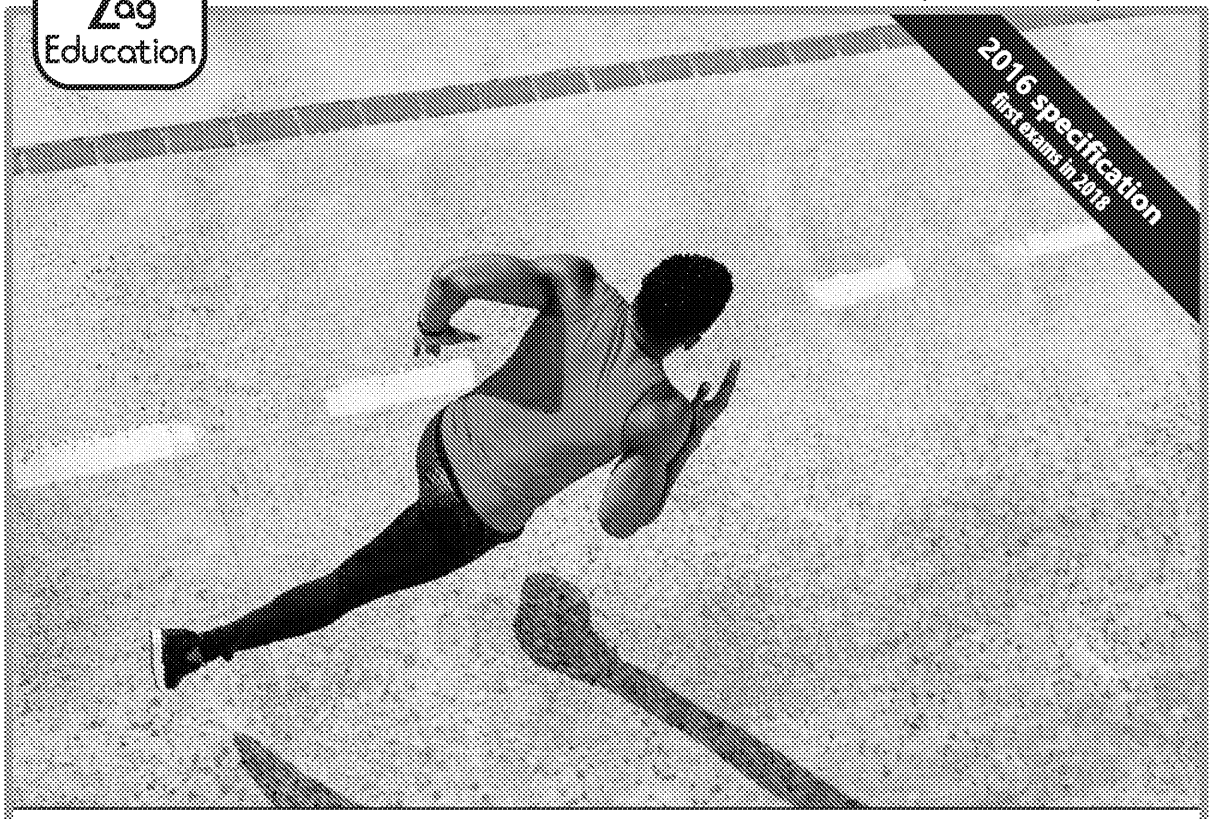
Zig Zag Education

PE

GCSE (9–1) | Edexcel | 1PE0



Tricky Topics for GCSE Edexcel PE

Movement Analysis and Movement Possibilities

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POD 10928

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Teacher's Introduction

This resource has been created to supplement your teaching and to support you and your students through the topic of **Edexcel GCSE PE (9–1): Movement Analysis**. It has been broken down into four sections ensuring time to fully develop the required knowledge and understanding:

- 2.1.1 – First-, second- and third-class lever systems
- 2.1.2 – Mechanical advantage
- 1.1.5 – Analysis of basic movements
- 2.2 – Planes and axes of movement

Remember!
Always check the exam board website for new information, including changes to the specification and sample assessment material.

Why is movement analysis a tricky topic?
I have found that students struggle with the concept of 'movement analysis' due to the complex nature of sporting movements. With sports skills being dynamic, it can be a challenge to interpret these movements, as a slight change in body position can lead students into incorrect answers. For example, a slight change in body position can deceive a student into thinking a certain lever system is being used, due to where the fulcrum is, or that a movement occurs through a certain plane, due to the multiple directions through which a skill takes place. Additionally, the terminology can be very technical and use terms that students may not be familiar with, leading to a reduction in their confidence in the topic.

Over the years it has become apparent that the analysis of movement should include activities that are visual in order to support students' understanding and application of, and ability to analyse, the key concepts. Additionally, I have often found that PE students enjoy being practical, so approaching this topic though physical activity is ideal for getting through to students and improving their confidence in this topic.

Worksheets provided throughout this pack have been designed to be visual and include a focus on 'doing' through a range of practical activities alongside more theoretical worksheets. There is a range of clear images and diagrams to support the students' understanding, which can also be used as a revision tool throughout the two-year course.

The pack contains four lessons, guided by the **teacher's overview page**, which highlights *timings*, *equipment required* and *guidance notes* for the activities that students receive. Each lesson then is inclusive of worksheets that include:

1. **Summary notes** – provide background knowledge and information on each subtopic to support students in completing the activities and give them a base to work from.
2. **Theoretical and practical tasks** – progressively build students' understanding of the topic step by step, introducing key terms and concepts individually before combining them as a whole. Tasks provide a variety of different approaches, and include individual, paired and small-group work. Each task is carefully instructed, allowing the students to be independent, and minimal input from the teacher is needed, allowing you to float between the groups and support students who need it. Optional extensions are also provided throughout – these can be supplied as in-class extension activities for the quicker learners or provided as homework.
3. **Top tips** – offer students key advice that can support knowledge retention and exam preparation.
4. **Questions to think about** – provide opportunities for in-class discussion springboards and encourage deeper thinking on the topic to stretch and challenge students.
5. **Practice exam-style questions** – expose students to the exam format for each subtopic and help them put their knowledge and understanding into practice.

Each lesson also contains **thought-provoking visual images and diagrams** to stimulate learners' interest and support their understanding of the tricky topic. Each worksheet is write-on and can be photocopied and handed out to students. The activities included require minimal equipment (except for the use of jelly babies in Lesson 4).

From the author
I am an experienced Head of Physical Education who has worked in London schools with a mix of ability students. I am also the Physical Education PGCE Lead Tutor at Roehampton University, and I use similar resources to the ones provided in this pack with my PGCE students to support their delivery of GCSE PE throughout schools in London. I would like to lay thanks to my previous GCSE classes who have gone through variations of these lessons in order to find clear and useable tasks to support their understanding of this section. Thank you!

June 2021

Teacher's Overview

This table provides an overall summary of how to use each worksheet in a lesson, providing time sugge
when setting students on each task. You may wish to hand these out for inden ent learning alongsid
can adapt to complete on their own. Optional extensions are provided ou – these can be supp
provided as homework.

