BTEC Level 1/2 First Award in Sport

Unit 1: Fitness for Sport and Exercise

Revision Guide

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Unit 1: Fitness for Sport and Exercise Revision Guide

BTEC Sport Tracking Sheet

Learning Aim A: know about the components of fitness and the principles of training

Activity	**Score**	**How can I Close the Gap?**	
A.1 Activities	**/**		
A.2 Activities	**/**		
A.3 Activities	**/**		
A.4 Activities	**/**		
A.5 Activities	**/**		
A.6 Activities	**/**		
Learning Aim A Test	**/**		**/**

Learning Aim B: explore different fitness training methods

Activity	**Score**	**How can I Close the Gap?**	
B1-B.3 Activities	**/**		
B.1–B.3 a Activities	**/**		
B.1–B.3 b Activities	**/**		
B.1–B.3 c Activities	**/**		
Learning Aim B Test	**/**		**/**

Learning Aim C: investigate fitness testing to determine fitness levels

Activity	**Score**	**How can I Close the Gap?**	
C.1 Activities	**/**		
C.2 Activities	**/**		
C.3 and C.4 Activities	**/**		
Learning Aim C Test	**/**		**/**
MOCK Exam Paper			
Practice Mock Paper 1	**/**		
Practice Mock Paper 2	**/**		

Contents

Key:

Learning Objective

Activity Questions

Learning Aim: A

Topic A.1: Components of Physical Fitness

LEARNING OBJECTIVE:

The objective of this section is to learn about the **six different components** of physical fitness.

KNOWLEDGE CHECKLIST

- Know what *aerobic endurance* means ❑
- Know the different names for aerobic endurance ❑
- Know what the cardiorespiratory system does, and that is it is made up of the cardiovascular system and the respiratory system ❑
- Know what *muscular endurance* means ❑
- Know what *flexibility* means ❑
- Know what *speed* means ❑
- Be able to describe the three different types of speed ❑
- Know what *muscular strength* means ❑
- Know what *body composition* means ❑
- Be able to give examples of different sports which need each component of fitness ❑

Aerobic Endurance

What is it?
The ability of the cardiorespiratory system to deliver oxygen and nutrients to working muscles.

Sports that require a lot of running require good aerobic endurance, such as marathon running, football and hockey.

What is the cardiorespiratory system?
It is made up of:

- The cardiovascular system (heart, blood and blood vessels)
- The respiratory system (lungs and airways)

It allows us to take oxygen from the air when we breathe in and transport it to workin g muscles. It also transports nutrients to muscles, and takes waste products such as carbon dioxide away from muscles.

Muscular Endurance

What is it?
The capability of muscles to undergo a number of contractions over a long period of time against a resistance.

It is needed for sports that last a long time, such as long-distance running, cycling and rowing.

Flexibility

What is it?
The ability to move a joint easily through its complete range of movement.

Gymnastics, martial arts, and yoga require flexibility.

Speed

What is it?
The distance covered in a certain amount of time, e.g. 'what was his maximum speed during the race?', or the ability to move body parts quickly, e.g. 'he will win the race because his speed is fast'.

$$\text{Speed (m/s)} = \frac{\text{Distance (m)}}{\text{Time (s)}}$$

There are three different types:
- Accelerative speed: up to 30 m sprinting
- Pure speed: up to 60 m sprinting
- Speed endurance: short recovery periods between sprints

Muscular Strength

What is it?
The maximum force that can be exerted by a muscle or group of muscles.

It is measured in kg or N.

Most sports would benefit from muscular strength, but particularly weightlifting and contact sports, such as boxing.

Body Composition

What is it?
The amount of body fat in the body compared to the mass of vital organs, muscle, and bone.

Different sports benefit from different body compositions. For example, a discus thrower would benefit from having a strong, muscular body, whereas a ballet dancer would benefit from having a lean, flexible body.

A.1 Activities:

1. Match up the components of physical fitness with the correct definitions:

Muscular endurance	The ability of the cardiorespiratory system to deliver oxygen and nutrients to working muscles
Flexibility	The proportion of body fat mass compared to the mass of vital organs, muscle and bone
Muscular strength	The distance covered in a certain amount of time
Aerobic endurance	The ability to move a joint easily through its complete range of movement
Body composition	The maximum force that can be exerted by a muscle or group of muscles
Speed	The capability of muscles to undergo a number of contractions over a long period of time against a resistance

2. For each of the components of physical fitness, suggest a sport that would benefit from it, and explain why.

Component of physical fitness	Sport	Why?
Muscular endurance		
Flexibility		
Muscular strength		
Aerobic endurance		
Body composition		
Speed		

Exam Questions

3. a) A gymnast is finding it difficult to perform some complex moves because they cannot bend their limbs far enough. Which physical fitness component do they need to improve?

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(1 mark)

b) Aerobic endurance is an important component of physical fitness for team games. Explain how a hockey player would benefit from having good aerobic endurance.

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(2 marks)

Topic A.2: Components of Skill-Related Fitness

LEARNING OBJECTIVE:

The objective of this section is to learn about the five different skill-related fitness components, and recognise which fitness components are required for different sports.

KNOWLEDGE CHECKLIST

- Know what *agility* means ❑
- Know what *balance* means ❑
- Be able to describe and give examples of the two different types of balance ❑
- Know what *coordination* means ❑
- Know what *power* means ❑
- Be able to express power as a formula ❑
- Know what *reaction time* means ❑
- Know which sports need which different types of skill-related fitness ❑

Agility

What is it?
The ability to change direction quickly without losing balance.

Team sports, such as netball, rugby and football, and racquet sports, such as tennis and squash, require agility.

Balance

What is it?
The ability to remain upright and steady by positioning the body's centre of mass over the base of support

There are two different types:

- Dynamic balance: maintaining balance during movement, such as while riding a bike.
- Static balance: maintaining balance while not moving, such as during a headstand.

Balance is particularly important for gymnastics, but also for cycling, martial arts, and figure skating.

Coordination

What is it?
The ability to use at least two body parts together, and produce a flowing movement efficiently and accurately. Efficient movements waste less energy and accurate movements improve performance.

Sports that involve use of balls particularly require good co-ordination. For example, racquet sports require coordination of the hands, eyes and racquet in order to connect with the incoming ball.

Reaction Time

What is it?
The time taken between identifying a stimulus (such as hearing the starting pistol in a 100 m sprint) and producing a reaction (such as leaving the starting blocks).

Power

What is it?
The product of speed and strength.

$$\text{Power (watts)} = \frac{\text{Work done (joules)}}{\text{Time taken (s)}}$$

Most sports require power, but particularly sprinting, weightlifting, and tennis.

A.2 Activities:

1. Unscramble the following to reveal the different skill-related fitness components:

YGTAIIL .....

ECLABNA .....

NDIOTARNCOOI .....

EPWOR .....

OENIATRC EITM .....

2. Read the following case study and answer the questions:

Joe is 14 years old and has played for his local tennis club since he was 10. He has also started playing for his secondary school club. Since he has started practising twice a week, he has noticed that he is able to react more quickly to serves and hits by his opponent, and he is able to move around the court more quickly so he doesn't miss the ball as often. However, he is still struggling to hit the ball hard, so he often hits it into the net. He also finds that he gets tired quickly during a game.

a) Which components of fitness are important for a tennis player?

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b) Which components of fitness has Joe developed since he has been training twice a week?

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c) Which components of fitness does Joe need to improve?

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A.2 Activities:

Exam Question

3. a) A goalkeeper moves quickly once the penalty has been taken to save the ball. Which skill-related fitness component is being described here? Tick the box next to the correct answer.

Flexibility	☐
Balance	☐
Reaction time	☐
Power	☐

(1 mark)

b) Explain why power is an important skill-related component of fitness for a sprinter.

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(3 marks)

Topic A.3: Why Fitness Components are Important for Successful Participation in Given Sports

LEARNING OBJECTIVE

The aim of this section is to understand why fitness components are important to meet the physical and skill-related demands of different sports in order to achieve your best performance. You should also consider how different events and different playing positions have different requirements.

KNOWLEDGE CHECKLIST

- Understand the importance of fitness components to meet the physical demands of different sports and perform as well as you can. ❑
- Understand the importance of fitness components to meet the skill-related demands of different sports and perform as well as you can. ❑
- Understand the importance of fitness components for an efficient performance (efficient performances save time and energy). ❑
- Understand the importance of fitness components for successful participation in different events and in different positions. ❑

Marathon Running

Physical fitness components:

- Aerobic endurance: marathons usually last hours, and the working muscles require a constant supply of oxygen and nutrients for aerobic respiration.
- Muscular endurance: for repeated contraction of muscles over a long period of time.
- Strength: because the runner needs to support their own body weight and apply force to the ground over a long period of time.
- Body composition: a tall, lean body shape is most suited to marathon running.

Rugby

Physical fitness components:

- Aerobic endurance: rugby games last 80 minutes, and involve a lot of running.
- Muscular endurance: rugby games are very physical, and require muscular action for running, kicking, tackling etc.
- Speed: players that can run fast will be able to run quicker from defenders and towards their try line.
- Strength: rugby is a contact sport, so strength is required to compete with opponents.
- Body composition: rugby players benefit from a muscular body shape.

