

Lesson plan

Lesson 1

Trigonometry in engineering and manufacturing

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Lesson plan

Programme name	T Level: Technical qualification in design and development for engineering and manufacturing (8714)	Suggested duration	2 hours
Lesson topic	Trigonometry in engineering and manufacturing	Lesson	1 of 4

Session description and context, including any last-minute information

The lesson is designed as an introduction to trigonometry in engineering and manufacturing. The aims of the lesson are for learners to understand the use of angles in engineering and manufacturing and for them to be able to calculate angles and the lengths of the sides of these triangles in given contexts.

This is part of a series of four lessons. By the end of the four lessons, it is intended that learners will be able to apply mathematics in a range of engineering applications. The lessons will gradually increase the level of complexity and expose learners to a range of different engineering contexts.

Learning outcomes

By the end of the lesson learners should be able to:

- identify the angles in a right-angled triangle
- identify the sides of a right-angled triangle
- determine the values of the angles in a right-angled triangle
- explain the use of angles in relation to engineering and manufacturing.

Links to the specification

4.1 Applied mathematical theory in engineering applications.

Trigonometry: Pythagoras' theorem, triangle calculations, trigonometric, sine and cosine rules, and common trigonometric identities and values.

Prerequisites

It is expected that learners can use a calculator prior to starting this lesson. If learners need support to use a scientific calculator, it is recommended that a good point to integrate this learning would be at slide 14 or 18.

Lesson resources

Scientific calculator

Presentation slides and worksheet

Timings	Slides	Teacher activity	Learner activity	Stretch and challenge
5 mins	1–3	Introduction to the topic. Explain that this is one of four lessons. Discuss the overall aim and learning outcomes.		
10 mins	4	Starter activity Encourage learners to consider engineering and manufacturing in the broad sense. Provide engineering and manufacturing examples to set the scene. Examples that could be used: • Manufacturing open girders • Calculating angles for suspension on Formula 1 cars • Manufacturing of lighting columns. Encourage learners to share their examples with the rest of the class.	• Individual completion of activity, learners to come up with examples. Five minutes allocated. • Group discussion. Five minutes to discuss examples.	More able learners to provide examples of when trigonometry has applied to their studies to date.
15 mins	5–6	State how trigonometry applies to right-angled triangles. Explain how this has a right angle and two acute angles. State the names for the sides of a right-angled triangle, identifying: • Hypotenuse	• Learners to complete the missing parts of the gapped worksheet. • Learners to be involved in small group discussion about their responses.	If they have enough time, more able learners to produce their own diagrams

		• Opposite • Adjacent. Go through the two slides drawing out the key information in the slides. Check understanding with the class by checking the correct words have been added to the worksheet. Ask both open and directed questions such as: Can they quickly identify given sides? Can they identify given angles?	• Answer both direct and open questions.	showing the sides and angles of a triangle.
5 mins	7	Ask learners to complete activity 2 using the worksheet to record their answers.	• Learners will complete activity 2 individually.	More able learners to offer support to peers if necessary.
20 mins	8–11	Illustrate to learners how almost anything manufactured would involve calculations of the angles on anything that is manufactured i.e. Car parts. Buildings. Chairs they are sitting on. Explain how we identify the sides of a right-angled triangle to calculate the hole angles for a brake disc or the heights of buildings. State that the longest side is always going to be the hypotenuse and that from this, with the right angle, we can identify the missing sides.	• Learners to complete the worksheet supplied. • Take part in open discussion. • Answer both open and directed questions.	More able learners to offer relevant applications of the subject area.

		Involve learners in open discussion about how we will refer to the other angles as acute angles and how we use these acute angles to identify the opposite and adjacent sides. Explain the relationship of angles and the ratio to the lengths of the sides of the triangle. Get learners to draw a right-angled triangle on a post it note, choose an angle and identify the sides. Ask more able learners for relevant applications.		
10 mins	12	Set activity 3, explaining that there will be five minutes for the activity and five minutes after to peer check. Teacher to check individual answers for each learner.	• Learners to complete activity 3 individually. • Peer check answers at the end of the activity.	If finished, more able learners to offer support to their peers.
15 mins	13–16	Explain how trigonometry is used in all aspects of engineering and manufacturing from cars to building design. State the functions or ratios of a triangle. • Sin • Cos • Tan Show the relationships of the angles and sides as formulas and how these formulas can be transposed and altered. Explain examples of identifying the sides of a triangle.	• Learners will insert answers into the missing sections of the worksheet. • Answer directed questions on triangle formulas. • Sine = Opposite/Hypotenuse • Cosine = Adjacent/Hypotenuse • Tangent = Opposite/Adjacent	More able learners to create examples for their peers.

		Ask both directed and open questions on the relationships of the sides and angles. Such as: Identify given formulas for shown angles and sides		
10 mins	17	Set activity 4 , explaining that there will be five minutes for the activity and five minutes after to peer check.	- Complete activity 4, showing the correct formulas for the ratios shown. - Peer review to check their answers.	If finished, more able learners to offer support to their peers.
10 mins	18	Explain how to convert decimal numbers into degrees and degrees back into a decimal. Get learners to carry these steps out on their own calculators. Ensure that the learners are aware of the procedure and which buttons to use.	- Learners will complete the unfinished sections of the worksheet. - Carry out conversions of decimals to fractions in example	More able learners to produce diagram at 15° intervals showing the cosine of angles between 0 and 90° .
5 mins	19	Set activity 5 . Teacher to check answers.	- Complete activity 5. - Learners to convert the given decimals and angles. - Peer assessment to verify answers.	
10 mins	21	Explain the plenary activity to calculate the sides, angles, and radius of a wind turbine.	- Learners to determine the height of the wind turbine when one of the blade tips is at maximum height. - Calculate the missing angles given.	If finished, more able learners can create worked examples for their peers.

			• Determine the length of the sides of the triangle to the top of the wind turbine.	
5 mins		Recap session. Discuss whether the learning outcomes have been met and check understanding of learning outcomes. Ask learners to write feedback on the session, including what they felt they understood or did not understand, what was good and what was bad during the session.	• Learners will be involved in open discussion around the contents of the session and their own thoughts on the application of trigonometry.	

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