Topic no.	Spec reference and title	Time sugge eeded		
1	**2.1.1** – First-, second- and third-class lever systems	1 hour	Scissors Sticky notes	**5–10 mins:** Discuss functions of levers **10 mins: (Activity 1)** Support students answers as a group. **10–15 mins: (Activity 2)** Discuss how Explain how different combinations/o the examples to support. **15 mins: (Activity 3)** Support students plantar flexion or dorsiflexion at the a **6 mins: (Activity 3)** Students should co mark in the exam, so guide their time students can do this without looking b **(Optional) Extension:** Students to pra **3 mins: (Exam-style questions)** Studer 1 mark per minute
2	**2.1.2** – Mechanical advantage	30 minutes		**5 mins:** Recap le er systems, naming t advan h levers, and explain t ity 1)** Students to rearra into the space provided. Give st **4 mins: (Activity 2)** Support students t arm. Students to justify their decisions **3 mins: (Activity 3)** Support students i **8 mins: (Activity 4)** Draw and label lev load/resistance arm **8 mins: (Exam-style questions)** Studer

Topic no.	Spec reference and title	Time suggestion	Equipment needed	
3	**1.1.5** – Analysis of basic movements	1 hour		**5–10 mins:** Introduction to, and discus students to demonstrate the moves if **10 mins: (A… 1)** Support students **1…s: …ivity 2)** Choosing a sport, …ch team **10 mins: (Activity 3)** Exam preparation the movement. One student at a time the movement. Discuss what other sp **10 mins: (Activity 4)** Exam preparation created in the leg action when running **5 mins: (Exam-style questions)** Studen allotted 5 minutes
4	**2.2** – Planes and axes of movement	1 hour	Jelly babies Blu Tack Cocktail sticks Scissors Card (or paper, if no card available) cut into 7 × 4 cm pieces	**5–10 mins:** Introduction to, and discus to planes and axes of movement. **10 mins: (Activity 1)** Students use jelly in the body. Support students in draw that axis. **10 mins: (Activity 2)** Support students **10 mins: (Activity 3)** Students use Blu students in drawing their diagrams an **10 mins: (Activity 4)** Support students **(Optional) Extension:** Students to pra **5 mins: (Acti…)** Support students i table …e direction of the move **…min… …am-style questions)** Studen

Student Introduction

You may be familiar with the muscles and joints, but do you know how they wor
sport? And do you know how different combinations of these can cause differen
effect physical activity and sports performance?

Building on the topics of the musculoskeletal system, this pack will help you to d
understanding of the principles of movement and their effect on performance. Y
lever systems that play a part in movement and how each lever system has a diff
analyse basic movement skills and identify how different sporting actions take pl
around different axes.

This 'Tricky Topics' pack will support you in being more competent in this topic a
the examination.

Each lesson plan covers a separate topic within **Topic 2 Movement analys**
specific exe o complete as part of your lessons, but if you're tackling a wor
- read the information on the worksheet – this will give you a base to work fr
- read the part of your textbook which covers this topic. (If you don't have a t
words or concepts online.)
- work through the activities or questions in the order given. If you have the a
you can before looking at it.
- check your answers against the answer sheet, or hand in your work to your

Good luck!

First-, second- and third-class le

A lever is a bar that moves a load/resistance when a force is applied to it. In our b
bones via tendons. When the muscles contract, they pull the bones, which act as
fulcrum, typically a joint. There are **three different types of lever system** in our b
movement to occur, as you will discover later.

The functions of the lever systems in the body are:
1. to multiply a force to move a large load
2. to increase the speed of body movement

All lever systems are similar in that each consists of a load, an **effort** and a **fulcru**
which categorises which of the three types of lever system is being used.

	Effort	Effort	
Any weight that needs to be moved. Also called resistance.	The force needed to move the load (weight)		T ro ta
e.g. body weight or the weight of an object	e.g. the muscle (at the point of insertion on the bone)		e

Activity 1 (individual)

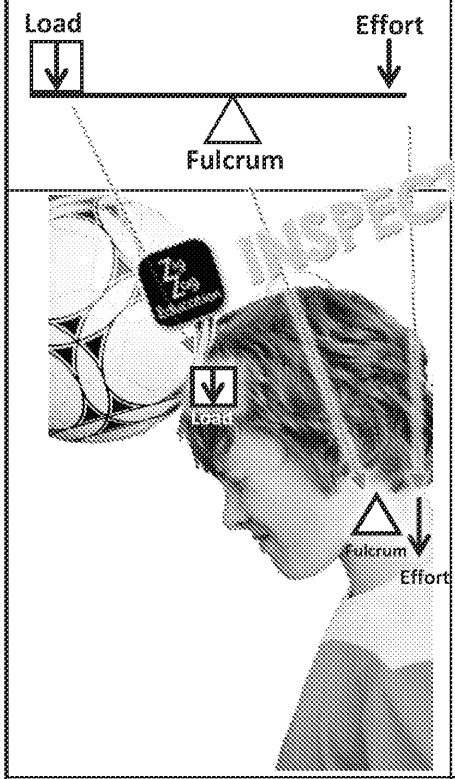
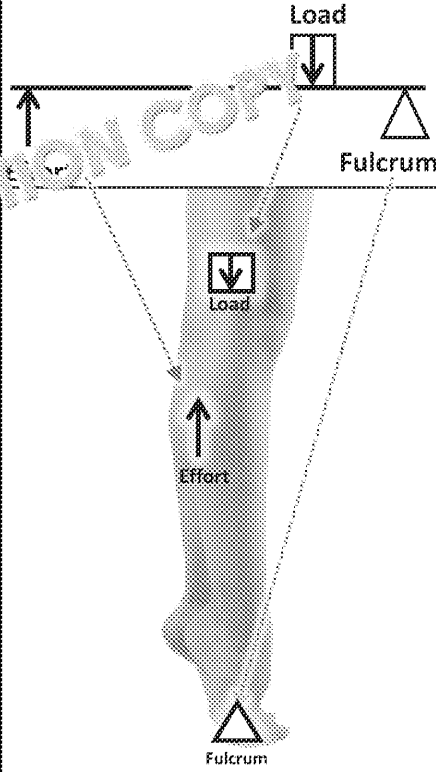
In your exam you will be expected to draw basic drawings of these components a
movements in order to identify which lever system is being used.

For each of the terms below, identify whether it would show the load, the effort
relevant component to represent this. One has been done for you.

Biceps	Shot	Ankle joint
Effort		
Knee joint	**Body weight**	**Gastrocnemius**
Quadriceps	**Basketball**	**Tibialis anterior**

The components mentioned (fulcrum, effort and load) will be put together to for
one of three lever systems, as shown below. This uses the bar that was mentione
fulcrum along it.

Top tip: You will be required to link correct lever systems to sp
in exam questions. However, you will not need to draw the an

First-class lever system	Second-class lever system	
		
Load = *football / weight of head* **Fulcrum** = *neck joint* **Effort** = *neck muscles (during flexion and extension)*	**Load** = *weight of the body* **Fulcrum** = *(metatarsophalangeal*) joint / ball of the foot* **Effort** = *gastrocnemius muscle (during plantar flexion)*	**Loa** **Effo** **Fulc** *flex*

**Not required knowledge. You can state the ball of the foot.*

Top tip: Memorise the rhyme '1, 2, 3, F, L, E'.
F, L and E are the components which are found
at the centre of the first-, second- and third-
class lever systems respe

Ques
How do
compon

Notice how the effo arrow points either up or down. To work this out you shou
linear draw... e a bit like a see-saw. In the first-class lever system the effort
keep the load up on the other end so the 'see-saw' is balanced. In the second- an
effort is applied upwards to keep the load up and the 'see-saw' balanced.