Skill-related fitness components:

- Agility: players need to manoeuvre around opponents to avoid being tackled.
- Coordination: rugby involves multitasking, such as running and kicking the ball, receiving a pass on the run whilst looking around to see the positions of opponents, etc.
- Power: players need power to dominate their opponents, particularly during the scrum.

Different positions:

- Different players benefit from different fitness components. For example, forwards benefit from strength, whereas back players benefit more from speed and agility.

Basketball

Physical fitness components:

- Aerobic endurance: basketball games usually last about 48 minutes, and involve a lot of running.
- Muscular endurance: repeated contraction of muscles is required for running around the court and bouncing the ball.
- Speed: it is beneficial for players to be able to move quickly round the court.
- Flexibility: flexible players are able to dribble around opponents better, avoid blocks from defenders, and perform a better jump shot.
- Body composition: height is particularly important for basketball players, who tend to be tall, lean and muscular.

Skill-related fitness components:

- Agility: it is important for players to be able to change direction quickly in order to dribble around opponents.
- Coordination: basketball players need to concentrate on dribbling the ball at the same time as moving and looking around the court.
- Reaction time: basketball is a fast-paced game so it is important to be able to react quickly to receive a pass, block a shot etc.

Different positions:

- Attackers particularly benefit from being tall because it makes it easier for them to score.

Long Jump

Physical fitness components:

- Speed: the greater the speed of the run up, the greater the distance travelled during the jump will be.
- Flexibility: this helps with the sprinting during the run up, and also helps prevent injury.

Skill-related fitness components:

- Power: greater power at take-off increases the height of the jump, so the distance travelled increases.

Golf

Physical fitness components:

- Flexibility: golf requires repeated rotation, particularly in the hips and lower back.
  Flexibility helps to avoid injury.
- Strength: strength is required to hit the ball a long way and help lower your score.

Skill-related components:

- Power: a golf swing requires a large force to be exerted quickly.
- Balance: without balance the golf swing will not be smooth and less power will be generated.
- Coordination: good hand-eye coordination is required in order to make good contact with the ball.

Football

Physical fitness components:

- Aerobic endurance: matches last 90 minutes and involve a lot of running.
- Muscular endurance: football requires bursts of activity followed by periods of rest. Muscular endurance is required to prevent fatigue and injury.
- Flexibility: flexibility is required, particularly in the hips, to allow a full range of motion, fluid movements, and to prevent injury.
- Speed: fast players are more able to escape their marker and run towards the goal.

Skill-related fitness components:

- Coordination: players are required to control the ball at the same time as looking for options to pass and avoiding defenders.
- Power: powerful shots, crosses and headers are harder to stop.
  Power is also required for sprinting.

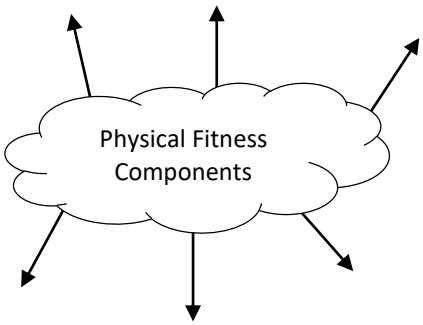
Different positions:

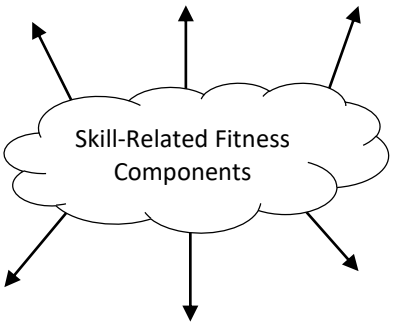
- Aerobic endurance is more important for outfield players than the goalkeeper.
- Speed and agility is more important for attacking players than defenders.
- Flexibility, agility, coordination and reaction time are particularly important for the goalkeeper.

A.3 Activities:

1. For a sport of your choice, complete the spider diagram below, identifying the different physical and skill-related fitness components required for optimal and efficient performance in that sport. Give a short explanation of why each component is important.

   Chosen Sport: .....





2. For a sport of your choice, explain how different playing positions require different fitness components in order to achieve optimal, efficient performance.

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Exam Question

3. a) The people in the picture below are running a marathon. Draw a line from the picture to the required fitness components.

Flexibility

Aerobic endurance

Coordination

Reaction time

Muscular endurance

Strength

(3 marks)

b) Explain how different players from different positions in a football team will benefit from different fitness components.

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(3 marks)

Topic A.4: Exercise Intensity and How it Can be Determined

LEARNING OBJECTIVE:

The objective of this section is to understand how heart rate and RPE can be used to determine exercise intensity, and how training zones and thresholds can be calculated using heart rate. Note: intensity refers to the level of training, or how difficult it is.

KNOWLEDGE CHECKLIST

- Be able to measure heart rate ❑
- Know how to calculate maximum heart rate and apply it to training ❑
- Know how to calculate target training zones and training thresholds ❑
- Be able to calculate the recommended training zone for cardiovascular health and fitness ❑
- Know that the rating of perceived exertion (RPE) scale can be used to measure exercise intensity ❑
- Understand the relationship between RPE and heart rate ❑

Heart Rate

What is it?
The number of heart beats per minute (bpm).

How is it measured?
a) By gently pressing the wrist with the index and middle fingers (as shown in the picture) and counting the number of pulses in one minute.
b) By wearing a heart rate monitor.

How do we calculate maximum heart rate (HR max)?
HR max = 220 – age (in years)

E.g. Calculate the HR max of an 18-year-old.
220 – 18 = 202 bpm

Target Training Zones and Thresholds

- The recommended training zone for cardiovascular health and fitness is 60–85% HR max.
- The lower threshold is 60% and the upper threshold is 85%.
- People training below the lower threshold are unlikely to get fitter, and people training above the upper threshold are more likely to get injured.

E.g. Calculate the recommended training zone for an individual with a HR max of 206 bpm.

60% of 206 = (60 ÷ 100) × 206 = 123.6

85% of 206 = (85 ÷ 100) × 206 = 175.1

Training zone = 124 – 175 bpm

6	No exertion
7	Extremely light
8	
9	Very light
10	
11	Light
12	
13	Somewhat hard
14	
15	Hard
16	
17	Very hard
18	
19	Extremely hard
20	Maximal exertion

The Borg Scale

- Also called the rating of perceived exertion scale (RPE).
- The athlete points to the position on the scale that indicates how hard they feel they are working, which is used to provide a measure of exercise intensity.
- For example, if an individual points to number 17 on the 6–20 Borg scale, it indicates that they feel they are working very hard.
- RPE is related to the individual's heart rate: RPE × 10 = HR (bpm). So in the example above, if you took the individual's heart rate it would be around 170 bpm.

A diagram of the Borg scale is shown to the right.

A.4 Activities:

1. Explain how heart rate can be measured.

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2. How can the Borg rating of perceived exertion (RPE) scale be used to estimate an individual's heart rate?

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Exam Questions

3. a) Calculate the recommended training zone for a 17 year old.

(4 marks)

b) Explain what a Borg scale is used for.

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(2 marks)

Topic A.5: The Basic Principles of Training (FITT)

LEARNING OBJECTIVES:

The main objective of this section is to understand how the basic (FITT) principles of training can be used to help plan an exercise or training programme.

The FITT principles are linked with **progressive overload**. Once the body adapts to training and you get fitter, the frequency, intensity and time spent training in a certain type of activity can be increased to overload the system.

KNOWLEDGE CHECKLIST

- Know what frequency means ❑
- Know what intensity means ❑
- Know what time means ❑
- Know what type means ❑
- Be able to apply the FITT principles to training and exercise situations ❑

F	**Frequency**	▪ How regularly we train (number of sessions per week). ▪ Should be a minimum of three times a week, but can be increased as you get fitter.
I	**Intensity**	▪ How hard we train. ▪ Intensity of training depends on the aims and type of training. ▪ A minimum intensity is required to achieve improvements in fitness. ▪ Training at too high an intensity can cause injury.
T	**Time**	▪ How long we train for. ▪ In order to improve cardiovascular fitness, a minimum of 20 minutes should be spent training in the target zone, between the warm-up and the cool-down. ▪ Longer than 20 minutes training in the target zone will be required to reach the required level of fitness for professional sport.
T	**Type**	▪ The method of training used to achieve particular goals. ▪ Training should be specific to what needs to be improved. ▪ This is more important for athletes who specialise in a particular event. For example, weightlifters should focus on strength training. ▪ People who are just trying to increase their overall fitness can choose from a variety of different types of activity, such as swimming, cycling and aerobics.

A.5 Activities:

1. Fill in the gaps in the passage below:

   Frequency refers to the number of …… per week, and should be a minimum of …….. times. …….. refers to how hard we train, and should be high enough to achieve improvements in …… . Time refers to how …….. we train for, and should be a minimum of …… minutes. Type refers to the method of training used to achieve particular …….. .

2. A new hockey team has been set up in the local area. Most of the players haven't played for a while and are feeling unfit. There are eight weeks to go before the start of the season. Imagine you are going to be coaching this team, and create a training programme using the basic (FITT) principles of training. Justify your choices.

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Exam Questions

3. a) A youth football player has not been performing well in recent matches. Their coach tells them that they need to work harder at training. Which basic principle is the coach referring to?

