



4 Essential mathematics for engineering and manufacturing

Criteria	Range	Resource identified
4.1 Applied mathematical theory in engineering applications	Standard arithmetic – ordering	https://www.bbc.co.uk/bitesize/topics/znmtsbk/articles/zj29dxs http://www.ultimatemaths.com/order-of-operation-bidmas.htm
	Standard arithmetic – integers, decimals	https://www.bbc.co.uk/bitesize/guides/zpf3k2p/revision/1 https://www.khanacademy.org/math/arithmetic-home/arith-review-decimals
	Standard arithmetic – standard forms	https://www.bbc.co.uk/bitesize/guides/zxsv97h/revision/1 https://revisionmaths.com/gcse-maths-revision/number/standard-form
	Standard arithmetic – fractions	https://www.mathplanet.com/education/pre-algebra/more-about-the-four-rules-of-arithmetic/calculating-with-decimals-and-fractions
	Standard arithmetic – percentages	https://www.bbc.co.uk/bitesize/guides/z9rjxfr/revision/1 https://revisionmaths.com/gcse-maths-revision/number/percentages https://www.khanacademy.org/math/cc-sixth-grade-math/cc-6th-ratios-prop-topic/cc-6th-percent-problems/v/finding-percentages-example https://www.youtube.com/watch?v=Zx9_ja_2H38
	Standard arithmetic – ratios	https://revisionmaths.com/gcse-maths-revision/number/ratios https://www.mathsisfun.com/numbers/ratio.html https://themathpage.com/Arith/ratio-and-proportion_1.htm#:~:text=Ratio%20is%20the%20spoken%20language,%2D%2D%20of%206%20to%2012





Algebra – factorising and manipulating equations	<p>https://www.bbc.co.uk/bitesize/guides/zcqmsrd/revision/1</p> <p>http://www.mathcentre.ac.uk/resources/workbooks/mathcentre/web-formulae2-tom.pdf</p> <p>http://www.mathcentre.ac.uk/resources/uploaded/3a3printableversion.pdf</p> <p>https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:modeling/x2ec2f6f830c9fb89:manipulating-formulas/v/rearrange-formulas-to-isolate-specific-variables</p> <p>http://www.studyphysics.ca/newnotes/20/unit01_kinematicsdynamics/chp02_intro/lesson06.htm</p> <p>https://www.youtube.com/watch?v=A-zkVOrbJHM</p>
Algebra – solving quadratics	<p>https://www.bbc.co.uk/bitesize/guides/z3hb97h/revision/1</p> <p>https://www.mathsisfun.com/algebra/quadratic-equation.html</p> <p>https://www.youtube.com/watch?v=3ayhvAI3IeY</p>
Algebra – using indices	<p>https://www.bbc.co.uk/bitesize/guides/zpmyrwx/revision/1</p> <p>https://thirdspacelearning.com/gcse-maths/algebra/laws-of-indices/</p> <p>https://www.engineeringtoolbox.com/laws-indices-d_1800.html</p> <p>http://www.ultimatemaths.com/powers-and-the-laws-of-indices.htm</p> <p>https://www.learninghub.ac.nz/laws-of-indices/</p>
Algebra – using logarithms	<p>https://www.bbc.co.uk/bitesize/guides/zn3ty9q/revision/1</p> <p>https://www.rapidtables.com/math/algebra/Logarithm.html</p> <p>https://mathinsight.org/logarithm_basics</p> <p>https://www.chilimath.com/lessons/advanced-algebra/logarithm-rules/</p>
Algebra – determining numbers in a sequence	<p>https://www.bbc.co.uk/bitesize/guides/zy82ng8/revision/1 https://www.mathsisfun.com/numberpatterns.html</p> <p>https://www.khanacademy.org/math/ap-calculus-bc/bc-series-new/bc-10-13/v/power-series-radius-interval-convergence</p>
Algebra – standard matrices and determinants	<p>https://www.mathsisfun.com/algebra/matrix-determinant.html</p> <p>https://www.intmath.com/matrices-determinants/matrix-determinant-intro.php</p>



