Cambridge Technicals Level 3 (OCR)  
Sport and Physical Activity

Complete this booklet if you are enrolled on either the  
Extended certificate (single award) or the Diploma  
(double award)

Diploma (double award) students also need to complete the Unit 4 booklet

Transition work for Unit 1  
Body systems and the effects of physical activity

Name………………………………………………………………………………………………………...
UNIT AIM

Whether you are aiming to become a coach, nutritionist, personal trainer or leisure centre manager, knowledge of the human body, its systems and how they function will help you to ensure that your clients gain the benefits of an active, healthy lifestyle. By understanding the effects that physical activity, training and lifestyle can have on the body systems you can ensure that sports and activities are properly focused and do not risk a client’s health or wellbeing and will help you to persuade others to pursue and maintain a balanced, active, healthy lifestyle.

In this unit you will gain an understanding of the structures and functions of the key body systems, how these support and impact performance in sport and physical activity and the effects that physical activity, training and lifestyle can have on them.

You are required to complete ALL tasks in the booklet ready to hand in to your Unit 1 teachers in September when you start the course. You can submit a handwritten copy or complete it electronically before printing off your final version.

➢ Skeletal system and respiratory system to Mr Wilson
➢ Muscular system and cardiovascular system to Mr Pickard

You will be tested on the content of this booklet at the start of Term 1 via a formal transition assessment so make sure that you prepare thoroughly by completing the tasks to the best of your ability and starting to prepare additional revision resources.

Underperformance in the transition assessment could result in you being removed from the course.

There are some exam questions at the end of each section for you to attempt. These are similar in content and style to the questions you are likely to be faced with in your transition test. Try and answer these without referring back to your notes if you can. If you struggle with this, go back over your revision resources and attempt the questions again once you’ve done some more independent study.
Section 1 – The skeletal system

Learning outcome 1
Understand the skeletal system in relation to exercise and physical activity

Learning objective 1.1
I can describe the difference between the axial and appendicular sections of the skeleton and identify the location of the following bones:

Axial skeleton
- Cranium
- Sternum
- Ribs
- Vertebral column
  - Cervical vertebrae
  - Thoracic vertebrae
  - Lumbar vertebrae
  - Sacrum
  - Coccyx

Appendicular skeleton
- Scapula
- Clavicle
- Humerus
- Radius
- Ulna
- Carpals
- Metacarpals
- Phalanges
- Ilium
- Ischium
- Pubis
- Femur
- Patella
- Tibia
- Fibula
- Tarsals
- Talus
- Metatarsals
Task 1.1
Label all the bones listed on the previous page on the diagrams of the skeleton and the vertebral column below. You can label the vertebral column as a whole on the first diagram but use the second diagram to label the different sections of it.

Once you have labelled all the bones, shade in or highlight the bones of the axial skeleton in the first diagram.
Fig. 12.1 shows a diagram of the vertebral column.

Cranium

A

B

C

D

Coccyx
Learning objective 1.2
I can identify the different functions of the skeleton and link these functions to the different types of bone.

You need to be able to describe (using an example of each) the following types of bones:

- long bones
- short bones
- flat bones
- irregular bones
- sesamoid bones

Task 1.2 (i)
Name the bones used as examples in the diagram below and identify which category of bone they belong to. Once you’ve done this complete the table on the next page to add some detail about each classification.
<table>
<thead>
<tr>
<th>Type of bone</th>
<th>Examples of bones within that classification</th>
<th>Additional information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sesamoid</td>
<td>• Patella (kneecap) • Pisiform bone of the wrist</td>
<td>Usually very small bones that are embedded within tendons. For example, the patella bone is found within the patella tendon of the knee. The name sesamoid was given to this type of bone because they are shaped a little bit like a sesame seed. Their function is to minimise friction between the tendon and the joint during movement. They do this by holding the tendon slightly away from the joint so that it does not rub excessively. This helps to protect the tendon from wear and tear.</td>
</tr>
<tr>
<td></td>
<td>• Scapula (shoulder blade)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Humerus</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Vertebrae</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Mandible (jawbone)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Calcaneus (one of the tarsals)</td>
<td></td>
</tr>
</tbody>
</table>
Task 1.2 (ii)
Research the following functions of the skeleton and add some explanatory detail to the table on the next page.

