STUDENT UNIT GUIDE

NEW EDITION

AQA

Physical Education

AS UNIT 1

Opportunities for, and the Effects of, Leading a Healthy and Active Lifestyle

Symond Burrows • Michaela Byrne • Sue Young

- clear **revision guidance**
- **examiner** advice
- sample **questions** and **answers**

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Contents

Getting the most from this book

Examiner tips

Advice from the examiner on key points in the text to help you learn and recall unit content, avoid pitfalls, and polish your exam technique in order to boost your grade.

Knowledge check

Rapid-fire questions throughout the Content Guidance section to check your understanding.

Knowledge check answers

1 Turn to the back of the book for the Knowledge check answers.

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Summaries

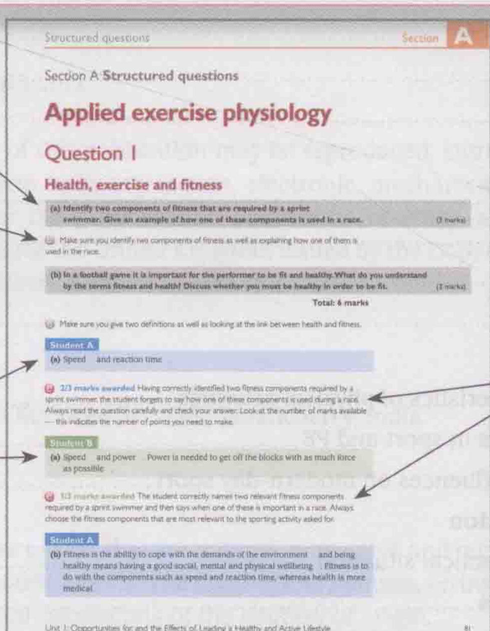
- Each core topic is rounded off by a bullet-list summary for quick-check reference of what you need to know.

Questions & Answers

Exam-style questions

Examiner comments on the questions
Tips on what you need to do to gain full marks, indicated by the icon (e).

Sample student answers
Practise the questions, then look at the student answers that follow each question.



Structured questions — Section A

Section A **Structured questions**

Applied exercise physiology

Question 1

Health, exercise and fitness

(a) Identify two components of fitness that are required by a sprint swimmer. Give an example of how one of these components is used in a race. (3 marks)

(e) Make sure you identify two components of fitness as well as explaining how one of them is used in the race.

(b) In a football game it is important for the performer to be fit and healthy. What do you understand by the terms fitness and health? Discuss whether you must be healthy in order to be fit. (3 marks)

Total: 6 marks

(e) Make sure you give two definitions as well as looking at the link between health and fitness.

Student A

(a) Speed and reaction time

(e) 2/3 marks awarded Having correctly identified two fitness components required by a sprint swimmer, the student forgets to say how one of these components is used during a race. Always read the question carefully and check your answer. Look at the number of marks available — this indicates the number of points you need to make.

Student B

(a) Speed and power Power is needed to get off the blocks with as much force as possible

(e) 3/3 marks awarded The student correctly names two relevant fitness components required by a sprint swimmer and then says when one of these is important in a race. Always choose the fitness components that are most relevant to the sporting activity asked for.

Student A

(b) Fitness is the ability to cope with the demands of the environment and being healthy means having a good social, mental and physical wellbeing. Fitness is to do with the components such as speed and reaction time, whereas health is more medical

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Examiner commentary on sample student answers
Find out how many marks each answer would be awarded in the exam and then read the examiner comments (preceded by the icon (e)) following each student answer.

About this book

This unit guide is written to help you prepare for the AQA PE Unit 1 test. **Section A** of the Unit 1 test examines the AS theoretical content of three aspects of PE, namely:

- applied exercise physiology
- skill acquisition
- opportunities for participation

The question in **Section B** relates to the practical aspects of applied skill and fitness and training, which are outlined in Unit 2 of the AS specification.

Each aspect of the specification required for the Unit 1 test is covered in the **Content Guidance** section, which summarises the key information that you need to understand and apply in the test. This section also includes examiner tips on what you will be expected to be able to do. Remember that this section is designed to *support* your revision, therefore it should be used in conjunction with your textbook, your own revision notes and other resources.

The **Questions & Answers** section of this guide provides examples of questions from various topic areas, together with student answers and examiner comments on how these could have been improved.

