Level 3 Personal Trainer – Anatomy and Physiology for Exercise and Health

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Course Start Date	June 2020
Course Location	Remote
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Statement of Achievement

Assessor, by signing this statement of unit achievement you are confirming that all learning outcomes, criteria and range statements have been achieved under specified conditions and that the evidence gathered is authentic.

This statement of unit achievement table must be completed prior to claiming certification.

Section	Pass/Refer	Assessor Full Name	Assessor Signature
Understand the heart and circulatory system and its relation to exercise and health			
Understand the musculoskeletal system and its relation to exercise			
Understand postural and core stability			
Understand the nervous system and its relation to exercise			
Understand the endocrine system and its relation to exercise and health			
Understand energy systems and their relation to exercise			

Learner Name	Tanya Wallman	IQA Name	
Learned Signature		IQA Signature	
Date	1 November 2021	Date	

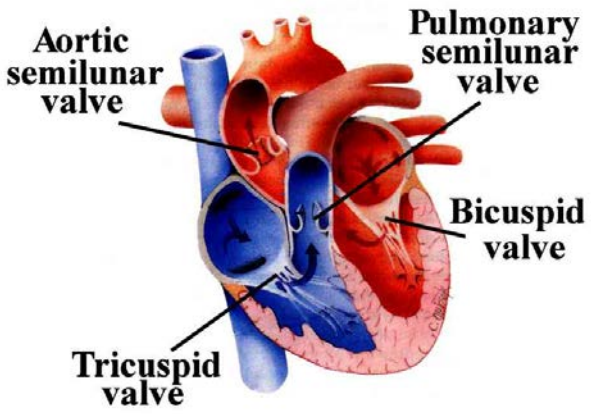
To pass this unit all questions must be answered correctly. If you answer a question incorrectly you will be asked to reattempt and resubmit that question.

Learner Guidance:

Pay close attention to the wording of each question:

- Identify: Label a diagram, can be a one-word answer
- Describe: Provide a short one to two-line description
- Explain: Requires more analysis to demonstrate your understanding of the topic, short paragraph.

Understand the heart and circulatory system and its relation to exercise and health



Q1 Explain the function of each of the heart valves labelled in the diagram above.

Learner guidance: this questions continues onto the next page

Tricuspid valve - regulates blood flow between the right atrium and ventricle and prevents any backflow of blood between the atrium and ventricle.

Aortic valve - ensures that the oxygen rich blood can pass from the left ventricle into the aorta without any backflow of blood.

Pulmonary valve- controls blood flow from the right ventricle into the pulmonary arteries which carry blood to the lungs to pick up oxygen without any backflow of blood.

Bicuspid valve - allows oxygen rich blood from the lungs to pass from the left ventricle to the left atrium and prevent back flow of blood from atrium to ventricle

Q2

Describe what is meant by the term coronary circulation.

Coronory circulation is the circulation of blood in the blood vessels that supply the heart through coronory arteries. When the heart is relaxed (diastole) the blood will act as a vacumm and will be sucked back towards the left ventricle. The aoertic valve will close and blood will trickle into the arteries to allow blood flow into the heart.

Q3

Explain the effect that atherosclerosis has on the structure and function of arteries.

When there is damage to the arteries, mineral, protein and fatty tissue build up can increase in the walls of the arteries. This results in a decrease in the elasticity of the arteries meaning they are unable to stretch by reacting to blood flow and therefore it may increase blood pressure. The fatty stores can become so big that they could limit blood supply and oxygen to the heart and therefore can cause a heart attack.

Q4 Explain the short term effects of blood pressure during exercise.

Learner guidance: short term = during exercise

Systolic pressure (heart contracting) will increase and the diastolic pressure will remain the same.

Q5 Explain the long term effects of exercise on blood pressure.

Learner guidance: long term = 3 months of exercise

Blood pressure will decrease and/or it will normalise blood pressure

Q6

Explain what is meant by the Valsalva effect.

The impact of holding your breath incorrectly when exerting rather than breating out on exertion which may result in increased blood pressure causing dizziness and potentially fainting.