Activity 2 (group)

Get into groups of three and cut out the labels below (or draw them onto four se
In turns, one of you should replicate/mime a sporting example, and the other tw
onto the individual to locate each component of the lever. Can you then classify

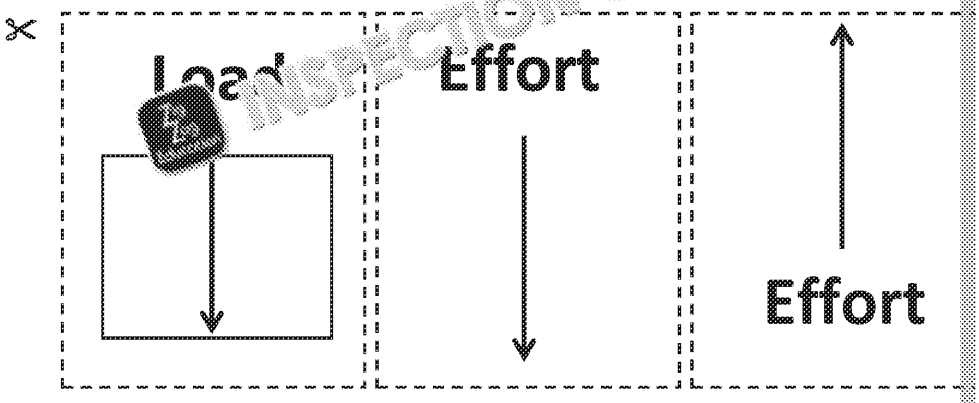
Swap roles and repeat. Complete three sporting examples each with a focus on f
elbow or knee and plantar flexion or dorsiflexion of the ankle.

Fill in the table below to record your answers.

Sporting example	Fulcrum	Effort	[illegible]	Lin
				

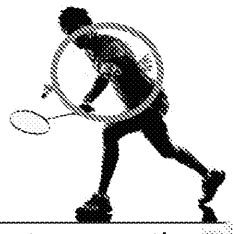
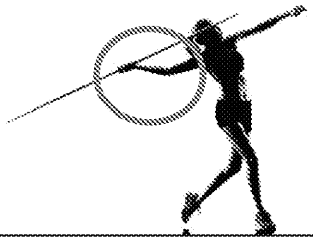
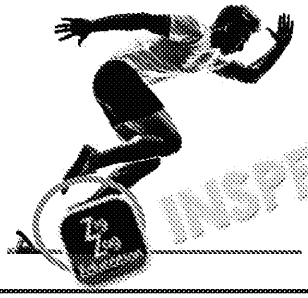
Top tip: You may be asked to draw the basic diagram of the three classifications of lever system. You must be able to label clearly the fulcrum, load and resistance.

Ques
For each
write th
advanta



Activity 3 (individual)

In your exam you may be asked to identify a lever system being used from a give
to draw a fully labelled diagram. For each of the following sporting movements,
draw the image.

Lever system operating at the elbow during a badminton backhand 	**Lever system:**	**Linear drawi**
Lever system operati[illegible] when kick[illegible] 	**Lever system:**	**Linear drawi**
Lever system operating at the elbow in a javelin throw 	**Lever system:**	**Linear drawi**
Lever system operating at the ankle when pushing off from the starting blocks at the beginning of the 100 m 	**Lever system:**	**Linear drawi**

Top tip: You must be able to label the resistance and effort arms on the three types of lever system.

You will be required to interpret sporting movements in relation to levers, which would include flexion, extension, plantar flexion and dorsiflexion.

Quest
What m
of the p
moveme

Extension activity

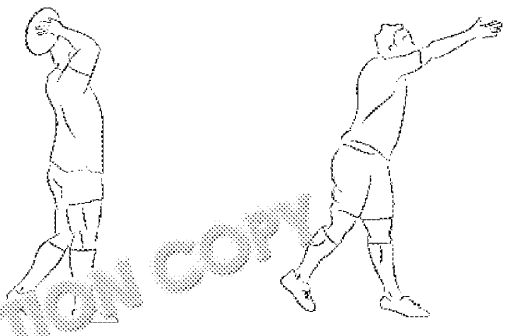
Time to practise! Can you identify the lever system operating at the following loc
are no images, so you could practise by replicating the movements, as in Activity
representations of them on paper. Tick the lever system and justify your choice.
of your own.

Sporting action	Lever system (✓)			
	First-class	Second-class	Third-class	
Lever system at the elbow during a forehand tennis shot				
Lever system at th… at the sta… or…ersault during the … routine in gymnastics				
Lever system at the neck when watching the flight of the ball in a squash game				
Lever system at the knee when pushing off the starting blocks for 200 m				
Lever system at the ankle during the take-off from a springboard to start a dive				
Lever system at the elbow when throwing a javelin				
Lever system at the neck when moving into a forward roll in gymnastics				

Exam-style questions

1. Figure 1 shows a rugby player throwing a ball into a line-out.

Figure 1



a) Identify the type of lever being used at the elbow.

.....

b) Draw a diagram with labels to show this type of lever.

2. Which one of the following uses a third-class lever system?
   a) Extension at the neck in preparation to head a football
   b) Flexion at the elbow to throw a javelin
   c) Extension at the knee when running
   d) Plantar flexion at the ankle to take off during a long jump

Mechanical advantage of leve

Levers are designed efficiently to increase force production, i.e. they are designe
greater than the effort that is put in. The efficiency of a lever system is known as

The mechanical advantage of each lever system is dependent on the relationship
1. The distance between the fulcrum and the load – known as the resistance (
2. The distance between the fulcrum and the effort – known as the effort arm.

A **second-class lever** system has a **high mechanical advantage** due to its having a
its load/resistance arm. Second-class levers can move relatively large loads with

A **first-class lever system**, if it has the fulcrum closer to the load, also has a **mech**
the fact that the effort arm is longer than the load/resistance arm. However, this
the fulcrum from the load. First-class levers also work at a mechanical disadva

A **third-class lever system** always works at a **mechanical disadvantage** as the load/resistance arm is longer than the effort arm. The muscles must exert more force than the weight opposing it. Third-class levers are most common in the body and allow us to move loads with a greater range of motion.

Questio
Which leve
and why? C
this lever s

Activity 1 (pairs)

The mechanical advantage (or disadvantage) can be summarised with an equatio
given below, discuss with a partner which order you would put them in to create
whether there is a mechanical advantage. Then, underneath, justify why you put

Top tip: Your answer to the equation would indicate whether t
an advantage or a disadvantage. If you get an answer that is le

=	*Load/resistance arm*	*Mechanical advantage*	÷

Equation for mechanical advantage:

Justification for equation:

.....

.....

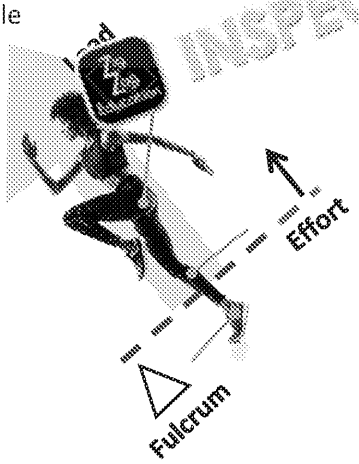
.....

Once you have checked your answer, be sure to write the correct answer here:

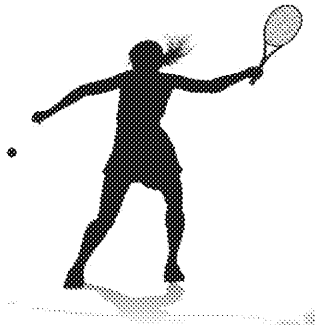
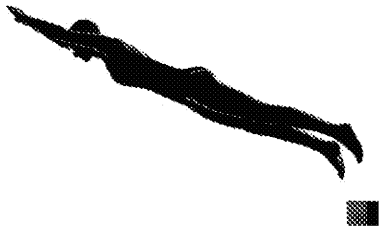
Activity 2 (pairs)

Discuss the following sporting movements with your partner. Label the lever syst
then label the load/resistance arm and effort arm of the lever. Draw the lever sy
the mechanical advantage or disadvantage of that lever. One has been complete

Top tip: Don't always look at the image straight on. Consider w
going. See how the line of the lever in the first example is diag
movement and effort.

