A2 Physiology Assessment – Mark Scheme

1. **British gymnast Beth Tweddle won the 2009 World Championship Floor Exercise title. Her routine involved a series of powerful tumbling sequences, balances and rotational movements, one of which is shown in Figure 1.**

**Explain how a gymnast can alter the speed of rotation during flight and outline how plyometrics can assist in their preparation to achieve maximum lift at take-off. (14 marks)**

Altering speed of rotation

A. Changing the shape of the body causes a change in speed

B. Change in moment of inertia leads to a change of angular velocity/speed/spin of rotation/ angular moment;

C. Angular momentum remains constant (during rotation)

D. Angular momentum = moment of inertia x angular velocity

E. Angular momentum - quantity of rotation/motion

F. Angular velocity - speed of rotation

G. Moment of inertia - spread/distribution of mass around axis/reluctance of the body to move

H. To slow down (rotation) gymnast increases moment of inertia

I. Achieved by extending body/opening out/or equivalent

J. To increase speed (of rotation) gymnast decreases moment of inertia

K. Achieved by tucking body/bringing arms towards rotational axis

Plyometrics

L. Description of activity – hopping/bounding/ depth jumping/medicine ball work

M. Aim – develop power/speed/explosive strength

N. Involves Fast Twitch Fibres/Type 2

O. Eccentric muscle contraction happens first

P. followed by concentric contraction

Q. Stretch Reflex activated

R. Detected by the muscle spindles

S. Sends nerve impulse to spinal cord/central nervous system/CNS/afferent impulses

T. Elastic energy stored

U. Protects over stretching of muscles/avoid injury

V. Three phases – stretch shortening cycle

1. **At the 2008 Beijing Olympic Games, David Davies won the silver medal in the swimming 10 kilometre marathon event, in a time of 1 hour 51 minutes and 53.1 seconds. Explain how the majority of energy used during the race would be provided and outline the process of ‘glycogen loading’ that may be used by performers to improve performance in this type of event. (14 marks)**

A good answer must address both parts of the question adequately, and should consider accurately the following topic areas:

Mark Scheme:

How the majority of energy would be provided, addressing points such as:

A. Majority produced by the aerobic system/oxygen

B. Glycolysis/Anaerobic glycolysis

C. Carbohydrates/glycogen/glucose

D. broken down into pyruvate/ pyruvic acid

E. Some ATP produced/2 ATP

F. Krebs cycle

G. Fats/triglycerides/fatty acids/glycerol

H. Beta oxidation

I. Oxidation of acetyl-coenzyme-A/Citric acid/ production of CO2

J. Electron transport chain

K. Water/H2O formed/hydrogen ions formed (H+)/ hydrogen/protons

L. Large quantities of ATP produced or resynthesised/34- 36 ATP

The process of glycogen loading, addressing points such as:

M. Aim to increase (muscle) glycogen stores/ supercompensation

N. Delays fatigue/increases endurance capacity/ increased ATP/energy production/hitting the wall

O. (Method 1) Reduce glycogen levels

P. Achieved by increased endurance training

Q. Following three days of low carbohydrate diet

R. And tapering/reduction in training levels

S. Few days before competition high carbohydrate level diet/ eg pasta

T. Trained/elite/equiv athletes may rest for several days before eating high carbohydrate diet

U. Increased water consumption helps the process

V. (Method 2) day before 3 minute high intensity exercise

W. Carb window opens

X. Immediately/within 20 minutes intake high carbohydrate diet

1. **The recovery process after training and between events during competition is vital to maximise performance.**

**The diagram illustrates the ‘excess post-exercise oxygen consumption’ (EPOC) of a performer following strenuous exercise.**

**Outline the function and process of the fast component of the recovery process. (4 marks)**

A. EPOC explanation – volume of oxygen consumed in recovery above the resting rate

B. The alactacid/alactic (debt/component)

C. Re-saturation of myoglobin/haemoglobin with oxygen

D. Re-synthesise ATP/PC levels

E. Uses 2-4 litres of oxygen

F. Completed in 2-3 minutes

G. 50% PC stores replenished within 30 seconds/75% within 60 seconds

1. **Describe the changes that occur in the body to make the aerobic energy systems more efficient following prolonged endurance training. (4 marks)**

Cardiac hypertrophy

Increased resting stroke volume

Decreased resting heart rate

Increased blood volume and haemoglobin levels

Increased muscle glycogen stores

Increased myoglobin content in muscles

Increased capilliarisation of muscle

Increased number and size of mitochondria

Resulting increase in VO2 max (maximal oxygen consumption)