- Shape
- Blood cell production
- Protection
- Movement
- Mineral storage
- Support

Why not use a mnemonic to help you remember the names of the functions?

**Sir believes preparation means massive success!**

Don’t forget you will also need to be able to explain each one in order to answer an exam question successfully. Use examples where you can.
<table>
<thead>
<tr>
<th>Function</th>
<th>Explanatory information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shape</td>
<td></td>
</tr>
<tr>
<td>Blood cell production</td>
<td></td>
</tr>
<tr>
<td>Protection</td>
<td></td>
</tr>
<tr>
<td>Movement</td>
<td></td>
</tr>
<tr>
<td>Mineral storage</td>
<td></td>
</tr>
<tr>
<td>Support</td>
<td></td>
</tr>
</tbody>
</table>
Skeletal system past-paper exam questions

Now test your knowledge by having a go at the following exam questions.

Answer all questions. Put a tick (✓) in the box next to the one correct answer for each question.

1 Which one of the following is not part of the pelvis?
   (a) Ischium
   (b) Pubis
   (c) Femur
   (d) Ilium

2 Which one of the following bones is part of the appendicular skeleton?
   (a) Humerus
   (b) Sacrum
   (c) Cranium
   (d) Ribs

3 Which of the following bones form the elbow joint?
   (a) Humerus, femur and ulna
   (b) Humerus, tibia and fibula
   (c) Humerus, radius and fibula
   (d) Humerus, radius and ulna
Complete the table by identifying the structural type of each bone below.

<table>
<thead>
<tr>
<th>Bone</th>
<th>Type of bone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vertebra</td>
<td>Irregular</td>
</tr>
<tr>
<td>Carpals</td>
<td></td>
</tr>
<tr>
<td>Cranium</td>
<td></td>
</tr>
<tr>
<td>Patella</td>
<td></td>
</tr>
<tr>
<td>Phalanges</td>
<td></td>
</tr>
</tbody>
</table>

Describe the following functions of the skeleton. Give an example of each.

Protection

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Movement

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Blood cell production

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........................................................................................................................................
........................................................................................................................................
Section 2 – The muscular system

Learning outcome 2
Understand the muscular system in relation to exercise and physical activity

Learning objective 2.1
I can identify the location of the following muscles:

- Deltoid
- Latissimus dorsi
- Pectoralis major
- Trapezius
- Teres major
- Biceps brachii
- Triceps brachii
- Pronator teres
- Supinator muscle
- Wrist flexors
- Wrist extensors
- Rectus abdominus
- Erector spinae
- Internal and external obliques
- Iliopsoas
- Gluteus maximus
- Gluteus medius
- Gluteus minimus
- Adductor longus
- Adductor brevis
- Adductor magnus
- Rectus femoris
- Vastus medialis
- Vastus intermedius
- Vastus lateralis
- Biceps femoris
- Semimembranosus
- Semitendinosus
- Tibialis anterior
- Gastrocnemius
- Soleus
Task 2.1 (i)
Label the following muscles on the two diagrams below. You only have to label each muscle once.

- Deltoid; Latissimus dorsi; Pectoralis major; Trapezius; Biceps brachii; Triceps brachii; Rectus abdominus; Internal obliques; External obliques; Tibialis anterior; Gastrocnemius
Task 2.1. (ii)
Complete the following activities. These are designed to introduce you to the muscles in the specification that you were not asked to label on the previous 2 diagrams.

The two muscles pictured above are part of the hip flexor muscle group. What is their collective name?

The gluteal muscle group is responsible for hip extension.

Label each of the individual muscles of the group on the diagram below.

- Gluteus maximus
- Gluteus medius
- Gluteus minimus
The muscles in the diagram below are part of a group of muscles called the adductors. They are responsible for adduction of the hip.

Label each of the adductors on the diagram

The muscle group pictured above contracts to extend the spine.

What is this group of muscles called?
The quadriceps are situated on the front of the thigh and is a muscle group made up of four individual muscles. They produce extension of the knee.

Label the 3 quadriceps muscles visible on the diagram below.

One of the quadriceps muscles isn’t visible on the diagram because it is hidden underneath the rectus femoris.

Label this ‘deep’ muscle of the quadriceps on the diagram below. This is what you would see if the other quadriceps muscles were ‘peeled back’.
The hamstrings are situated on the back of the thigh and is a muscle group made up of three individual muscles. They produce flexion of the knee.