   Frequency ☐ Intensity ☐ Time ☐ Type ☐

   (1 mark)

   b) Choose from the options below and write the correct principle of training in the spaces.

   Frequency *Intensity* *Time* *Type*

   …….. refers to how hard we train.

   …….. refers to the method of training used.

   (2 marks)

Topic A.6: Additional Principles of Training

LEARNING OBJECTIVES:

The main objective of this section is to understand how the additional principles of training can be used to help plan an exercise or training programme.

KNOWLEDGE CHECKLIST

- Know what *progressive overload* means ❑
- Know what *specificity* means ❑
- Know what *individual differences and* needs are ❑
- Know what *adaptation* means and when it occurs ❑
- Know what *reversibility* means ❑
- Understand the importance of variation ❑
- Understand the importance of *rest* and recovery ❑
- Be able to apply the above principles of training to training and exercise situations ❑

Progressive Overload	**Specificity**
• Training needs to be gradually increased so that it is demanding enough for the body to adapt and for fitness to improve. • It can be achieved by increasing any of the FITT principles. • *E.g. reviewing a six-week training programme every two weeks and gradually increasing the intensity.* • Note: it does **not** mean training too hard!	• Training should be specific to the requirements of the activity. • *E.g. cardiovascular fitness training is important for most team sports, such as hockey, football and rugby, but is of little benefit for athletic field events, such as shot put and discus.*
Individual Differences/Needs	**Rest and Recovery**
• Individual needs must be taken into consideration when planning a personal exercise programme. • The individual's body build, fitness levels, and personal aims must be taken into consideration. • *E.g. an elderly person should not follow the same programme as an adolescent because they will not be as fit and are likely to become injured.*	• It is important to have adequate periods of rest between training sessions in order to allow the body to recover. • Recovery involves the repair of damage to the body that has occurred during training or competition. • Adaptation occurs during the recovery period. This is where the body responds to training by increasing its ability to cope with future training.
Reversibility	**Variation**
• If you stop training or reduce the intensity of training, any adaptations that had taken place will be lost. • This can happen if you are unable to train due to illness or injury. • Fitness levels will decrease.	• Training sessions should be varied to make sure that those taking part do not experience boredom. • Boredom (or tedium) will mean that participants no longer enjoy training. • *E.g. a coach who uses different drills and activities each week is more likely to keep the participants interested than a coach who uses the same routine each week.*

A.6 Activities:

1. Match the following coaching methods with the correct principle of training:

The number of training sessions per week is increased from two to three.	Reversibility
There is a minimum of one day between each training session.	Individual needs/differences
A netball player is unable to train for six weeks after spraining her ankle. When she goes back to training she feels less fit.	Progressive overload
Two brothers are training to run a marathon; one has run a marathon before but the other hasn't. They have different training programmes.	Specificity
A goalkeeper coach trains the goalkeeper, while the rest of the team do fitness training.	Variation
Each week the coach uses different drills and activities to keep the participants interested.	Rest and recovery

Exam Questions

2. a) Explain why it is important for a training programme to include adequate periods of rest.

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(4 marks)

b) A netball coach encourages players to train every week so that they keep their fitness levels high. Which additional principle of training does this refer to?

Variation ☐ Reversibility ☐ Progressive overload ☐ Specificity ☐

(1 mark)

Learning Aim A Test Score:	**Remark Score:**
H2I (How to Improve)	
Extension Questions from the Activities:	

Learning Aim: B

Topic B.1: Warm-Up and Cool-Down

LEARNING OBJECTIVE:

The main objective of this section is to learn about the importance of a warm-up and a cool-down in a training session, and what they should include.

KNOWLEDGE CHECKLIST

- Understand the importance of a warm-up and cool-down before any fitness training ❑
- Be able to describe what a warm-up and cool-down should include ❑

All training sessions should begin with a warm-up and end with a cool-down.

A typical training session would be split into stages as follows:

Warm-up Stage 1	Fitness/Exercise Stage 2	Skill Stage 3	Cool-down Stage 4

Warm-Up

Why is it important?

- It increases the heart rate and breathing rate so the body is physically prepared for activity, and activates the nervous system allowing for mental preparation.
- It lowers the likelihood of injury.

What should it include?

- Continuous movement, such as a jog, to increase the heart rate.
- Gentle exercises which aim to work certain muscle groups.
- Stretching of specific muscles and main joints.

What affects the length and type of warm-up?

- The activity type, e.g. some activities which have more distractions may require more mental rehearsal.
- The temperature, e.g. when it is cold, more time should be spent making sure the muscles are suitably warm.

Cool-Down

Why is it important?

- It enables body temperature to reduce gradually back to normal.
- It enables the heart rate to be lowered to resting heart rate.
- It helps rid the body of lactic acid and therefore reduce muscular pain.
- It helps prevent aching the following day.

What should it include?

- Activities similar to the warm-up activities.

B.1 Activities:

1. You have been asked to lead the warm-up at your next rugby training session. Write a plan, highlighting what the warm-up will include.

2. Explain to your team why it is important to do a cool-down at the end of a training session.

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Exam Questions

3. a) Explain why it is important to do a warm-up before any physical exercise.

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(3 marks)

b) Explain why some activities require a longer warm-up than others.

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(2 marks)

Topic B.1-B.3: Fitness Training Methods and their Requirements

LEARNING OBJECTIVE:

The main objective of this section is to learn about the different methods of fitness training, including how they should be performed safely and correctly, which fitness components they are associated with, their advantages and disadvantages. This section also looks at how the basic (FITT) principles of training can be applied and how goals can be set for each fitness training method.

KNOWLEDGE CHECKLIST

- Know which equipment is required for each fitness training method, and how it is used safely and correctly ❑
- Know what techniques are required for each fitness training method, and how they are carried out safely and correctly ❑
- Be able to apply the basic (FITT) principles of training for each fitness training method Link each fitness training method with the associated fitness component ❑
- Be able to identify advantages and disadvantages of each fitness training method ❑
- Be able to set goals, aims and objectives related to each fitness training method ❑

This section is divided into four sections:

- B.1–B.3 a – Flexibility Training
- B.1–B.3 b – Strength, Muscular Endurance and Power Training
- B.1–B.3 c – Aerobic Endurance Training
- B.1–B.3 d – Speed Training

B.1–B.3 a: Flexibility Training

What equipment is required?

- Can be performed without equipment.
- Some stretches require another person for assistance.
- Some stretches require objects to push against, such as a wall.

What is the training technique?

There are three different types of flexibility training.

1. **Static Stretching:** A stretch which is held for a roughly 30 seconds, such as the triceps stretch. It can be active or passive. Active stretching involves the performer applying internal force to stretch the muscle, whereas passive stretching involves the performer using another person or an object to apply an externalforce causing the muscle to stretch. Passive static stretching is alsoknown as assisted static stretching.

2. **Ballistic Stretching** involves stretching joints through the complete range of motion by completing fast and bouncy movements. The stretches are specific to the movements required in the sport that is going to be performed. Ballistic stretching must be completed carefully because there is a risk of injury!

3. **Proprioceptive Neuromuscular Facilitation (PNF) Stretching** requires assistance from a partner or immovable object to provide resistance to movement. The first stage involves the performer stretching the muscle to the upper limit of its range of motion. They are then required to hold the muscle in an isometric contraction, using the help of their partner, for 6–10 seconds. During this stage the muscle is not being actively shortened or lengthened. The performer then relaxes the muscle before performing a static pressure stretch with the help of their partner. This process inhibits the stretch reflex, which allows the muscles to be stretched even further.

Passive stretch

Contract against resistance

Relax passive stretch

Which fitness components are associated with flexibility training?

Flexibility!

It is beneficial to be flexible for most sports, but it is particularly important for gymnasts, divers and ballet dancers to do flexibility training.

Application of the basic (FITT) principles of training:

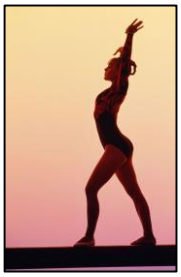
- **Frequency:** The number of training sessions should be increased gradually to avoid injury.
- **Intensity:** The intensity of training can be gradually increased to widen the range of motion of a joint without causing injury. For example, during passive static stretching the partner can push the stretch slightly harder.
- **Time:** The time that each stretch is held for can be gradually increased, and the overall time spent doing flexibility training can be increased.
- **Type:** The type of flexibility training used will depend on the situation. For example, if there is no other person or object available, static passive stretching will not be possible. PNF stretching is more advanced, so will probably be used later in the training programme.

Advantages: It improves the joint range of motion which makes it easier to perform movements and reduces risk of injury.

Disadvantages: Overstretching or bouncing on a stretch (ballistic stretching) can cause injury.

Example of a situation which would require flexibility training

A gymnast has just started competing and wants to be able to perform more complex moves.



B.1-B.3 a Activities:

1. Complete the table below by filling in either the name, description, or an example of the stretching technique.

Name of Technique	Description	Example
Static stretching	Held for roughly 30 seconds. It can be active or passive.	
	Increasing the range of a stretch by performing bouncing movements.	Performing a kicking action repeatedly to stretch the hamstring.
PNF stretching		Lying on your back with one leg raised and a partner pushing the raised leg backwards.

2. Give an example of a situation in which flexibility training can be applied.

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Exam Questions

3. a) Explain the advantages and disadvantages of flexibility training.

