Now test yourself answers

1.1 Skeletal system

1.1.1 Structure of the skeleton

1 D
2 Any two from:
   - clavicle
   - femur
   - fibula
   - humerus
   - patella
   - pelvis
   - phalanges
   - radius
   - scapula
   - tarsals
   - tibia
   - ulna.

No credit given for carpals.

3

Identify the bone | Location of the bone
--- | ---
Femur (1) | Upper leg or thigh
Patella | The knee cap/front of knee joint (1)
Humerus | Upper arm/arm above elbow (1)
Phalanges (1) | The bones of the fingers or toes

1.1.2 Functions of the skeletal system

1 C
2 Red blood cells carry/transport oxygen to the working muscles (1).
White blood cells fight/prevent infection (1).
3 Movement: When muscles contract they pull on bones, moving them (1). Suitable response linked to chosen health and fitness activity, for example: ‘in swimming, the hamstring and quadriceps muscles contract, flexing and extending the knee joint to kick’ (1).

Protection of vital organs: The hard bones of the skeleton cover the softer vital organs within the body (1). Suitable response linked to chosen health and fitness activity, for example: ‘in football the cranium protects the brain when the ball is headed’ (1).

1.1.3 Types of bones

1 C
2 Any two from:
   - ribs
   - sternum
   - cranium
   - scapula
   - pelvis.

3 Long bones: Long bones act as levers; muscles pull on them to create movement (1). Suitable examples from health and fitness activities, for example: ‘during a bicep curl, the biceps pull on the radius and ulna to lift the weight’ (1).

Short bones: Short bones are weight bearing (1). Suitable examples from health and fitness activities, for example: ‘during a press up, the carpals of the wrist bear the weight of the body’ (1).

1.1.4 Types of joints

1 B
2 Hip, shoulder
3

<table>
<thead>
<tr>
<th>Joint type</th>
<th>Name of joint</th>
<th>Joint action performed when striking the ball</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hinge joint (1)</td>
<td>Knee (1)</td>
<td>Extension</td>
</tr>
<tr>
<td>Ball and socket joint (1)</td>
<td>Hip</td>
<td>Flexion (1)</td>
</tr>
</tbody>
</table>

1.1.5 Joint actions

1 D
2 Flexion and extension
3

<table>
<thead>
<tr>
<th>Joint action</th>
<th>Phase of a star jump</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abduction</td>
<td>Moving the legs away from the body during the outward phase</td>
</tr>
<tr>
<td>Adduction</td>
<td>Bringing the legs back towards the body during the inward phase</td>
</tr>
</tbody>
</table>
1.1 Extended response question

Extended response questions are marked using marking grids, which are broken down into levels, marks and descriptions. When marking, if your answer meets everything in the lowest level, move to the next one, and keep doing so until the response matches your level. You can find examples of marking grids, which are broken down into levels, on the NCFE website here: www.qualhub.co.uk/qualification-search/qualification-detail/ncfe-level-12-technical-award-in-health-and-fitness-4579#SupportMaterials

1. **Knee** – the knee is a hinge joint [1]. Hinge joint allows flexion and extension [1]. Flexion is required at the knee to pick the foot up from the floor/recovery phase [1]. Extension is required at the knee to propel the foot forward to stride out/drive phase [1].

2. **Shoulder** – the shoulder is a ball and socket joint [1]. Ball and socket joints allow flexion and extension during sprinting [1]. Flexion to drive the arm forward and upwards at the shoulder [1] and extension when bringing the arm back down [1] during the driving/pumping action of the arms when sprinting.

1.1.6 Structure of a synovial joint (the knee)

1. C
2. A is synovial fluid, B is articulating cartilage.
3. Ligaments: tough/strong/connective tissue that connects bone to bone [1]. Holds bones in place/helps with stability of the joint to prevent injury or dislocation/ensures joint performs correct actions [1].

Tendons: strong/fibrous/tough tissue that connects muscle to bone [1]. Allows muscular contraction to initiate movement of bones [1].

1.1 Structure of the spine and posture

1. B
2. Kyphosis: the curve in the thoracic region of the spine is greater than usual, making the person look ‘round shouldered’.