Content Guidance

Applied exercise physiology

Health, exercise and fitness

Definitions of fitness and health

Fitness can be difficult to define because it means different things to different people. One generic definition of fitness is: the ability to perform daily tasks without undue fatigue.

These daily tasks will be quite different for a non-athletic person compared with an elite performer. The fitness requirements of physical activities also vary. For example, the 100 metres sprint requires the body to work anaerobically with great strength, speed and power, whereas the marathon requires good muscular endurance and excellent aerobic capacity.

Examiner tip
Make sure you understand the relationship between health and fitness — you can be fit and healthy as well as fit and unhealthy.

Health is often defined as a state of complete physical, mental and social wellbeing, and not merely the absence of disease or infirmity.

Components of fitness

- Components of health-related fitness include cardiorespiratory endurance (also called stamina, VO_2(max) or aerobic capacity), muscular endurance, maximum strength, static strength, explosive strength, speed, power and flexibility.
- Components of skill-related fitness include agility, reaction time, coordination and balance.

Definitions of the components of fitness are given in Tables 1 and 2.

Table 1 Health-related components

Component	Definition
Cardiorespiratory endurance (stamina)	The ability to take in and use oxygen during prolonged exercise to delay the onset of fatigue
Muscular endurance	The ability of a muscle to perform repeated contractions and withstand fatigue
Maximum strength	The maximum force a muscle can exert in a single voluntary contraction
Static strength	Holding a position by muscles maintaining a state of contraction
Explosive strength	Rapid contraction of muscle fibres to achieve maximum force (related to power)
Speed	How fast a person can move a specified distance or how quickly a body part can be put into motion

Power	The amount of work performed per unit of time. It is the product of strength and speed
Static flexibility	Range of movement around a joint
Dynamic flexibility	Resistance of a joint to movement

Table 2 Skill-related components

Component	Definition
Agility	Ability to move and position the body quickly and effectively while under control
Reaction time	The time taken from detection of a stimulus to the initiation of a response
Coordination	The ability of the motor and nervous systems to interact so that motor tasks can be performed more accurately
Balance	The ability to keep the centre of mass over the base of support. It can be static, such as a handstand, or dynamic, where balance is retained in motion

Knowledge check 1

What do you understand by the term 'power'?

Examiner tip

As well as defining each component of fitness, make sure you can apply each of these components to different sports.

Effect of lifestyle choices on health and fitness

Individuals make choices in life and these can have an effect on both health and fitness. For example, a poor diet can lead to obesity and health complications; smoking can affect the efficiency of oxygen transport; a lack of exercise can lead to heart and mobility problems; alcohol can affect concentration levels and make you less alert and, in excess, can damage the heart.

Knowledge check 2

Explain how lifestyle choices can negatively affect performance in endurance sports.

Summary

After studying this topic, you should be able to:

- define health and fitness and understand the relationship between them and the problems associated in their definition
- understand the effects of lifestyle choices on health and fitness
- define the health-related components of fitness: stamina, muscular endurance, strength, speed, power and flexibility
- define the skill-related components of fitness: agility, reaction time, coordination and balance

Nutrition

The seven classes of food

Carbohydrates

Simple carbohydrates are found in fruit and are easily digested by the body. They are also present in many processed foods and anything with refined sugar added. **Complex carbohydrates** are found in nearly all plant-based foods, and usually take longer for the body to digest. They are most commonly found in bread, pasta, rice and vegetables.

Carbohydrate is an important source of energy during activity, and it is the main source of energy during high-intensity exercise. Carbohydrates are stored in the muscle and liver as glycogen and transported in the form of glucose. They store a lot of energy and should be consumed before, during and after exercise.

It is important to consider the glycaemic index (release rate) of different carbohydrates and the consequence this has on *when* they should be consumed in relation to training. Foods with a low glycaemic index cause a slow, sustained release of glucose to the blood, whereas foods with a high glycaemic index cause a rapid, sharp rise in blood glucose. Suitable foods to eat 3–4 hours before exercise include beans on toast, pasta or rice with a vegetable-based sauce, breakfast cereal with milk, or crumpets with jam or honey. Suitable snacks to eat 1–2 hours before exercise include fruit smoothies, cereal bars, fruit-flavoured yoghurt and fruit. An hour before exercise, liquid consumption appears to be more important — for example, sports drinks and cordials.

