

Deyes High School Remote Learning



DEYES
HIGH
SCHOOL

LYDIA'FÉ
LEARNING TRUST

Year 13 Engineering


Engage, Enable and Empower

Work for individual students not attending school

Half Term 3: January- February

Pupils who are absent should select the activity that they are up to. Click on the link in the activity box below. This will take you to Office 365 where the work is stored. In the lesson it will tell the pupil if they need to submit the work to their teacher.

Lessons

Date (week commencing)	Lesson	Focus/Topic/Theme	Hyper link to Activity
4/01/21	1	Working Safely as Part of a Team – individual tasks see MS teams for updates	<p>Keep in touch with your teammates so that you don't fall behind in your work.</p> <p>Links to lesson PowerPoints below </p> <p>https://deyes.sharepoint.com/sites/TemporaryCurriculumResources/Documents/Forms/AllItems.aspx?id=%2Fsites%2FTemporaryCurriculumResource%2FDocuments%2FTemporary%20Curriculum%20Resources%2FEngineering%20Construction%2FYear%2012%2FMr%20Norbury&viewid=4fb17346%2Dh524%2D46a5%2Dbc23%2Df06eb6070cfr</p>
11/01/21	2	Working Safely as Part of a Team – individual tasks see MS teams for updates	
18/01/21	3	Working Safely as Part of a Team – individual tasks see MS teams for updates	
25/01/21	4	Working Safely as Part of a Team – individual tasks see MS teams for updates	
01/02/21	5	Working Safely as Part of a Team – individual tasks see MS teams for updates	
08/02/21	6	Unit 6 CAD/CAM	
15/02/21	7	Unit 6 CAD/CAM	

Who to contact

You can email **your class teacher** if you have any questions regarding the activities set.

D.Jones@deyeshigh.co.uk
E.fearon@deyeshigh.co.uk
S.norbury@deyeshigh.co.uk



Year 12 TI Electrical and Electronic Engineering Knowledge Organiser

Trigonometric methods

Angular measurement

You are already familiar with angular measurements made in degrees. In practical terms, this is the most common way to define an angle on an engineering drawing that a technician might use when manufacturing a component in the workshop.

However, there is another unit of angular measurement, called the **radian**, which is used extensively in engineering calculations.

Key terms

- Degree** (symbol °) – one degree is $\frac{1}{360}$ of a complete circle. A complete circle contains 360°.
- Radian** (symbol rad) is a unit which is the angle subtended at the centre of a circle by two radii of length that describe an arc of the same length as the circumference. A complete circle contains 2π rad.
- Subtend** – to form an angle between two lines at the point where they meet.

Circular measurement

One revolution of a full circle contains 360° or 2π radians. It is necessary to convert angles stated in degrees to radians and vice versa.

Given that 2π radians = 360°

$$1 \text{ radian} = \frac{360^\circ}{2\pi} = 57.3^\circ \text{ (to 3 s.f.)}$$

$$\text{and } 1^\circ = \frac{2\pi}{360} = 0.0175 \text{ rad (to 3 s.f.)}$$

The use of radians makes it straightforward to calculate some basic elements of circles with the general formulae shown in Table 1.6, where the angle θ is measured in radians.

Table 1.6 General formulae for circular measurements (see Figure 1.7)

Arc length	$s = r\theta$
Circumference of a circle	$c = 2\pi r = 2\pi r$
Area of a sector	$A = \frac{1}{2}r^2\theta$
Area of a full circle	$A = \frac{1}{2}(2\pi r)^2 = \pi r^2$

Figure 1.7 Arc length and sector of a circle

Triangular measurement

In right-angled triangles we name the three sides in relation to the right angle and one of the other two angles. (See Figure 1.8)

Figure 1.8 Trigonometric naming conventions for a right-angled triangle

- The side opposite the right angle is the **hypotenuse** (hyp).
- The side next to the angle θ is the **adjacent** (adj) side.
- The side opposite the angle θ is the **opposite** (opp) side.