Q7 Explain two benefits of cardiovascular endurance or aerobic training.

Learner guidance: this questions continues onto the next page

Improved body composition - cardiovascular training is a good way to manage weight given aerobic exercise will use fat as energy

Lower resting heart rate and lower blood pressure due to the systolic pressure increasing with exercise

Q8

Explain two risks of cardiovascular endurance or aerobic training.

Over use injuries (muscular strains)

Angina (pain in the heart)

Q9

What are the NHS guidelines for the following categories of blood pressure and associated health risks:

Normal

120/80 or below

Hypertension

140/90. Associated health risks atre potential heart attack, stroke, dementia, alzheimers

Pass/Refer

Understand the musculoskeletal system and its relation to exercise

Q1

Explain the following structures that together make up individual muscle fibre:

Nucleus

A nucleus controls and regulates the activities of the cell and contains the genes (or DNA)

Mitochondria

Mitochondria are the networks which make up the muscle cell and create energy aerobically for ATP.

Myofibrils

Within the myofibrils are units called fasiculi and each of these are connected seperately to the muscle so they can contract on their own. Sarcomeres are units within the myofibril and are made up of mifilaments of protein called actin (thin filament) and myosin (thick filament).

Cell walls

Learner guidance: please describe the structure of the sarcolemma

The sarcolemma is the thin, transparent, extensible plasma membrane of the muscle cell. It contains a muscle membrane and an outer coat made up of a thick layer of material with numerous thin collagen fibrils.

Q2

Describe the sliding filament theory and how myofilaments work together to bring about muscle contraction.

There are two proteins called myosin and actin or thick and thin filaments. These are arranged in a series of compartments called sarcomeres within the myofibrils.

These slide over each other by the myosin head attaching to the actin. To enable movement the myosin head bends, pulling the thin filament towards the midline of the sacromere. ATP is required which attaches to the myosin head. Calcium is then required to trigger the stored ATP energy to be released causing it to detach which pulls the thin filament from the actin. The cycle is then ready to start again.

Q3

What type of muscle fibre responds best to strength training?

2B fast twitch fibres respond the best to strength training.

Q4

What effect will strength training have on the size of the muscle and explain why?

Strength training will increase the size of the muscle because the fibres of the muscle sustain small tears. The body repairs damaged fibres by fusing them together, which increases the mass and size of the muscle.

Q5

What type of muscle fibre responds best to cardiovascular endurance training?

Type 1 slow twitch fibres as they carry oxygenated blood which is required for cardiovascular endurance training.