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(3 marks)

b) Write the type of stretching that is being performed in the pictures below:

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(2 marks)

B.1–B.3 b: Strength, Muscular Endurance and Power Training

What equipment is required?

- Some types of strength training can be performed with no equipment, e.g. press-ups.
- Some types of strength training require basic equipment, such as objects to jump over for plyometric training.
- Weights are commonly used for strength training.
- Gyms and fitness suites have resistance machines for strength training.

1. Free Weights

Using free weights involves lifting barbells or dumb-bells either standing up or lying on a bench or table. Sometimes a training partner is required to help lift the weights and prevent injury.

Some useful definitions:

- Repetitions: A repetition refers to performing the particular movement, such as a bicep curl, once.
- Sets: A set is made up of a number of repetitions, for example, 15 bicep curls.
- One repetition max (or 1 RM): The maximum weight that can be lifted in one go.
- Intensity: a percentage of 1 RM, e.g. 'I am working at an exercise intensity of 6% of my 1 RM'.

Training Technique:

- Core exercises should be completed before assistance exercises; this involves working muscles which stabilise the spine and pelvis before working muscles associated with your specific sport.
- When training for strength endurance, use high reps and low loads, e.g. 20 reps at 50–60% 1 RM.
- When training for elastic strength, use medium reps and medium loads, e.g. 12 reps at 75% 1 RM.
- When training for maximum strength, use low reps and high loads, e.g. 6 reps at 90% 1 RM.

Which fitness components are associated with free weights?

- Mostly strength
- Also muscular endurance and power

Advantages:

- Increases in strength are beneficial for most sports, but particularly wrestling and Olympic weightlifting.

Disadvantages:

- It can be dangerous if equipment is not used correctly**.**
- It requires a 'training partner'.

2. Circuit Training

Training Technique
- Involves moving around different stations which make up a circuit.
- Different exercises are performed at each station using different pieces of equipment.
- For strength, muscular endurance and power training, a weights circuit would be used.
- An example of an exercise performed at one station would be to do 20 bicep curls.
- The exercises performed at each station use different muscles, to stop the individual getting tired.

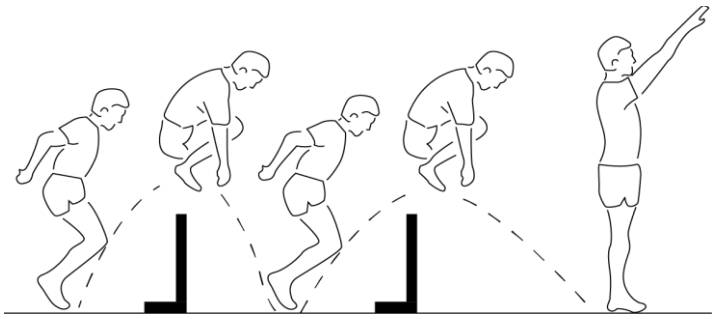
Which fitness components are associated with circuit training?
- Particularly muscular endurance
- Also strength and power

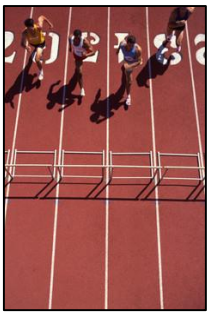
Advantages:
- Muscular endurance is beneficial for many sports, particularly those lasting a long time, such as marathon running.
- Circuit training is adaptable and can be changed to suit the individual's needs.

Disadvantages:
- It requires a lot of equipment compared to other methods.

3. Plyometrics

Training Technique:
- Involves jumping movements to allow a quick contraction after muscle loading. The muscle lengthens (eccentric action) and is immediately followed by the muscle shortening (concentric action).
- It helps you increase the speed of muscular contractions.
- Examples of plyometric exercises include jumping, bounding, lunging, incline press-ups, and barrier hopping.





Which fitness components are associated with plyometrics?
- Mainly sport-specific explosive power and strength.

Advantages:
- Explosive power is beneficial for many sports performers, including sprinters, hurdlers, and basketball players.

Disadvantages:
- It can cause muscle soreness and injury if it is not performed correctly.

Application of the basic (FITT) principles of training:

	Circuit Training	Free Weights	Plyometrics
Frequency	Can increase the number of training sessions per week, the number of stations in a circuit, or the number of circuits.	Can increase the number of training sessions per week, or the number of repetitions or sets performed in a session.	Can increase the number of training sessions per week.
Intensity	Can make the exercises performed at each station more strenuous.	Can lift heavier weights (work at a higher % of 1 RM).	Can make the jump higher.
Time	Can lengthen the training session, increase the length of time spent at each station, or reduce the rest time between stations.	Can lengthen the training session, or hold a weight for longer.	Can lengthen the training session.
Type	Can change the exercises performed at each station.	Core exercises should be used for core stability, and assistance exercises should be used for working sport-specific muscles. When training for strength use low reps and high loads, for endurance use high reps and low loads, and for elastic strength use moderate reps and loads.	Can perform different plyometric exercises depending on where you are trying to increase power, e.g. lower-body or upper-body exercises.

Example of a situation which would require strength, muscular endurance or power training:

A university student has recently joined the rowing team, but he has never rowed before so his upper arms are weak. He wants to be able to keep up with the rest of the team.

B.1-B.3 b Activities:

1. Circle the correct fitness components that are associated with strength training.

Aerobic endurance	Flexibility	Power	Coordination
Strength	Muscular endurance	Reaction time	Agility

2. Explain how the frequency principle can be applied to strength, muscular endurance and power training.

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Exam Questions

3. a) An athlete is trying to increase their elastic strength. Select the correct combination of intensity and frequency that they should use:

90% 1 RM and 6 reps	☐
75% 1 RM and 12 reps	☐
50–60% 1 RM and 20 reps	☐
20% 1 RM and 40 reps	☐

b) Explain the purpose of plyometric training and how it works.

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(4 marks)

B.1–B.3 c: Aerobic Endurance Training

What equipment is required?

- Some types of aerobic endurance training methods don't require any specialist equipment, such as jogging.
- Some types of aerobic training methods require equipment, such as a bike, or facilities, such as a swimming pool.
- Fartlek training can require different terrains and specialist equipment, such as a harness or weights.

1. Continuous Training

Training Technique:

- Continuous training involves continuous movement at moderate intensity to maintain a high heart rate for a minimum of 30 minutes.
- Training intensity: aims to be 60–85% of maximum heart rate.
- The oxygen required and consumed needs to be equal
- Examples of continuous training include running, cycling and rowing.

Which fitness components are associated with continuous training?

- Mainly aerobic endurance
- Also muscular endurance (because muscles are contracting for a long time)

Advantages:

- Improved aerobic endurance allows performers to keep going for longer, which is important for many activities, including team sports and marathons.
- It improves cardiovascular health.
- Training intensity can be readily changed, e.g. cycling at 60% of maximum heart rate and then increasing intensity up to 70% of maximum heart rate.

Disadvantages:

- Training can become monotonous causing the individual to lose interest.
- It does not improve anaerobic fitness.

2. Fartlek Training

Training Technique:

- Fartlek training involves varying the pace that you are running at throughout your continuous training period.
- The intensity of running can be varied at different intervals, with running at a slower pace allowing for recovery from the faster running intervals. It also involves running over different terrains.
- Intensity can also be varied using equipment, such as a weighted backpack.

Which fitness components are associated with continuous training?

- Mainly aerobic endurance
- Also speed (because it involves sprinting)

Advantages:

- Improved aerobic endurance allows performers to keep going for longer, which is important for many activities, including team sports and marathons.
- It improves cardiovascular health.

Disadvantages:

- It does not improve anaerobic fitness.

3. Interval Training

Training Technique:
- Interval training involves alternating periods of work and rest, e.g. running for 10 minutes, followed by a one-minute rest period, and repeating this cycle.
- Work intervals should be at 60% of maximal oxygen uptake (VO_2 max), and usually last between 30 seconds and five minutes.
- Rest periods include complete rest, walking or light jogging.

Which fitness components are associated with continuous training?
- Mainly aerobic endurance
- Also speed (because it involves sprinting)

Advantages:
- Improved aerobic endurance allows performers to keep going for longer, which is important for many activities, including team sports and marathons.
- It improves cardiovascular health.

Disadvantages:
- It does not improve anaerobic fitness.

4. Circuit Training

Training Technique:
- Involves moving around different stations which make up a circuit.
- Different exercises are performed at each station using different pieces of equipment.
- For aerobic endurance, a fitness circuit would be used.
- An example of an exercise performed at one station would be to skip for two minutes.
- The exercises performed at each station use different muscles to stop the individual getting tired.

Which fitness components are associated with circuit training?
- Aerobic endurance

Advantages:
- Circuit training is adaptable and can be changed to suit the individual's needs.
- Improved aerobic endurance allows performers to keep going for longer, which is important for many activities, including team sports and marathons.
- It improves cardiovascular health.

Disadvantages:
- It requires a lot of equipment compared to other methods.
- It does not improve anaerobic fitness.