Pythagorean Theorem

For any right-angled triangle with sides a and b and hypotenuse c, the squares of the two shorter sides add to give the square of the other two sides.

$$a^2 + b^2 = c^2$$

The ratios of the lengths of these sides are given specific names and are widely used in engineering (see Figures 1.9–1.13).

- sine** (sin), where $\sin \theta = \frac{\text{opp}}{\text{hyp}}$
- cosine** (cos), where $\cos \theta = \frac{\text{adj}}{\text{hyp}}$
- tangent** (tan), where $\tan \theta = \frac{\text{opp}}{\text{adj}}$

From these definitions it can also be deduced that $\tan \theta = \frac{\sin \theta}{\cos \theta}$

Graphs of the trigonometric functions

When plotted graphically, both the sine and the cosine function generate periodic waveforms. Both functions are used to describe an amplitude of 1.0m function that repeats itself at intervals of 2π radians. (See Figure 1.14)

The tangent function also plots a periodic waveform, although the graph is not plotted at intervals of 2π or π radians.

Table 1.7 Values of the trigonometric ratios and phase angles

Angle θ (degrees)	sin θ	cos θ	tan θ	Phase angle φ (degrees)
0	0.000	1.000	0.000	0
15	0.259	0.966	0.267	15
30	0.500	0.866	0.577	30
45	0.707	0.707	1.000	45
60	0.866	0.500	1.732	60
75	0.966	0.259	3.762	75
90	1.000	0.000	>	90
105	0.966	-0.259	-3.762	105
120	0.866	-0.500	-1.732	120
135	0.707	-0.707	-1.000	135
150	0.500	-0.866	-0.577	150
165	0.259	-0.966	-0.267	165
180	0.000	-1.000	>	180
195	-0.259	-0.966	0.267	195
210	-0.500	-0.866	0.577	210
225	-0.707	-0.707	1.000	225
240	-0.866	-0.500	1.732	240
255	-0.966	-0.259	3.762	255
270	-1.000	0.000	>	270
285	-0.966	0.259	-3.762	285
300	-0.866	0.500	-1.732	300
315	-0.707	0.707	-1.000	315
330	-0.500	0.866	-0.577	330
345	-0.259	0.966	-0.267	345
360	0.000	1.000	0.000	360

Figure 1.12 Forming conventions when applying the sine rule and the cosine rule

The cosine rule can take three different forms depending on the missing value to be determined.

$$a^2 = b^2 + c^2 - 2bc \cos A$$

$$b^2 = a^2 + c^2 - 2ac \cos B$$

$$c^2 = a^2 + b^2 - 2ab \cos C$$

Vectors and their applications

Many quantities encountered in engineering, such as force and velocity, are only fully described when magnitude, direction and sense are known (see Figure 1.15). Such quantities are called **vectors**. When adding or subtracting vectors you must always take into account the direction in which they act.

Diagrammatic representation of vectors

- The length of the arrow represents the magnitude of the vector.
- The angle it specifies the direction of the vector.
- The head of the arrow specifies the positive sense of the vector.

Vector addition

To find the sum (or resultant) of two vectors v_1 and v_2 , you can represent the situation graphically by drawing each vector diagrammatically. In Figure 1.16 the two vectors are drawn to scale. Forming a triangle or parallelogram from which the characteristics of the resultant vector(s) can be measured.

Phasors

Phasors are rotating vectors that are useful in analysing sinusoidal (sine-shaped) waveforms. Figure 1.17 shows the relationship between a phasor and the sine wave it represents.

Vector rotation

When using phasors in the analysis of alternating current, the length of the phasor represents the peak voltage (V) or amplitude of the sinusoidal waveform, and the phasor rotates about a point of origin with an **angular velocity** of ω .

Always bear in mind that the phasor will have a phase angle φ and a vertical component will be equal to the instantaneous voltage (v) on the corresponding sine wave.

In the instantaneous voltage (v) at any point on the waveform is $v = V \sin \omega t$.

In terms of angular velocity, this gives $\omega = 2\pi f$.

The relationship between the phasor length (or amplitude) and the instantaneous voltage (v) is $v = V \sin \omega t$.

The angular velocity of the phasor (ω) is related to the frequency of the waveform (f) by $\omega = 2\pi f$.