Your notes

GCSE Engineering: revision notes

Mechanical systems

Contents

1. Motion and levers
2. Gears
3. Other mechanisms
4. Key terms
5. Quick questions
6. What to do next

Motion and levers

- Four types of motion: rotary (turning in a circle), linear (in a straight line), reciprocating (backwards and forwards in a line) and oscillating (swinging back and forth in an arc).
- A lever turns about a pivot (**fulcrum**). First class: the **fulcrum** is between the effort and the load (a crowbar). Second class: the load is between (a wheelbarrow). Third class: the effort is between (tweezers).
- **Moment** = force × perpendicular distance from the pivot. In balance, clockwise **moments** = anticlockwise **moments**. An effort of 50 N at 2 m balances a load of 200 N at 0.5 m.
- **Mechanical advantage** = load ÷ effort. Lifting 200 N with 50 N gives a **mechanical advantage** of 4.

Gears

- **Gear ratio** = number of teeth on the driven gear ÷ number of teeth on the driver gear. A 20-tooth driver turning a 60-tooth driven gear gives a ratio of 3.
- Output speed = input speed ÷ **gear ratio**. With a ratio of 3, 300 rpm in gives 100 rpm out, but with three times the turning force (torque).
- Meshing gears turn in opposite directions; an **idler gear** between them makes the output turn the same way as the input.
- Compound gear trains multiply ratios. A worm and wheel gives a large reduction: a single-start worm with a 40-tooth wheel gives a ratio of 40. A rack and pinion changes **rotary motion** to linear motion.

Other mechanisms

- Pulleys and belts transfer **rotary motion** between shafts; the ratio uses pulley diameters. Chains and sprockets don't slip.
- Cams and followers change **rotary motion** into **reciprocating motion**. Cranks and sliders convert between rotary and reciprocating, as in an engine.

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- Bearings reduce friction on rotating shafts, and lubrication reduces wear.

Key terms

Rotary motion	Turning in a circle.
Reciprocating motion	Moving backwards and forwards in a straight line.
Oscillating motion	Swinging back and forth in an arc.
Fulcrum	The pivot point of a lever.
Moment	Force multiplied by the perpendicular distance from the pivot.
Mechanical advantage	Load divided by effort.
Gear ratio	Driven teeth divided by driver teeth.
Idler gear	A gear that makes the output turn the same way as the input.

Quick questions

Cover the answers and test yourself: remembering is what makes it stick.

1. What type of motion is a pendulum's swing?
2. Which class of lever is a wheelbarrow?
3. A 20-tooth driver turns a 60-tooth driven gear. What is the gear ratio?
4. The gear ratio is 3 and the input speed is 300 rpm. What is the output speed in rpm?
5. What does an idler gear do?
6. Which mechanism changes rotary motion into linear motion?
7. An effort of 50 N lifts a load of 200 N. What is the mechanical advantage?
8. A load of 200 N is 0.5 m from a pivot. What effort is needed 2 m from the pivot?

Answers

1. Oscillating
2. Second class
3. 3
4. 100
5. Makes the output turn the same way as the input
6. Rack and pinion
7. 4
8. 50 N

What to do next

Practise 10 questions on this topic

Try 3 exam questions, with mark schemes

Read the lesson, one step at a time

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