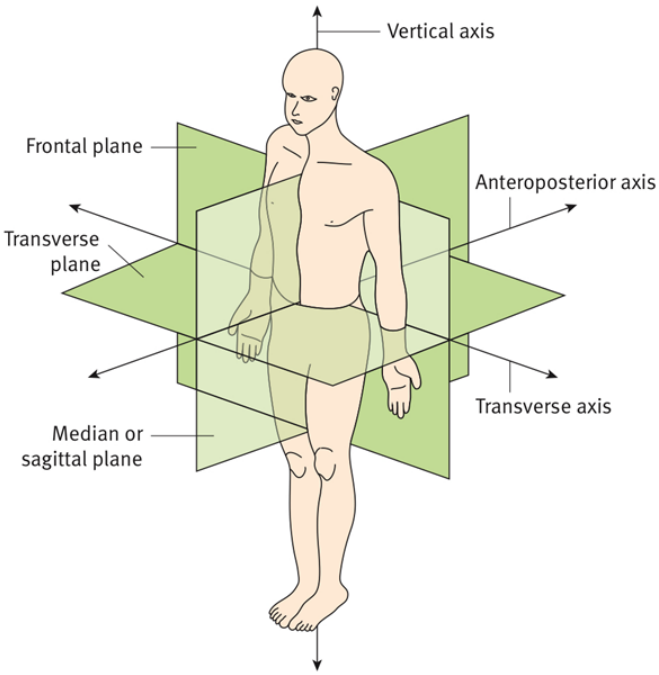


Figure 4.5: Axes of rotation and planes of movement of the human body

Complete the table, providing examples of the types of movement that can occur at synovial joints.

Type of movement	Description	Diagram (stick man)
Flexion		
Extension		
Abduction		
Adduction		
Pronation		

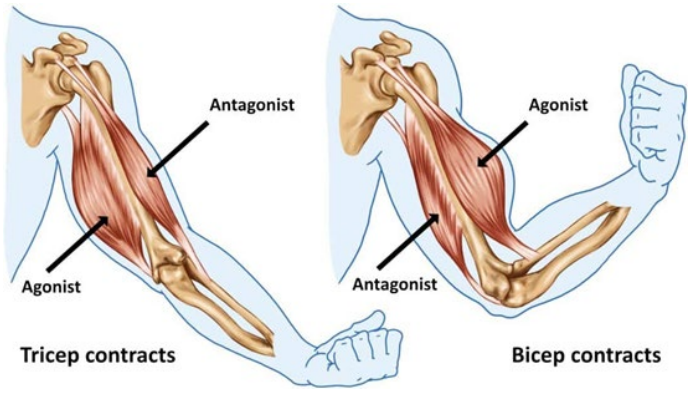
Supination		
Elevation		
Depression		
Rotation		
Circumduction		
Dorsi flexion		
Plantar flexion		
Eversion		
Inversion		

4.2.2 Outline the types of muscle contraction.

Fill in the types of muscle contraction to complete the table.

Type of muscle contraction	Definition
	When a muscle contracts and changes length, occurs when movement happens.
	The muscle produces tension but stays the same length, no movement involved.
	Similar to isotonic, except the contractions produce movement of a constant speed.
	An isotonic contraction when the muscle SHORTENS (contracts).
	An isotonic contraction when the muscle LENGTHENS (elongates).

4.2.3 Explain the concept of reciprocal inhibition.



Muscles can only pull, so must exist in antagonistic pairs to generate movement.

Reciprocal inhibition occurs where one muscle contracts and another relaxes.

When the agonist (prime mover) contracts there is simultaneous relaxation of the antagonist muscles.

This works because an inhibitory nerve impulse is sent to the antagonist to stop it contracting.

Complete the table below to define the key terms.

Term	Definition	Example
Agonist		

Antagonist		

4.2.4 Analyse movements in relation to joint action and muscle contraction.

Exam Questions
Explain reciprocal inhibition during knee extension when kicking. (3 marks)

_____

_____

_____

_____

_____

Explain reciprocal inhibition during arm flexion when completing a bicep curl. (3 marks)

_____

_____

_____

_____

_____

4.2.5 Explain delayed onset muscle soreness (DOMS) in relation to eccentric and concentric muscle contractions.
Complete the text below.

Delayed Onset Muscle Soreness (DOMS)

This is when muscles are tender and painful, 24-72 hours, following heavy exercise.

It is associated with injury within the muscle caused by _____ of the muscle fibres, inflammation and _____.

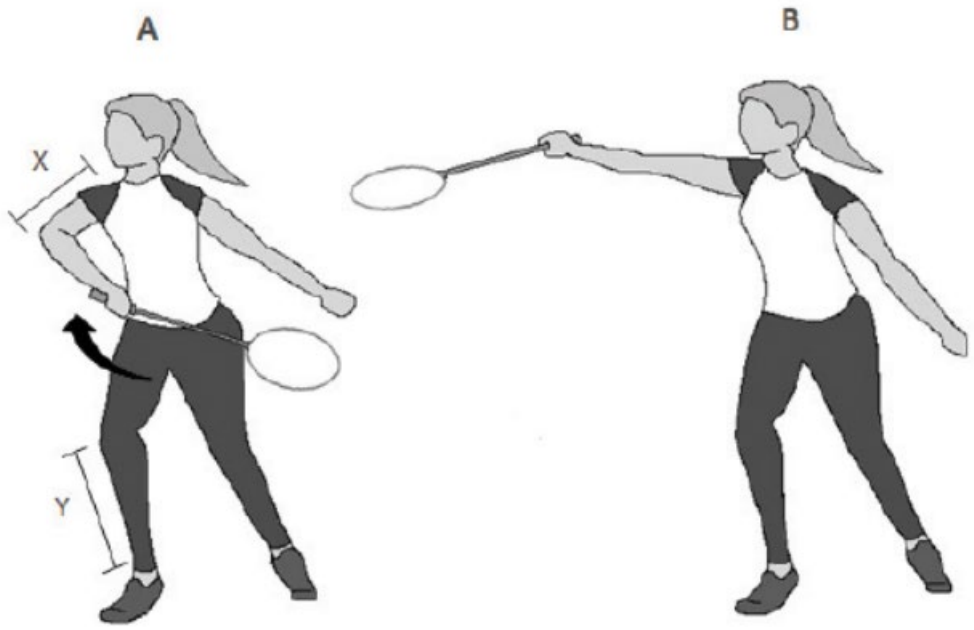
Usually occurs following excessive _____ contractions when muscle fibres are put under a lot of strain.

Eccentric muscle contraction occurs mostly in weight training.

The symptoms can last up to _____ days.

Exam Questions

The diagram shows the performance of a backhand lob in badminton.



State the names of muscles X and Y. (2 marks)

X: _____

Y: _____

Identify the movement at the elbow during the upward phase from position A to position B in the diagram. (1 mark)

_____

Outline the type of muscle contraction of the agonist at the elbow joint during the upward phase from position A to position B in the diagram. (1 mark)

_____

_____

Describe delayed onset muscles soreness. (2 marks)

_____

_____

Topic 5: Skill in sports - 5.1 The characteristics and classification of skill

5.1.1 Define the term *skill.*

Complete and learn the definition below.

Skill is the c……. production of g…….-orientated movements, which are l…… and s…… to the task.

5.1.2 Describe the different types of skill.

Match up the 4 types of skill with their summaries below.

Skill	Summary
Cognitive	Using our senses to interpret information. Senses: vision, vestibular (for balance), touch and auditory (hearing) Decision making. e.g. reading the green when putting in golf
Perceptual	Involves thinking. Involves decision making. e.g. playing chess, knowing tactics/rules.
Motor	Smooth movement. Not much thinking. e.g. weight lifting
Perceptual motor	Making decisions whilst using smooth muscle movements. When an athlete needs to adapt to an environment whilst carrying out a movement. e.g. dribbling against a defender in basketball.

5.1.3 Outline the different approaches to classifying motor skills.

5.1.4 Compare skill profiles for contrasting sports.

For each continuum add a description for each term and a sporting example.

Open **Closed**

Gross **Fine**

Discrete **Serial** **Continuous**

External paced **Internal Paced**

Interaction Continuum

Individual **Coactive** **Interactive**

Exam Questions

Using a sporting example, outline a gross skill. (2 marks)

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_____

Using a sporting example, outline a coactive skill. (2 marks)

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5.1.5 Outline ability.

Complete and learn the definition below.

Ability refers to a g…… trait or capacity of the individual that is related to the p…… and performance potential of a variety of s…… or tasks.

5.1.6 Distinguish between Fleishman's *physical proficiency abilities* (physical factors) and *perceptual motor abilities* (psychomotor factors).

Below is a table summarising Fleishman's abilities. Use this information to complete the exam question below.

PERCEPTUAL-MOTOR ABILITIES	PHYSICAL PROFICIENCY ABILITIES
Control precision (control over fast, accurate movements that use large areas of the body)	Extent (or static) flexibility
Multi-limb coordination	Dynamic flexibility
Response orientation (selection of the appropriate response)	Static strength
Reaction time	Dynamic strength
Speed of arm movement	Explosive strength
Rate control (coincidence-anticipation)	Trunk strength
Manual dexterity	Gross body coordination
Arm–hand steadiness	Gross body equilibrium
Wrist–finger speed (coordination of fast wrist and finger movements)	Stamina (cardiovascular fitness)
Aiming	
Postural discrimination (coordination when vision is occluded)	
Response integration (integration of sensory information to produce a movement)	

Exam Questions

Distinguish between Fleishman's two broad categories of human abilities. (2 marks)

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5.1.7 Define the term *technique.*

Complete and learn the definition below.