Q6

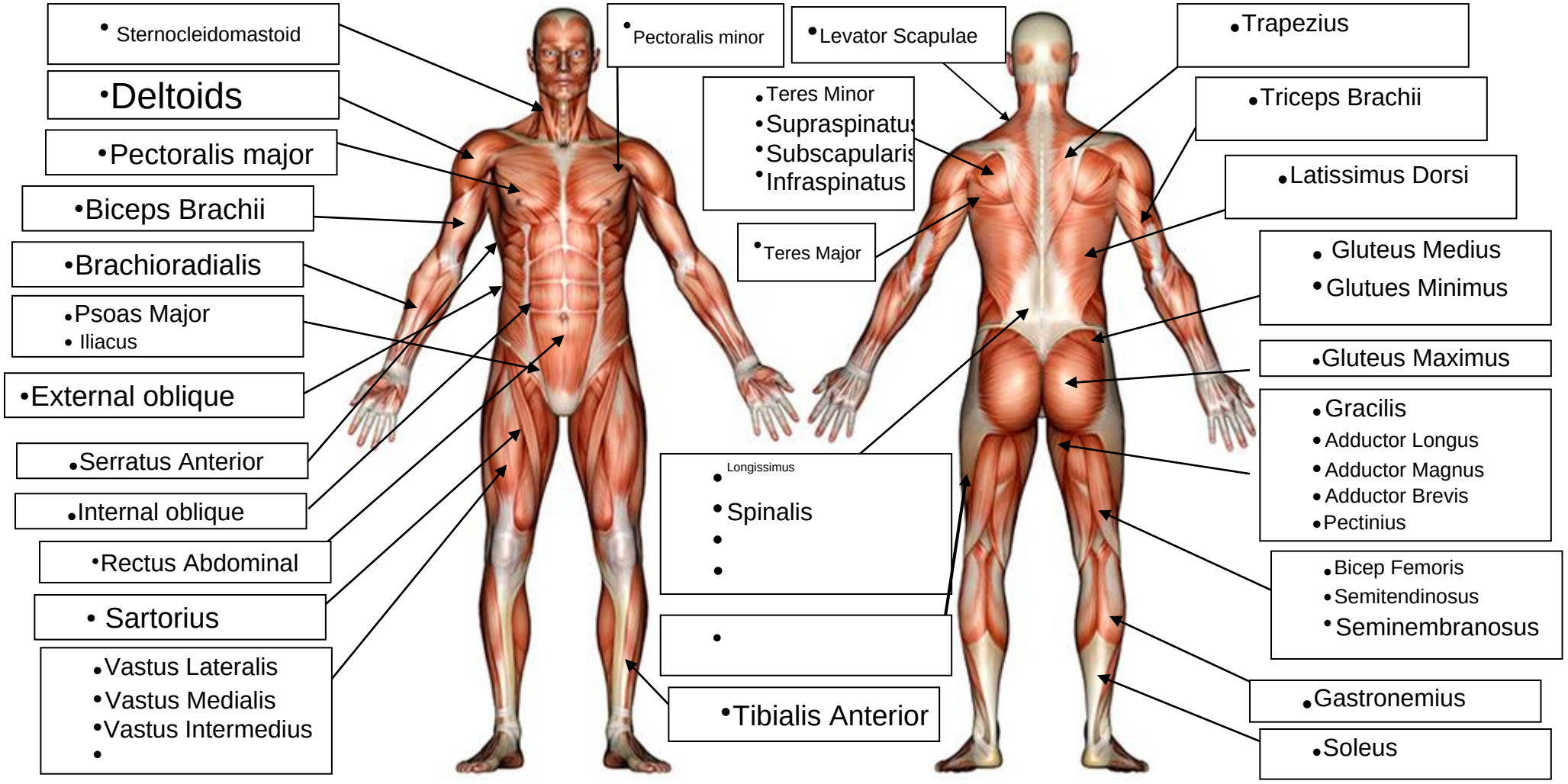
What effect will cardiovascular endurance training have on the size of the muscle and explain why?

Endurance training will increase existing muscle however it won't create new muscle fibres as the muscles are not being given stimulus for the muscles to grow. Fast twitch fibers may not also being used therefore they may decrease in size.

Q7 Please use the following table to label the muscle diagram below.

Learner guidance: some muscles will be grouped together e.g. the four quadriceps

• Adductor Brevis • Vastus Intermedius • Pectoralis Minor • Pectoralis Major • Iliacus • Psoas Major • Serratus Anterior • Gracilis • Adductor Magnus • Rectus Femoris • Brachioradialis • Vastus Medialis • Pectineus • Tibialis Anterior • Tensor Fascia Latae • Sartorius • Transversus Abdominis • Rectus Abdominal • Adductor Longus • Biceps Brachii • Vastus Lateralis • Sternocleidomastoid • External & Internal Obliques	• Levator Scapulae • Deltoid • Infraspinatus • Iliocostalis • Latissimus Dorsi • Longissimus • Spinalis • Gastrocnemius • Gluteus Medius • Soleus • Trapezius • Subscapularis • Teres Major • Gluteus Maximus • Triceps Brachii • Glutues Minimus • Supraspinatus • Bicep Femoris • Erector Spinae • Seminembranosus • Teres Minor • Semitendinosus