Fats

Fats are the secondary energy fuel for low-intensity aerobic work such as jogging and are made from glycerol and fatty acids. Fats contain a high proportion of carbon, which is why they give us so much energy, and they are also a good source of vitamins A, D, E, and K. Fats are stored in the muscle as triglycerides and transported as fatty acids.

Proteins

Proteins consist of chains of amino acids. They are important for tissue growth and repair and to make enzymes, hormones and haemoglobin. Proteins in the muscles may start to be broken down to provide energy when glycogen and fat stores are low, such as during strenuous activities or sustained periods of exercise.

Knowledge check 3

Give two classes of food suitable for a games player.

Vitamins

Vitamins are needed for muscle and nerve functioning, tissue growth and the release of energy from foods. Vitamins cannot be stored in the body and excess amounts are excreted through urine.

Minerals

Minerals assist in bodily functions. For example, calcium is important for strong bones and teeth, and iron helps form haemoglobin, which is needed for the transport of oxygen and therefore to improve stamina levels. Minerals tend to be dissolved by the body as ions and are called electrolytes. These facilitate the transmission of nerve impulses and enable effective muscle contraction, both of which are important during exercise. However, it is important to get the right balance — too much sodium (contained in salt) can result in high blood pressure. As with vitamins, excessive consumption is unlikely to enhance performance.

Fibre

Good sources of fibre are wholemeal bread and pasta, potatoes, nuts, seeds, fruit, vegetables and pulses. Fibre is important during exercise as it can slow down the time it takes the body to break down food, which results in a slower, more sustained, release of energy.

Water

Water constitutes approximately 60% of a person's body weight and is essential for good health. It carries nutrients to cells in the body and removes waste products. It also helps to control body temperature. When an athlete starts to exercise, production of water increases (water is a by-product of the aerobic system). We also lose a lot of water through sweat. The volume of water lost depends on the external temperature, the intensity and duration of the exercise and the volume of water consumed before, during and after exercise. Water is important to maintain optimal performance. Sports drinks such as Lucozade Sport and Gatorade can boost glucose levels before and after competition, while water rehydrates during competition.

Examiner tip

Make sure you know the exercise-related function of each food type, e.g. fats are a good energy source for aerobic/low-intensity exercise and a good source of vitamins A, D, E and K.

A balanced diet

A balanced diet should contain 15% protein, 30% fat and 55% carbohydrate. For athletes in training, the percentage of carbohydrate should be increased. Sports nutritionists recommend:

- 10–15% protein
- 15–25% fat
- 60–75% carbohydrate

Knowledge check 4

What do you understand by the term 'balanced diet'?

The energy balance of food

Energy is obtained from the food we eat (or from what the body stores). It is measured in calories. A calorie (cal) is the amount of heat energy required to raise the temperature of 1 g of water by 1°C. A kilocalorie (kcal) is the amount of heat required to raise the temperature of 1000 g of water by 1°C.

The basic energy requirement of an average person is generally given as 1.3 kcal per hour per kilogram of body weight. So someone who weighs 60 kg requires 1.3 × 24 (hours in a day) × 60 = 1872 kcal per day.

The energy requirement increases during exercise to 8.5 kcal per hour for each kilogram of body weight. So in a 1-hour training session the performer needs an extra 8.5 × 1 × 60 = 510 kcal. The total daily energy requirement of this performer is therefore 1872 + 510 = 2382 kcal.

What should you eat before a competition?

A pre-competition meal should be eaten 3–4 hours before competing because the food needs to be digested and absorbed in order to be useful. The meal needs to be high in carbohydrate, low in fat and moderate in fibre, to aid digestion (foods high in fat, protein and fibre tend to take longer to digest). High levels of carbohydrate will keep the blood glucose levels high throughout the competition/performance.

Examiner tip
Questions will ask you to compare the diets of a power athlete and endurance athlete, but make sure you also know *why* power athletes eat more protein and endurance athletes eat more carbohydrates.

Diet of an endurance athlete versus a power athlete

The body's preferred fuel for endurance sport is muscle glycogen. If glycogen stores become depleted, the athlete becomes fatigued and is unable to maintain the intensity of training. To replenish and maintain glycogen stores, endurance athletes need a diet rich in carbohydrates — at least 6–10 grams of carbohydrate per kilogram of body weight per day. Water is also essential, to avoid dehydration.

Some endurance athletes manipulate their diet to maximise aerobic energy production. One method is **glycogen loading**, which is covered at A2.