In general terms, t…….. is a “w…….. of d……..”. In the performance of a specific sports skill it is defined as the “way in which that s…….. s…….. is p……..”.

5.1.8 State the relationship between ability, skill and technique.

Complete and learn the equation below.

Skill = …….. +
……
……

5.1.9 Discuss the differences between a skilled and a novice performer.

Using the words in the middle column, complete descriptions in the other two columns and learn.

Skilled Performer	Keywords to use	Novice Performer
	Consistency	
	Accuracy	
	Control	
	Learned	
	Efficiency	
	Goal-directed	

	Fluency	

Topic 5: Skill in sports - 5.2 Information Processing

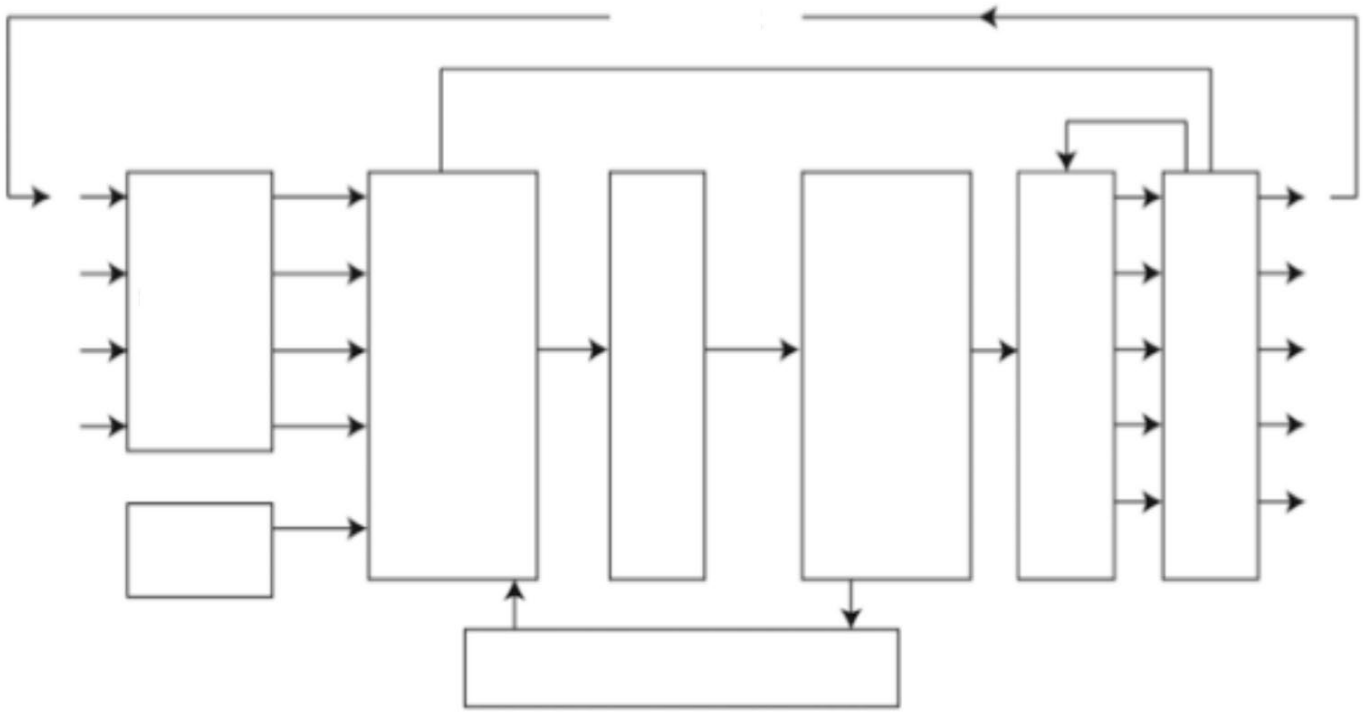
5.2.1 Describe a simple model of information processing.

Information processing is the system by which we take information from our surrounding environment, use it to make a decision and then produce a response.

In the space below, sketch and annotate a simple diagram of information processing.
Keywords to include: CNS, output, input, decision making, action, receptors/sense organs.

5.2.2 Describe Welford's model of information processing.

Complete the diagram of Welford's information processing model below.
Video description found here: https://youtu.be/ueiuDDlLEvg



[Source: P Beashel *et al.*, (1999), *Advanced Studies in Physical Education and Sport*, page 244]

Each of the next sections can be linked back to Welford's model of information processing.

5.2.3 Outline the components associated with sensory input.

Sense organs, sensory systems and receptors take in the sensory information. There are three types or categories of receptors: exteroceptors, proprioceptors and interoceptors.

Add descriptors to the table below to describe the three types of receptors. Then learn them!

Exteroceptors	
Interoceptors	

Proprioceptors	

5.2.4 Explain the signal-detection process.

Signal detection is the process in the brain of judging and interpreting information it receives from the sense organs.

The **signal** is the important piece of information.

The signal detection process is often referred to as the detection – comparison – recognition process (DCR).

Complete and learn the table below, which outlines the 3 parts of the signal-detection process.

Part	**Description**	**Factors affecting it**
Detection		Stimulus strength or signal intensity Background noise Efficiency of the sense organs Arousal Experience
Comparison		

Recognition	

Exam Questions

Explain the signal-detection process. (5 marks)

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5.2.5 Distinguish between the characteristics of *short-term sensory store, short term memory* and *long-term memory.*

Short term sensory store (STSS)	Holds **all information** for **all sensors** for **0.5 seconds** with **unlimited storage**, continually replacing previous stored information. **Selective attention** operates here, filtering information and transferring this info to STM. This prevents info overload.
Short term memory (STM)	Is held for **10 seconds**, however **can only hold up to 10 pieces of information at once**. STM will be active for as long as attention is paid to the information. If something is **rehearsed** it will **transfer** into **LTM**.

Long term memory (LTM)	Can hold **unlimited pieces of information** and the information can be stored for a **lifetime**. LTM **retrieves** a memory and sends information to STM to allow movement or a skill to be carried out.

Using the table above, complete and learn the summary table below of different memory stores.

Memory Type	Capacity	Duration	Retrieval
Short term sensory store (STSS)			
Short term memory (STM)			
Long term memory (LTM)			

5.2.6 Discuss the relationship between selective attention and memory.

Complete and learn the discussion of selective attention below.

Selective attention (SA) operates in the
…… (STSS).

Only the r…… information is passed to the
…… memory (STM) where it is held for
…… seconds.

SA ensures that information o…… does not occur and prevents
c……, as the brain would not be able to cope with streams of information.

A f…… mechanism operates, which separates the
r…… information from the
i…… (noise) information so that athletes

c…… on one cue or stimulus (for example, the ball, position of player in a game of tennis) to the exclusion of others.

SA is very important when accuracy or …….. responses are required and can be improved by learning through past ……. and interaction with ……. Memory (LTM).

Exam Question

Discuss the relationship between selective attention and memory. (6 marks)

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5.2.7 Compare different methods of memory improvement.

Match up the memory improvement technique with its description, then learn!

Association		Avoid trying to teach two similar but distinct items in the same session, as the memory might overlap with the other
Brevity		Repeat the information over and over, this creates a memory trace which is repeated shuttle between STM and LTM
Chunking		Name/label sets of information

Clarity		Link new information with information that the learner already knows, even in a different context to the new information
Coding		If the information is taught in small bundles, it has more chance of transferring to LTM than if it was taught in its entirety.
Organisation		Processed and prepared, either mentally and/or physically
Practice		Giving a learner a small amount of information at a time to avoid overload
Rehearsal		Providing information in an order, allowing for meaningful learning

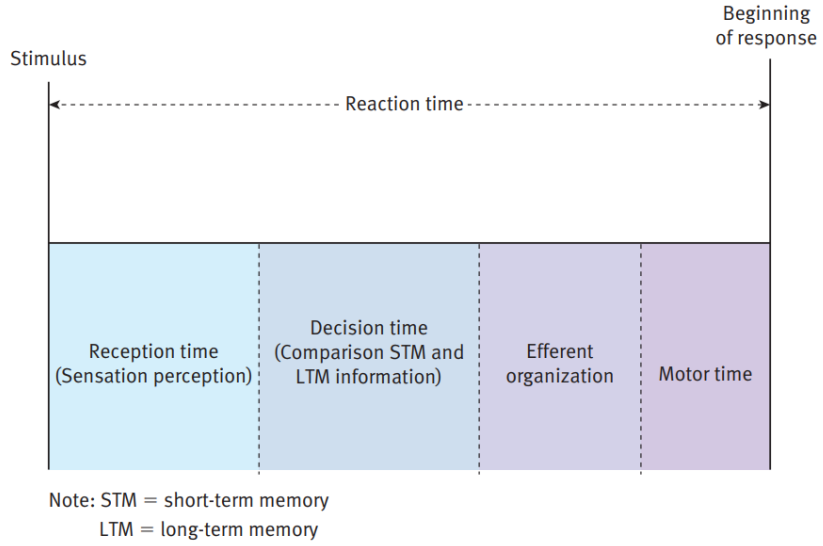
5.2.8 Define the term *response time.*

Complete and learn the definition below.

Response time = …… time + …….. Time

5.2.9 Outline factors that determine response time.

Read and learn the information below.



↑ Figure 5.8: Reaction time

Response time is an ability but can also be affected by different factors.

Age can affect response time, children through to teenagers increase their response time, but then after that, as we age, our response time gets slower. Gender may also have an affect.

You can see in the diagram reaction time can be affected by stimulus transmission, i.e. how long it takes your senses to perceive the stimulus.

Once the stimulus has been recognised, the decision time can affect reaction time. Comparing it to your long term memory will be quicker if you have more experience (have practiced more).