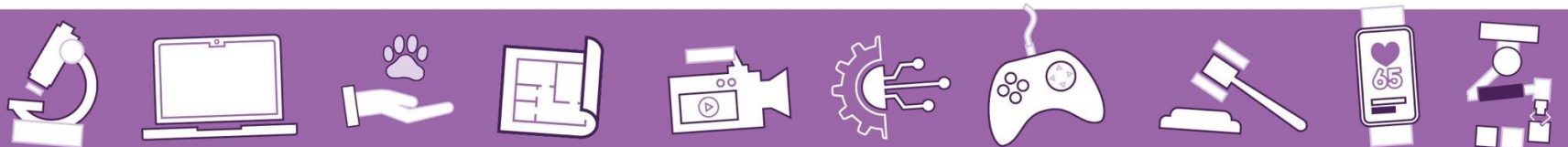


Geometry – calculation of areas	https://revisionmaths.com/gcse-maths/geometry-and-measures/area https://www.mathsisfun.com/area.html
Geometry – calculation of volumes	https://www.bbc.co.uk/bitesize/guides/zcnb8mn/revision/2 http://www.math.com/tables/geometry/volumes.htm or http://math2.org/math/geometry/areasvols.htm
Calculus – Graphs and charts relevant to engineering and manufacturing contexts	https://www.bbc.co.uk/bitesize/guides/z9387p3/revision/3 https://philschatz.com/algebra-trigonometry-book/contents/m49362.html https://philschatz.com/algebra-trigonometry-book/contents/m49364.html
Calculus – differentiation	https://www.bbc.co.uk/bitesize/guides/zyj77ty/revision/1 https://www.engineeringtoolbox.com/differentials-integrals-d_1799.html https://www.stem.org.uk/resources/elibrary/resource/30356/differentiation
Calculus – integration	https://www.bbc.co.uk/bitesize/guides/zgxttfr/revision/1 https://www.engineeringtoolbox.com/differentials-integrals-d_1799.html https://www.stem.org.uk/resources/elibrary/resource/30361/integration
Trigonometry – Pythagoras’ theorem	https://www.bbc.co.uk/bitesize/guides/z3hv97h/revision/1 https://www.stem.org.uk/resources/community/collection/424222/pythagoras-theorem-engineering https://www.engineeringtoolbox.com/pythagorean-theorem-d_1713.html
Trigonometry – triangle measurement	https://www.mathwarehouse.com/geometry/triangles/ http://www.montereyinstitute.org/courses/DevelopmentalMath/COURSE_TEXT2_RESOURCE/U07_L1_T3_text_final.html https://owlcation.com/stem/Everything-About-Triangles-and-More-Isosceles-Equilateral-Scalene-Pythagoras-Sine-and-Cosine





Trigonometry – circular measure	https://www.engineeringtoolbox.com/radian-d_942.html https://www.mathwarehouse.com/trigonometry/radians/convert-degee-to-radians.php https://www.purplemath.com/modules/radians.htm https://www.youtube.com/watch?v=MzJoEqrefBs
Trigonometry – trigonometric functions	https://www.teachengineering.org/lessons/view/uno_handheld_lesson01 https://x-engineer.org/undergraduate-engineering/mathematics/trigonometry/introduction-to-trigonometry/
Trigonometry – graphs of trigonometric functions	https://www.mathsisfun.com/algebra/trig-sin-cos-tan-graphs.html https://www.bbc.co.uk/bitesize/guides/zwbwgd/revision/1 https://www.youtube.com/watch?v=oaJz9qpEAjl https://www.youtube.com/watch?v=JD5Nfh23jol
Trigonometry – sine and cosine rules	https://www.mathcentre.ac.uk/resources/Engineering%20maths%20first%20aid%20kit/latexsource%20and%20diagrams/4_6.pdf https://x-engineer.org/undergraduate-engineering/mathematics/trigonometry/law-of-sines-and-cosines/ https://www.bbc.co.uk/bitesize/guides/z84297h/revision/1
Trigonometry – common trigonometric identities and values	https://www.mathsisfun.com/algebra/trigonometric-identities.html https://www.purplemath.com/modules/idents.htm https://www.embibe.com/exams/trigonometry-formulas/ https://sites.google.com/a/scienceleadership.org/trig_identities/home/real-world-applications
Trigonometry – applications of vectors and coordinates, scalars	https://courses.lumenlearning.com/boundless-physics/chapter/vectors/ http://mechanicsmap.psu.edu/websites/A1_vector_math/vectors/vectors.html http://mechanicsmap.psu.edu/websites/A1_vector_math/vectoraddition/vectoraddition.html https://www.mathsisfun.com/algebra/vectors-dot-product.html https://www.youtube.com/watch?v=OIX3iwoXglg





	Statistical analysis – Analysis of data in engineering contexts	https://www.bbc.co.uk/bitesize/guides/znhsqk7/revision/1 https://revisionmaths.com/gcse-maths-revision/statistics-handling-data/standard-deviation http://www.freestudy.co.uk/analytical/outcome4t1.pdf https://www.toppr.com/guides/maths/statistics/range-and-mean-deviation-for-grouped-data/
	Statistical analysis – calculation of probabilities in engineering contexts	https://www.bbc.co.uk/bitesize/guides/z3p3k2p/revision/2 https://www.mathplanet.com/education/pre-algebra/probability-and-statistic/probability-of-events https://www.khanacademy.org/math/statistics-probability/probability-library/basic-theoretical-probability/a/probability-the-basics
	Statistical analysis – estimation	https://www.bbc.co.uk/bitesize/guides/z8fj6yc/revision/1 https://www.mathsisfun.com/numbers/estimation.html https://www.youtube.com/watch?v=JTQ2Wh5E2js https://www.youtube.com/watch?v=fVAMKbBGzTY
4.2 Number systems used in engineering and manufacturing	Numbering systems – Decimal, binary, hexadecimal	https://www.engineeringtoolbox.com/binary-decimal-hexadecimal-ascii-converter-d_1914.html and https://www.engineeringtoolbox.com/binary-octal-hexadecimal-numbers-d_1802.html https://medium.com/coderscorner/number-systems-decimal-binary-octal-and-hexadecimal-5e567e55ab28 https://x-engineer.org/undergraduate-engineering/mathematics/arithmetic/numbers-representation-systems-decimal-binary-octal-and-hexadecimal/