	Linear drawing and explanation	d
At the start of the 100 m sprint the runner applies a large force to the ground through their ankle 	*Load arm* / *Load distance* Load Fulcrum Effort *Effort arm* This is a second-class lever as the load (bodyweight) is centred between the fulcrum (ankle joint) and effort (gastrocnemius muscle) to cause plantar flexion at the ankle.	The than This adva bein arm give large the s from
A football player flexes the left knee in preparation for a shot. 		

Top tip: When describing the lever, you need to compare the l
effort arms of that lever and explain why that is important.

	Linear drawing and explanation	d
Lever system at the elbow during a tennis player's movement towards the ball to perform a forehand stroke 		
Lever syst[illegible]e ankle when a swimmer pushes off from the starting block 		

Activity 3 (individual)

In order to understand questions on 'mechanical advantage' you need make sure
term means. Without using your notes, write down your understanding of the te
systems operate at a mechanical advantage/disadvantage. Then, check your ans
required changes in a different coloured pen to ensure thorough understanding.
know whether you are correct.

.....

.....

.....

.....

Top tip: Remember the location of the fulcrum in a first class lever system can influence the mechanical advantage.

Quest
Can you
differen

Activity 4 (individual)

Now let's put everything together. Complete the table below to draw and label each lever system, incl
describe each lever using a sporting example that uses each lever system, before explaining whether it
suitable justification.

Class of lever	Drawing of joint *(include effort arm and load/resistance arms)*	Desc…ever *(describe the lever usi… sporting example)*
First-class lever		
Second-class lever		
Third-class lever		

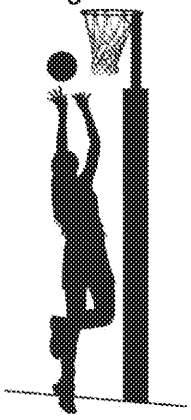
Exam-style questions

Complete the following exam-style questions to practise what you have learnt.

1. Which one of the following best describes mechanical advantage of a lever?
   a) Allows a large load to be moved with little effort
   b) Allows a large range of motion with little effort
   c) Allows powerful movements with a lot of effort
   d) Allows a large load to be moved with no effort

2. **Figure 1** shows a netball player using the elbow joint during the execution p
   is said to work at a mechanical disadvantage.

Figure 1



   a) Explain the term 'mechanical disadvantage'.

   .....

   .....

   .....

   .....

   b) Levers are made up of different parts.
   Complete the table to state the effort and load at the ankle joint when

Fulcrum	Ball of foot
Effort	
Load	

3. Explain [redacted]evers that are considered to have a mechanical disadvantage a

   .....

   .....

   .....

   .....

Analysis of basic moveme

Basic movement analysis is linked closely to mechanical advantage and lever syst
more detail to the movement analysis required in the examination. At all joints i
movement produced; the types of movement available are listed and defined be
paired off due to movements occurring in opposite directions.

- **Flexion:** decreasing an angle at the joint
- **Extension:** increasing the angle at the joint
- **Abduction:** movement away from the midline of the body
- **Adduction:** movement towards the midline of the body
- **Rotation:** movement around an axis
- **Circumduction:** combination of shoulder mo en s so that the hand creat
- **Plantar flexion:** increasing the a a ankle by pointing the toes down
- **Dorsiflexion:** decreasing the ang t the ankle by pulling the toes upward

th you need to be able to apply your wledge of anatomy and physiology along with this section. Make sure you reread your notes on these sections!

Quest
What m
and incr

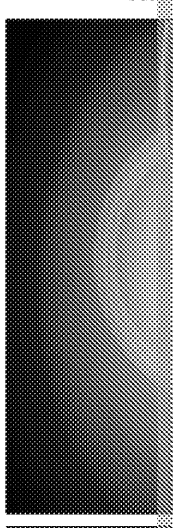
Activity 1 (pairs)

In pairs, discuss the joints in the pictures below. Take it in turns to move the requ
under each picture, list the range of movement available at that joint

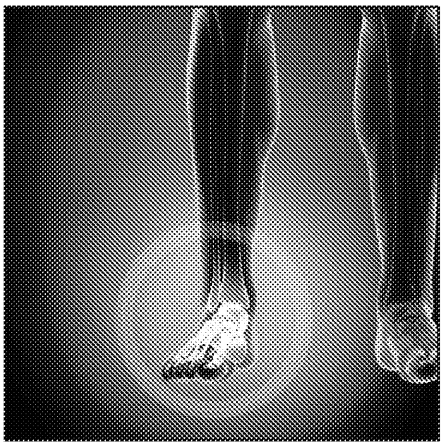
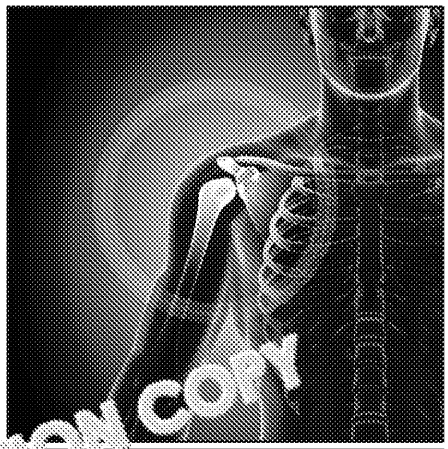
Elbow joint

Movem at can
ned:

Kn



Movement
be perform

Ankle joint	Shoulder joint	
		
Movements that can be performed:	**Movements that can be performed:**	

In an exam you will be required to analyse the movement of a sportsperson com
To gain the maximum number of marks you will need to link the anatomy and ph
movement available within your answers.

Top tip: ANALYSE: to examine something methodically and in detail in order to explain and interpret it.

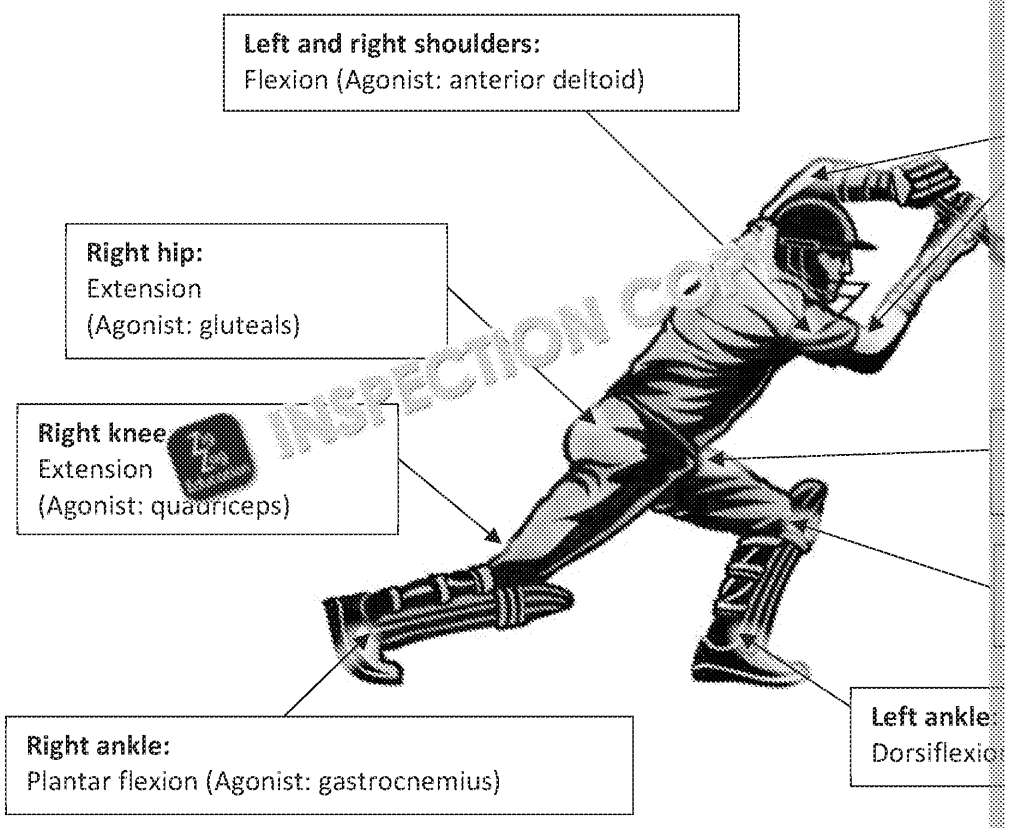
Quest
Can you
groups i
and che

For example: **Sport:** *Badminton*

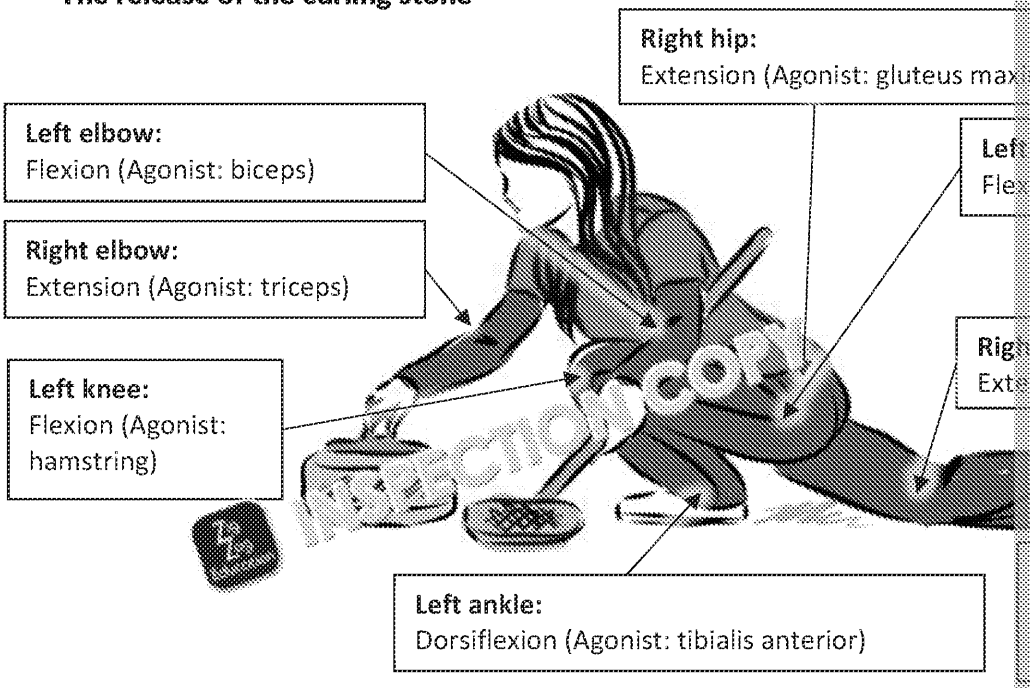
Action	Movement analysis
Running to return the shuttle	**Hip joint (ball-and-socket joint):** The hip undergoes flexion. Thi upper leg and the core. This is caused by the contraction of the undergoes extension, increasing the angle between the upper l the gluteals working agonistically to pull the leg backwards. **Knee joint (hinge joint):** The knee flexes due to the contraction angle between the upper and lower leg. The hamstring relax because they work as an agonist pair; the contraction of the q knee in preparation for the next stroke.
Overhead clear	**Shoulder joint (ball-and-socket joint):** The shoulder extends us (posterior deltoids to bring arm backwards in preparation the anterior deltoids) by moving the arm away from the midline arm up and above the head in preparation to hit the shuttle. On shoulder uses the latissimus dorsi as the agonist to perform ext **Elbow joint (hinge joint):** Flexes due to the biceps contracting a arm. The triceps then starts to contract to extend the joint and the shuttle at its highest point. Once the shuttle has been hit, th elbow during the downward swing of the arm.

Sometimes seeing the movements being performed is a lot clearer. Let's take a l
images below.

Batting in cricket



The release of the curling stone



Activity 2 (groups or pairs)

Now it's your turn! Pick a sport, analyse the movements at the joints during spec
the table.

Top tip: Remember to ANALYSE (see definition on p. 16) and t
in that action.

Sport: _____

Action	Movement an
	
	

Top tip: Perform the movements yourself. You will always hav
in the exam.

Activity 3 (pairs)

Exam preparation 1

In pairs, take it in turns to complete a slow press-up. While your partner is compl
questions below in order to analyse the movement. Write your analysis in the bo

1. What muscles are being used in the press-up?
2. What movement is created (where, and during what phase of the press-up)

Top tip: While seated during the exam, you CAN move your limbs to help you identify the movements being created, although you CANNOT get out of your seat!

Quest
What ot
moveme
complet

Make notes here on your partner's [illegible]:

Compare your notes to those of your partner. Add points that you may have mis

Activity 4 (individual)

Exam preparation 2

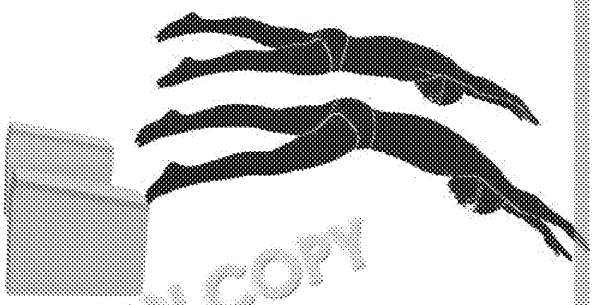
During your exam you will be required to analyse movements in a variety of spor
the movement in the most common denominator in sport: leg action when runn
preparation 1 to help you break down what you are looking for.

Make your notes here:

Exam-style questions

Complete the following exam-style questions to practise what you have learnt.

Figure 1



1. Using **Figure 1**, identify the joint movements at the hip and ankle of the right leg.

   Hip: .....

   Ankle: .....

2. a) Define the term 'rotation'.

   .....

   .....

   b) Give an example of when rotation would be used in sport.

   .....

   .....

3. Complete the table to state the role of each muscle in allowing movement.

Muscle	Role in allowing movement
Deltoids	
Triceps	
Gastrocnemius	

Planes and axes of moven

This section looks at the imaginary planes and axes of movement that run throug
the body that are used during sporting actions. You will need to be able to expla
what plane or axis is being used in your exam questions.

There are three types of plane and three types of axis that you need to know, an
we will go through these in the activities below.

Top tip: 'Axes' is just the plural of the word 'axis'.

Ques
How ma
you wou

There are three types of [illegible] create movements such as somersaults, cartwh

- **Fronta[illegible]** lin[illegible] through the hips (left to right)
- **Sagitta[illegible]** ine going through the belly button (front to back)
- **Vertical axis:** line going through the top of the head to the toe (top to botto

Activity 1 (pairs)

Using your Jelly Babies and cocktail stick:
Pick one of the axes and carefully push the cocktail stick through the jelly baby to
and see whether it looks the same as their jelly baby. Check with your teacher th
draw a diagram of it in one of the labelled boxes below. Hold the top and bottom
fingers and spin the jelly baby – what movements would that create? You are loo
and pirouettes!

Complete the activity for all three axes.

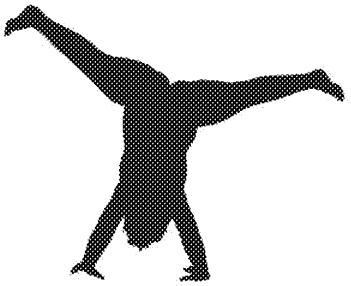
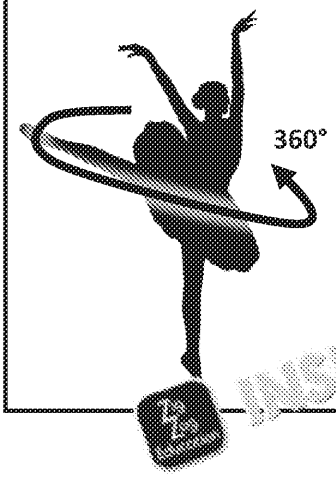
Frontal axis	Sagittal axis	Ver
Movement create[illegible]	Movement created:	Mo

Top tip: Planes and axes are paired!

Question t
Each axis is link
them and explai

Activity 2 (individual)

Look at the pictures in the table below. Name the movement and then name the
decision by describing the movement that is being created on that axis. Try to co
the previous task. Once completed, check through your previous task and notes
necessary changes if you made any mistakes.

Picture of movement	Name of movement	
		
		
		

There are three types of plane in which a range of movements can take place!

- **Transverse plane:** passes through the middle of the body, dividing the body into top and bottom. Movements such as rotation are created on this plane.
- **Sagittal plane:** passes vertically through the body, dividing the body into left and right. Movements such as flexion and extension are created on this plane.
- **Frontal plane:** passes vertically through the body, dividing the body into front and back. Movements such as abduction and adduction are created on this plane.

Top tip: Movements such as a bicep curl, kicking a ball, star jumps and discus throw all work on planes of movement!

Ques
Can you
each of

Activity (Pairs)

Using your Blu Tack and rectangular piece of card:
Pick one of the planes and stick a piece of Blu Tack (which represents the body) o
card. Holding the card, move the 'body'. In what direction are you moving the bo
to the description. Show your partner and see whether it looks the same as their
the plane is correct and then draw a diagram of it in one of the labelled boxes be

Complete the activity for all three planes.

Transverse plane	Sagittal plane	Fro
Movement(s) creat	**Movement(s) created:**	**Mo**

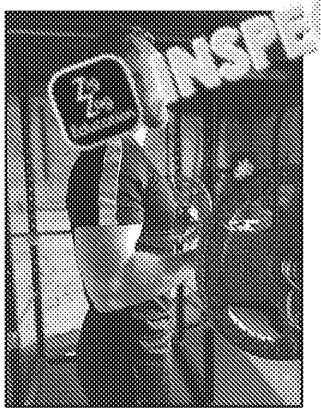
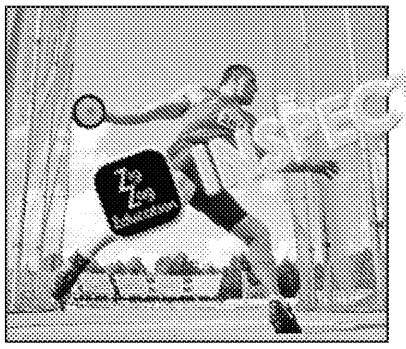
Activity 4 (individual)

Look at the pictures in the table below. In the second column, describe the move
is using and justify your decision. Try to complete this without looking at the pre
check through your previous task and notes to ensure it is correct. Make any nec
any mistakes.

Top tip: When describing the movement, name the muscles involved too!

Question t

What lever sys
Draw the linea
mechanical ad

Picture of movement	Plane and justi
	
	
	

Extension Activity

Time to practise! Try identifying both the planes and axes on the following skills

Movement	Plane	Axis	
A forward roll in gymnastics			
A gymnast abducting the shoulders on the rings			
Kicking a rugby ball			
A full twist jump in trampolining			
A ballet dancer performing the splits			
A goalkeeper raising the arms to the side to make a save			
Performing a drive shot in golf			

Activity 5 (pairs)

Complete the table below linking the planes and axes with the range of movements they produce. Che
your teacher!

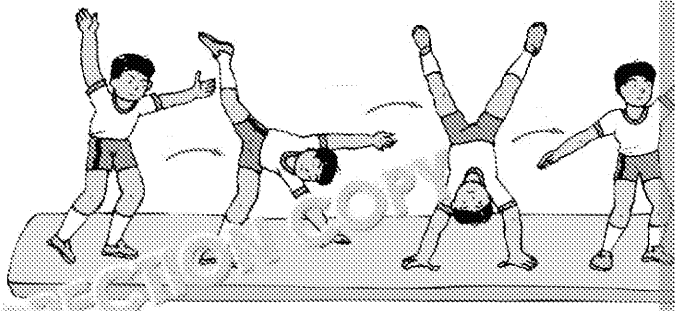
Plane	Type of movement	Sporting exam le	Axis	

Exam-style questions

Complete the following exam-style questions to practise what you have learnt.

1. **Figure 1** shows a gymnast completing a cartwheel during their floor routine.

Figure 1



a) Complete the table to state the plane and axis in which a cartwheel take

	Plane	Axis
Cartwheel		

b) The gymnast wants to transition into a front tucked somersault.

Complete the table to state the plane and axis in which a front tucked s

	Plane	Axis
Front tucked somersault		

c) Identify the plane and the axis about which a 360° pirouette takes plac
   a) Frontal plane and sagittal axis
   b) Sagittal plane and frontal axis
   c) Transverse plane and vertical axis
   d) Vertical plane and frontal axis

Answer Section

First-, second- and third-class lever systems

Activity 1

Students to draw correct drawings for each as follows:

Biceps = effort	Shot = load	Ankle joint = fulcrum
Knee joint = fulcrum	Body weight = load	Gastrocnemius = effort
Quadriceps = effort	Basketball = load	Tibialis anterior = effort

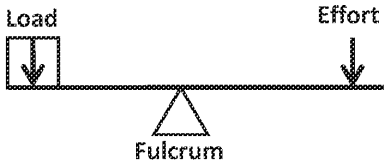
Activity 2

Student's answers will vary depending on which sporting movements they choose. Stude
levers as the most common one is found in the body.

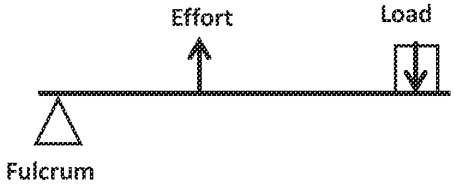
Activity 3

Student's dr should be representative of the relevant lever.

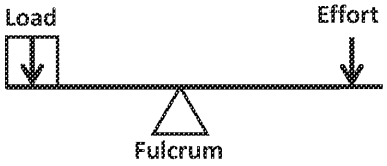
Badminton ba and (forearm): first-class lever (effort: triceps, fulcrum: elbow joint, loa



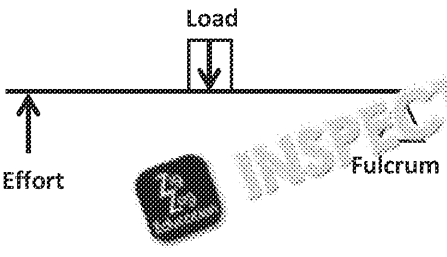
Football strike: third-class lever (fulcrum: knee joint, effort: quadriceps, load: football)



Javelin throw: first-class lever (load: javelin, fulcrum: elbow joint, effort: biceps)



Sprint start (ankle): second-class lever (fulcrum: ankle joint, effort: gastrocnemius, load:



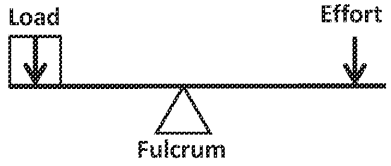
Extension activity

Sporting action	Lever system (✓)			
	First-class	Second-class	Third-class	
Lever system at the elbow during a forehand tennis shot			✓	The effort undergo fl in the mid the load (r
Lever system at the ankle at the start of a somersault during the floor routine in gymnastics		✓		The effort to underg resistance (ball of fo effort (gas
Lever system at the neck when watching the flight of the ball in a squash game				The effort to look up middle of
Lever system at the knee when pushing off the starting blocks for 200 m			✓	The effort the body c knee is the
Lever system at the ankle during the take-off from a springboard to start a dive		✓		The effort to underg resistance (ball of fo effort (gas
Lever system at the elbow when throwing a javelin	✓			The effort extension is in the m the javelin
Lever system at the neck when moving into a forward roll in gymnastics	✓			The effort to look do middle of

Exam-style questions

1. a) Award 1 mark for identifying the type of lever (AO1)
   - First-class lever (**N.B.** Extension at the elbow the effort is created by the t the ulna. The fulcrum is between the effort and the load).

   b) Award 2 marks for drawing a fully labelled diagram, up to 2 marks (AO2)



   - *Correct order of components (load, fulcrum, effort)*
   - *Correct drawing of the system*

   A ***sis ance (instead of load). Accept if drawing is reversed.***

2. Award 1 mark for the correct answer (AO2)
   - c) Extension at the knee when running

Mechanical advantage of lever systems

Activity 1

Correct equation for mechanical advantage:
Mechanical advantage = Effort arm ÷ Resistance arm

Justification:
The efficiency of a lever is calculated by the difference between the effort arm and the r
then determine whether the lever has a mechanical advantage or a mechanical disadvan

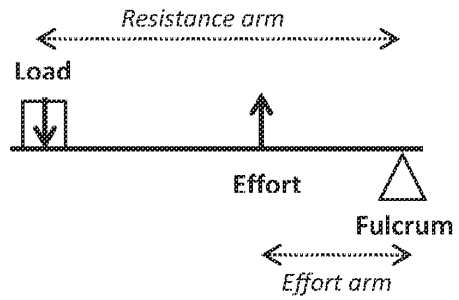
Activity 2

Support students to label the three images using effort arm, load/resistance arm.

The picture of the sprinter has been completed for yo or e cond-class lever.

Footballer preparing to strike the b t t ass lever
Students to label the pict
- Fulcrum:
- Load/re weight of lower leg
- Effort: ha ings (causing flexion at the knee)

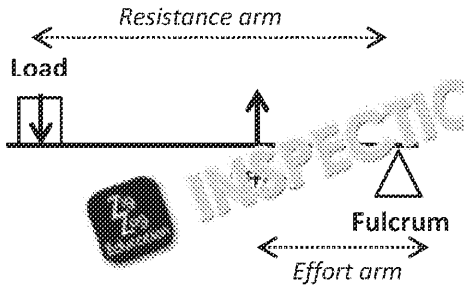
Linear drawing of a third-class lever with the effort and resistance arms labelled (accept



Justification:
This lever has a mechanical disadvantage as the effort arm is shorter than the resistance
means we can move the load further and faster so the movement is powerful and throug

Tennis player getting ready to strike the ball: third-class lever
Students to label the picture:
- Fulcrum: elbow joint
- Effort: biceps (causing flexion at the elbow)
- Load/resistance: impact of ball and racquet

Linear drawing of a third-class lever with the effort and resistance arms labelled (accept



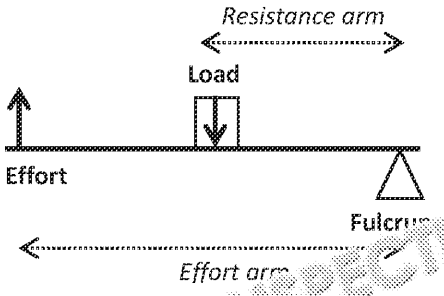
Justification:
This lever has mechanical disadvantage as the effort arm is shorter than the resistance a
means we can move the load further and faster, so when the racquet impacts the ball a
ball further/faster

Swimmer pushing off from the starting block: second-class lever

Students to label the picture:

- Fulcrum: metatarsophalangeal joint (ball of foot)
- Effort: gastrocnemius
- Load/resistance: body weight

Linear drawing of a second-class lever with the effort and resistance arms labelled (accep



Justification:

The resistance arm is shorter than the effort arm, meaning this has a high mechanical adv advantage means you are able to lift a heavier load (e.g. body weight) with relatively little requires little effort from the gastrocnemius muscle to cause plantar flexion at the ankle

Activity 3

Support students overall summary of mechanical advantage/disadvantage:

Mechanical advantage relates to the efficiency of a lever system and is dependent on the resistance, usually calculated by effort ÷ weight (resistance).

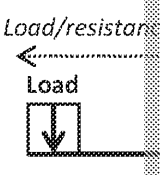
- If the effort arm is longer than the load/resistance arm, it is said to have a high mech large loads with relatively little effort. This can be seen in second-class lever system fulcrum is closer to the load.
- If the load/resistance arm is longer than the effort arm it is said to have a mechanic loads. It has a low load to force ratio. However, they allow for a greater range of mo allows for speed of the lever system.

Activity 4

Check the table to ensure both the drawing and the description are correct for the joint iden sporting examples.

First-class lever – e.g. elbow when using the triceps (as in a throw-in for football or rugby

- **Elbow description**
  - **Fulcrum** – elbow
  - **Effort** – triceps
  - **Load** – weight or object in the hand
- **Neck description**
  - **Fulcrum** – neck
  - **Effort** – trapezius
  - **Load** – weight of the head

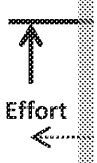


Mechanical advantage or mechanical disadvantage:

The fulcrum is situated in the middle of the resistance and the effort. The length of the load dependent on the joint and type of movement. If the fulcrum is closer to the load, the eff mechanical advantage. If the fulcrum is closer to the effort it will have a longer load/resis mechanical disadvantage.

Second-class lever – e.g. ankle during plantar flexion during a vertical jump in basketball

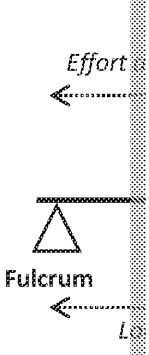
- **Ankle description**
  - **Fulcrum** – ball of foot
  - **Effort** – gastrocnemius
  - **Load** – weight of the body



Mechanical advantage:
The fulcrum is at the end of the linear drawing with a longer effort arm than the load/resistance arm. With the effort arm being longer, this means that it has a high mechanical advantage and can move a large load with little effort.

Third-class lever – elbow / knee flexion and extension

- **Elbow description:**
  - **Fulcrum** – elbow
  - **Effort** – biceps
  - **Load** – weight in hands
- **Knee description**
  - **Fulcrum** – k
  - **Ef** an
  - **Lo** t / lower leg



Mechanical disadvantage:
Third-class levers are the most common type of lever in the body and are involved in the
shorter effort arm compared to the load/resistance arm, meaning they are at a mechani
disadvantage has a low load force-to-effort ratio, meaning you cannot lift heavy loads bu
through a large range of motion and with power.

Exam-style questions

1. Award 1 mark for the correct answer (AO1)
   a) Allows a large load to be moved with little effort

2. a) Any 2 marks from (AO1):
   - This is a third-class lever, where the effort arm is shorter than the load/re
     heavy loads (1)
   - The load/resistance arm is longer than the effort arm as it is further from
     effort have to be applied to move the small load

   b) Award 2 marks for the correct identification of each component part of the lev

Fulcrum	Ball of foot
Effort	Gastrocnemius (1)
Load	Body weight (1)

3. Award 2 marks for a correct comparison of effort and resistance arm followed b
   Sub-max 1 mark (comparison):
   - Shorter effort arm than resistance arm
   - Mechanical advantage/disadvantage = Effort arm ÷ Resistance arm or load

   Sub-max 1 mark (importance):
   - Third-class lever systems allow powerful and quick movements
   - Third-class lever systems allow greater range of movement/motion

Analysis of basic movements

Activity 1

Ensure correct movements are linked to the joints.

- **Elbow** – flexion, extension
- **Knee** – flexion, extension
- **Ankle** – plantar flexion, dorsiflexion
- **Shoulder** – flexion, extension, abduction, adduction, rotation
- **Hip** – flexion, extension, abduction, adduction

Activity 2

Student's answers will depend on the choice of sport and movement. Use the two exam
annotated examples to support the student's descriptions.

Activity 3

Analysis of a press-up

- During the downward phase (lowering) of a press-up:
  - The elbow is flexed, decreasing the angle at the joint
  - The triceps (agonist) is contracting, the triceps (antagonist) is relaxing
  - While the shoulder is extended, increasing the angle at the joint
  - The pectorals (agonist) are contracting, the latissimus dorsi (antagonist) is rela
- During the upward phase of a press-up:
  - The elbow extends, extending the angle at the elbow joint
  - The triceps (agonist) is contracting, the biceps (antagonist) is relaxing
  - The pectorals (agonist) are contracting, the latissimus dorsi (antagonist) is rela

Activity 4

Analysis of the leg when running:

There are three key joints to think about when writing about leg action when running wi

1. The drive phase:
   - The hip extends (and hyperextends) using the gluteus maximus muscles and th
   - The knee extends using the quadriceps.
   - The ankle plantar flexes using the gastrocnemius.
2. The recovery phase:
   - The hip flexes using the hip flexors* (iliopsoas).
   - The knee flexes due to the hamstrings.
   - The ankle undergoes dorsiflexion due to the contraction of the tibialis anterio

Exam-style questions

1. Award 1 mark per correct answer (AO2)
   - Hip: extension (straightening the leg)
   - Ankle: plantar flexion (increasing the angle between the top of the foot and th
2. a) Award 1 mark for the definition
   - Rotation is the movement around an axis

   b) Award 1 mark for a suitable example
   - An example of rotation can be seen at the shoulder when bowling in cric
   NB any other correct sporting example of rotation
3. Award 1 mark for each role:

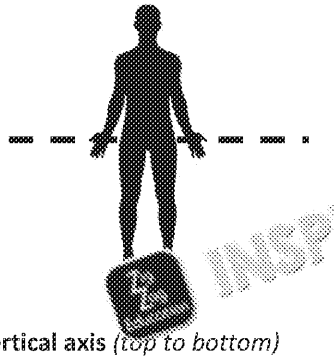
Muscle	Role in allowing movement
Deltoids	Allows abduction at the shoulder
Triceps	Allows extension at the elbow
Gluteus maximus	Allows extension at the hip

Planes and axes of movement

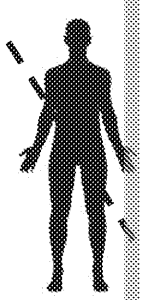
Activity 1

Look at the students' jelly babies and see whether the cocktail stick has been inserted co
correct movement around the intended axis.

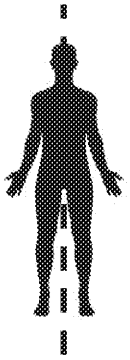
Frontal axis *(side to side)*
Movement created: extension, flexion



Sagittal Axis *(front to bac*
Movement created: abdu



Vertical axis *(top to bottom)*
Movement created: rotation



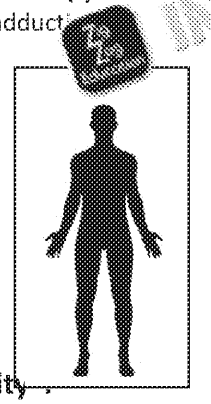
Activity 2

Picture	Name of movement	Axis and justification
1	Back somersault	This takes place on the **frontal** axis as the rotation is line through the sides
2	Cartwheel	This takes place on the **sagittal** axis as the rotation is line going through the belly button
3	Pirouette	This takes place around the **vertical** axis as the rotat imaginary line going through the top of the head

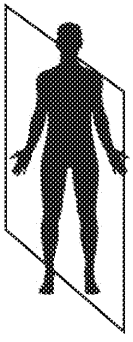
Activity 3

Students are required to stick Blu Tack onto the front a ac of the rectangular card to
movement that can be created on the planes.

Frontal plane *(divides front and b x)*
Movement(s) created: a
and adduct



agittal plane *(divides left and right)*
Movement(s) created: extension
and flexion



Tra
and
Mo

Activity

Students to work on their own and name the pictured movement and the plane it takes p
to justify their choice.

Picture	Name of movement	Plane and justifi
1	Biceps curl	Sagittal plane as the movement created in a b extension at the elbow joints
2	Side kick (karate)	Frontal plane as the movement created by do away from and then towards the midline of th
3	Discus throw	Transverse plane as the discus thrower is req in their throw

Extension activity

Students to work on their own and name the pictured movement and the plane it takes p
to justify their choice.

Movement	Plane	is	Ju
A forward roll in gymnastics	Sag	Frontal	Forward roll requires flexi around the frontal axis.
A gymnast abducting shoulders during	Frontal	**Sagittal**	The deltoid and trapezius the shoulder on the fronta
Kicking a rugby ball	Sagittal	**Frontal**	The gluteals contract caus the leg back on the sagitta bringing the leg forward to frontal axis.
A full twist jump in trampolining	Transverse	**Vertical**	The full twist is around the while in flight by moment
A ballet dancer performing the splits	Sagittal	**Frontal**	The gluteals contract caus one leg back on the sagitta This takes place on the fro
A goalkeeper raising the arms to the side to make a save	Frontal	**Sagittal**	The deltoid and trapezius the shoulder on the fronta
Performing a drive shot in golf	Transverse	**Vertical**	The rotation of the should the swinging of the golf clu

Activity 5

Students are required to work on their own and to complete the table linking the axes an

Plane	Direction of movement	Sporting example	Axis	D
Sagittal	Flexion, extension	Biceps curl	**Frontal**	Flex
Frontal	Abduction, adduction	Star jump	**Sagittal**	Abd add
Transverse	Rotation	Pirouette	**Vertical**	Rot

Exam-style questions

1. a) Award 1 mark for the correct plane and 1 mark for the correct axis (AO2)

	Plane	Axis
C eer	Frontal (1)	Sagittal (1)

b) Award 1 mark for the correct plane and 1 mark for the correct axis (AO2)

	Plane	Axis
Front tucked somersault	Sagittal (1)	Frontal (1)

2. Award 1 mark for (AO1):
   - c) Transverse plane and longitudinal axis