Then the time taken for your nerves to transmit the message (efferent time) will be different depending on age and experience.

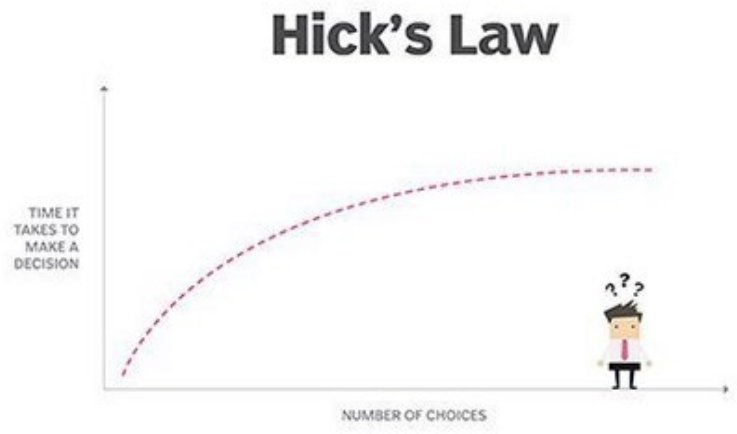
This will also affect how quickly your motor response is.

Reaction time can be affected by the number of choices an individual has to make.

If an individual has no choices to make, this is called a simple reaction time and reactions can be as fast as 170 mili seconds.

However, if there are more choices, choice reaction time causes the time to react to increase.

This leads us to Hick's law. There is an increase in reaction time with increased number of choices (stimuli). See the diagram below which shows Hick's law.



5.2.10 Evaluate the concept of the psychological refractory period (PRP).

Read and learn the information below.

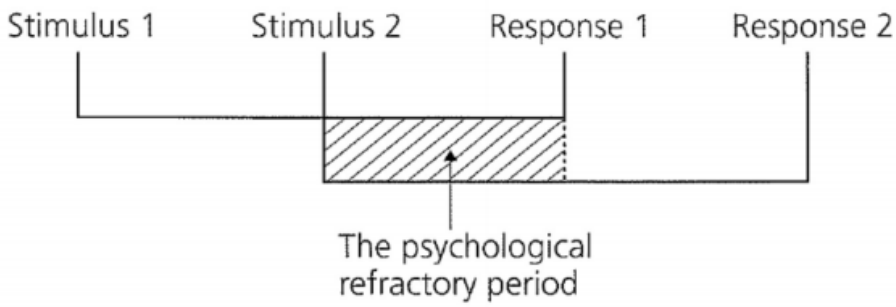
Welford (1968) suggested that we can only deal with one stimulus at a time. This is known as the "Single Channel Theory".

To test this theory, Welford had participants respond to a stimulus, stimulus ONE and he found the reaction time was as expected.

However, when he introduced a second stimulus, stimulus TWO shortly after stimulus ONE, the participants demonstrated slower than normal reaction times to stimulus 2.

He concluded, that when two stimuli are presented close together the reaction time to the second stimulus is slower than normal reaction time.

This time gap was known as the **psychological refractory period.**



Welford claimed that processing of stimulus TWO could not take place until processing of stimulus ONE had been completed.

The dip is stimulus 1 and the actual movement (the dodge) is stimulus 2.

If the timing is well executed, the defender will be comparatively slow in reacting to the real (actual) movement).

Other examples can be seen in a drop shot in badminton, or a dummy punch in boxing.

The psychological refractory period has strengths and weaknesses.

Strengths	**Limitations**

Can be used to help a performer have greater chances of success *eg* pretending to pass / run one direction then quickly changing to pass / run the other way; Provides a performer with a greater range of options in their play; External noise *eg* other players calling, or crowd noise can enhance the effectiveness of the PRP; The more options that a player has will increase the reaction time to the stimulus <Hick's law> *eg* the defender sees that an attacker has a number of passing options;	If a performer uses it too often, they will become predictable and this limits success *eg* dummying once to the left before leading to the right; PRP may be reduced by anticipation/early cue detection/effective coach analysis/ practising «open» skills *eg* a football player would be able to detect cues earlier than a swimmer; Anxiety might make the performer get the timing wrong and thus the PRP is not effective;

Exam Question

Outline how Hick's Law and the psychological refractory period account for the increase in the response time of a team games player. (6 marks)

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5.2.11 Describe a motor programme.

A motor programme is a set of movements stored as a whole in the memory, regardless of whether feedback is used in their execution.

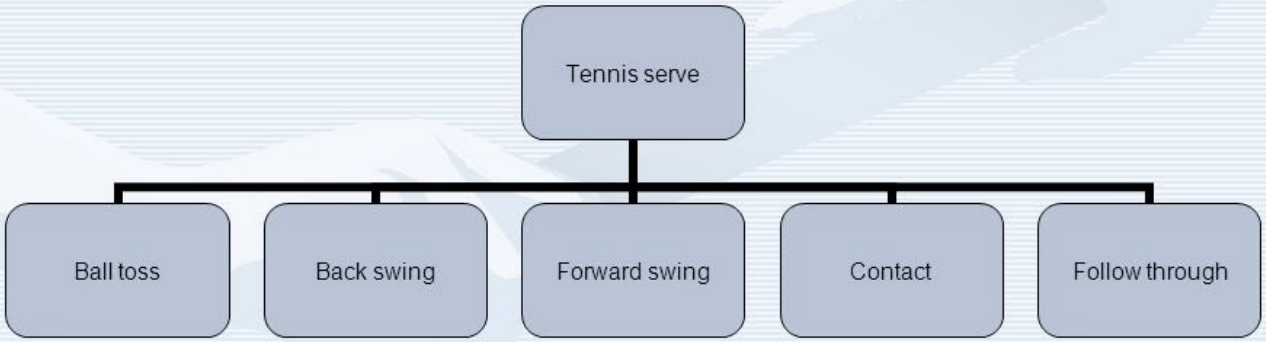
i. **Executive**: a number of motor programs put together (gymnastics routine)

ii. **Subroutine:** building block of a motor program; "mini skills" (kicking, catching, throwing, dribbling)

Motor programmes:

a generalised series or pattern of movements stored in the long term memory

- Every skill performed in sport is the result of a motor programme.
- Motor programmes are heirarchical – there is an order of importance with the executive motor programme being of the highest status.
- Motor programmes are also sequential – they are performed in a particular order.
- Motor programmes are made up of sub-routines performed in a particular order



Using the information above, sketch a simple diagram showing a motor programme from a sport of your choice and its subroutines.

Coordination of subroutines

a. When a specific action is required, the memory process retrieves the stored programme and transmits the motor commands via nerve impulses to the relevant muscles allowing movement to occur. This is known as 'executive motor programme'.

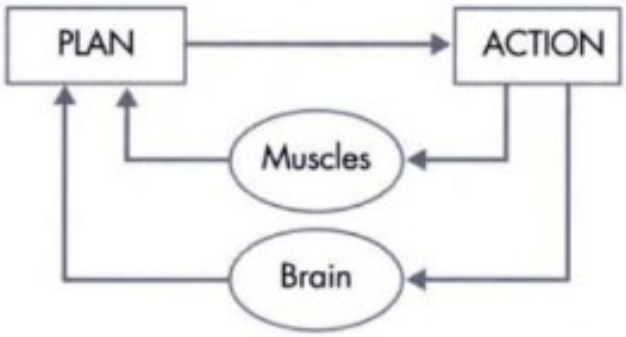
b. When needed this programme is recalled. If this skill is learned then the reaction time to produce the skill is very short.

Therefore, we can see that practice of these motor programmes is important in learning.

c. When the performer becomes more skilled then the motor programme is taken away and superseded by a new programme. Then this new one will become learned.

5.2.12 Compare motor programmes from both open- and closed- loop perspectives.

In the table below, add descriptors of the two types of motor programme perspectives.

Open-Loop Motor Programme	Closed-Loop Motor Programme
	

5.2.13 Outline the role of feedback in information-processing models.

Complete and learn the table below of the different types of feedback.

Intrinsic	

Extrinsic	
Knowledge of results (KR)	
Knowledge of performance (KP)	
Positive	
Negative	
Concurrent	
Terminal	

5.2.14 Outline the role of feedback with the learning process.

Read and learn the notes below.

Reinforcement of Learning

- Reinforcing correct technique and skill performance is commonly demonstrated through positive feedback and by stating what was positive about the performance.
- "Well done you rotated through your hips during the golf swing."
- KR can also reinforce learning when the outcome is correct.

Motivation

- This is dependent on the personality of the performer as some feedback methods will motivate whilst other will deter.
- KR and KP can both be effective motivators as they provide explicit targets for repeated success.
- Negative feedback can be used but it is very much dependent on the personality type of the performer.

Adaptation of Performance

- All types of feedback can lead to a performer adapting a performance.
- The more variety in the feedback the more likely an adaptation will occur within the skill performance.
- If the performer just receives one form of feedback, the adaptation (improvement) will be limited.

Punishment

- Negative feedback can be used to provide punishment to a performer.
- This can be concurrent and terminal in its delivery.

Topic 5: Skill in sports - 5.3 Principles of skill learning

5.3.1 Distinguish between *learning* and *performance*.

Complete and learn the definitions in the table below.

Learning	Performance
A relatively p…… Change in performance brought about by e…… , excluding changes due to maturation and degeneration.	A t…… occurrence, fluctuating over t……
A change in …… over time is often used to infer ……	

5.3.2 Describe the phases (stages) of learning.

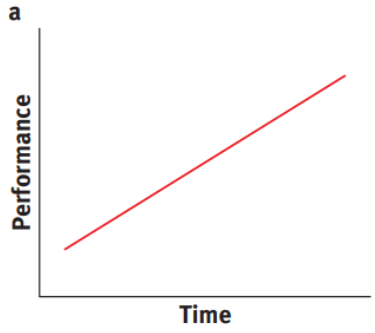
Complete and learn the table below.