Scoliosis: a sideways curve of the spine.
3. Posture means the position that the body is held in when sitting, lying or standing [1]. An individual should try to retain the natural curvature of the spine [1], for example when lifting a barbell or dribbling a hockey ball, the knees should be bent to retain curvature of the spine [1]. Other suitable examples are acceptable. Poor posture can lead to injury/problems of the ligaments, tendons, muscles, bones (for example the spinal column) [1].

1.2 Muscular system

1.2.1 Types of muscle

1. B
2. Any two from:
   - Involuntary
   - Myogenic
   - Oxygen dependent

3. Award two marks for identifying the functions and two marks for the descriptions.
   - Oesophagus/stomach/small intestine – to move food through the digestive system
   - Blood vessels – to control blood flow/pressure
   - Bronchi/lungs – to control air flow in and out of the lungs.

1.2.2 Structure of the muscular system

1. A
2. 

<table>
<thead>
<tr>
<th>Muscle</th>
<th>Movement</th>
<th>Health and fitness example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bicep</td>
<td>Flexion of the elbow</td>
<td>Forehand tennis stroke</td>
</tr>
<tr>
<td>Gluteus maximus</td>
<td>Extension of the hip</td>
<td>Jumping in volleyball</td>
</tr>
<tr>
<td>Hamstrings</td>
<td>Flexion of the knee</td>
<td>Preparing to kick a football</td>
</tr>
<tr>
<td>Gastrocnemius</td>
<td>Plantar flexion of the ankle</td>
<td>Pointing the toes in gymnastics (or equivalent example)</td>
</tr>
</tbody>
</table>
Now test your self answers

1.2.3 Muscle movement and contraction
1 D
2 Agonist: quadriceps
   Antagonist: hamstrings
3
<table>
<thead>
<tr>
<th>Joint</th>
<th>Agonist</th>
<th>Antagonist</th>
<th>Type of muscle contraction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shoulder</td>
<td>Pectoralis major/deltoids</td>
<td>(isotonic)</td>
<td>eccentric</td>
</tr>
<tr>
<td>Elbow</td>
<td>Triceps</td>
<td>Biceps</td>
<td></td>
</tr>
</tbody>
</table>

1.2.4 Muscle fibre types
1 A
2 Award one mark for identifying one characteristic and one mark for its description, for example:
   - Fast/powerful contraction speed – moves the limb/body part quickly/run quicker to beat the opponents.
   - Does not use oxygen/anaerobic – energy/ATP can be generated quickly.
3
<table>
<thead>
<tr>
<th>Fibre colour</th>
<th>Fast twitch</th>
<th>Slow twitch</th>
</tr>
</thead>
<tbody>
<tr>
<td>White</td>
<td>White</td>
<td>Red</td>
</tr>
<tr>
<td>Force of contraction</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>Fatigue</td>
<td>Quick</td>
<td>Slow</td>
</tr>
<tr>
<td>Oxygen needed?</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>

 Equivalent answers are acceptable.

1.2 Indicative content:
   - Long jumper will focus on improving strength/not muscular endurance.
   - Weight training will make the long jumper stronger/more powerful/faster (power = strength × speed).
   - Need heavy weights and low reps to increase strength (not low weights and high reps).
   - Regular/long-term training leads to adaptation/hypertrophy/bigger muscles/greater muscle mass.
   - This will lead to a greater distance jumped.
   - Lifting weights that are too heavy can lead to injury/muscle damage.
   - Other training methods can also be used, such as sprints/flexibility training.

1.3 Respiratory system
1 A
2 A: nose; B: trachea
3 4 marks for seven structures identified in the correct order.
   - 3 marks for five structures identified in the correct order.
   - 2 marks for three structures identified in the correct order.
   1 mark for two structures identified in the correct order:
     - nasal cavity
     - pharynx
     - larynx
     - trachea
     - lungs
     - bronchi
     - bronchioles
     - alveoli.

1.3.2 Functions of the respiratory system
1 B
2 – The diaphragm contracts and moves down (flattens).
   – The intercostal muscles contract.
   – The ribs move up and out.
   – The thoracic cavity gets bigger.
   – Pressure inside the lungs decreases.
   – Air rushes in.
3 – Moist alveoli to assist with faster diffusion.
   – They are folded, providing a large surface area for more gaseous exchange to occur.
   – They are surrounded by many capillaries, allowing for more places/surface area for diffusion.
   – There is a short diffusion distance between the alveoli and blood capillary, allowing for faster diffusion.
   – They have very thin walls (one cell thick), allowing for faster diffusion.