• Sternocleidomastoid
•Deltoids
•Pectoralis major
•Biceps Brachii
•Brachioradialis
•Psoas Major
• Iliacus
•External oblique
•Serratus Anterior
•Internal oblique
•Rectus Abdominal
• Sartorius
•Vastus Lateralis
•Vastus Medialis
•Vastus Intermedius
•
•Pectoralis minor
•Levator Scapulae
•Teres Minor
•Supraspinatus
•Subscapularis
•Infraspinatus
•Teres Major
•Longissimus
•Spinalis
•
•
•
•Tibialis Anterior
•Trapezius
•Triceps Brachii
•Latissimus Dorsi
• Gluteus Medius
•Glutues Minimus
•Gluteus Maximus
•Gracilis
•Adductor Longus
•Adductor Magnus
•Adductor Brevis
•Pectinius
•Bicep Femoris
•Semitendinosus
•Seminembranosus
•Gastronemius
•Soleus

Q9

Identify the origin and insertion and joint actions possible for each of the following muscles.

Muscle	Pectoralis Minor
Origin	Anterior surface, costal cartilages of ribs 3 - 5
Insertion	Medial border and coracoid process of scapula
Joint Actions	It produces movement of the scapula and stabalises scapula on thoracic wall

Muscle	Infraspinatus
Origin	Infraspinous fossa of the scapula
Insertion	The posterior aspect of the humerous and the shoulder joint
Joint Actions	The main external rotator of the shoulder joint. It abducts the inferior angle of the scapula.

Muscle	Gluteus Maximus
Origin	Gluteal surface of the illium, lumbar fascia sacrum, sacrotuberous ligament
Insertion	Gluteal tuberosity of the femur and iliotibial tract
Joint Actions	External rotation and extension of the hip joint, supports the extended knee through the iliotibial tract

Muscle	External Oblique
Origin	
Insertion	
Joint Actions	

Muscle	Rectus Femoris
Origin	
Insertion	
Joint Actions	

Muscle	Semimembranosus
Origin	
Insertion	
Joint Actions	

Muscle	Iliacus
Origin	
Insertion	
Joint Actions	

Muscle	Subscapularis
Origin	
Insertion	
Joint Actions	

Muscle	Quadratus Lumborum
Origin	
Insertion	
Joint Actions	

Muscle	Tensor Fascia Latae
Origin	Anterior superior illiac crest
Insertion	Iliotibial tract
Joint Actions	It stablises hip and knee joint. Hip joint: Thigh internal rotation, Knee joint: leg external rotation

Muscle	Gluteus Medius
Origin	Gluteal surface of the illium
Insertion	Lateral aspect of greater trochanter of femur
Joint Actions	Hip joint - thigh abduction, thigh internal rotation

Muscle	Adductor Magnus
Origin	
Insertion	
Joint Actions	

Q10

Identify three anatomical planes and two different exercises that occur in each.

1. Sagital	Exercise
	1. Front lunges
	2. Leg extensions

2. Transverse	Exercise
	1. Clamshell
	2. Twisting lunge

3. Cornol	Exercise
	1. Side lunge
	2. Side plank with hip dips

Q11

Complete the table below to analyse the movements of certain exercises.

Exercise	Joint(s) moving	Joint action(s) concentric	Agonist(s)	Antagonist(s)	Synergist (s)
Leg Extension			Calf		
Bench Press					
Lateral Raise					

Q12

Complete the table below by describing the different motion/movements available at the following joints/joint and the potential risk of injury.

	Describe range of movement (small/medium/large)	Joint actions possible	Potential risk of injury
Hip			
Ankle			
Shoulder			

Q13

Describe the role of the sacrotuberous ligament at the pelvic girdle.

The ligament helps to hold up and stablise the sacrum, increasing ridigity to the pelvic girdle as it holds the body weight.

Q14

Describe the role of the sacroiliac ligament at the pelvic girdle.

This ligament adds passive strength and ridigity to the pelvic girdle as it holds the body weight.

Q15

Identify the muscles that act across the sacroiliac joint and describe the role they have in 'force closure'.

Pass/Refer

Understand postural and core stability

Q1

Describe the structure and function of the two longitudinal ligaments of the spine.