Endurance athletes require more carbohydrates and fats than power athletes because they exercise for longer periods of time and need more energy. Protein is very important for power athletes. Insufficient protein leads to muscle breakdown. Protein is necessary for tissue growth and repair.

Body fat composition

This is the physiological make-up of an individual in terms of the distribution of lean body mass and body fat. On average, men have less body fat (15%) than women (25%). Less body fat generally means a better performance. However, some sports have specific requirements for large amounts of fat, for example the defensive linesman in American football and sumo wrestlers.

Body mass index (BMI)

Body mass index (BMI) takes into account body composition. To calculate BMI, a person's weight in kilograms is divided by his/her height (in metres) squared. For example, a person who is 1.80 m tall weighing 75 kg has a BMI of 75/(1.8 × 1.8) = 23.15.

BMI classifications vary but the following is representative of most literature:

- **BMI < 19** underweight
- **BMI 19–25** normal
- **BMI 25–30** overweight
- **BMI 30–40** obese
- **BMI > 40** morbidly obese

Obesity and limitations of definition

Obesity is an excess proportion of total body fat, usually due to energy intake being greater than energy output. Obesity carries an increased risk of heart disease, hypertension, high blood cholesterol, stroke and diabetes. It increases stress on joints and limits flexibility.

An individual is considered to be obese when his/her body weight is 20% or more above normal weight, or when a male accumulates 25% and a female 35% total body fat. The body mass index can also be used as a measure of obesity. An individual is considered obese when his/her BMI is over 30.

Knowledge check 5

Identify two diseases associated with obesity.

Summary

After studying this topic, you should be able to:

- list the seven classes of food and understand the exercise-related function of each food type
- describe a balanced diet and the energy balance of food, and be able to relate this to your own practical activity
- identify the difference in diet composition between endurance athletes and power athletes
- identify the percentage of body fat/body composition and body mass index (BMI) as measures of nutritional suitability
- give a definition of obesity and understand the limitations in trying to define it

Pulmonary function

The mechanics of breathing

Air moves from areas of high pressure to areas of low pressure. The greater the pressure difference, the faster air flows.

Changing the volume of the thoracic cavity alters the pressure of air in the lungs. **Inspiration** increases the volume of the thoracic cavity through contraction of the muscles surrounding the lungs. This reduces the pressure of air in the lungs. **Expiration** decreases the volume of the thoracic cavity. This increases the pressure of air in the lungs, forcing air out. At rest, expiration is a passive process. The muscles involved in respiration are given in Table 3.

Knowledge check 6

During a game of football, name the extra muscles used during inspiration.

Table 3 Respiratory muscles

Ventilation phase	Muscles used during breathing at rest	Muscles used during exercise
Inspiration	Diaphragm	Diaphragm
	External intercostals	• External intercostals • Sternocleidomastoid • Scalenes • Pectoralis major
Expiration	Diaphragm and external intercostals relax (passive process)	• Internal intercostals • Abdominals

Respiratory volumes

Definitions and values of respiratory volumes, and the way they change during exercise, are given in Table 4.

Table 4

Lung volume or capacity	Definition	Average values at rest (litres)	Change during exercise
Tidal volume	Volume of air breathed in *or* out per breath	0.5	Increase
Inspiratory reserve volume	Volume of air that can be forcibly inspired after a normal breath	3.1	Decrease
Expiratory reserve volume	Volume of air that can be forcibly expired after a normal breath	1.2	Slight decrease
Residual volume	Volume of air that remains in the lungs after maximum expiration	1.2	No change
Vital capacity	Volume of air forcibly expired after maximum inspiration in one breath	4.8	No change
Minute ventilation	Volume of air breathed in or out per minute	6	Large increase
Total lung capacity	Vital capacity + residual volume	6	No change

Examiner tip

Questions usually ask for definitions of tidal volume, inspiratory reserve volume and expiratory reserve volume, together with an explanation of what happens to these volumes during exercise.

Lung capacities can be measured from a spirometer trace (see Figure 1).