Application of the basic (FITT) principles of training:

	Continuous Training	Fartlek Training	Interval Training
Frequency	Can increase the number of training sessions per week.	Can increase the number of training sessions per week, can change running pace more often, and can run against a harness, or with weights or a weighted backpack.	Can increase the number of training sessions per week and can increase the number of work-rest cycles.
Intensity	Can increase your speed or the percentage of maximum heart rate that you are working at.	Can increase your speed or the percentage of maximum heart rate that you are working at.	Can increase your speed or the percentage of maximum heart rate that you are working at.
Time	Can lengthen the whole training session.	Can lengthen the whole training session.	Can lengthen the whole training session or increase the work time and reduce the rest time.
Type	The type of method chosen depends on the aim of the training: continuous training would be best for training for a marathon.	The type of method chosen depends on the aim of the training: Fartlek training would be best for speed training.	The type of method chosen depends on the aim of the training: interval training would be best for gradually increasing fitness.

Example of a situation which would require aerobic endurance training:
A youth hockey player has recently moved from the under 16s team to the adult team. The adult team plays longer matches and he is finding it difficult to last the whole match without getting tired towards the end.

B.1–B.3 d: Speed Training

What equipment is required?

- No specialist equipment, just running trainers and a stopwatch.
- Some types of sprint require different terrains, such as hill sprints.

What is the training technique?

- Fartlek or interval training with periods of faster-paced running without the need for covering great distances. Periods of work should involve high speed for a minimum of six seconds.
- The number of rest periods and the intensity of work periods should be increased to develop speed.
- There are different types of sprint training:
- Hollow sprints: sprints are separated by a 'hollow' period, which involves walking or jogging.
- Acceleration sprints: there is a gradual increase in pace from walking, to jogging, to striding and finally to maximum sprint.

Which fitness components are associated with speed training?

- Speed
- Power

Example of a situation which would require speed training:

A sprinter wants to reduce their 100 m sprint time in order to increase their chance of winning the race at an athletics event.

Advantages: Speed training helps you burn calories, improve your fitness, increase your bone strength and density and increase your speed, which is beneficial for winning races and running past your opposition.

Disadvantages: Sprinting is a high impact activity, so can lead to injuries such as stress fractures.

Application of the basic (FITT) principles of training:

See aerobic endurance training.

B.1-B.3 c Activities:

1. Suggest an activity or sport that would benefit from each training method and explain why.

   Continuous .....

   .....

   Fartlek .....

   .....

   Interval .....

   .....

   Circuit .....

   .....

2. What is the main advantage of aerobic endurance training?

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Exam Questions

3. a) Explain how Fartlek or interval training should be adapted for sprint training.

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   (4 marks)

   b) The picture below shows a lady running on a treadmill. She varies her speed between walking, jogging and sprinting. What type of training is this?

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Learning Aim B Test Score:	**Remark Score:**
H2I (How to Improve)	
Extension Questions from the Activities:	

Learning Aim: C

Topic C.1: Fitness Test Methods for Components of Fitness

LEARNING OBJECTIVE:

The main objective of this section is to learn about the most commonly used methods for assessing the different components of fitness and the advantages and disadvantages of each method.

KNOWLEDGE CHECKLIST

- Be familiar with the following fitness test methods and which components of fitness they are used to measure:
  - Sit and reach test ❑
  - Grip dynamometer ❑
  - Multi-stage fitness test ❑
  - Forestry step test ❑
  - 35 m sprint ❑
  - Illinois agility run test ❑
  - Vertical jump test ❑
  - One-minute press-up, one-minute sit-up ❑
  - Body mass index (BMI) ❑
  - Bioelectrical impedance analysis (BIA) ❑
  - Skinfold testing ❑
- Know the definition of VO_2 max ❑
- Be able to identify the advantages and disadvantages of different fitness test methods. ❑

Flexibility (measured in cm or inches)

How is it measured?
A frequently used method is the sit and reach test, which records hamstring and lower back flexibility:

- The subject sits with their back of their legs kept on the floor and feet pressed against the box.
- They reach forward as far they can and stay in the position for roughly two seconds.
- The distance that has been reached is measured.
- The furthest stretch out of three is recorded.

Advantages:

- It is a commonly used measure of flexibility.
- There is lots of data for comparison.
- It is quick and easy to do.

Disadvantages:

- Comparison between individuals can be misleading due to variations in limb and trunk length.
- It only measures flexibility of the lower back and hamstrings.

Strength (measured in kgw)

How is it measured?
Strength is commonly measured using a grip dynamometer:

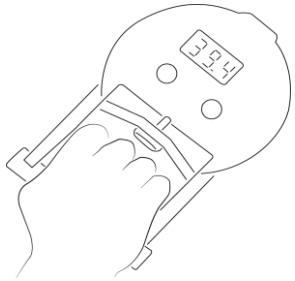
- The participant holds the grip dynamometer in their hand and squeezes it as hard as possible.
- The best of three scores is recorded.

Advantages:

- It is a commonly used measure of general strength.
- There is lots of data for comparison.
- It is quick and easy to do.

Disadvantages:

- Adjusting the dynamometer for hand size can affect the accuracy of measurement.



Aerobic Endurance (VO_2 max predicted in ml/kg/min)

How is it measured?
- The two most commonly used measures of aerobic endurance are the multi-stage fitness test and the forestry step test.
- It gives an indication of the subject's VO_2 max, which is the maximum amount of oxygen taken up and transported around the body to working muscles.

The Multi-Stage Fitness Test
- The subject runs repeatedly between the start point and the 20 m mark in time with the bleeps.
- The time period between each bleep decreases so they have to run faster as time goes on.
- They keep going until they can no longer keep up with the bleeps.

Advantages:
- Large groups can be tested at the same time.

Disadvantages:
- Requires lots of motivation to get an accurate score.
- Unsuitable for people that are unable to do maximal testing, such as injured people or people with medical conditions.

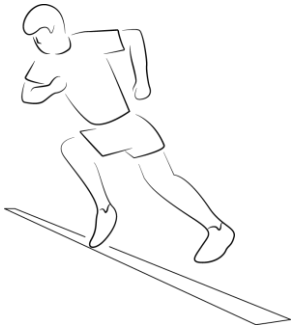
The Forestry Step Test
- The subject steps up and down on a step in time with a metronome (set at 90 beats per minute) for five minutes.
- When the time is up, the subject sits down and their heart rate is measured and recorded between 15 and 30 seconds post-exercise.
- Aerobic endurance is calculated using age, post-exercise heart rate, weight and a published table of data.

Advantages:
- It is a simple test; it doesn't require much equipment.
- It can be performed anywhere.

Disadvantages:
- It is unsuitable for unfit people or people that don't have good coordination because they will not be able to maintain the stepping rate.

Speed (measured in s)

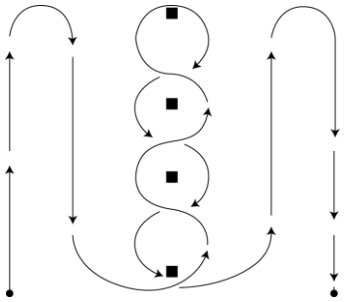
How is it measured?
- A commonly used method is the 35 m sprint test, which measures the ability of the subject to accelerate and run at maximum speed.
- After doing a warm-up, the subject sprints down a 35 m track.
- The time taken to complete the sprint is recorded.
- This is repeated three more times and the best score is recorded and compared with a table of scores.



Advantages:
- It is simple to set up and do and doesn't require much equipment.
- It can be done almost anywhere.

Disadvantages:
- It requires an assistant to time the sprint.
- Timing errors can produce inaccurate results.

Speed and Agility (measured in seconds)



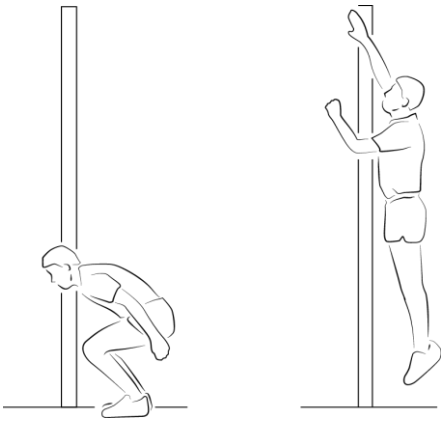
How is it measured?
- A commonly used measure of agility is the Illinois agility run.
- After a warm-up, the subject lies face down by the start cone.
- When the assistant shouts 'go' the subject gets up and runs around the cones, as shown in the diagram on the right.
- The time taken to complete the run is measured and recorded.

Advantages:
- It is simple to set up and do, requires minimal equipment, and can be done almost anywhere.

Disadvantages:
- An assistant is required to time the test.
- Times can be affected by the type of footwear worn or the surface.

Anaerobic Power (measured in kgm/s)

How is it measured?
- A commonly used test is the vertical jump test.
- The subject stretches up as high as they can, and a mark is made on the wall to show how high they have reached.
- They then jump as high as they can and another mark is made on the wall.
- The distance between the two marks is measured and compared with a table of values.

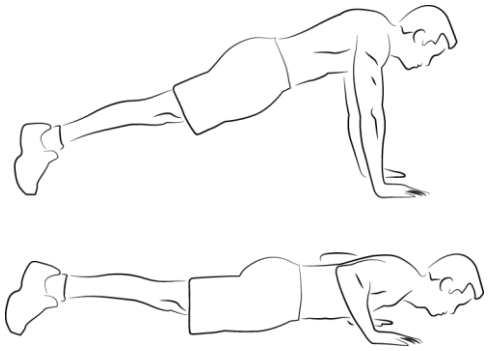


Advantages:
- The test is simple to set up and do.
- It takes the height of the subject into consideration.