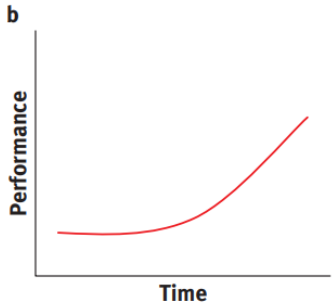
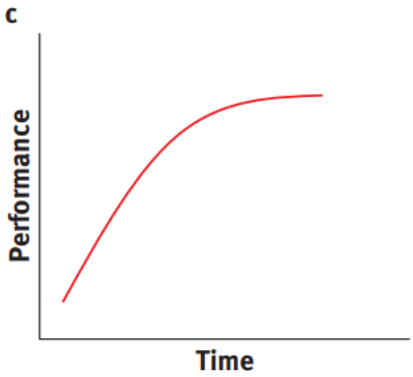
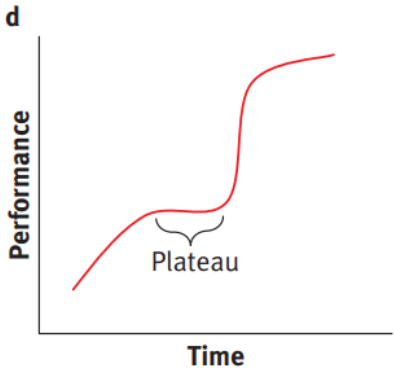
Stage of learning	Description
1..Cognitive (early) stage	Beginner. Individual tries to make …… of instructions. Uses verbalisation to aid …….. Makes ……..

	Movements are crude and uncoordinated.
2. Associative (intermediate) stage	Individual has …….. of what to do. Needs to …… . Can self-correct to some extent. They can …….. a mental image of the skill with their movements. Movements become …….. consistent.
3. Autonomous (final) stage	Skill performed …… / instinctively. Skill is in …….. term memory. Skill performed with consistency, fluency, accuracy. Can self …….

5.3.3 Outline the different types of learning curves.

Complete and learn the table below.

Learning Curve	Description
Linear Learning Curve  	
Positive Acceleration Learning Curve	

b  	
Negative Acceleration Learning Curve c  	
Plateau d  	

5.3.4 Discuss factors that relate to different rates of learning.

Complete the table below with descriptors of each factor that can affect the rate of learning, then learn!

Factor affecting learning	Description
Physical Maturation	

Physical Fitness	
Individual differences of coaches	
Age	
Difficulty of task	
Teaching environment	
Motivation	

Exam Question

Using an example, define the different phases of learning a skill. (6 marks)

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5.3.5 Define the concept of *transfer*.

Complete and learn the definition below.

The concept of transfer is the …… of learning and/or p…….. of one skill on the learning and/or performance of ……..

5.3.6 Outline the types of transfer.

Complete the table below.

Positive transfer	Type of Transfer	Negative Transfer
Tennis player is able to transfer hand eye coordination skill amongst other racket sports		Tennis player transfers their groundstroke technique whilst playing overhead clear in badminton (allows the shuttle to come below head height before returning)

A basketball player practicing shooting skills in isolation and under pressure from opponents in practice, which can be transferred into performance		A footballer practicing penalty taking (in particular for a shootout) in practice without replicating the scenario of pressure in the competitive situation
A gymnast needs to use balance in a range of skills in order to carry them out effectively		There is an optimum level of strength required for sprinting. Some sprinters have increased their muscle mass too much which hinders their ability to sprint effectively
A football player can transfer knowledge of passing with one foot to passing with the other foot		A golf coach might teach his player to do certain things with his left arm and leg. If the performer was to transfer this learning onto his right side this would hinder his performance, as golf is a unilateral sport.
With practice a rugby player will be able to transfer a skill from the cognitive to associative phase of learning		If a skill is considered to be within the autonomous phase, this infers that the perform can demonstrate the skill without thinking about it. However, this could hinder performance if too much information is provided to the athlete about what to do with the skill
A defender in handball may be able to apply a defensive skill more effectively, if the skill information is delivered alongside a principle of defensive play		A hockey coach may not have covered enough examples of attacking in play and the performer may not have a variety of ways to perform this skill in the principle (attacking), which can hinder the success of the skill in play.

5.3.7 Outline the different types of practice.

Complete and learn the table below.

Type of Practice	Description	Who it is good for
Distributed		Beginner, youth, demotivated

	Practice on 'mass'. As in time in mass. Continuous practice with no rest.	Experienced, motivated, fit
Fixed		Discrete, closed skills, develop subroutines
	The environment is variable, ever changing. Practice is in a variety of contexts and the skills are practiced in a number of scenarios to replicate match play.	Open, interactive skills
Mental		All skills can be benefited by mental rehearsal, its how the rehearsal is done which differs

5.3.8 Explain the different types of presentation.

Complete and learn the table below.

Type of Presentation	Description	Example
Whole-part-whole		A golf coach would ask you to 'take a few swings' first so the coach can see what your strengths and weaknesses are. They would then focus on one or two weak areas before asking you to hit the full swing again.
Whole		Advanced performers, in the autonomous phase, who need to practice on skills in match play.
Part		Swimming can be taught in part. Using swimming aids to separate breathing, kicking and arm action.
Progressive Part		A gymnast/trampolinist would practice a routine in isolation before piecing together the subroutines. They may also try and progress certain aspects to increase the routine difficulty.

5.3.9 Outline the spectrum of teaching styles.

Complete and learn the table below, by adding in a description of each type of teaching style.

Command	
Reciprocal	
Problem Solving	

Exam Questions

Using examples, describe two different types of practice. (4 marks)

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Using Welford's model of information processing, describe how information enters the short-term memory (STM). (4 marks)

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Define *motor programme*. (1 mark)

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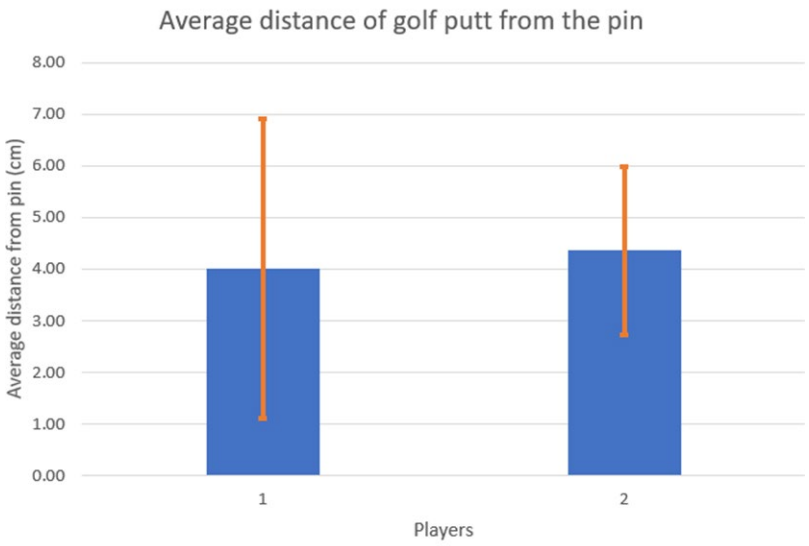
Topic 6: Measurement and evaluation of human performance - 6.1 Statistical analysis

6.1.1 Outline that error bars are a graphical representation of the variability of data.



Error bars are a graphical representation of the variability of data.

On this graph, the orange, error bars show the standard deviation (SD) of each player.

Player 1 has a much larger SD, suggesting they are more inconsistent and there is a wider spread around the mean.

Complete the sentence about player 2

Player 2 has a much smaller SD, suggesting they are _____ _____.

6.1.2 Calculate the mean and standard deviation of a set of values.

Using the results from the women's 100 m final from the Tokyo 2020 Olympics (below), calculate the mean and standard deviation for the race.

Rank	Country	Name	Time
1	JAM	THOMPSON-HERAH Elaine	10.61
2	JAM	FRASER-PRYCE Shelly-Ann	10.74
3	JAM	JACKSON Shericka	10.76
4	CIV	TA LOU Marie-Josee	10.91
5	SUI	del PONTE Ajla	10.97
6	SUI	KAMBUNDJI Mujinga	10.99
7	USA	DANIELS Teahna	11.02
8	GBR	NEITA Daryll	11.12

Mean: _____

Standard deviation: _____

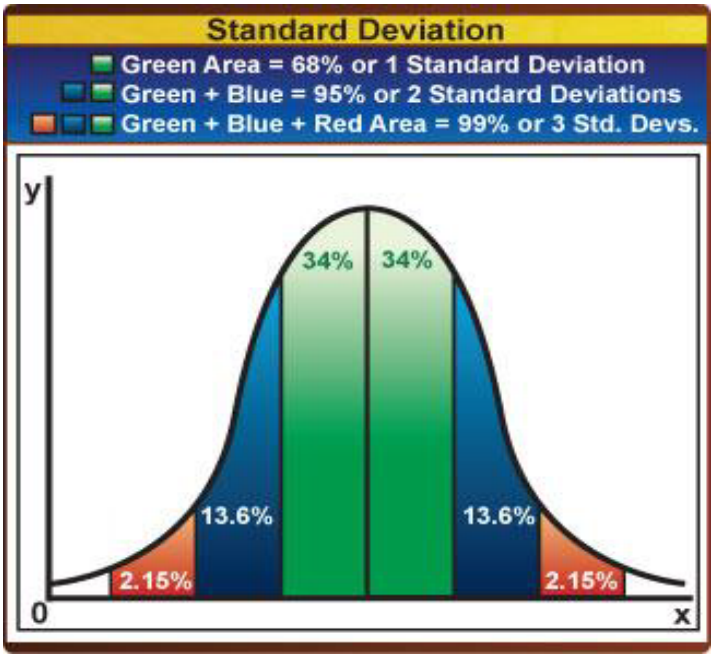
Using the results from the men's 100 m final from the Tokyo 2020 Olympics (below), calculate the mean and standard deviation for the race.