1.3.3 Lung volumes
1 A
2 – Increases in depth of breathing.
   – Increase in frequency of breathing/peaks become closer together.
3 A is tidal volume, B is residual volume, C is vital capacity.
1.3 Extended response question

1 Indicative content:
   Functions of the respiratory system:
   - increased breathing rate
   - deeper breathing/increased size of thoracic cavity
   - more forceful breathing
   - additional respiratory muscles help breathing – for example, the abdominals (other suitable additional respiratory muscles are acceptable)
   - increased oxygen uptake/removal of carbon dioxide
   - increased gaseous exchange/diffusion.
   Lung volumes:
   - increased tidal volume/decrease in inspiratory and expiratory reserve volumes
   - increased minute ventilation
   - increased vital capacity.

1.4 Cardiovascular system

1.4.1 Structure and function of the blood vessels

1 D
2 – Thin walls.
   – Large lumen size.
   – They have valves.
3 – Blood is redistributed to the working muscles to provide them with more oxygen through vasodilation of blood vessels at the muscles.
   – Blood is taken away from organs such as the gut (digestive system) through vasoconstriction of blood vessels at the gut.

1.4.2 Structure of the heart

1 B
2 A is the right ventricle; B is the aorta.
3 – The heart has a double pump so that oxygenated blood and deoxygenated blood do not mix.
   – The right side of the heart carries deoxygenated blood to the lungs to remove carbon dioxide/waste.
   – The blood is also oxygenated/picks up oxygen at the lungs and is returned to the left side of the heart.
   – The left side of the heart pumps oxygenated blood around the body, where it releases oxygen/nutrients and picks up carbon dioxide/waste.

1.4.3 The cardiac cycle

1 B
2 – Atrial systole
   – Ventricular systole
   – Diastole.
3 – Blood travels through the pulmonary vein.
   – It enters the left atrium.
   – It then enters the left ventricle.
   – Finally, it is pushed through the aorta to deliver oxygen to the rest of the body.

1.4.4 Cardiovascular measurements

1 A
2 Cardiac output (CO) = stroke volume (SV) \times heart rate (HR).
3 – Stroke volume increases due to cardiac hypertrophy (bigger/stronger heart).
   – Resting heart rate decreases/heart rate is lower at any given workload due to an increase in stroke volume.

1.4.5 Blood pressure

1 A
2 Systolic and diastolic
   Systole and diastole are not acceptable.
3 Any two from:
   – Age – blood pressure increases with age.
   – Stress – increases blood pressure.
   – Diet – foods high in fat/salt/sugar can increase blood pressure. Fruits, vegetables and low-fat dairy foods can reduce blood pressure/maintain ideal blood pressure.
   – Activity levels – short-term exercise increases blood pressure/long-term exercise reduces/maintains ideal blood pressure.

1.4 Extended response question

1 Indicative content:
   – increased size of the heart/cardiac hypertrophy
   – increased stroke volume/more powerful contractions
   – decreased resting heart rate/bradycardia
   – increased maximum cardiac output
   – increased capillarisation around muscles/alveoli
   – increase in number of red blood cells/blood volume
   – reduced resting blood pressure
   – reduced recovery time from exercise/heart rate returns to resting levels quicker
   – other training methods could also be used, such as interval training.
1.5 Energy systems

1 C
2 Lactic acid; it causes muscles to fatigue/tire.
3 – High intensity.
   – Short duration.
   – Not sufficient time for oxygen to be delivered to the muscles, therefore muscles resynthesise ATP without oxygen.
   – Lactic acid is produced.

1.5 Extended response question

1 Indicative content:
   – Aerobic energy system.
   – The 1500 m event is predominantly aerobic/approximately 80%.
   – Oxygen is used/carbon dioxide is a waste product.
   – Lasts more than one minute.
   – Sub-maximal running/steady running pace.
   – Anaerobic systems make a smaller contribution/approximately 20%.
   – No oxygen used/lactic acid produced.
   – Used for quick start/change up in pace/sprint finish.
   – Limited supply/less than one minute.
   – All energy systems use/resynthesise ATP.

2.1 Effects of health and fitness activities on the body

2.1.1 Short-term effects of health and fitness activities

1 A
2 Blood pressure increases; breathing rate increases.
3 Any two from:
   – Heart rate/stroke volume/cardiac output increase – more blood containing oxygen can be pumped to the working muscles.