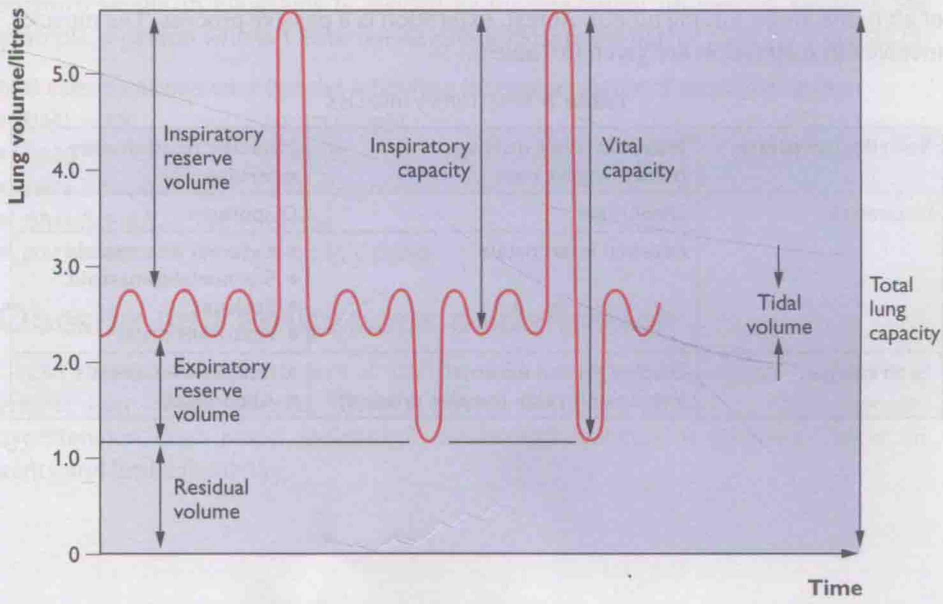

Figure 1

Gaseous exchange at the lungs

Gaseous exchange at the lungs is concerned with the replenishment of oxygen in the blood and the removal of carbon dioxide.

Diffusion is the movement of a gas from an area of high concentration to an area of low concentration down a concentration gradient until equilibrium is reached. In the lungs, diffusion of gases is aided by the structure of the alveoli. Alveoli are only one cell thick, so there is a short diffusion pathway; they have a vast surface area, which facilitates diffusion; and they are surrounded by a dense network of capillaries. The rate of diffusion is approximately 250 cm^3 of oxygen per minute at rest but this can rise to over 5 litres of oxygen per minute during exercise.

Oxygen makes up approximately 21% of air, so it exerts a **partial pressure**. Gases flow from areas of high pressure to areas of low pressure. As oxygen moves from the alveoli to the blood and then to the muscle, its partial pressure in each has to be successively lower.

partial pressure the pressure exerted by an individual gas when it exists within a mixture of gases

The exchange of gases in the lungs takes place between alveolar air and blood flowing through the lung (pulmonary) capillaries. Oxygen enters the blood from the alveoli because the partial pressure of oxygen in the alveoli (105 mmHg) is higher than the partial pressure of oxygen in the incoming blood vessels (40 mmHg). This is because the working muscles remove oxygen, so its concentration in the blood is lower and therefore so is its partial pressure. The difference between any two pressures is referred to as the pressure gradient and the steeper this gradient, the faster diffusion will be. Oxygen diffuses from the alveoli into the blood until the pressure is equal in both.

The movement of carbon dioxide occurs similarly but from the blood to the alveoli, because the partial pressure of carbon dioxide in the blood is higher (46 mmHg) than that in the alveoli (40 mmHg).

Inspired air contains more oxygen than expired air; expired air contains more carbon dioxide than inspired air. The percentage concentrations of gases found in inspired and expired air are shown in Table 5.

Examiner tip

Remember that the order of movement for oxygen is:

alveoli → blood → muscles

and carbon dioxide is the reverse:

muscles → blood → alveoli

Table 5

	Inspired air (%)	Expired air at rest (%)	Expired air during exercise (%)
Oxygen	21	16.4	15
Carbon dioxide	0.03	4	6

Gaseous exchange at the tissues

This takes place between arterial blood, flowing through the tissue capillaries, and the cells. Oxygen diffuses out of the arterial blood and into the muscle cells because the partial pressure of oxygen is higher (100 mmHg) in the blood than in the cells (40 mmHg).

Arterio-venous difference

This is the difference between the oxygen content of the arterial blood arriving at the muscles and the venous blood leaving the muscles. At rest, the arterio-venous difference is low because the muscles do not require much oxygen. However, during exercise the muscles need more oxygen, so the arterio-venous difference is high. This increase