Rank	Country	Name	Time
1	ITA	JACOBS Lamont Marcell	9.80
2	USA	KERLEY Fred	9.84
3	CAN	de GRASSE Andre	9.89
4	SA	SIMBINE Akani	9.93
5	USA	BAKER Ronnie	9.95
6	CHN	SU Bingtian	9.98
	NGR	ADEGOKE Enoch	DNF
	GBR	HUGHES Zharnel	DQ

Mean: _____

Standard deviation: _____

6.1.3 State that the statistic deviation is used to summarize the spread of values around the mean, and that within a normal distribution approximately 68% and 95% of the values fall within plus or minus one or two standard deviations respectively.



Answer the questions using the image.

What percentage of data lies within 1 standard deviation of normally distributed data?

_____

What percentage of data lies within 2 standard deviations of normally distributed data?

_____

What percentage of data lies within 3 standard deviations of normally distributed data?

_____

Looking back at the data from the women's 100 m final in Tokyo 2020, what percentage of data lies within 1 standard deviation? (show your working)

_____

_____

_____

Is this data normally distributed? Explain your answer.

_____

_____

_____

6.1.4. Explain how the standard deviation is useful for comparing the means and the spread of data between two or more samples.

A small standard deviation shows that the data is clustered closely around the mean value.

A large standard deviation shows a wider spread around the mean.

6.1.5 Outline the meaning of the coefficient of variation.

Coefficient of variation is the ratio of the standard deviation to the mean expressed as a percentage.

$$CV = \left(\frac{\text{standard deviation}}{\text{mean}} \right) \times 100$$

Calculate the coefficient of the following, show your working!

Looking back at the data from the women's 100 m final in Tokyo 2020, calculate the coefficient of variation? (show your working)

_____

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Looking back at the data from the men's 100 m final in Tokyo 2020, calculate the coefficient of variation? (show your working)

_____

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If the coefficient of variation for a runner performing a 100 m time trial is 3.0%, a runner who does the test in 10 seconds has a typical variation from test to test of how many minutes? (show your working)

_____

_____

_____

6.1.6 Deduce the significance of the difference between two sets of data using calculated values for *t* and the appropriate tables.

A T-test is a statistical test that calculates statistical significance of data. It used between two sets of data.

The T-test looks at the amount of error of the data, in an attempt to prove that the results are statistically significant and not through chance.

The T-test is presented as a p value >0.05 (meaning >5% error).

If the p value is greater than 0.05% than it shows that the data has error and the higher the p value, the more chance is considered for the data set.

A higher p value suggests less likelihood of a relationship between your variables.
There are two types of T test that we need to know.

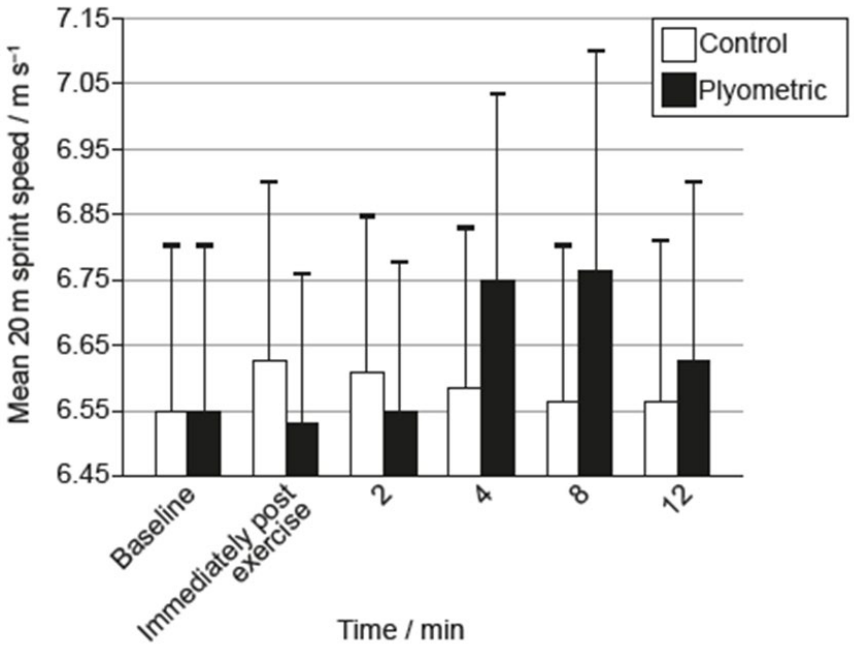
Type of t-test	Paired t-test (dependent)	Unpaired t-test (independent)
Description	is the same group, tested twice. Depending on the changing variable to infer results.	is on different groups, tested once – independent of the variable.
Example	same group body temperature response to exercise; room temperature and in extreme environment	blood pressure response to a mode of exercise between genders; male vs females

Exam Questions

A study investigated the effect of plyometric exercise on sprint speed. (Plyometric exercise involves rapid and repeated stretching and contracting of the muscles.) The mean speed of each participant was measured during a 20 m sprint as a baseline and then in a further five 20 m sprints. During the first 75 seconds of the interval between sprints the participants carried out one of the following activities:

- **Plyometric: three sets of alternate leg bounds (running-like movement, jumping from one leg to the other consecutively)**
- **Control: continuous walking.**

The graph shows the mean sprint speed and positive standard deviation value for both conditions.



A paired *t*-test was conducted to compare mean sprint speed at 4 minutes with mean sprint speed at baseline. The results were:

- **Plyometric condition: $p < 0.05$**
- **Control condition: $p > 0.05$**

Identify the time and condition with the highest mean sprint speed. (1 mark)

_____

_____

Calculate the difference in mean sprint speed, in m s^{-1}, between baseline and at 4 minutes for the plyometric condition.. (2 marks)

_____

_____

Using the data, discuss the hypothesis that plyometric exercise can improve sprint performance. (3 marks)

_____

_____

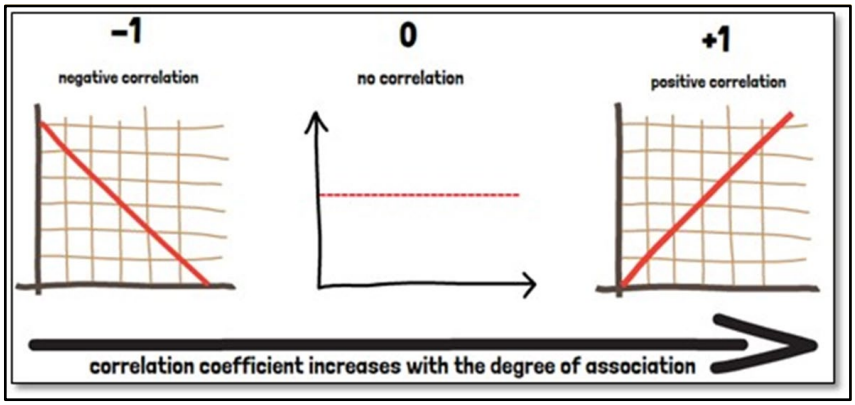
6.1.7 Explain that the existence of a correlation does not establish that there is a causal relationship between two variables.

A correlation is used to describe or measure the relationship between variables.
Even though it may appear to, correlation does not imply a causal relationship. Correlation indicates the magnitude of relationship, a degree of linear association between the two variables.

The correlation coefficient can be a positive or negative value expressed from -1 to 1.

A value of zero suggests no relationship.

Correlations can, in some cases, help predict outcomes of relationships.



Exam Questions

Outline why sports science students must be careful when interpreting the correlation between two variables. (4 marks)

_____

_____

_____

_____

_____

_____

Topic 6: Measurement and evaluation of human performance - 6.2 Study design

6.2.1 Outline the importance of specificity, accuracy, reliability and validity with regard to fitness testing.

Match up the term, definition and example.

Term	Definition	Example
Specificity	Ensuring the protocol is adhered to each and every time the test is administered.	If a performer wanted to measure power in the legs, then a 30m sprint test would not provide the required information. A sergeant jump or a broad jump would be valid for the fitness outcome.
Accuracy	Ensuring that the test is suitable for the desired fitness outcome.	Using an electronic split device, or a video camera will provide more accurate results than a stopwatch for a sprint test.