2.1.2 Long-term effects of health and fitness activities

1 D
2 – The heart becomes bigger and stronger and can pump more blood per beat [1].
   – Stroke volume increases/cardiac output increases [1].
   – There are more blood capillaries at the alveoli and the muscles [1] so the capillaries become better at collecting and delivering more blood containing oxygen to the working muscles so they can work for longer without tiring [1].

3 Endomorph – high body fat [1]. More calories used when exercising can reduce percentage of body fat [1].
Ectomorph – low muscle and body fat [1]. Increased load on the muscles can increase the percentage of muscle [1]. More calories used when exercising can reduce percentage of body fat further [1].

2.1 Extended response question

1 Any three long-term effects can be selected and explained. Indicative content is given in the following table:

<table>
<thead>
<tr>
<th>Long-term effect of exercise</th>
<th>Effect on the body</th>
<th>Impact on cycling performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardiovascular endurance increases</td>
<td>The heart becomes bigger/stronger, and can pump more blood per beat, there are more blood capillaries at the alveoli/muscles; these effects lead to increased delivery of blood containing glucose and oxygen to the working muscles</td>
<td>This means that the cyclist can work for longer/hill-climb more easily/race at a faster pace without tiring</td>
</tr>
<tr>
<td>Body uses oxygen more efficiently</td>
<td>The number of capillaries in the muscles increase; more blood containing oxygen can be transported to the working muscles</td>
<td>The cyclist can keep working aerobically for longer/climb hills easier/travel at a faster pace without tiring</td>
</tr>
</tbody>
</table>
### Long-term effect of exercise

<table>
<thead>
<tr>
<th>Effect on the body</th>
<th>Impact on cycling performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lower heart rate for any given workload/a greater heart-rate range</td>
<td>The cyclist will be able to work at a higher intensity/climb steeper hills/cycle faster at a lower heart rate</td>
</tr>
<tr>
<td>Muscular endurance increases</td>
<td>The cyclist can keep going for longer/hill climb/ride at a fast pace/travel further without tiring</td>
</tr>
<tr>
<td>Muscular strength and size (hypertrophy) increases</td>
<td>Cyclist can sprint faster to outpace an opponent over a short race/at end of long race/climb short hills faster</td>
</tr>
<tr>
<td>Number of red blood cells increases</td>
<td>Cyclist can go for longer without tiring/hill climb for longer/race at a faster pace for longer</td>
</tr>
<tr>
<td>Flexibility increases</td>
<td>The cyclist can adopt a streamlined position more easily for a faster pace</td>
</tr>
<tr>
<td>aat increased capacity for delivering oxygenated blood to the working muscles</td>
<td>Reduced likelihood of injury means training can continue and fitness levels can continue to increase/be maintained.</td>
</tr>
<tr>
<td>Body shape changes</td>
<td>Less body weight to carry will mean a faster time can be achieved</td>
</tr>
<tr>
<td></td>
<td>Increased muscle mass means sprints can be quicker due to the generation of greater power</td>
</tr>
</tbody>
</table>

### 3.1 Health and fitness

1. B

2. Fitness is being able to cope with the demands of the environment that an individual lives within [1]. Different individuals live in different environments with different demands [1]. For example, an Olympic marathon runner’s environment will be much more physically demanding than the environment of a recreational badminton player [1].

3. **Fit with poor physical health** [1], for example an athlete with diabetes/asthma can have a very high level of cardiovascular endurance but be described as having poor physical health [1].

4. **Fit with poor mental health** [1], for example an athlete may suffer with anxiety/depression/high stress levels, but rows regularly and has a high level of cardiovascular endurance [1].

5. **Fit with poor social health** [1], for example an individual may swim regularly with a high level of cardiovascular endurance but have no friends/find interaction with others difficult/lack of confidence around other people [1].

   Other suitable examples for each category are acceptable.

### 3.2 Components of fitness

#### 3.2.1 Components of health-related fitness

1. A

2. A long-distance runner needs a high level of cardiovascular endurance to be able to supply the working muscles with sufficient oxygen [1] to keep on running at a consistently fast pace for a long period of time without tiring [1].