Label the 3 muscles of the hamstrings on the diagram below.

You should already have labelled the main calf muscles (the gastrocnemius) in Task 2.1.i.

There is another ‘deep’ muscle of this muscle group that is almost entirely hidden by the gastrocnemius (1 on the diagram below). Label the other calf muscle (2 on the diagram below) that lies beneath the gastrocnemius.

The calf muscles work together to help produce plantar flexion of the ankle.

The tibialis anterior, which you should have labelled in Task 1.1.i., produces the opposite movement at the ankle, which is called dorsiflexion.
Label the muscle shown on the diagram below. One of its functions is to assist the latissimus dorsi to produce adduction at the shoulder joint.

Label both of the following muscles on both of the diagrams below:

- supinator muscle (contracts to supinate the forearm)
- pronator teres (contracts to pronate the forearm)

Supination = palm forwards
Supination = palm upwards (e.g. bicep curl)

Pronation = palm backwards
Pronation = palm downwards (e.g. dribbling a basketball)
The **wrist flexors** are a group of muscles responsible for flexing the wrist.

The muscles are situated on the anterior (front) of the forearms (the sides that are facing forwards if you are stood in the anatomical position). You do not need to know the individual muscles that make up this group, but some are named in the left-hand section of the diagram above of the muscles of the forearm.

The **wrist extensors** are a group of muscles responsible for extending the wrist.

The muscles are situated on the posterior (back) of the forearm (the sides that are facing backwards if you are stood in the anatomical position).

You do not need to know the individual muscles that make up this group, but some are named in the right-hand section of the diagram above of the muscles of the forearm.

In this diagram you can see the wrist flexors because the anterior side of the forearm is facing forwards. You cannot see the wrist extensors because they are on the posterior side of the forearm, which is facing backwards.

Complete the table below to provide some examples of when these muscles would be required in sport and physical activity. Make sure you are specific about the phase of the action to which you are referring. Basketball and badminton are two sports that include some good examples.

<table>
<thead>
<tr>
<th>Muscle group</th>
<th>Movement they produce</th>
<th>Example from sport or physical activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wrist flexors</td>
<td>Flexion of the wrist</td>
<td>Basketball, badminton</td>
</tr>
<tr>
<td>Wrist extensors</td>
<td>Extension of the wrist</td>
<td>Basketball, badminton</td>
</tr>
</tbody>
</table>
Learning objective 2.2
I can identify the different types of muscle function during movement at a joint.

- Agonist
- Antagonist
- Fixator

Antagonistic pairs- Muscles that work in pairs. Whilst one is contracting the other is relaxing.

Agonist- Sometimes known as the ‘prime mover’, it is the muscle that is contracting to produce the majority of the force required for the movement.

Antagonist- The opposite muscle to the agonist. It relaxes to allow the agonist to produce the desired movement.

Synergist- Sometimes known as ‘secondary movers’, they contract at the same time as the agonist to help provide some additional force for the desired movement.

Fixator- Muscles that contract isometrically (a contraction where the muscle length doesn’t change) to prevent unwanted movement at a joint.

They allow the agonist to produce a more effective pulling force because they help to keep the origin (the point at which a tendon of the agonist attaches to the bone that doesn’t move) still.

Task 2.2
Complete the missing words in the paragraph below. Choose from the following words:
synergist; triceps brachii; biceps brachii; deltoids

The biceps brachii and triceps brachii are an antagonistic pair.

During the lifting (upwards) phase of a bicep curl, the ________________ are the agonists because they contract to produce the majority of the force required to flex the elbow and lift the weight.

The ________________ are the antagonists because they relax to allow the agonists to produce the desired movement.

To prevent any unwanted movement at the shoulder joint, the ________________ contract isometrically to keep the origin of the agonist stable.

Two muscles of the forearm called the brachialis and the brachioradialis help the agonist to flex the elbow. They are called ________________ muscles because of the assistance that they provide during the movement.
Muscular system past-paper exam questions

Now test your knowledge by having a go at the following exam questions.

Which one of the following muscles contracts to cause flexion at the knee?

(a) Biceps brachii  
(b) Rectus femoris  
(c) Biceps femoris  
(d) Vastus medialis

[1]

Which one of the following muscles does not act at the shoulder joint?