Disadvantages:
- It requires a wall, ruler / tape measure, and an assistant.

Muscular Endurance (measured in reps/minute)

How is it measured?
- Commonly used tests are the one-minute press-up and one-minute sit-up tests.
- After a warm-up, the subject performs sit-ups/press-ups for one minute and the assistant records the number of correct moves.
- The results are compared with a table of values.



Advantages:
- It is simple to set up and do and no equipment is required.
- It can be done anywhere.
- The position can be varied depending on fitness levels.

Disadvantages:
- An assistant is required to record the score.
- Scores can be affected by upper arm injuries.

Body Composition

How is it measured?
There are three commonly used methods for assessing body composition:

Body Mass Index (BMI) (kg/m^2):
- The subject's weight and height is measured and recorded.
- BMI is calculated using : BMI = Weight (kg) ÷ Height (m^2)

Example:
Tom is a 17-year-old male, who is 1.76 m tall and weighs 86 kg. Calculate his BMI.

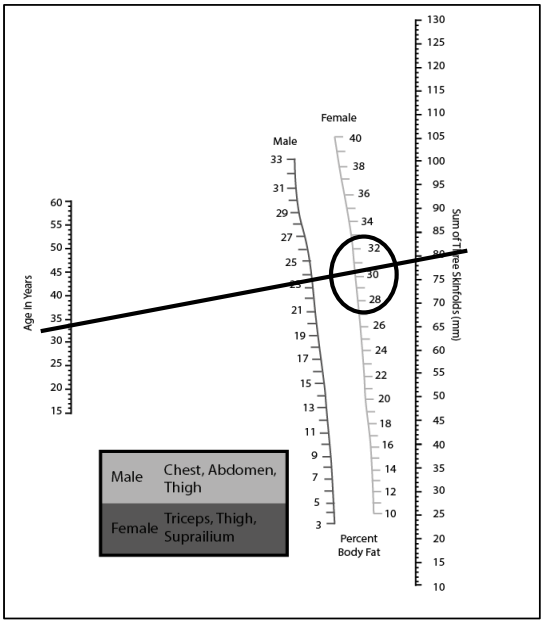
BMI = 86 ÷ 1.76^2
= 86 ÷ 3.0976
= 27.76 kg/m^2

Advantages: It is simple to do and produces a weight classification quickly.

Disadvantages: It measures weight not body fat, so muscly people may be inaccurately classed as overweight.

Skinfold Callipers
- Skinfold measures are taken at different sites (males: chest, abdominals, thighs; females: triceps, suprailiac and thighs).
- All of the readings are added together to give a total.
- A line is drawn from the participant's age on the age scale to the relevant value sum of skinfolds on the scale. The value at the point in which the line crosses the percentage body fat scale is read off and recorded.

- *E.g. An 18-year-old female has a sum of skinfolds score of 65. Use the nomogram on the right to predict her percentage body fat.*



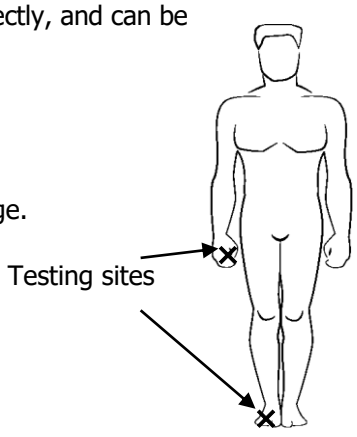
The line crosses the 'female' scale for percentage body fat at 25.

Advantages: It is the most simple, inexpensive and commonly used method of assessing body composition.

Disadvantages: Can produce inaccurate results if callipers are not used correctly, and can be considered invasive.

Bioelectrical Impedance Analysis (**BIA)**
- A low, safe electrical current is passed through the subject's body.
- Body fat creates more resistance (bioelectrical impedance) than muscle.
- The bioelectrical impedance score is used to calculate body fat percentage.

Advantage: It is simple and quick to do.
Disadvantage: The equipment is quite expensive.



C.1 Activities:

1. What is the most common method for measuring flexibility?

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2. What does a grip dynamometer measure?

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3. Suggest two commonly used methods for assessing aerobic endurance.

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4. Give one advantage and one disadvantage of the 35 m sprint test.

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5. Describe the method of the Illinois agility run test.

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6. What is the vertical jump test commonly used to measure?

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7. How is muscular endurance commonly measured?

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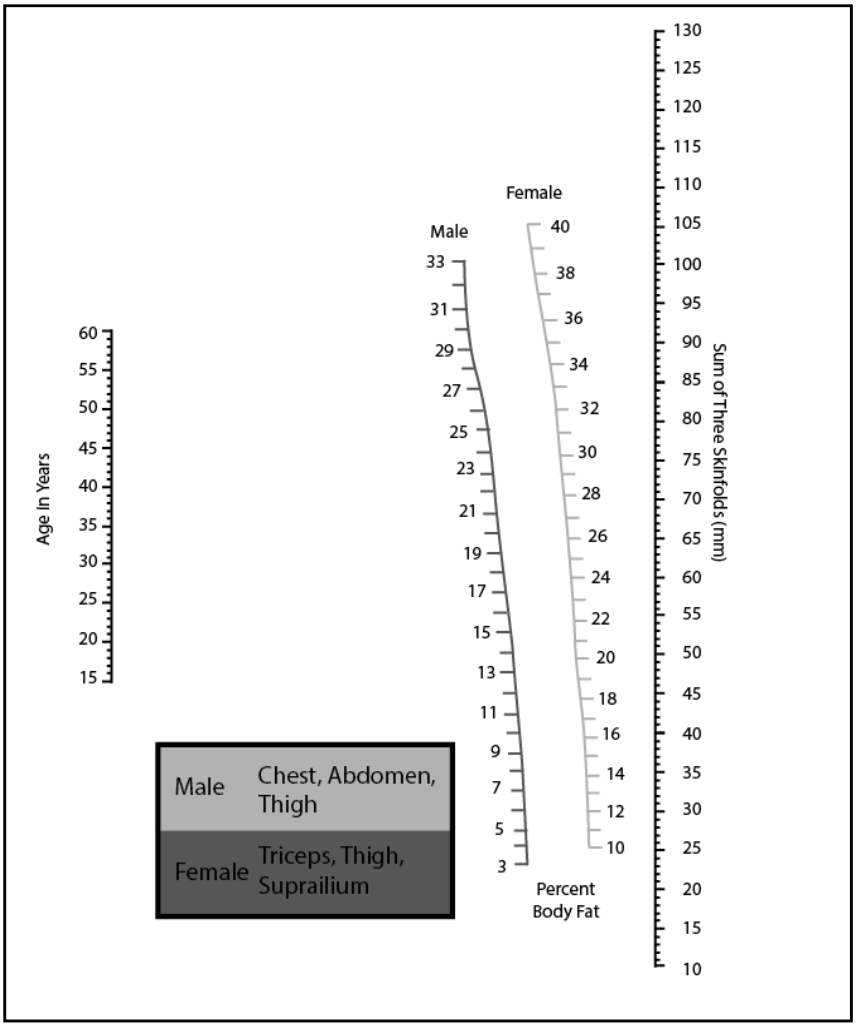
Exam question:

8. a) James is 18 years old. He is 1.68 m tall and weighs 78 kg. Calculate his BMI.

(3 Marks)

b) An 18-year-old female has a skinfold result of 55 mm. Use the nomogram to predict her percentage body fat.



Answer .....

(2 marks)

Topic C.2: Importance of Fitness Testing to Sports Performers and Coaches

LEARNING OBJECTIVE:

The main objective of this section is to learn about the different reasons for fitness testing, and how it can be used to help a sports performer or coach.

KNOWLEDGE CHECKLIST

- Understand what fitness testing is used for:
  - To give baseline data (data taken before the programme starts) for designing a training programme ❑
  - To see if there are any changes in performance ❑
  - To see if a training programme helps improve performance ❑
  - To give the performer something to aim for/set goals ❑

Baseline Data

- Once you have decided which fitness component you would like to improve, you should test it.
- This gives a baseline value and provides a starting point for your training programme.

E.g. Sarah wants to create a training programme for running a half-marathon. Before designing the programme she completes the multi-stage fitness test, which reveals that her aerobic endurance levels are poor. This indicates that she needs to begin running short distances and gradually build up to prevent injury or health problems.

Monitoring Performance

- Doing fitness tests at different stages allows you to monitor any changes in the fitness components that you are interested in.

E.g. Tom is a football player. He wants to assess whether his speed and agility change at different times throughout the year. He completes the Illinois agility run test at the start of pre-season, at the start of the season, at the end of the season, and halfway through off-season.

Giving the Performer Something to Aim for / Goal Setting

- A low score on a fitness test may motivate an individual to work hard to improve their score.
- Targets can be set for the individual to achieve within a certain time frame.

E.g. A gymnastics coach tests the flexibility of the club members when they join. Based on their score, the coach gives them a target to reach by week 10. This motivates them to do their flexibility exercises at home.

Monitoring the Effectiveness of a Training Programme

- Measuring the fitness component that you are trying to improve at the beginning and the end of the training programme will indicate whether the training programme has been effective.