Q2

Describe the structure of two of the stabilisation muscles of the spine.

Learner Guidance: Muscles that located in the inner unit of the core.

Transverse abdominis

Multifidus

Q3

What are the roles of these two muscles?

Q4

When the core is not functioning properly to stabilise the spine describe the changes in the inner and outer unit muscles.

Q5

Explain how high levels of abdominal adiposity can effect posture and movement efficiently.

Q6

Identify the two different postural deviations and explain a potential problem linked to each.

Hyperlordosis

This can cause lower back or neck pain or restricted movement.

Forward Head posture

This posture can cause neck pain, stiffness and headaches. It can also cause excess strain in your spine.

Q7

Explain how a ‘kyphotic’ posture can affect function and movement efficiently.

Q8

If you are training an experienced client what core exercises would you include in a session and explain why.

Q9

From the exercises explained above what are the potential injury/aggravation of problems to your client?

Q10

There are three main forms of stretching, complete the table below by explaining the benefits, risks and when you might use these stretches.

Type of stretch	Benefits of this type of stretching	Risks of this type of stretching	When might you use this type of stretching
Active static stretching			
Passive static stretching	Can help increase rhe range of motion and improve performance	Can risk stretching beyond where your muscles would naturally move therefore risking over stretching and injury	At the end of your workout
Dynamic stretching	The body is stretched safely due to the movement increasing blood flow to muscles, therefore preventing injury	It is easy to over exert the client during this type of stretching	You would use dynamic stretching during the warm up
Proprioceptive Neuromuscular Facilitation (PNF)	Trick the clients body to stretching further after the contractuation as the body is in a relaxed state	Could potentially over stretch the body	Post work out when the body has warmed up

Pass/Refer

Understand the nervous system and its relation to exercise

Q1

Describe the specific role of the central nervous system (CNS).

The central nervous system - the main organs being the brain and spinal cord - receives information from and sends information to the peripheral nervous system. It also receives external information and ensures the body takes any necessary action in terms of motor response.

Q2

Describe the specific role of the peripheral nervous system (PNS) including somatic and autonomic.

Role

The peripheral nervous system are all the nerves and nerve cells located outside of the central nervous system. It is responsible for receiving information from sensory nerves inside and outside of the body and relaying information from the brain and spinal cord to the rest of the body thus helping us to perform voluntary and involuntary actions.

Somatic

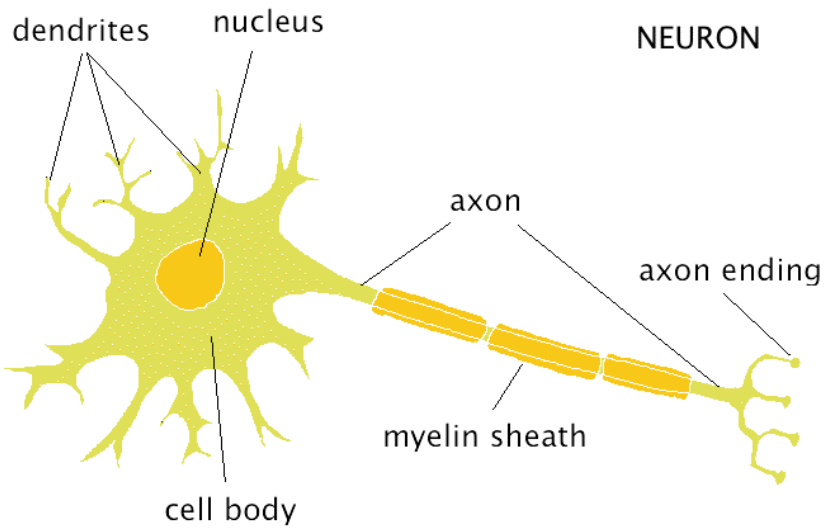
The somatic nervous system is a branch of the PNS that is concerned with changes in the external environment. It regulates voluntary body movement through the control of skeletal muscles and is under our conscious control.

Autonomic

The automatic nervous system controls mechanisms within the body that are automatic e.g. heart rate and blood pressure. There are two types - parasympathetic which calms and relaxes and sympathetic which creates action.

Q3

Describe the structure of a motor neuron.



Cell Body (Soma)

This is the spherical part of the neuron containing the nucleus. This connects to the dendrites which brings information down to the axon and nerve.

Nucleus

This is the main architect of the nerve cell which contains the DNA of the cell.

Axon

The axon sends signals away from the body and they are long and cydindrical in shape. The axon has a covering (mylin sheath) which is a form of insulation and its is required for quick impulses. The axon terminal is at the end of the axon and this acts as a boundary between the neuron and other cells such as the cell muscles.

Dendrites

The dendrites allow signals to be carried to the cell body through neuro transmitters in order for the cell to become active and are spread out like branches of a tree. These sense the stimulus i.e. heat or pain.

Q4

Describe the role of a motor neuron.

The role of the motor neuron is to transmit information from the CNS to the organs, muscles and glands.

Q5

Describe the role each of the following structures have in transmission a nervous impulse:

Axon terminals

These are at the end of a neruron and form the long pathway that the impulse can travel along and where the impulse is converted to a chemical signal.

Neurotransmitters

Neurotransmitters provide an electrical pulse which sends signals to another motor neuron to enable muscles to receive and respond to stimuli.

Q6

Explain the role of a motor unit.

A motor unit is one motor neuron and can provide activation to up to 1000 muscle fibres. The musle fibres are formed in groups called motor units. The more motor units that are fired during exercise the more power will be exerted.

Q7

Describe the 'all or none' principle.

The nervous system will either contract a muscle or not contract a muscle - i.e the impulse may contract all or not at all due to the amount of stimulus provided.

Q8

Explain how the number of muscles fibres innervated by a motor neuron impacts on the types of movements created.

Learner guidance: think large (gross) and small (fine) movements

The greater the number of muscle fibres in the motor neuron, the greater the movement or contraction it creates.

Q9

Explain the function of muscle proprioceptors.

These are found in muscles and tendons and give different information to the CNS to detect change in muscle length and automatically react to generate muscle contractions to prevent injury.

Q10

Explain the function of the stretch reflex.

The spindle is a round seperate bundle of muscle fibres. When the muscle changes length the spindle is either taken apart or pushed towards each other depending on whether the muscle is being shortened or lengthened.

Neural firing is instigated when a muscle is quickly extended in length. This means an action potential is transmitted from the spindle to a motor neuron in the spinal cord. This sends a signal to the motor neuron which sends a signal to the muscle. This results in the muscle contracting quickly to avoid damage.

Q11

Explain reciprocal inhibition and its relevance to exercise.

This explains the restriction in reflex of antagonist muscle when the agonist contracts to enable movement and activity. In order for the agonist to contract the antagonist must be relaxed. During exercise the reflex occurs to make sure that it is smoothly operated and explosive movements can be started by an agonist with no resistance of the antogonist muscle.

Q12

Explain what adaptations to the nervous system have taken place to bring about the following benefits:

Learner guidance: think of adaptations that take place in the motor neurons and motor units

Improvement in balance and coordination

Motor neurons will be activated across different muscle groups in order to bring about balance and co-ordination.

Improvement of power

The frequency of nerve impulses into the muscle cell and number of motor neurons activated will improve and all the nerves and muscle fibres will be turned on at the same time to promote power

Pass/Refer

Understand the endocrine system and its relation to exercise and health

Q1

Describe the functions of the endocrine system.

The endocrine system includes all glands in the body aswell as the hormones that are triggered by those glands. Hormones are chemicals that are released into the bloodstream and send messages to other parts of the body. Within the body there are two types of communication that use hormones; the first is between two endocrine glands and the second is betwene the endocrine gland and organ. The endocrine system works in conjunction with the nervous system to formualte the huma body's control system. The endocrine system is slower than the CNS but the effects can be wider than the CNS.