3. **Muscular endurance** – the ability of a muscle/group of muscles to make repeated contractions over a prolonged period of time, without tiring [1]. **Examples**: a rower must use muscles of the arms and shoulders to keep pulling on the oar many times without tiring to maintain a good pace throughout the race [1]; a cyclist must keep using muscles of legs/gluteals to keep turning the pedals many times without tiring to maintain a good pace throughout the race [1].

   **Cardiovascular endurance** – the ability of the heart, blood and blood vessels to continually supply the working muscles with blood containing oxygen so an individual can continue to exercise.
3.2.2 Skill-related fitness

1 B

2

<table>
<thead>
<tr>
<th>Sports performer</th>
<th>Skill-related fitness component most important</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sprinter</td>
<td>Speed</td>
</tr>
<tr>
<td>Shot putter</td>
<td>Power</td>
</tr>
</tbody>
</table>

3 Any two from:
- **Agility** – to be able to change the position of the body quickly to create the Fosbury Flop shape from a running position to clear the bar.
- **Speed** – for a fast run up to generate the height needed to clear the bar.
- **Co-ordination** – to use the arms/legs/back/neck at the same time to create the correct shape to clear the bar. To use the arms/legs/eyes at the same time to observe and travel towards the bar whilst performing the running action.
- **Power** – to have sufficient strength and speed to create enough height to clear the bar.
- **Balance (dynamic)** – to maintain the correct position of the body during run up/take off/flight.

3.2 Extended response question

1 Content of response:
- Balance is maintaining stability of the body during a sporting performance. There are two types: static (still) and dynamic (during motion).
- Gymnasts need good static balance to hold difficult positions such as the handstand with splits on the beam.
- Gymnasts need good dynamic balance to stay on the beam during and between moves without falling off.
- If Natasha has a high level of balance, she is likely to score more points.
- Balance is more important than cardiovascular endurance for the beam routine.
- Cardiovascular endurance is the ability of the heart, blood and blood vessels to continually supply the working muscles with blood (containing glucose and oxygen) so an individual can continue to exercise the whole body, without tiring.

4.1 Principles of training

4.1.1 The principles of training – SPORT

1 D

2 Specificity – making your training match/suit your sport/the performer’s needs

- **Overload** – making the body work harder than it normally does.

3 Specificity (1); performing weight training/squats to strengthen leg and gluteal muscles, which are used when jumping high (1).

Reversibility (1); Ethan had to stop training because of injury and he can now only squat with 35 kg (1).

4.1.2 Principles of FITT

1 D

2 Time – he could increase the time so he cycles for to 5.5 miles/6 miles.

Intensity – he could choose a more hilly route/cycle faster/cycle in a higher gear.

3 Frequency – Edie goes twice a week

Time – Edie rows for 20 minutes each session

4.1 Extended response question

1 Possible content:
- **Specificity** – making training match/suit the sport/component of fitness/individual needs of the performer. Train to improve cardiovascular endurance to improve bleep test score. Continuous training/fartlek/running activity suitable.
- **Progression** – gradually increasing the workload – for example, start training at a short distance and then increase the distance run when this becomes easy (for example, two miles increasing to three miles, or other suitable example). This will increase cardiovascular endurance as the body will adapt to new demands placed on it.
- **Overload** – making training harder/use FITT principle. Over time, increase the distance run/pace of run when training becomes easy (for
example, run at 75 per cent MHR rather than 65 per cent, or other suitable example). This will increase cardiovascular endurance as the body will adapt to new demands placed on it.

- **Reversibility** – if you stop/reduce level of training, fitness gains may be lost/reduced. Train progressively/with rest days. This will reduce chances of injury/enable body sufficient time to recover/adapt.
- **Tedium** – make training interesting to avoid boredom. Combine fartlek/continuous/cross training. Motivation levels will be higher and increased chances for cardiovascular endurance to improve.

**FITT** may be covered during discussion of overload above:

- **Frequency** (how often you train): increase number of training sessions in a week, for example from two to three sessions.
- **Intensity** (how hard you train): increase MHR percentage when sessions become easy (65–75 per cent); train over more hilly terrain/faster pace. Cardiovascular endurance will be improved as the body will adapt to increased demands placed on it.
- **Time** (how long you train for): increase the duration of training when session becomes easy, for example increase running time from 20 to 30 minutes. Cardiovascular endurance will be improved as the body will adapt to increased demands placed on it.
- **Type** (which method of training you use): continuous/fartlek would develop cardiovascular endurance. Running is relevant to the bleep test.