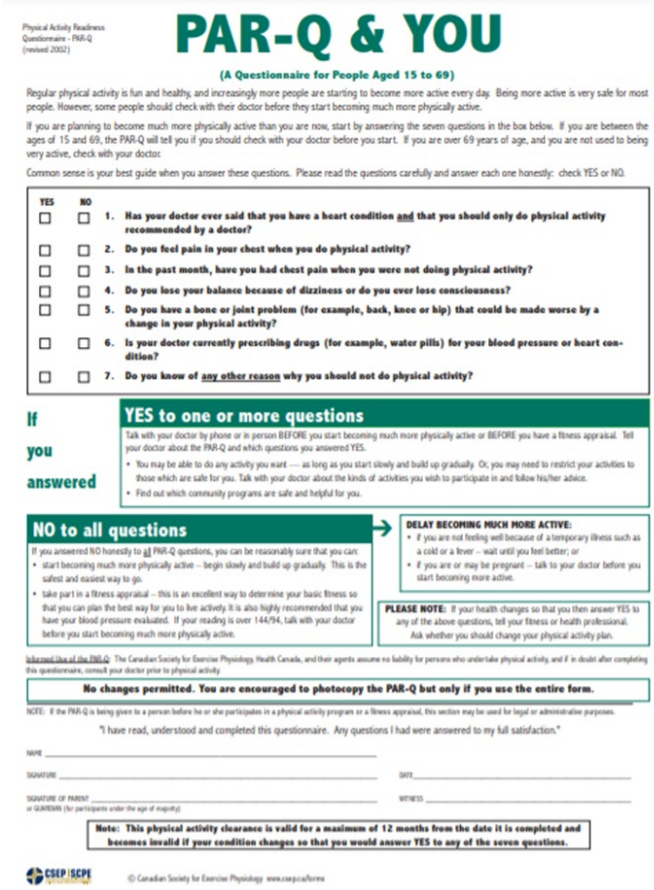
Reliability	Ensuring that the equipment used can be precise in recording data.	When measuring VO2 MAX for a distance runner, you wouldn't use a bike ergometer to gather results.
Validity	Ensuring the test is specific to the performer.	Correct protocol for all tests is vital to gather effective data. Such as ensuring the performer keeps legs straight, shoes off and slowly extends into the sit and reach test.

6.2.2 Discuss the importance of study design in the context of the sports, exercise and health sciences.
Complete the table below to summarise some key components of study design.

Component	What it is and why it is important
Control groups	
Randomised groups	
Blind	

Double blind	
Placebo	

6.2.3 Outline the importance of the Physical Activity Readiness Questionnaire (PAR-Q).



Physical Activity Readiness Questionnaire - PAR-Q (revised 2002)

PAR-Q & YOU

(A Questionnaire for People Aged 15 to 69)

Regular physical activity is fun and healthy, and increasingly more people are starting to become more active every day. Being more active is very safe for most people. However, some people should check with their doctor before they start becoming much more physically active.

If you are planning to become much more physically active than you are now, start by answering the seven questions in the box below. If you are between the ages of 15 and 69, the PAR-Q will tell you if you should check with your doctor before you start. If you are over 69 years of age, and you are not used to being very active, check with your doctor.

Common sense is your best guide when you answer these questions. Please read the questions carefully and answer each one honestly: check YES or NO.

YES	NO	
☐	☐	1. **Has your doctor ever said that you have a heart condition and that you should only do physical activity recommended by a doctor?**
☐	☐	2. **Do you feel pain in your chest when you do physical activity?**
☐	☐	3. **In the past month, have you had chest pain when you were not doing physical activity?**
☐	☐	4. **Do you lose your balance because of dizziness or do you ever lose consciousness?**
☐	☐	5. **Do you have a bone or joint problem (for example, back, knee or hip) that could be made worse by a change in your physical activity?**
☐	☐	6. **Is your doctor currently prescribing drugs (for example, water pills) for your blood pressure or heart condition?**
☐	☐	7. **Do you know of any other reason why you should not do physical activity?**

If you answered

YES to one or more questions

Talk with your doctor by phone or in person BEFORE you start becoming much more physically active or BEFORE you have a fitness appraisal. Tell your doctor about the PAR-Q and which questions you answered YES.

- You may be able to do any activity you want — as long as you start slowly and build up gradually. Or, you may need to restrict your activities to those which are safe for you. Talk with your doctor about the kinds of activities you wish to participate in and follow his/her advice.
- Find out which community programs are safe and helpful for you.

NO to all questions

If you answered NO honestly to all PAR-Q questions, you can be reasonably sure that you can:

- start becoming much more physically active – begin slowly and build up gradually. This is the safest and easiest way to go.
- take part in a fitness appraisal – this is an excellent way to determine your basic fitness so that you can plan the best way for you to live actively. It is also highly recommended that you have your blood pressure evaluated. If your reading is over 144/94, talk with your doctor before you start becoming much more physically active.

DELAY BECOMING MUCH MORE ACTIVE:

- if you are not feeling well because of a temporary illness such as a cold or a fever – wait until you feel better; or
- if you are or may be pregnant – talk to your doctor before you start becoming more active.

PLEASE NOTE: If your health changes so that you then answer YES to any of the above questions, tell your fitness or health professional. Ask whether you should change your physical activity plan.

Informed Use of the PAR-Q: The Canadian Society for Exercise Physiology, Health Canada, and their agents assume no liability for persons who undertake physical activity, and if in doubt after completing this questionnaire, consult your doctor prior to physical activity.

No changes permitted. You are encouraged to photocopy the PAR-Q but only if you use the entire form.

NOTE: If the PAR-Q is being given to a person before he or she participates in a physical activity program or a fitness appraisal, this section may be used for legal or administrative purposes.

"I have read, understood and completed this questionnaire. Any questions I had were answered to my full satisfaction."

NAME _____

SIGNATURE _____ DATE _____

SIGNATURE OF PARENT or GUARDIAN (for participants under the age of majority) _____ WITNESS _____

Note: This physical activity clearance is valid for a maximum of 12 months from the date it is completed and becomes invalid if your condition changes so that you would answer YES to any of the seven questions.

CSEP | SCPE

© Canadian Society for Exercise Physiology www.csep.ca/forms

Answer the following

How many questions make up the PAR-Q?

_____

Who should complete the PAR-Q?

_____

_____

What does the PAR-Q determine?

_____

_____

_____

What is the PAR-Q designed to prevent?

_____

_____

What is it more commonly designated to do?

_____

6.2.4 Evaluate field, laboratory, sub-maximal and maximal tests of human performance.

Read and learn the strengths and limitations of different tests below.

Test	Examples	Strengths	Weaknesses/limitations
Field	Illinois agility test Swimming bleep test Running bleep test	-Easy to set up -Usually cheap and effective -Specific to the sport	-Can lack accuracy -Require level of motivation -Usually completed in groups, so other factors may disrupt accuracy of results (peer pressure, anxiety, self esteem, motivation)
Laboratory	VO2 MAX test Wingate test Force plate test	-Accurate to component of fitness -Results can precisely inform training design -Individually completed, eliminating external factors	-Usually expensive equipment required -Chance of injury -Not sport specific
Sub-Maximal	Harvard step test Astrand test The Bruce Treadmill test	-Less stressful/less chance of injury -Can repeat in short time frame -Good correlation with maximal tests	-Estimation of maximal fitness -Hard to set intensity accurately -Level of motivation required
Maximal	30m sprint test VO2 MAX test Multistage fitness test 12 minute Cooper run Wingate test	-Accurate measure of fitness -Accurate results, allows specific training targets to be set -Strict protocol and administration making retest comparisons reliable	-Chance of injury -Cannot repeat within short time frame -Might not complete test, yielding no result for performer

Topic 6: Measurement and evaluation of human performance - 6.3 Components of fitness

6.3.1 Distinguish between the concepts of *health-related-fitness* and *performance-related-fitness (skill related).*

See below, with 6.3.2

6.3.2 Outline the major components of fitness identified in 6.3.1.

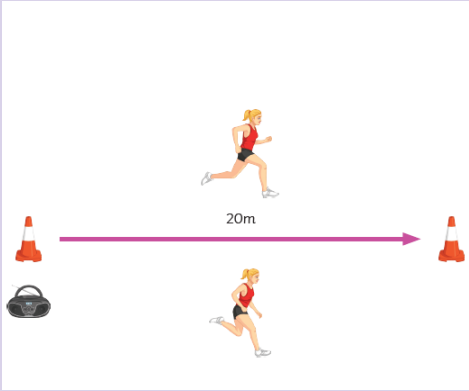
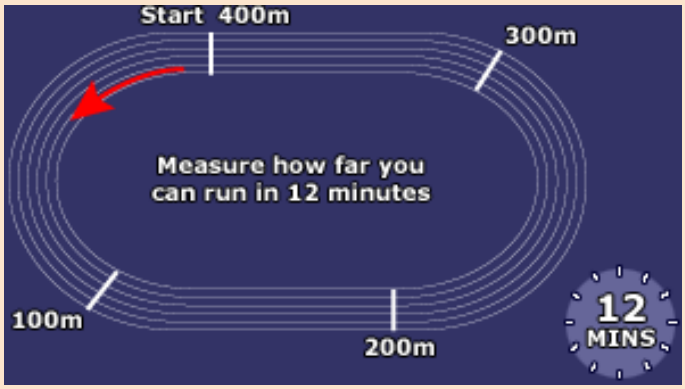
Complete the table below to summarise the different fitness components.

Fitness component **Health** **Performance**	**Description**	**Example of where it is used in sport**

	Percentage of body mass made up of fat, muscle and bone. Body composition differs depending on sport and position.	
	A.K.A. CV endurance, aerobic capacity. The ability to exercise the whole body repeatedly without tiring. The ability of the heart, lungs and blood to transport oxygen.	
	The range of motion (ROM) available at a joint. Can improve aesthetic performance, as well as generate more power and speed.	
	Ability to use muscles repeatedly without tiring, maintaining intensity and accuracy.	
	The amount of force a muscle can exert against a resistance (opponent, object, your own body weight).	
	The ability to change direction at speed (turning, dodging, twisting).	
	Stabilising your centre of gravity over a base of support. Two types: static (staying still and balanced, e.g. yoga) and dynamic (staying balanced whilst moving, e.g. windsurfer).	
	Using two or more body parts at the same time. Usually combining limbs or your eyes with a limb (hand eye).	
	Strength x Speed. Exerting strength at speed, e.g. hammer throw.	
	Time taken to respond to a stimulus. Onset of movement against a stimulus. Reaction time = response time – movement time	
	The rate at which a task is completed. Could be body speed or object (bike) speed.	