E.g. Matthew measures his BMI after a training programme. However, he doesn't know what it was before the programme so he is not able to tell if it has improved.

Laura measures her BMI at the beginning and end of a training programme and can see that it has decreased. The training programme has been successful in helping her achieve her goal of achieving a healthier body weight.

C.2 Activities:

1. Complete the spider diagram below by identifying the different reasons for fitness testing:

Exam Questions

2. a) Explain how the one-minute press-up test can be used to help a coach design a fitness programme to improve muscular endurance?

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(4 marks)

b) Explain how fitness testing can be used to increase the motivation of an individual that is undertaking a fitness programme.

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(2 marks)

Topics C.3 and C.4: Requirements for Administration of Fitness Tests and Interpretation of Results

LEARNING OBJECTIVE:

The main objective of this section is to learn about the procedures that must be carried out before doing a fitness test, and what to do with the results after the test.

KNOWLEDGE CHECKLIST

- Be able to identify the pre-test procedures:
  - Informed consent ❑
  - Calibration of equipment ❑
  - Practise ❑
- Be familiar with the accurate measurement and recording of test results ❑
- Understand the terms 'reliability', 'validity' and 'practicality' related to fitness test methods ❑
- Understand how to process test results for interpretation ❑
- Understand how to interpret test results:
  - Compare results to normative published data ❑
  - Compare results with peers ❑
  - Draw conclusions from, analyse and evaluate test results ❑
- For a given situation, be able to suggest and justify appropriate recommendations for improvements to fitness and appropriate fitness training methods that could be used. ❑

Pre-Test Procedures

Informed Consent

- All participants should be given an informed consent form before doing any fitness test.
- This is because some tests involve taking measurements that can be personal, such as weight, and some involve intense exercise.
- The form should explain what the test involves and that they can withdraw at any time.
- The participant should sign and date the form to show that they understand what they are required to do and are willing to take part.
- If the participant is younger than 18, they must have consent from their parent or guardian.

- **Calibration of Equipment**
- All equipment should be calibrated before use.
- This means checking for accuracy and making sure it is set up correctly to measure in the correct units.
- Equipment that is not set up correctly should be adjusted before use.
- E.g. Treadmills must be correctly calibrated to ensure they show the correct distance run.

Practise

- Practise carrying out the test before collecting data to make sure you know how to do it correctly.

Accurate Measurement and Recording of Test Results

- It is important that the measurements that you take are accurate, otherwise the results will be incorrect.
- You should practise using the equipment before carrying out the test so that you are familiar with taking measurements.
- For example, you should practise using callipers and measuring skinfolds at the correct sites before assessing body composition.
- It is also important to accurately log data.
- Results should be recorded straight away so that you don't forget them and record incorrect results.
- Results should be recorded on an appropriate form.
- Use the correct units of measurement.
- Data should be clearly labelled so that it doesn't get mixed up.
- Results can be recorded in various forms, such as on graphs and in computer programs.

Reliability

- Reliability refers to getting consistent results if the test is repeated.
- Use a recognised test for the fitness component that you are assessing.
- Use the correct equipment and follow set procedures.

Practicality

- Completing the test must be possible with the equipment and facilities that you have available.
- For example, you will not be able to calculate someone's BMI unless you have scales to measure weight and a tape measure to measure the height of the participant.

Validity

- Validity refers to the test measuring what it is supposed to measure.
- For example, the one-minute press-up test must be carried out for one minute in order for the results to be valid.

Interpretation of Results

- It is essential to accurately interpret the findings so that the conclusions that you draw from them are correct.
- Results can be compared to a table of normative published data. This is an existing table of standard data
  For example, multi-stage fitness test scores can be can be compared to a normative data table, which gives a score from poor to excellent, depending on age and gender. This gives an idea of how the participant compares to an average person of the same age and gender.

  E.g. Lucy, a 16-year-old girl, achieves a score of 6/7 during the multi-stage fitness test at school. Use the normative data table below to state what this score suggests about her aerobic endurance.
  Lucy's score is in the 'average' category, suggesting that her aerobic endurance is the same as an average girl of her age.

Multi-stage fitness test scores table:

Gender and age (years)	Excellent	Good	Average	Fair	Poor
Males 14–16	12/7	11/2	8/9	7/1	<6/6
Females 14–16	10/9	9/1	**6/7**	5/1	<4/7
Males 17–20	12/12	11/6	9/2	7/6	<7/3
Females 17–20	10/11	9/3	6/8	5/2	<4/9
Males 21–30	12/12	11/7	9/3	7/8	<7/5
Females 21–30	10/8	9/2	6/6	5/1	<4/9
Males 31–40	11/7	10/4	6/10	6/7	<6/4
Females 31–40	10/4	8/7	6/3	4/6	<4/5
Males 41–50	10/4	9/4	6/9	5/9	<5/2
Females 41–50	9/9	7/2	5/7	4/2	<4/1

- Results can also be compared with others.
  For example, producing a table of sit and reach scores for all members of a gymnastics club will give an idea of how flexible members are compared with the rest of the group.

- It is important to be able to analyse and evaluate fitness test results in order to make the data meaningful.
  For example, a set of skinfold calliper measurements is meaningless until it is analysed using a nomogram to work out the participant's percentage body fat.
- The percentage body fat score can be evaluated by comparing it with normative values to determine if the participant's score is higher or lower than average and what this means. Based on this information, you should be able to suggest and justify appropriate ways for the participant to improve their fitness score.
  For example, if the percentage body fat is higher than average, it would suggest that the participant needs to change their diet, increase their physical activity levels, or both, in order to reduce their body fat percentage.

- Before making your suggestion, it is important to consider:
  a) Purpose: *For example, if the purpose is to reduce the body fat percentage so that the overweight participant is no longer at risk of serious health implications, the fitness programme will need to be much more rigorous than if the purpose is to reduce body fat percentage so that the average weight participant can get in better shape.*
  b) Situation: *For example, if the participant's body fat percentage needs to be reduced by a certain time, such as for an important competition, an intense fitness programme will be needed to produce fast results. If there is no time frame, a longer-lasting programme that involves small changes to their diet may be suggested.*
  c) Participant: *For example, it would be inappropriate to suggest to an elderly person to start going for a run twice a week to reduce their body fat percentage.*

C.3 Activities:

1. Make a list of everything that should be included on an informed consent form.

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2. Read the following case study. Based on this information, suggest and justify appropriate recommendations for Lucy to improve her fitness. You should use the normative data tables pages 45 and 47 to help you.

Lucy is 17 years old and has just joined the local hockey team. During the first week of pre-season fitness training, the coach carries out a number of fitness tests. Lucy's score for the multi-stage fitness test is 9/3, and her score for the one-minute press-ups test is 13. They have four weeks until the season starts.

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Exam Questions

3. a) A basketball coach wants to assess the anaerobic power of the players in the team. Explain how they can ensure reliability and validity when assessing this.

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(4 marks)

b) Explain the procedures that must be carried out before doing a fitness test.

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(3 marks)

c) Joe, a 20-year-old male, completes 38 press-ups in one minute. Use the normative table below to explain how his aerobic fitness compares with an average person.

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(1 mark)

One-minute press-ups:

Gender	Excellent	Good	Average	Poor
Male	>40	30–39	18–29	<17
Female	>30	20–29	13–19	<12

Learning Aim C Test Score:	**Remark Score:**
H2I (How to Improve)	
Extension Questions from the Activities:	

Answers to Activities

A.1 Activity Answers

1.

Muscular endurance	The capability of muscles to undergo a number of contractions over a long period of time against a resistance.
Flexibility	The ability to move a joint easily through its complete range of movement.
Muscular strength	The maximum force that can be exerted by a muscle or group of muscles.
Aerobic endurance	The ability of the cardiorespiratory system to deliver oxygen and nutrients to working muscles.
Body composition	The proportion of body fat mass compared to the mass of vital organs, muscle and bone.
Speed	The distance covered in a certain amount of time.

2.

Component of physical fitness	Sport	Why?
Muscular endurance	cycling	Muscles have to contract repeatedly over a long period of time
Flexibility	gymnastics	They have to perform complex movements that require limbs to move through a wide range of motion
Muscular strength	weightlifting	Muscles have to be able to exert a large amount of force in order to lift the weight
Aerobic endurance	marathon running	The cardiorespiratory system needs to be able to supply oxygen and nutrients to working muscles for a long period of time to allow the athlete to respire aerobically
Lean body composition	figure skaters	Athletes would benefit from a thin body composition as they need to be flexible and agile
Speed	sprinting	The winner is the athlete that crosses the finish line in the shortest amount of time.

3. a) Flexibility
   b) Aerobic endurance refers to the ability of the cardiorespiratory system to supply oxygen and nutrients to working muscles for a long period of time to allow aerobic respiration (1).
   A hockey player with good aerobic endurance will be able to last the whole match without getting tired and therefore their performance will improve (1).

A.2 Activity Answers

1. Agility, balance, coordination, power, reaction time

2. a) Muscular endurance, strength, agility, coordination, reaction time, power
   b) Reaction time and agility
   c) Strength, power and muscular endurance

3. a) Reaction time
   b) Power is the product of speed and strength (1).
   Having high power means that more work can be done in less time (1).
   A sprinter with high power will be able to complete a race in less time, so is more likely to win (1).