Q2

Identify six hormones, what gland produces each hormone and explain the function of each.

Hormone	Gland where hormone is produced	Hormone functions
Growth/thyroid	Hypothalamas and pituatary gland	Growth hormone which will increase muscle mass, fat hormone, and will help with ATP synthesis.
Insulin and glyogen	Pancreas	To control glucose levels. Glyogen increases blood sugar levels whilst insulin decreases blood sugar levels. During exercise gluscose levels rise and insulin decreases.
Adrenaline and nor adrenaline	Adrenal glands	Adrenaline gets the body ready for stress.
Testosterone	Testies	It regulates sex drive, bone mass fat distribution and muscle mass and strength.
Oestrogen and progesterone	Ovaries	Oestrogen is involved in repairing and thickening the uterus lining and progesterone maintans the uterine lining. They prepare the uterus for menstration.
Relaxin	Ovary and placenta	Releases relaxin during pregnancy and labour and equips lining of the womb for pregnancy.

Pass/Refer

Understand energy systems and their relation to exercise

Q1

Identify what energy system would predominantly be used during a set of 4 reps on the chest press and explain why.

This woud use the phosphocreatine system as it is very intense and for a short period of time. It may also use the lactic acid system but predominately the phosphocreatine system.

Q2

Identify what energy system would predominantly be used during a 100 metre sprint and explain why.

This would be the phosphocreatine system as it is used for high intensity short duration activity. The energy supplied by creatine phosphate creates ATP which can release energy very quickly and this will be needed for the explosive action of the 100 m sprint. The reaction does not depend on oxygen and can be used for fast twitch fibres which sprinting will use.

Q3

How does the type of an exercise performed dictate what energy system is used?

Slower steady exercise for longer periods uses oxygenated muscles and slow twitch fibres within the muscles therefore ATP can be replenished by oxygen using the Aeorbic Energy system. For shorter more intense exercise this relies on anerobic muscles therefore the two Anaerobic energy systems will be used as they create ATP to produce energy without the need for oxygen.

Q4

How does the intensity of an exercise performed dictate what energy system is used?

The more intense the exercise the greater amount of anaerobic energy in the form of phosphate and muscle glycogen will be used therefore the phosphocreatine or lactic energy system will be predominant. For less intense exercise oxygenated muscle will be used therefore the aerobic system will be predominant.

Q5 Identify the by-product of the creatine phosphate system and its significance in muscle fatigue.

Learner guidance: this is a two part question

The by product is creatine and ATP, however the stores of energy cannot be used for very long i.e. 6-10 seconds therefore the muscles will fatigue very quickly.

Q6 Identify the by-products of the lactate system and its significance in muscle fatigue.

Learner guidance: this is a two part question

The by product of the lactate system is lactic acid build up which would increase the burning sensation in the muscles and therefore muscle fatigue.

Q7 Identify the by-products of the aerobic system and its significance in muscle fatigue.

Learner guidance: this is a two part question

The by products are carbon dioxide and increased sweating in the form of water. Loss of water can lead to dehydration which will lead to muscle fatigue.

Q8 What type of intervals will have the greatest effect on increasing creatine phosphate and ATP stores?

Learner guidance: explain what intensities, timings and rest periods you will be using

High intensity exercise - i.e. 100m fast sprinting, or very heavy weight training for 10 -15 seconds. The rest period should be 3-4 minutes, maximum of 5 minutes, after which point ATP will be replenished.

Q9

What effect do anaerobic sprint intervals have on fuel (glycogen) utilisation?

Anaerobic sprint intervals uses glycogen which will rapidly deplete glycogen stores.

Q10 What factors will dictate the effect long slow duration exercise has on fuel (glycogen) utilisation?

Learner guidance: consider the variables of F.I.T.T. and identify the main factors for fuel utilisation

The factors effecting glycogen on long slow exercise will be frequency of the exercise i.e. how often it is performed and how long the exercise will last i.e. 10km run vs a marathon.

Pass/Refer

Assessor Feedback

Assessor Feedback