6.3.3 Outline and evaluate a variety of fitness tests.

Complete the table below to summarise and evaluate a variety of fitness tests.
Link the evaluation to reliability and validity.

Fitness component and test	**Procedure summary**
Aerobic capacity — **multistage fitness test/bleep test (Leger test)**	 **Procedure** **This test is best done as a whole class.** 1. Start behind the line and on the first bleep begin to jog to the second line. 2. Wait at this line until you hear the next bleep. 3. On the next bleep return to the first line. 4. Continue to do this. The bleeps will be far apart to begin with so don't leave until you hear the next one. 5. Gradually the time between the bleep with decrease and your running speed will need to increase. 6. When you can no longer reach the line before or on the bleep you record the level the you reached.
Advantages	**Disadvantages**
Aerobic capacity - **Cooper's 12-minute run**	
Advantages	**Disadvantages**

Aerobic capacity - **Harvard Step Test**

Harvard Step Test

Test Protocol:

- Use a standard gym bench (45cm)
- Record resting heart rate
- Step up and down off the bench in time to the metronome/tape for 5 minutes (once every two seconds)
- One minute after the exercise take heart rate for 30s. Record as rate 1.
- Take heart rate again after 2 minutes, for 30s, and record as rate 2.
- Take heart rate again after 3 minutes, for 30s, and record as rate 3.
- Calculate your score using the following formula:

Score = 100 x (300 seconds / 2 x (rate 1 + rate 2 + rate 3)

Gender	Excellent	Above Average	Average	Below Average	Poor
Male	>90.0	80.0 - 90.0	65.0 - 79.9	55.0 - 64.9	<55
Female	>86.0	76.0 - 86.0	61.0 - 75.9	50.0 - 60.9	<50

Advantages

Disadvantages

Flexibility — **sit and reach**

Gender	Excellent	Above Average	Average	Below Average	Poor
Male	>14	14.0 - 11.0	10.9 - 7.0	6.9 - 4.0	<4
Female	>15	15.0 - 12.0	11.9 - 7.0	6.9 - 4.0	<4

Procedure

Make sure you are fully warmed up before you do this test.

1. Remove your shoes and sit with your feet against the box.
2. Reach forward with both hands as far as possible, touching the box with your fingertips.
3. Hold this stretch for 3 seconds whilst your partner records the distance.

Advantages

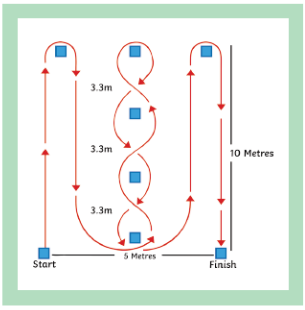
Disadvantages

Muscle endurance — **maximum sit-ups, maximum push-ups**	Test Protocol: • Lie face down on a mat • Place hands shoulder width apart and extend fully until straight • Lower body until your elbows are bent at 90 degrees • Record number of press ups and compare to normative data 
Advantages	**Disadvantages**
Muscle endurance — **flexed arm hang**	• This test is as alternative to the push-up and measures upper-body strength. • Grasp bar with palms facing away. Spotter may assist in helping raise chin above bar. • Partner should begin stopwatch when you are in position. Partner stops the watch when your chin touches the bar, chin falls below the bar, or head tilts back. • Body may not swing during the test. • Allow one trial. Record number of seconds chin was held above bar. 
Advantages	**Disadvantages**

Flexed Arm Hang: Standards for Healthy Fitness Zone®

Age	Boys (seconds)	Girls (seconds)
5	≥2	≥2
6	≥2	≥2
7	≥3	≥3
8	≥3	≥3
9	≥4	≥4
10	≥4	≥4
11	≥6	≥6
12	≥10	≥7
13	≥12	≥8
14	≥15	≥8
15	≥15	≥8
16	≥15	≥8
17	≥15	≥8
>17	≥15	≥8

Agility — **Illinois agility test**



Procedure

Familiarise yourself with the course before you complete it.

1. Start by lying down on your stomach on the start line, with your hands resting on the back of your head.
2. On the whistle, stand up as quickly as possible and run to the first cone, then the second.
3. You then weave in and out of the cones and back again.
4. Sprint diagonally up to the next cone and onto the finish line.
5. Your partner uses the stopwatch to record the time taken for you to complete the test.

Advantages

Disadvantages

Strength — **hand grip dynamometer**

Gender	Excellent	Good	Average	Fair	Poor
Male	<56	51-56	45-50	39-44	<39
Female	<36	31-36	25-30	19-24	<19

Procedure

1. Grab the dynamometer with one hand and apply as much pressure as possible.
2. Record the result and compare to the table.
3. Now carry out the same test with your other hand.

Advantages

Disadvantages

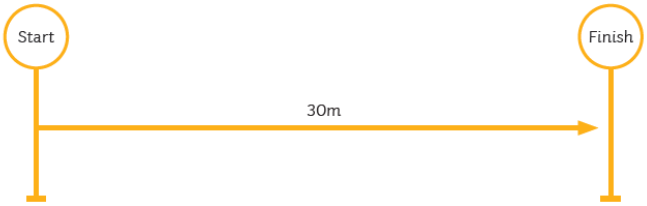
Speed — **20/30/40 metre sprint**

Gender	Excellent	Above Average	Average	Below Average	Poor
Male	<4.0 secs	4.0-4.2 secs	4.3-4.4 secs	4.5-4.6 secs	<4.6 secs
Female	<4.5 secs	4.5-4.6 secs	4.7-4.8 secs	4.9-5.0 secs	<5.0 secs

Table adapted from Davis et al. (2000)

Procedure

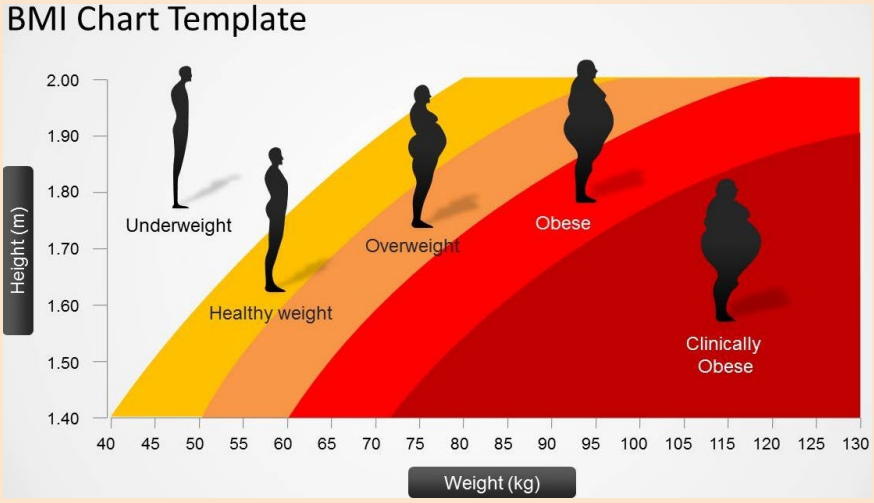
1. Start by standing behind the start line.
2. On the whistle, start to sprint as fast as you can to the finish line.
3. When you cross the finish line the stopwatch is stopped.
4. Record your time.



Advantages

Disadvantages

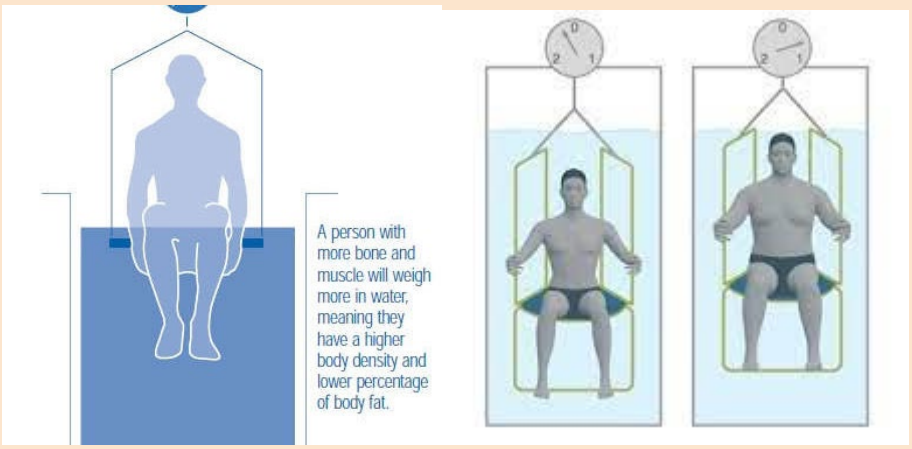
Body composition — **body mass index (BMI)**



Advantages	Disadvantages

Body composition — **Anthropometry, skin fold test**	

Advantages	Disadvantages

Body composition — **underwater weighing**	

Advantages	Disadvantages

Balance — **stork stand**

Gender	Excellent	Above Average	Average	Below Average	Poor
Male	>50	41-50	31-40	20-30	<20
Female	>30	23-30	16-22	10-15	<10

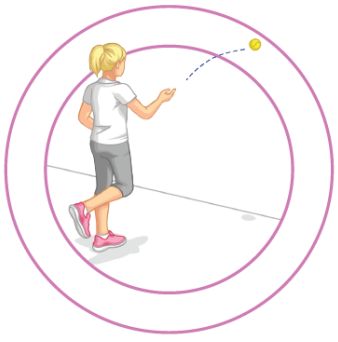
Procedure

Make sure you are fully warmed up before you do this test.

1. Remove your shoes and begin by standing on both feet with your hands on your hips.
2. Then lift one leg and place the sole of your foot against the inside of your knee.
3. Place your arms out to the side to help with balance.
4. As you move your arms, your partner should start the stopwatch.
5. Hold this position for as long as possible.
6. If you move your foot away from your kneecap or your foot touches the floor the time is stopped and recorded.
7. Carry out this test for your left and right foot.