A.3 Activity Answers

3. a) Aerobic endurance, muscular endurance and strength
   b) Strikers will benefit from having good speed to sprint past their defenders (1).
   Midfield players will benefit from having good aerobic endurance because they have to do the most running (1).
   Defenders will benefit from having good strength to hold off their opponents (1).

A.4 Activity Answers

1. By gently pressing the wrist with the index and middle fingers and counting the number of pulses in one minute, or by wearing a heart rate monitor.

2. The athlete points to the position on the scale that indicates how hard they feel they are working. This number is multiplied by 10 to give an estimate of heart rate.

3. a) HR max = 220 – 17
   = 203

   Lower threshold = (60 ÷ 100) × 203 = 121.8
   Upper threshold = (85 ÷ 100) × 203 = 172.55

   Recommended training zone = 122 – 173

   b) The athlete points to the position on the scale that indicates how hard they feel they are working, and is used to provide a measure of exercise intensity (1).
   It can be used to estimate the participant's heart rate because RPE × 10 = HR (bpm) (1).

A.5 Activity Answers

1. Frequency refers to the number of **sessions** per week, and should be a minimum of **three** times. **Intensity** refers to how hard we train, and should be high enough to achieve improvements in **fitness**. Time refers to how **long** we train for, and should be a minimum of **20** minutes. Type refers to the method of training used to achieve particular **goals**.

2. Example training programme:

   Frequency: three training sessions per week, because this is the minimum. The players are unfit so any more than three sessions is likely to be too much and may lead to injury.
   Intensity: 60–85% of maximum heart rate, as this is the recommended training zone for cardiovascular health and fitness. Training below this threshold will not increase fitness levels but training above this threshold may lead to injury.
   Time: sessions will last one hour: 10 minute warm-up, 20 minutes fitness training in the training zone, 20 minutes skills-based practise, and a 10 minute cool-down.
   Type: running to improve aerobic endurance and specific hockey skill-based practice.

3. a) Intensity
   b) Intensity (1), type (1)

A.6 Activity Answers

1.

The number of training sessions per week is increased from two to three.	Progressive overload
There is a minimum of one day between each training session.	Rest and recovery
A netball player is unable to train for six weeks after spraining her ankle. When she goes back to training she feels less fit.	Reversibility
Two brothers are training to run a marathon; one has run a marathon before but the other hasn't. They have different training programmes.	Individual needs/differences
A goalkeeper coach trains the goalkeeper, while the rest of the team do fitness training.	Specificity
Each week the coach uses different drills and activities to keep the participants interested.	Variation

2. a) Four of the following (total 4 marks):
   - Rest allows the body to recover (1)
   - Recovery involves the body repairing damaged tissue (1)
   - This helps prevent long-lasting injury (1)
   - Adaptation occurs during the recovery period (1)
   - This is where the body responds to training loads by increasing its ability to cope with future demands (1)

   b) Reversibility (1)

B.1 Activity Answers

1. The warm-up should include:
   - Continuous aerobic movement, such as a jog, to increase the heart rate
   - Gentle exercises which aim to work certain muscles
   - Stretching of specific muscles and main joints

2. It is important to do a cool down because:
   - It enables body temperature to reduce gradually to normal.
   - It enables the heart rate to be lowered to resting heart rate.
   - It helps rid the body of lactic acid and therefore reduce muscular pain.
   - It helps prevent aching the following day.

3. a) It increases the heart and breathing rates so the body is physically prepared for activity (1).
   It activates the nervous system allowing for mental preparation (1).
   It lowers the likelihood of injury (1).

   b) Some activities require more stretching to increase flexibility and reduce injury risk, such as figure skating (1).
   Some activities take place in cold environments, such as football played outside during the winter (1).

B.1–B.3 a Activity Answers

1.

Name of Technique	Description	Example
Static stretching	Held for roughly 30 seconds. It can be active or passive.	**A quadriceps stretch.**
Ballistic stretching	Increasing the range of a stretch by completing bouncing motions.	Performing a kicking action repeatedly to stretch the hamstring
PNF stretching	**When the muscle is moved into position, it is stretched whilst keeping still for roughly 6 seconds, with some resistance being applied to the muscle to ensure that it is kept still. The muscle is then relaxed before stretching again for a longer period of time (roughly 30 seconds).**	Lying on your back with one leg raised and a partner pushing the raised leg backwards.

2. Any suitable example that relates to increasing flexibility, such as a gymnast wanting to be able to perform more complex moves.

3. a) It improves joint range of motion which makes it easier to perform movements (1) and reduces risk of injury (1). However, overstretching or bouncing on a stretch (ballistic stretching) can cause injury (1).
   b) Passive static (1), active static (1)

B.1–B.3 b Activity Answers

1. Strength, power and muscular endurance.

2. Frequency can be increased by:
   - Increasing the number of training sessions per week
   - Increasing the number of repetitions or sets performed in a session
   - Increasing the number of moves performed at each station during circuit training
   - Increasing the number of stations during circuit training
   - Increasing the number of circuits during circuit training

3. a) 75% 1 RM and 12 reps
   b) It involves jumping movements to allow a quick contraction after muscle loading (1).
   The muscle lengthens (eccentric action) and is immediately followed by the muscle shortening (concentric action) (1).
   When a concentric contraction follows an eccentric contraction, more force can be generated (1).
   Athletes use plyometric training to increase muscular power (1).

B.1–B.3 c Activity Answers

1. *Continuous*: Any sport or activity that requires steady-state continuous activity, such as long distance running and cycling.
   Fartlek: Any sport or activity that requires bursts of activity, such as football and hockey.
   Interval: Individual activities, such as swimming and athletics, or any example of a team game that requires bursts of activity followed by periods of rest, such as football and hockey.
   Circuit: Any example of an activity that requires good fitness levels.

2. It allows you to keep going for longer, which means you will be able to perform well for the whole activity, game or match.

3. a) It should periods of faster running without the need for covering great distances (1).
      Periods of work should involve high speed for a minimum of six seconds (1).
      There should be more rest periods (1).
      Intensity of work periods should be greater (1).
   b) Fartlek training

C.1 Activity Answers

1. Sit and reach test

2. Strength

3. Multi-stage fitness test and forestry step test

4. *Advantages*:
   It is simple to set up and do and does not require much equipment.
   It can be done almost anywhere.
   Disadvantages:
   It requires an assistant to time the sprint.
   Timing errors can produce inaccurate results.

5. After a warm-up, the subject lies face down by the start cone.
   When the assistant shouts 'go' the subject gets up and runs around the cones.
   The time taken to complete the run is measured and recorded.

6. Anaerobic power

7. Commonly used tests are the one-minute press-up and one-minute sit-up tests.
   After a warm-up, the subject performs sit-ups/press-ups for one minute and the assistant records the number of correct moves.
   The results are compared with a table of normative values.

8. a) BMI $= 78 \div (1.68 \times 1.68)$
      $= 78 \div 2.8224$
      $= 27.64$
   b) Line drawn from 18 on the age scale to 55 on the skinfold measurement scale (1).
      Correct answer of 22% (1).

C.2 Activity Answers

1. To give baseline data to design a training programme
   To monitor performance
   To determine if a training programme is effective in improving performance.
   To give the performer something to aim for / set goals

2. a) It gives a baseline level of fitness, which gives the coach an idea of the level of difficulty required for the training programme (1).
   Doing the test at the beginning and end of the programme will provide an indication of whether the individual's performance has improved (1) and whether the training programme has been effective (1).
   The coach can set goals based on the individual's baseline score to motivate them to train hard (1).
   b) A low score on a fitness test may motivate an individual to work hard to improve their score (1).
   Targets can be set for the individual to achieve within a certain time frame (1).

C.3 and C.4 Activity Answers

1. Included on the comment form should be:
   - Participant's name
   - Participant's contact details
   - General health questions
   - A description of everything that the test involves
   - A statement about the participant being allowed to withdraw from the study at any point
   - A place for the participant to sign and write the date
   - A place for a parent/guardian to sign for participants under the age of 18

2. Lucy's fitness
   - The results reveal that Lucy's aerobic fitness is 'good' compared with a 'normal' person of the same age and gender.
   - However, her muscular endurance is at the low end of 'average'.
   - This suggests that she needs to concentrate on improving her muscular endurance over the next four weeks of pre-season training.
   - Muscular endurance can be improved by doing long periods of moderate intensity activity rather than short bursts of activity.
   - Lucy could go running or cycling, for example, to improve her muscular endurance.
   - She will need to do this at least twice a week, because she only has four weeks to improve before the season starts.
   - As she is young and has good aerobic fitness, she will be able to increase her training without being at risk of any health problems.

3. a) Use a recognised test for assessing anaerobic power, such as the vertical jump, rather than making up your own (1).
   Use the correct equipment and follow the guidelines (1).
   Repeat the test the same day to test the consistency of the results (1).
   Make sure that the test used measures what it is supposed to (i.e. anaerobic power) (1).
   b) An informed consent form should be read and signed by the participant to show that they understand what they are required to do and are willing to take part (1).
   Equipment should be calibrated to make sure readings are accurate (1).
   The test should be practised beforehand to make sure that it is performed correctly (1).
   c) Joe's score is at the high end of the 'good' category, suggesting that his aerobic fitness is better than the 'average' person (1).

NOTES: