



Exam practice 1 - Materials 1



Material	Info / Advantages	Typical Uses
Wool (Natural Fibre)	An animal / protein fibre, from the fleeces of sheep, Warm, Soft, Absorbent, Crease resistant.	Felt, Flannel, Gabardine, Jumpers, Suits, Dresses, Carpets.
Polyester (Synthetic Fibre)	Produced from coal and oil. Strong, Durable, Elastic, Crease Resistant.	Sportswear.
Foil Lined Board (230-420 gsm)	Made by laminating aluminium foil to one side of cardboard, solid white board or duplex board. Can keep moisture in/out.	Drinks cartons, Ready meal lids.
Layout/Tracing paper (50-90 gsm)	Relatively hard and translucent. Cheap.	Working Drawings / Tracing for designers
Aluminium (Non-Ferrous Metal)	Lighter than steel, but not as strong. Light, Malleable, Can be shaped easily.	Drinks cans, Cooking pans, Food Packaging.



Exam practice 1 - Materials 1



Exam question answers:

- 1) This jumper needs to be warm, soft and crease resistant which material should it be made from? (1)

Wool (1)

- 2) Discuss why some sportswear is made from polyester and not wool. Give a reason and explain (2)

Strong – Can take some abuse (1)

Durable – Lasts a long time (1)

Elastic – Perfect for moving around in (1)

- 3) Which paper or board would an architect use to draw up his plans? (1)

Layout paper (1)

- 4) Give one advantage to why this paper or board would be best. (1)

Relatively hard (1) Translucent (1) Cheap (1)

- 5) Which paper or board would be used to make this orange juice container? (1)

Foil – lined board (1)

- 6) Describe a benefit of using this paper or board. (1)

Insulating properties (1) Can keep the moisture in (1)





Exam practice 1 - Materials 1



Exam question answers:

Below is pictured an Airbus A380 Aeroplane.

7) Give **two** reasons and explain why aluminium has been used for the body of this aeroplane. (4)

Aluminium is a lightweight material which is perfect for a plane as it needs to be as light as possible. (2)

Aluminium has good corrosive resistance which means it will last longer especially at the high Altitude. (2)

Aluminium is malleable so can be formed into different shapes easily which is perfect for the Curved shapes of a plane. (2)



8) Details of a part made from aluminium for the aeroplane are shown below.

Calculate the area of the part. (show all workings) (4)

**Area of the rectangle = length x breadth
= 400 x 220 = 88000 (1 Mark)**

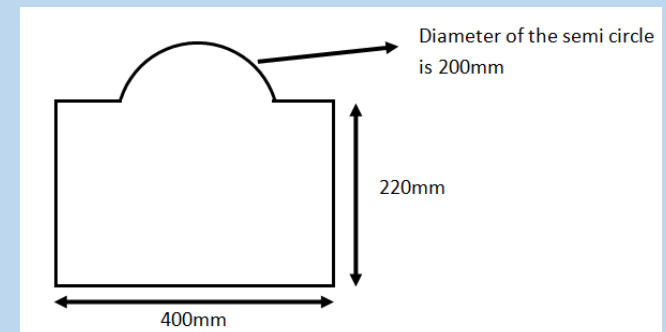
Area of the semi – circle = 200 divided by 2 = 100 for the radius

$A = \pi r^2$ (Radius x π Squared)

= 3.142 x 100 squared = 31420 (2 Marks)

Now divide the number by two to get the area of the semi circle = 15710

15710 + 88000 = 103,710 (1 Mark)





Exam practice 2 - Materials 2

Material	Advantages	Disadvantages
Pine (Soft wood)	Very durable, Easy to work, Quite cheap as it grows quickly enough to be forested, Reasonably strong, Lightweight.	Can warp, Crack and splinter more than some other woods
Plywood (Manufactured)	Flat and structurally strong, Surface looks like wood, Resistant to warping / cracking / twisting, Can be shaped unlike timbers.	Quite expensive, Edges can look rather rough, Susceptible to water damage if wrong grade is used.
Acrylic (Thermoplastic)	Tough, Easy to cut, Easily finished, Easily cleaned, Available in a range of colours, Widely available, Can be shaped using heat.	Brittle, Breaks easily if dropped, Relatively expensive.
UF (Thermosetting plastic)	Rigid, Hard, Heat resistant, Excellent electrical insulation	Can break easily if dropped, Brittle, Can not be shaped more than once as it is a thermosetting plastic.
Cast Iron (Ferrous Metal)	Affordable, Hard skin, Good in compression, Self Lubricating, Magnetic.	Rusts, A lower melting point than other Ferrous metals.



Exam practice 2 - Materials 2



Exam question answers:

- 1) **Discuss** the properties of pine which make it suitable for this chair. (3)

Very durable, Easy to work, Quite cheap as it grows quickly enough to be forested, Reasonably strong, Lightweight. (3)

Written in sentences!



- 2) Why is plywood a **better suited** material for this chair? (2)

Plywood can come in thin sheets also known as Flexi-ply. (1)

Flexi-ply can be shaped into designs such as this using lamination. (1)



- 3) **Discuss** which plastic would be best for this plug.(3)

UF (1)

UF is an excellent electrical insulator which is perfect for a plug (2)

UF is cheaper than acrylic (1)





Exam practice 2 - Materials 2



Exam question answers:

Below is pictured a set of cast Iron dumb bells.

4) Give **one** reason and explain why cast iron has been used for the weights . (2)

It is affordable or cheap - Explained (2)

It is a hard material - Explained (2)



5) The spinlock collars are made from Aluminium, some are made from Acrylic. Evaluate which material you think is best and give reasons why. (3)

Acrylic would wear quicker and could also shatter easier when dropped although it is tough

Aluminium is light for a metal but still strong and can be easily shaped. (3)

6) Mr Mason needs to buy 60KG worth of standard cast iron disks for his home gym. How much will this cost him if he buys these sets for £34.99 off Amazon? –

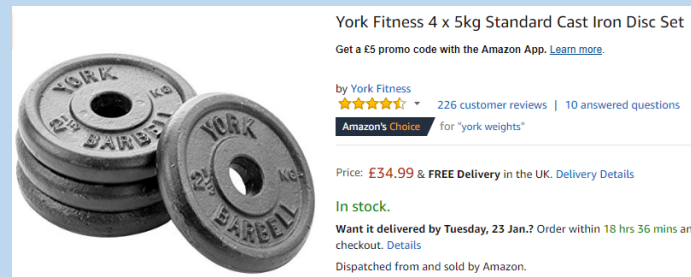
Show your working in the box below. (2)

4 x 5kg = 20KG (1)

£34.99 is the cost for 20KG so for 60KG it's x 3

£34.99 X 3 = £104.97 (1)

Answer - £104.97





Exam practice 3 – Scales of manufacture




Type	Characteristics	Example
One-off production	Only one product is made at a time. Every product is different so it is labour intensive. Products may be made by hand or a combination of hand and machine methods. Usually high quality.	Expensive watches, Yachts, Specialist furniture.
Batch production	A set number of identical products are made. Batch production may also be labour intensive, but jigs and templates are used to aid production. Batches of the product can be made as often as required. The machines can be easily changed to produce a batch of a different product. Most products are made in batches.	School chairs, Baked goods, Clothing, Computer chips, Electrical goods, Very expensive rare sports cars.
Mass production	Identical products are made, usually on a production line. Mass production often involves the assembly of a number of sub-assemblies of individual components. Parts may be bought from other companies.	I phone, Common cars – Ford Fiesta, Lego, Socks.
Continuous Production	When many thousands of identical products are made. The difference between this and mass production is that the production line is kept running 24 hours a day, seven days a week to maximise production and eliminate the extra costs of starting and stopping the production process. The process is highly automated and few workers are required.	Sheet material, Nuts & Bolts, Biro's, Newspapers.



Exam practice 3 – Scales of manufacture

Exam question answers:

- 1) State the most suitable scale of production for your chosen product. (1)
- 2) Evaluate the suitability of this scale of production for your chosen product (3)

1000 are manufactured	50 are manufactured	100,000 are manufactured
		
BATCH	BATCH	MASS

Answers must be appropriate to the product (including the scale of production) chosen by the candidate.

1 mark for each correct evaluative comment written.

Mass Production – relevant points include: Suitable for a product where a high volume is required, such as disposable cups (1). Less skilled work required means the cups can be made cheaply (1). Costs of set up are spread over hundreds of thousands of cups (1). Good for producing cups that are all the same (consistent) (1).

Batch Production – relevant points include: Identical tables/bags can be produced (1). Changes in design can be made between batches (1). Costs of set up are spread over many tables/bags (1).

- 3) Analyse your chosen product in terms of its environmental impact (2)

The bag is made mainly from textile materials, which could be recycled at the end of its life (1) As a bold design, the bag may be a fad product that is replaced before it is worn out causing a bigger environmental impact than if it had a longer life. (1)

The table is made in small numbers, limiting the product's overall impact on the environment (1) It would be better for the environment if the wood for the sides of the table was obtained from a sustainable source (1)

The cup is made of recycled materials which is good for the environment as it is produced in huge quantities (1) As a 'use once' product, the cup is less environmentally friendly than a re-usable version (1)



Exam practice 3 – Scales of manufacture

Exam question answers:

4) Evaluate your chosen product in terms of two safety considerations (4)

The rucksack should be made of a material that will be strong enough to hold the expected contents (1) to reduce any possibility of the bag breaking when in use (1). All bought in components, clips etc. should be BSI/CE approved (1) to reduce the risk of the user getting injured due to substandard parts (1).

The cup's sleeve is made of an insulating material (1) which does not conduct heat which could burn the user's hand / insulates the user's hand from the hot liquid (1). The paper used for the lip should not tear and injure the user's lips (1). The outer card sleeve must have grip to ensure it does not slip from the user's hand (1).

The table's legs/sides must support the top securely (1). The top of the table must not have deep grooves which could collect crumbs and harbour germs (1). The table must not be too heavy to move (1). The corners must be sanded to a smooth round in order to reduce harm to children (1).

5) You have been asked to re-design your chosen product. Describe one benefit of using the design strategy of collaboration to carry out this task (2)

Answers must be appropriate to the product chosen by the candidate and related to design collaboration.

1 mark for the benefit and 1 mark for justification.

Collaboration allows many people to contribute to the design (1) drawing upon their different expertise and perspectives so that these can be taken into consideration (1).

6) For your chosen product, identify a type of drawing that could be used to:

A) - Show your initial ideas for discussion _____ Sketched Illustrations / 2D, 3D Images / CAD 2D or 3D Drawings / Exploded Drawings _____ (1)

B) - Show your final proposal to a potential client _____ Presentation Drawing _____ (1)

C) - Provide details for manufacture _____ Engineering Drawing / Working Drawing _____ (1)





Exam practice 4 – Electronic Systems and Programmable components

Exam question answers:

- 1) Place a tick in the box to indicate the correct term for **each** of the statements. (3)

STATEMENT	INPUT	PROCESS	OUTPUT
Pressing the button on a computer mouse.	✓		
The sound coming out of Mr Mason's new pioneer speakers.			✓
A microcontroller receiving a signal and telling a component what to do.		✓	

- 2) Explain **Two** of the main benefits in detail of using a programmable microcontroller. (2)

- Microcontrollers are versatile because they have the ability to control numerous inputs and outputs simultaneously. (1)
- Microcontrollers can run multiple programs simultaneously and include interrupts / override features. Microcontrollers are small in size and can reduce the number of components required and therefore size of control systems can be reduced / miniaturised. (1)
- Many microcontrollers run off low voltage supplies (3v – 4.5v) making them energy efficient / more environmentally friendly and are also reusable. (1)
- Microcontrollers can be updated with new software to de-bug and improve performance and are reusable once a product has reached the end of its useful life. (1)

- 3) A thermostat in a house relies on feedback to control the central heating. Explain what would happen if the thermostat didn't receive any feedback at all. (2)

- Without feedback, the boiler would be constantly switched on or switched off irrespective of the temperature within the room. (1) This would cost the user a lot of money if it were switched on as the heating would not be switched off when the room got to a desired temperature (1).



Exam practice 4 – Electronic Systems and Programmable components

Exam question answers:

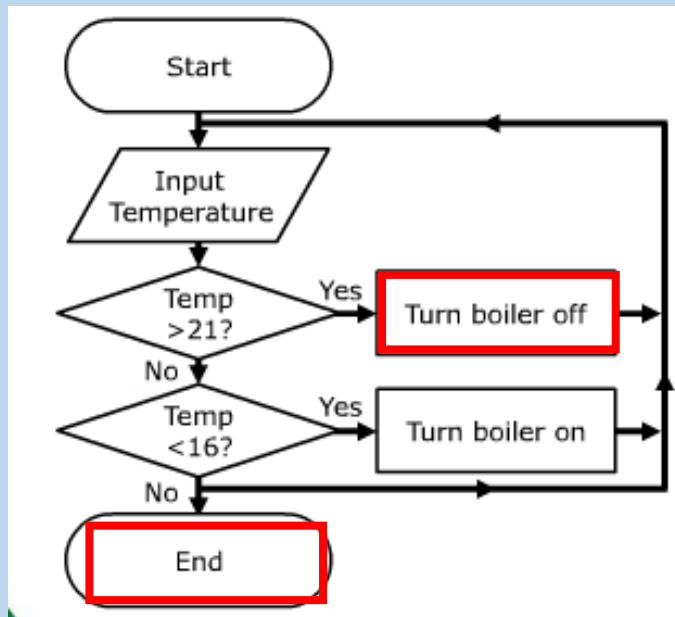
4) Describe in as much detail as possible the three stages of programming a microcontroller. (2)

Stage 1: Compose a program (could be in the form of lines of code or in flowchart form, could include CAD).

Stage 2: Run / test the program to see if it works as required / or download onto a Micro controller IC or circuit board.

Stage 3: Run / test the system to see if it works and / or edit program and repeat for new program. or Place microcontroller IC into control system and run.

5) Complete the flow chart below for the thermostat. (2)



6) The cost of a resistor is £0.05 pence. The cost of a thermistor is £0.03 pence. For an electronics project, Miss Knight needs enough components for six classes of 23 students. Unfortunately, the price resistors have just risen by 6%. Show your working and work out how much it cost Miss Knight to purchase these components. (4)

Resistor = 0.05 6% of 0.05 = 0.003 pence (1)

$0.05 + 0.003 = 0.053$ pence per resistor (1)

$6 \times 23 = 138$ Students

$138 \times 0.053 = £7.314$ for the resistors (1)

$138 \times 0.03 = £4.14$ for the thermistors (1)

OR £11.454 in total

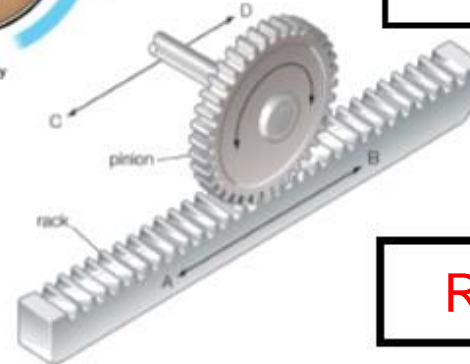


Exam practice 5 – Mechanisms/Levers/Pulleys

Pulleys & Belts

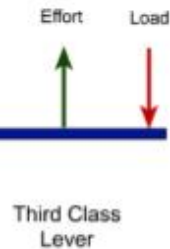
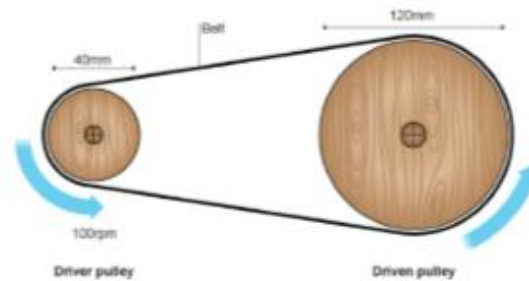
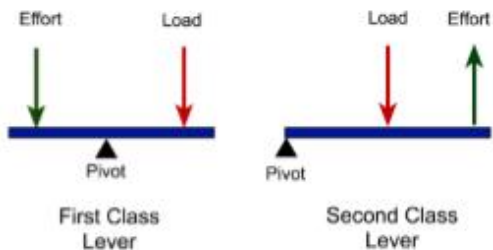


CAMS



Rack & Pinion

Levers



1) Name the different Mechanisms (4)



Exam practice 5 – Mechanisms/Levers/Pulleys

Exam question answers:



- 2) What type of lever is the wheelbarrow? (1) Class 2
- 3) Calculate the mechanical advantage of the wheelbarrow and show your working. (2)

Mechanical advantage = Load divided by Effort so $100\text{N} / 100\text{N} = 1\text{N}$ (1Newton)

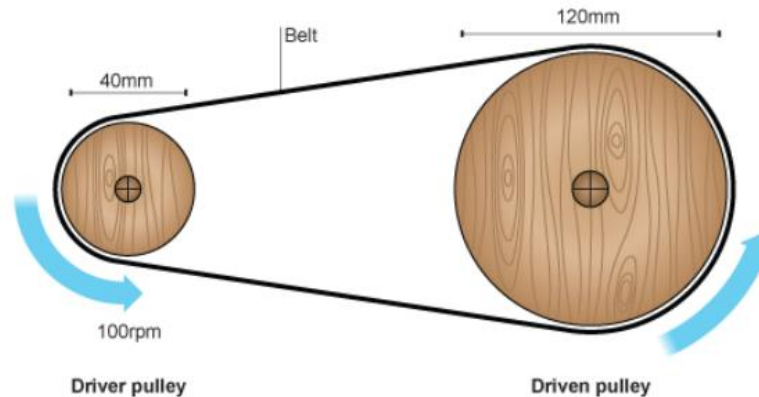


Exam practice 5 – Mechanisms/Levers/Pulleys

- 3) Calculate the Velocity ratio for the pulley system and show your working. (3)

Velocity ratio = diameter of the driven pulley \div diameter of the driver pulley

So – $120\text{mm} / 40\text{mm} = 3\text{mm}$



- 4) Calculate the output speed of the pulley system and show your working. (3)

Output speed (RPM) = input speed \div velocity ratio

So – $100 \text{ RPM divided by } 3\text{mm} = 33.3 \text{ RPM}$

- 5) State how the design of this pulley system could be changed to make wheels go faster. (2)

The pulley system could be modified by either using a larger diameter driver pulley
or a smaller diameter driven pulley



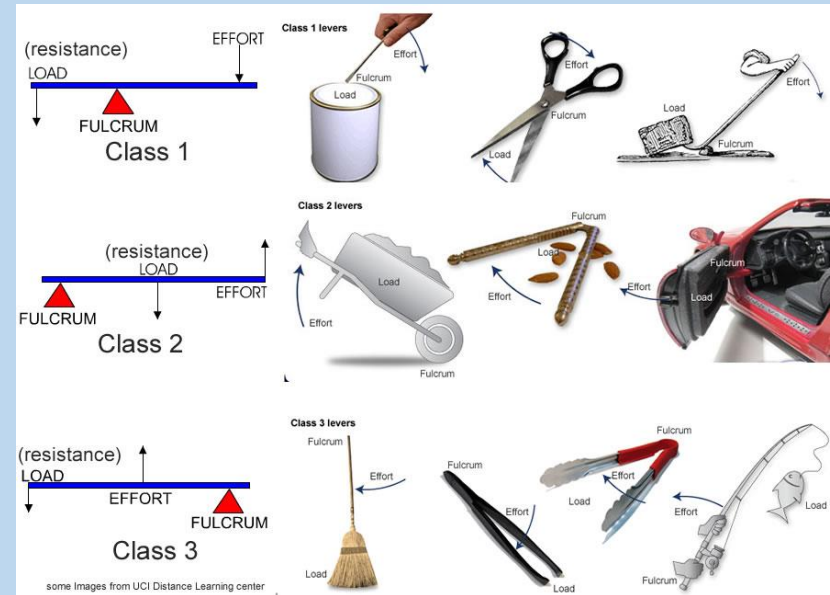
Exam practice 5 – Mechanisms/Levers/Pulleys

Levers

A lever is the simplest kind of mechanism. There are three different types of lever. Common examples of each type are the crowbar, the wheelbarrow and the pair of tweezers. All **levers** are one of three types, usually called **classes**. The class of a lever depends on the relative position of the load, effort and fulcrum:
The **load** is the object you are trying to move.

The **effort** is the force applied to move the load.

The **fulcrum** (or **pivot**) is the point where the load is pivoted.





Exam practice 5 – Mechanisms/Levers/Pulleys

CAMS

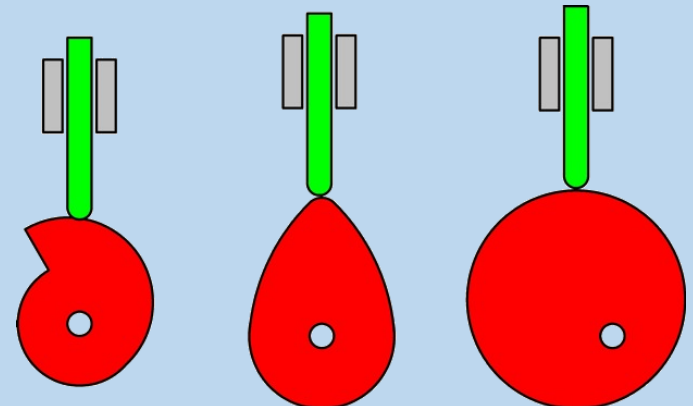
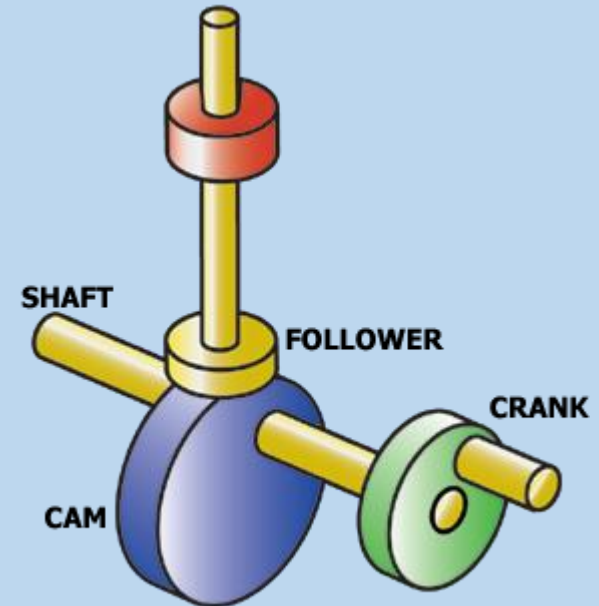
A cam is a shaped piece of metal or plastic fixed to a rotating shaft. A **cam mechanism** has three parts: **cam**, **slide** and **follower**.

The cam shaft rotates continually, turning the cam. The follower is a rod that rests on the edge of the turning cam. The follower is free to move up and down, but is prevented from moving from side to side by a slide or guide, so the follower can only do three things:

Rise (move up)

Fall (move down) or

Dwell (remain stationary)



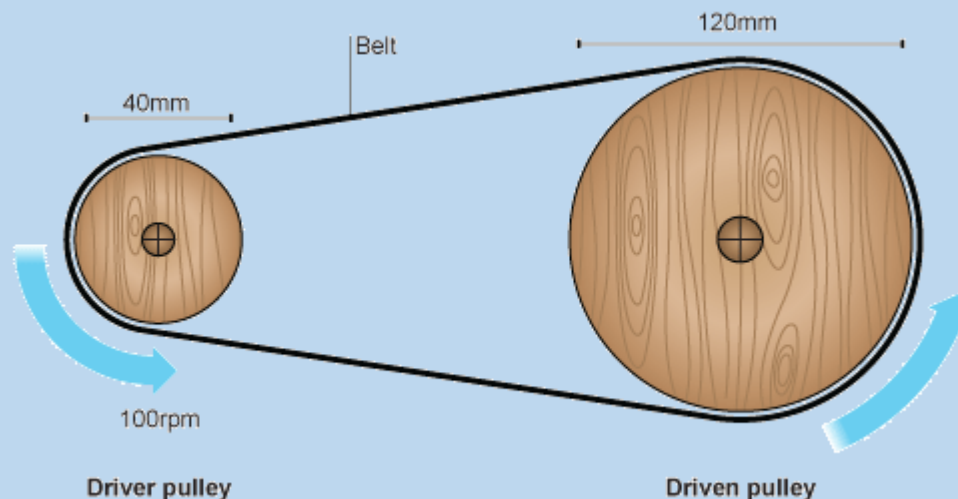


Exam practice 5 – Mechanisms/Levers/Pulleys

Pulleys & Belts

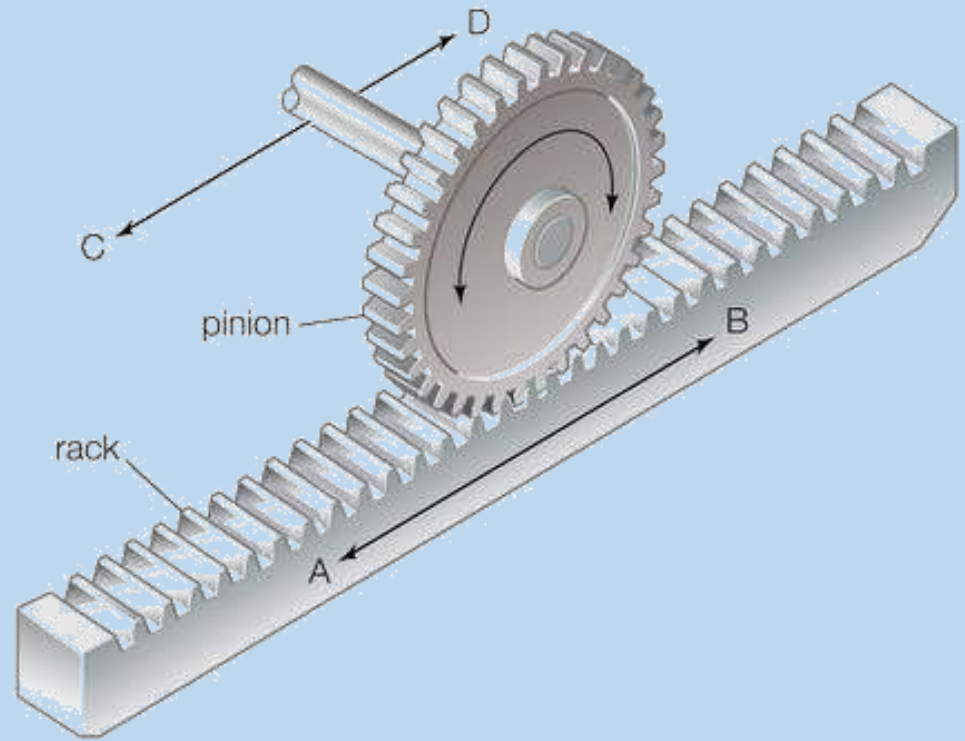
Pulleys are used to change the speed, direction of rotation, or turning force or **torque**.

A **pulley system** consists of two **pulley wheels** each on a shaft, connected by a **belt**. This transmits rotary motion and force from the input, or driver shaft, to the output, or driven shaft.



Rack and Pinion

A rack-and-pinion changes rotary motion to reciprocating motion. A crank, link and slider could also be used for this. A cam-and-follower will change reciprocating to rotary motion.





Exam practice 5 – Mechanisms/Levers/Pulleys

Equation	Explanation	Calculation
Mechanical Advantage	Class 1 and class 2 levers both provide mechanical advantage . This means that they allow you to move a large output load with a small effort. Load and effort are forces and are measured in Newtons (N).	Mechanical advantage (N) $= \text{load} \div \text{effort}$
Velocity Ratio for Levers	The mechanical advantage gained with class-one levers and class-two levers makes it seem like you are getting something for nothing: moving a large load with a small effort. The catch is that to make the effort smaller, you have to move a greater distance.	Velocity Ratio = distance moved by effort \div distance moved by load
Velocity Ratio for a Pulley System	If the pulley wheels are different sizes, the smaller one will spin faster than the larger one. The difference in speed is called the velocity ratio .	Velocity ratio = diameter of the driven pulley \div diameter of the driver pulley
Output speed of a Pulley System	If you know the velocity ratio and the input speed of a pulley system, you can calculate the output speed.	Output speed = input speed \div velocity ratio



Exam practice 6 – Ergonomics / Anthropometrics

Equation	Explanation
Ergonomics	Is about how a person interacts with a product and their environment. It is important that users feel comfortable using a product. A mobile phone needs to fit into the “Average” persons hand they need to be able to use it properly.
Anthropometrics	Is the study of the measurements and proportions of the human body. In product design it involves taking measurements of people. Anthropometric data is taken from a large sample of people of various sizes and shapes. It is used to determine the most likely size required by the average product user.
5th to the 95th Percentile	People come in all shapes and sizes so there will always be a small number of people who fall outside of the average range. Manufacturers usually aim to make products to suit most of the target market.

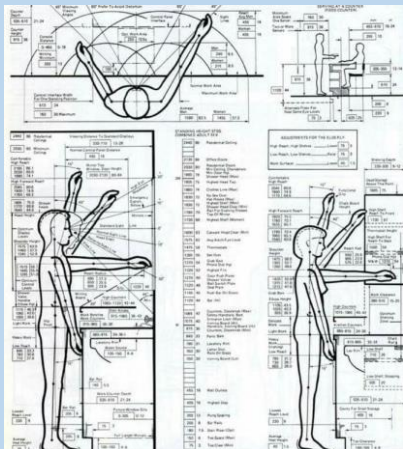


Exam practice 6 – Ergonomics / Anthropometrics

- 1) Why is it important that designers think carefully about ergonomics when designing an Xbox controller? (2)

An Xbox controller has a key purpose and that is to fit into people's hands so that it can be used as a controller. The whole design of a controller is based around Ergonomics so that as many people as possible can use it. It has to be designed right with a lot of user testing along the way.

- 2) The sheet above shows anthropometric measurements. Name a product that could be designed using this sheet. (1)



A computer or monitor or keyboard / Something that is sat on top of a desk to be operated.

Exam practice 6 – Ergonomics / Anthropometrics



3) What pieces of anthropometric data (Measurements) would you need to collect to design the drivers seat, steering wheel and dashboard for this car? (4)

- Hip width
- Arm length
- Grip strength / Size
- Height
- Shoulder width
- Hand size
- Etc.....