1. **The Sliding Filament Hypothesis suggests muscular contraction occurs in the sarcomeres of the muscle fibres. Explain how actin and myosin filaments in the sarcomere bind together causing muscular contraction. (7 marks)**

A. Filaments unable to bind due to tropomyosin

B. Receipt of nerve impulse/action potential/electrical impulse/wave of depolarisation

C. Sarcoplasmic reticulum (releases)

D. Calcium (ions released)

E. (Calcium) Attach to troponin (on actin filaments)

F. Causes change of shape of troponin/moves tropomyosin

G. Exposes myosin binding site (on actin filament)/ ATP

H. Cross bridge formation

I. Powerstroke occurs/Ratchet Mechanism/Reduce H zone/z lines closer together

1. **All gymnastic events require controlled powerful movements.**

**How can a performer vary the strength of muscular contractions to ensure that a skill is completed correctly? (4 marks)**

A. (Greater the force needed) larger motor units recruited

B. More units recruited

C. Need fast twitch fibres rather than slow twitch fibres

D. Multiple unit summation/spatial summation

E. All or none law/All or nothing law/or explanation

F. Wave summation/frequency of impulse/innervations

G. Motor unit unable to relax/increase the force

H. Tetanus/titanic for powerful contraction

I. Muscle spindles detect changes in muscle length/speed of contraction

J. Send information to brain/CNS

K. Compares information to long term memory to ensure correct force applied/past experiences

L. Spatial summation – rotating the frequency of the impulse to motor units to delay fatigue

1. **Describe the physiological reasons why a performer may use anabolic steroids. (3 marks)**

A. Aid/use/assimilation storage of protein

B. Decrease in fat in the muscles

C. Able to train for longer/higher intensity

D. Faster recovery time/to train more frequently/ quicker repair of muscle tissues

E. Increase muscle size/strength/mass

1. **Explain how a swimmer would use ‘periodisation’ to prepare for competitions. (4 marks)**

A. Cycle based on World Championships/Olympics

B. Possible to plan for double periodisation

C. Preparation phase/pre season training – involves development of base levels of fitness/general conditioning/quantity rather than quality

D. Competitive phase – refinement of skills/ maintenance of fitness levels/quality rather than quantity/relevant examples

of training modifications

E. Tapering/peaking – preparation for specific competition/mainly skill focus

F. Transition phase – active rest/out of season recovery period

G. Macro-cycles – long term planning/yearly/two yearly cycle

H. Meso-cycles – periods of two to eight weeks/months

I. Micro-cycles – periods of a week/day/individual training sessions

1. **Elite athletes must develop and maintain extremely high levels of fitness to maximise their chances of winning. Elite athletes may use the results from lactate sampling and their respiratory exchange ratio (RER) to ensure their training is effective.
Explain the terms lactate sampling and respiratory exchange ratio. (4 marks)**

Sub max of 2 marks:

A. (Lactate sampling) – taking blood samples (to measure the level of lactic acid)

B. Ensures training is at the correct intensity/monitor improvements over time

C. Provides accurate/objective measure

D. Measures OBLA/lactate threshold/occurs at 4 mmols

Sub max of 2 marks:

E. (Respiratory Exchange Ratio) – ratio of carbon dioxide released compared to oxygen used by the body

F. Estimates use of fats and carbohydrates used during exercise/ calculates energy expenditure

G. Tells if performer working aerobically/anaerobically/energy system used

H. RER close to 1 performer using carbohydrates/close to 0.7 using fats/respiratory quotient

1. **Explain how the use of an ice bath can help to reduce the ‘delayed onset of muscle soreness’ (DOMS). (4 marks)**

A. (Involves sitting in ice cold water for) between 5 – 20 minutes

B. Causes blood vessels to tighten/decreases metabolic activity/vasoconstriction

C. Restricting blood flow to the area

D. Reduces swelling/tissue breakdown/aids muscle repair

E. After leaving the ice bath, area is flooded with new blood/vasodilation

F. Fresh oxygen removes lactic acid (when out of the ice bath)

G. Some studies suggest ice baths of limited value

1. **Using ‘Newton’s First and Second Laws of Motion’, explain how the swimmer dives off the starting blocks. (4 marks)**

A. Force is applied by the muscles

Newton’s First Law of Motion/Law of inertia

B. Performer will remain on the blocks unless a force is applied

C. Performer continues to move forwards with constant velocity until another force is applied

D. Water slows the swimmer

Newton’s Second Law of Motion/Law of Acceleration

E. Mass of swimmer is constant

F. Greater the force exerted on the blocks, the greater the acceleration/momentum

G. Force governs direction