(a) Deltoid  
(b) Trapezius  
(c) Teres major  
(d) Iliopsoas

[1]

Which one of the following muscles contracts to cause knee extension?

(a) Vastus medialis  
(b) Tibialis anterior  
(c) Adductor magnus  
(d) Semimembranosus

[1]
Fig. 11.1 shows the major skeletal muscles of the body.

![Fig. 11.1]

Identify the muscles labelled A, B, C and D.

A. .......................................................................................................................... [4]
B. ..........................................................................................................................
C. ..........................................................................................................................
D. ..........................................................................................................................

Fig. 16.1 shows a basketball player taking a shot.

![Fig. 16.1]

The elbow extends during the performance of the basketball shot.

(a) Identify two muscles acting at the elbow and two muscles acting at the wrist during the shot.

Elbow .................................................................................................................... [4]
Elbow ....................................................................................................................
Wrist ......................................................................................................................
Wrist ......................................................................................................................
Section 3 – The cardiovascular system

Learning outcome 3
Understand the cardiovascular system in relation to exercise and physical activity

Learning objective 3.1
I can identify the following structures of the heart and explain their roles in the circulation of blood:

- Atria (right atrium and left atrium)
- Ventricles (right ventricle and left ventricle)
- Bicuspid valve
- Tricuspid valve
- Pulmonary valve
- Aortic valve
- Aorta
- Superior venae cavae
- Inferior venae cavae
- Pulmonary artery
- Pulmonary valve

Watch the following video before you attempt the tasks
Blood Flow through the Heart in 2 MINUTES by the Neural Academy
https://www.youtube.com/watch?v=jBt5jZSWhMI

Task 3.1 (i) Label all the structures listed above on the diagram below
Task 3.1 (ii)
Describe the journey of blood into the heart, to the lungs, back to the heart and around the rest of the body.

Make sure that your description includes reference to all of the features you have labelled on the diagram above. Don’t just write out the script from the video. Challenge yourself to write the description in your own words. Use your labelled diagram to help you.
Learning objective 3.2
I can define the following terms relating to the cardiovascular system and explain what happens to these values during exercise:

- Stroke volume
- Heart rate
- Cardiac output

Task 3.2 (i)
Research the key terms above and complete the table below:

<table>
<thead>
<tr>
<th>Key term</th>
<th>Definition</th>
<th>Units of measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stroke volume</td>
<td>The number of times the heart beats per minute.</td>
<td>Beats per minute</td>
</tr>
<tr>
<td>Heart rate</td>
<td>The volume of blood pumped out of the left ventricle per beat.</td>
<td>Millilitres per beat</td>
</tr>
<tr>
<td>Cardiac output</td>
<td>The volume of blood pumped out of the left ventricle per minute.</td>
<td>Litres per minute</td>
</tr>
</tbody>
</table>

Task 3.2 (ii)
Complete the following equation using the 3 key terms:

\[ \text{X} \times \text{ } \text{ } \text{ } \text{ } = \text{ } \text{ } \text{ } \text{ } \]

Task 3.2 (iii)
Complete the following table below to show typical values of heart rate, stroke volume and cardiac output at rest and during exercise:

<table>
<thead>
<tr>
<th>Key term</th>
<th>Typical values at rest of an ‘average’ sedentary adult male</th>
<th>Typical maximum values of an ‘average’ sedentary adult male</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heart rate</td>
<td>71 beats per minute</td>
<td>185 beats per minute</td>
</tr>
<tr>
<td>Stroke volume</td>
<td>65 ml per beat</td>
<td>120 ml per beat</td>
</tr>
<tr>
<td>Cardiac output</td>
<td>4.6 litres per minute</td>
<td>22 litres per minute</td>
</tr>
</tbody>
</table>

Cardiovascular system past-paper exam questions

Now test your knowledge by having a go at the following exam questions.

Which one of the following is a normal value for cardiac output at rest?

(a) 2 litres/minute
(b) 5 litres/minute
(c) 8 litres/minute
(d) 10 litres/minute

Which of the following is the correct order of blood flow through a section of the heart?

(a) Right atrium – right ventricle – tricuspid valve – pulmonary artery
(b) Right atrium – left atrium – left ventricle – right ventricle
(c) Right atrium – bicuspid valve – left atrium – left ventricle
(d) Right atrium – tricuspid valve – right ventricle – pulmonary artery

Which one of the following heart valves prevents blood flowing back into the left atrium?