Advantages	Disadvantages

Coordination — **hand ball toss**



Average(s)	Score (No. of Catches)
Excellent	>35
Good	30-35
Average	20-29
Fair	15-19
Poor	<15

Procedure

1. Make sure you are standing behind the line facing the wall.
2. Start with the ball in your **right hand** and underarm throw the ball against the wall.
3. Then as the ball rebounds off the wall catch the ball in your **left hand**.
4. Continue and record how many times you caught the ball.
5. Compare your score to the results table.

Advantages	Disadvantages

Reaction time — **drop test, computer simulation**

Excellent	Above Average	Average	Below Average	Poor
<7.5cm	7.5-15.9cm	15.9-20.4cm	20.4-28cm	>28cm

Davis (2000)

Procedure

1. Your partner needs to hold the ruler at the top with their thumb and index finger.
2. Now, place the bottom of the ruler level with 0cm between your thumb and your index finger of your dominant hand
3. Your partner will then release the ruler.
4. As soon as it has been released, try and catch it with your thumb and index finger as quickly as possible.
5. Record the distance that you caught the ruler at in cm.
6. Repeat the test 3 times and take the average of the scores.

Advantages	Disadvantages

Power — **vertical jump**

Gender	Excellent	Above Average	Average	Below Average	Poor
Male	>65cm	56 - 65cm	50 - 55cm	49 - 40cm	<40cm
Female	>65cm	51 - 60cm	41 - 50cm	35 - 40cm	<35cm

Procedure

1. Place the chalk on the fingers of your dominant hand.
2. Then, stand sideways on to the wall with your hand fully stretched upwards.
3. Place your chalk hand onto the wall so it leaves a mark. (picture 1)
4. Then jump as high as possible, reaching up to make another chalk mark on the wall as you jump. (picture 3)
5. Measure the distance between the two chalk marks on the wall.

Advantages	Disadvantages

Power — **standing broad jump**		**Procedure** 1. Stand behind the line with two feet together. 2. Using your arms, jump forward as far as possible. 3. Try not to fall back. 4. Measure from the line to the back of your closest foot. 5. Compare your score to the results table.

Advantages	Disadvantages

Topic 6: Measurement and evaluation of human performance - 6.4 Principles of training programme design

6.4.1 Describe the essential elements of a general training programme.

Complete the table below to describe the essential elements of a general training programme.

Element of a general training programme	**Description**

Warm-up	
Stretching activities	
Endurance training	
Cool down	
Flexibility training	
Resistance training	

Incorporation of recreational activities and sports	

6.4.2 Discuss the key principles of training programme design.

Complete the table below to outline the key principles of training programme design.

Key Principle	Definition
	The training must **match the needs of the specific sport/activity**. For example, a swimmer would do most of their training in the pool, a footballer winger would work on agility (turns, jumps and dummies), and a sprinter would focus on straight line power, strength and speed work.
	A **gradual increase** in the workload of exercise. This is to avoid a plateau in your level of fitness.
	Training is performed in cycles. Each cycle differs in intensity, specificity and volume of work. By cycling, the body adapts to its ever changing environment and can allow performers to reach peak performance at the right time. For example, boxers and athletes preparing for an event.
	An athlete must overload the system they are working. This is how progression takes place. **The athlete trains harder than they have previously.** An increase in frequency per week, intensity and/or duration (time) of training will apply overload to a performers programme.
	To be avoided. Can be brought about by injury, demotivation or a lack of progressive overload. **An athlete will experience reverse fitness effects as a result of training less frequently.** General rule of thumb; you lose fitness twice as fast as you gain it so gains from a 4 week programme will be lost within 2 weeks of no training.
	Prevents boredom. Vital for motivation and desire to progress and maintain required intensity levels.

6.4.3 Outline ways in which exercise intensity can be monitored.

Heart Rate and training zones

Measuring a performer's heart rate can give a very strong prediction for exercise intensity. It is widely accepted that heart rate increases in line with exercise intensity. It is also an indicator of maximum volume of oxygen that can be consumed (VO2 MAX).

Exam Question

Describe three ways you can measure heart rate? (3 marks)

_____

_____

_____

_____

_____

However, once a heart rate is recorded it needs to be used against a set of values to have any relevance. There are several values that need to be considered:

MAX HR: 220 – age

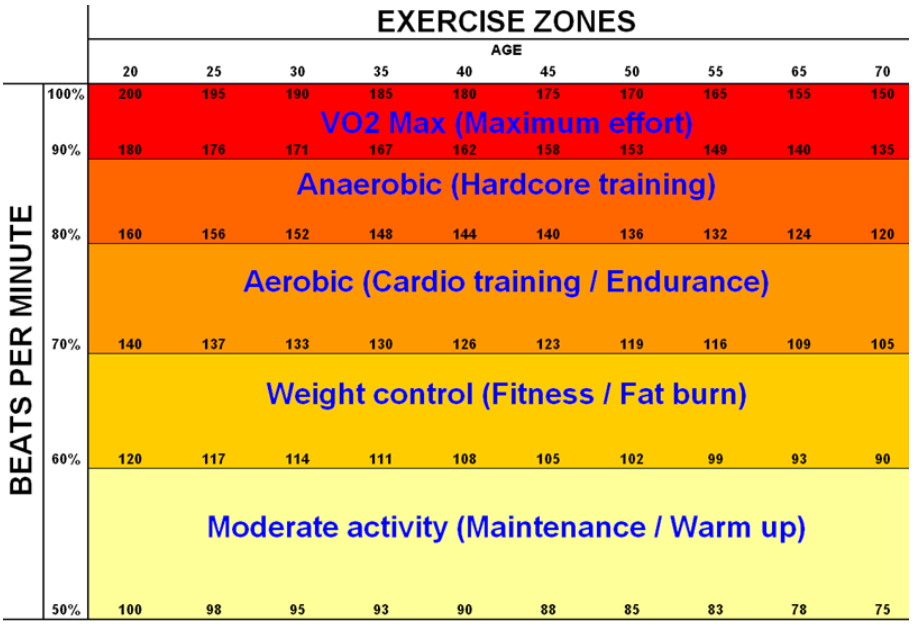
RHR: Resting heart rate

THR: Training heart rate

RR1-5: Recovery heart rate in the 5 minutes that follow exercise

All of the above are indicators and valuable values for measuring exercise.

The MAX HR can also assist with calculating target zones for a performer.



Exam Question

A 28 year old athlete is training for a marathon and wants to do a training run working on their endurance. Calculate and explain what heart rate range they should aim for in their training run to prepare for their marathon. (3 marks)

_____

_____

_____

_____

_____

A 32 year old athlete is training for the 100 m sprint, and wants to do a training session to improve their anaerobic fitness. Calculate and explain what heart rate range they should aim for in their training session to prepare for their race. (3 marks)

_____

_____

_____

_____

_____

Karvonen Method

A trained athlete will have a lower resting heart rate, due to the relationship between stroke volume, heart rate and cardiac output.

This was considered when devising the Karvonen method.
It takes your resting heart rate into consideration by introducing the difference between your maximum heart rate and your resting heart rate. To determine your HR for the Karvonen method, you take your HRmax and subtract your resting heart rate (RHR).

For example, for a 25 yr old who has a resting heart rate of 65, wanting to know his training heart rate for the intensity level 60% - 70%.

His Minimum Training Heart Rate:

- 220 - 25 (Age) = 195
- 195 - 65 (Rest. HR) = 130
- 130 x .60 (Min. Intensity) + 65 (Rest. HR) = 143 Beats/Minute

His Maximum Training Heart Rate:

- 220 - 25 (Age) = 195
- 195 - 65 (Rest. HR) = 130
- 130 x .70 (Max. Intensity) + 65 (Rest. HR) = 156 Beats/Minute

His training heart rate zone will therefore be 143-156 beats per minute.

Exam Question

A 34 year old who has a resting heart rate of 64 bpm, wants to know his training heart rate for the intensity level 70 - 80%. Calculate the minimum and maximum training heart rates. (4 marks)

_____

_____

_____

_____

_____

Rate of Perceived Exertion (RPE) is a different method for measuring exercise intensity. Heart rate measurements are quantitative (even if they do vary in accuracy), whereas RPE is subjective.

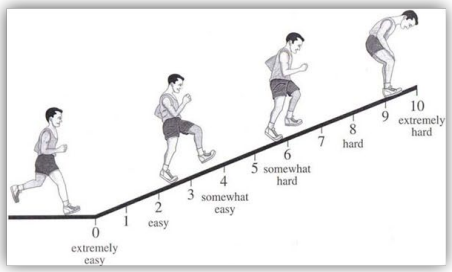
A performer simply rates their efforts on a scale. This has obvious flaws as one person's 7/10 max effort is very different to another person. An element of truth telling is required too.

Examples, from left to right:

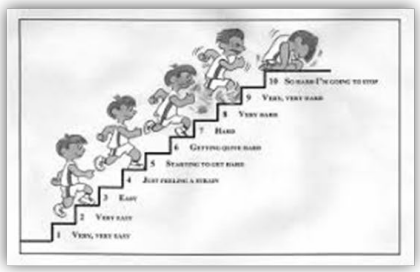
Borg Scale

7	very, very light
8	
9	very light
10	
11	fairly light
12	
13	somewhat hard
14	
15	hard
16	
17	very hard
18	
19	very, very hard
20	

Omni Scale



CERT Scale



Complete the statements below.

The _____ scale is out of 20.

The _____ scale is 0-10.

The _____ scale is used with _____ and is rated 1-10.