3) This is an ergonomic chair which has been designed with ergonomics at its heart. What benefits will a user have from using this chair? (4)

- Lower back support
- Neck support
- Fully adjustable
- Will fit to the users back



Exam practice 6 – Ergonomics / Anthropometrics



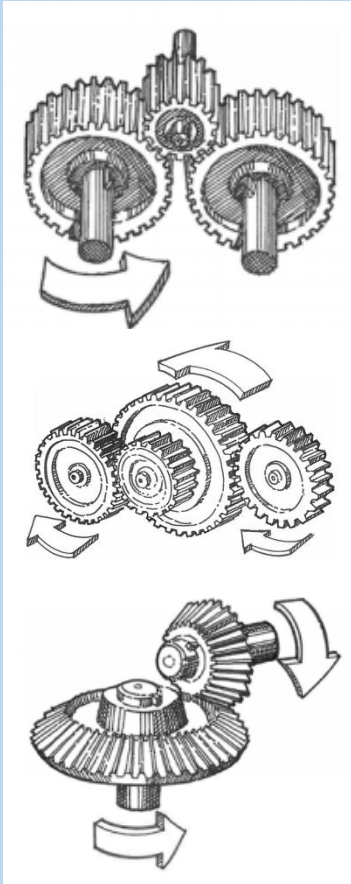
4) These earphones are a prototype in the iterative design process. Why is it so important that anthropometric data is used when developing this product? (3)

- This product needs to fit comfortably over ears
- It will be used for sport so will need to be stable
- It will need to be easy to place into the ears
- It does not want to harm the ears

5) How could you test these earphones? (1)

Get lots of different people with different head / ear sizes to wear them and give feedback.

Exam practice 7 – Gears



This is a simple gear train - This is when a number of gears are connected together in a train.

This is a compound gear system - Sometimes a simple gear train cannot provide a big enough gear ratio. If a large reduction in speed (or increase) is required then more than one set of gears can be used together. This is referred to as - “Compound gear trains”.

This is a bevel gear system - Bevel gears are used to transmit motion through 90 degrees (Like a hand drill) the bevel is the shape and angle of the gears themselves.



Exam practice 7 – Gears

Equation	Explanation	Calculation
Gear Ratio (2:1)	The larger gear always equals 1. The smaller gear is calculated by dividing the number of teeth on the larger gear by the number of teeth on the smaller gear. If a gear ratio is 1:2 this means 1 turn of the driver gear = 2 turns of the driven gear.	Calculating the smaller gear = Number of teeth on the larger gear \div Number of teeth on the smaller gear
Output Speed (RMP)	If you know the gear ratio, and the speed input at the driver gear, you can calculate the speed output at the driven gear using the formula: Output speed = input speed \div gear ratio So if the gear ratio is 4 and the driver gear is revolving at 200 rpm then the output speed = 200 \div 4 = 50 rpm	Input speed \div gear ratio

Exam practice 7 – Gears

- 1) Name the type of gear shown

Standard gear train. _____ (1)

- 2) The input (driver) gear is turning clockwise. What is the direction of the output (driven) gear?

Anti-Clockwise. _____ (1)

- 3) Imagine that the driver gear has 12 teeth and the driven gear has 36 teeth. Calculate the velocity ratio showing your working.

The number of teeth on the larger gear divided by the number of teeth on the smaller gear = 1:3 (Driver gear 1 : Driven gear 3) _____ (2)

- 4) If the central green cog was twisted clockwise, which way would the orange cog below it turn?

Anti-Clockwise. _____ (2)

- 5) Using prior knowledge, suggest a suitable material for this toy
To be made from and why?

Plywood can be laser cut, does not have any knots, Easy to work with and can be finished to a high standard. 1 mark for pine or painted MDF. _____ (2)





Exam practice 7 – Gears

- 6) A driver gear rotating at 100rpm is connected to a gear system with a gear ratio of 1:18. Calculate the output speed of the gear system. (Show your working).

The input speed (100) divided by the gear ratio:

100 divided by 18 = 5.6rpm _____ (3)

- 7) A designer needs to have an input speed of 3200rpm and an output speed of 800rpm in a simple gear system. If the driven gear has 20 teeth, calculate how many teeth does the driver gear need to have and then the gear ratio. Show your working. (4)

The input speed (3200) divided by the Output speed (800) = 4

The driven gear has 20 teeth and the driver gear has 4.

This would make the gear ratio 5:1