(a) Bicuspid valve
(b) Tricuspid valve
(c) Pulmonary valve
(d) Aortic valve
Identify A, B and C and describe the role of each in the circulation of blood.

A ........................................................................................................................................
Description ........................................................................................................................
........................................................................................................................................

B ........................................................................................................................................
Description ........................................................................................................................
........................................................................................................................................

C ........................................................................................................................................
Description ........................................................................................................................
........................................................................................................................................

[6]

Define the terms ‘stroke volume’ and ‘cardiac output’. State typical resting values for each for an untrained individual.

Stroke volume ........................................................................................................................
........................................................................................................................................

Typical untrained resting value ......................................................................

Cardiac output ....................................................................................................................
........................................................................................................................................

Typical untrained resting value ....................................................................................
........................................................................................................................................

[4]
Section 4 – The respiratory system

Learning outcome 4
Understand the respiratory system in relation to exercise and physical activity

Learning objective 4.1
I can identify the following structures of the respiratory system explain how they contribute to the inhalation of air:

- Nasal cavity
- Epiglottis
- Pharynx
- Larynx
- Trachea
- Bronchi
- Bronchioles
- Alveoli

Task 4.1
Label the diagrams below using the key terms listed above. Use the following links to help you:

https://www.youtube.com/watch?v=zRvStNCMpyY
http://www.innerbody.com/anatomy/respiratory
**Learning objective 4.2**
I can identify the following respiratory muscles and explain how they contribute to our breathing during exercise:

- Sternocleidomastoid
- Scalene
- Pectoralis minor
- Internal intercostals
- External intercostals
- Rectus abdominus
- Diaphragm

**Task 4.2 (i)**
Label the muscles listed above on the diagrams below:
**Task 4.2 (ii)**
Watch the following clip and use the information in the clips to help you complete the table below:
https://www.youtube.com/watch?v=VweHwyrX2qs

NB – The scalene muscle group is not mentioned in the clip above, but you need to know that they are accessory muscles that help to lift the ribcage upwards when we are deep breathing during exercise. You can see where they are located in more detail by watching the short preview video that can be accessed via the following link:

<table>
<thead>
<tr>
<th>Phase of the breathing cycle</th>
<th>Muscles contracting</th>
<th>Change to the volume of thoracic cavity (and therefore the lungs)</th>
<th>Change to the pressure of air in the lungs</th>
<th>Direction of airflow</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inspiration (breathing in) at rest</td>
<td></td>
<td></td>
<td>Decreases</td>
<td>Air is drawn into the lungs from outside of the body.</td>
</tr>
<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inspiration (breathing in) during exercise</td>
<td></td>
<td></td>
<td>Decreases</td>
<td>Air is drawn into the lungs in larger volumes than at rest.</td>
</tr>
<tr>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Expiration (breathing out) during exercise</td>
<td></td>
<td>Decreases</td>
<td></td>
<td>Air is forced out of the lungs</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Expiration (breathing out) during exercise</td>
<td></td>
<td></td>
<td>Decreases</td>
<td>Air is forced out of the lungs more quickly and in larger quantities than at rest.</td>
</tr>
</tbody>
</table>
**Respiratory system past-paper exam questions**

Now test your knowledge by having a go at the following exam questions.

Which one of the following is the correct definition of tidal volume?

(a) The volume of oxygen inspired per breath

(b) The volume of carbon dioxide expired per breath

(c) The volume of air inspired per breath

(d) The volume of air inspired per minute

Which one of the following is the correct order of respiratory passages that air would pass through during expiration?

(a) Bronchi – trachea – nasal cavity - epiglottis

(b) Bronchi – alveoli – bronchioles - epiglottis

(c) Bronchioles – trachea – epiglottis - larynx

(d) Bronchioles – bronchi – trachea - larynx

Which one of the following respiratory structures is also known as the voice-box?

(a) Epiglottis

(b) Pharynx

(c) Larynx

(d) Nasal cavity
Identify the structures labelled A, B and C.

A

B

C

[3]

Explain the mechanics of breathing during inspiration using the following terms:

<table>
<thead>
<tr>
<th>External intercostals</th>
<th>diaphragm</th>
<th>rib cage</th>
<th>thoracic cavity</th>
<th>pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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[5]