

# Revision checklist

The tables below can be used as a revision checklist: **It doesn’t contain all the detailed knowledge you need to know, just an overview.**

For more detail see the syllabus and talk to your teacher.

[A Level Further Mathematics A – H245 specification.](https://www.ocr.org.uk/Images/308752-specification-accredited-a-level-gce-further-mathematics-a-h245.pdf)

The table headings are explained below:

| **OCR Reference.** | **Content Description**  (unshaded content is AS content) | **R** | **A** | **G** | **Notes** |
| --- | --- | --- | --- | --- | --- |
| Each item of content has a unique specification reference code.   * **Mathematics A – H240**  1. Mathematics A: Pure 2. Mathematics A: Statistics 3. Mathematics A: Mechanics  * **Further Mathematics A – H245**  1. Further Mathematics A: Pure Core 2. Further Mathematics A: Statistics Option 3. Further Mathematics A: Mechanics Option 4. Further Mathematics A: Discrete Option 5. Further Mathematics A: Additional Pure | | You can use the tick boxes to show when you have revised an item and how confident you feel about it.  R = **RED** means you are really unsure and lack confidence; you might want to focus your revision here and possibly talk to your teacher for help  A = **AMBER** means you are reasonably confident but need some extra practice  G = **GREEN** means you are very confident.  As your revision progresses, you can concentrate on the **RED** and **AMBER** items in order to turn them into **GREEN** items.  You might find it helpful to highlight each topic in red, orange or green to help you prioritise. | | | You can use the notes column to:   * add more information about the details for each point * add formulae or notes * include a reference to a useful resource. * Highlight areas of difficulty or things that you need to talk to your teacher about or look up in a textbook. |

**You must be able to use the following formulae and identities for A Level Further Mathematics, without these formulae and identities being provided, either in these forms or in equivalent forms.**

**These formulae and identities may only be provided where they are the starting point for a proof or as a result to be proved.**

**Pure Mathematics**  
  
**Quadratic Equations**



**Laws of Indices**

**Laws of Logarithms**

 for  and 



**Coordinate Geometry**

A straight line graph, gradient *m* passing through  has equation



Straight lines with gradients  and  are perpendicular when 

**Sequences**

General term of an arithmetic progression:

General term of a geometric progression:

**Trigonometry**

In the triangle ABC

Sine rule: 

Cosine rule: 

Area

   
   


   




**Mensuration**Circumference and Area of circle, radius *r* and diameter *d*:



Pythagoras’ Theorem: In any right-angled triangle where *a*, *b* and *c* are the lengths of the sides and *c* is the hypotenuse:



Area of a trapezium =, where *a* and *b* are the lengths of the parallel sides and *h* is their perpendicular separation.  
  
Volume of a prism = area of cross section × length

For a circle of radius *r*, where an angle at the centre of *θ* radians subtends an arc of length *s* and encloses an associated sector of area *A*:   
  


**Complex Numbers**

For two complex numbers  and :





Loci in the Argand diagram:

 is a circle radius centred at 

 is a half line drawn from  at angle  to a line parallel to the positive real axis

Exponential Form:



**Matrices**

For a 2 by 2 matrix  the determinant 

the inverse is 

The transformation represented by matrix **AB** is the transformation represented by matrix **B** followed by the transformation represented by matrix **A**.

For matrices **A**, **B**:  
  


**Algebra**



For  with roots  and :



For  with roots ,  and :



**Hyperbolic Functions**







**Calculus and Differential Equations**

Differentiation

FunctionDerivative

    
    
    
    
    
    
    
 

Integration

FunctionIntegral

    
    
    
    
    
    
 

Area under a curve 

Volumes of revolution about the *x* and *y* axes:

 

Simple Harmonic Motion:



**Vectors**

Scalar product of two vectors  and  is

 = = 

where is the angle between the vectors  and 

The equation of the line through the point with position vector  parallel to vector  is:



The equation of the plane containing the point with position vector  and perpendicular to vectoris:



**Mechanics**

**Forces and Equilibrium**

Weight = mass 

Friction: 

Newton’s second law in the form: 

**Kinematics**

For motion in a straight line with variable acceleration:









**Statistics**

The mean of a set of data: 

The standard Normal variable: where 

Learners will be given a Formulae Booklet in each assessment which has both the A Level Mathematics and the A Level Further Mathematics formulae (the version used for AS has only the AS Maths and Further Maths formulae).

***DISCLAIMER***

This resource was designed using the most up to date information from the specification (section 5d) at the time it was published. Specifications are updated over time, which means there may be contradictions between the resource and the specification, therefore please use the information on the latest specification at all times.If you do notice a discrepancy please contact us on the following email address: [resources.feedback@ocr.org.uk](mailto:resources.feedback@ocr.org.uk)

Learners will be given the following Pure Mathematics formulae in the Formulae Booklet in each assessment.

**Arithmetic series  
**

**Geometric series  
  
**

**Binomial series  
**,  
where   
****

**Series**, 

**Maclaurin series**

+… for all *x*



 for all *x*

…… for all *x* 

**Matrix transformations**Reflection in the line : 

Anticlockwise rotation throughabout *O*: 

Rotations through θ about the coordinate axes. The direction of positive rotation is taken to be anticlockwise when looking towards the origin from the positive side of the axis of rotation.







**Differentiation**

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Quotient rule , 

**Differentiation from first principles  
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**Integration** ****

Integration by parts 

The mean value of  on the interval  is 

Area of sector enclosed by polar curve is 

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**Numerical methods**  
Trapezium rule: …}, where   
The Newton-Raphson iteration for solving : 

**Complex numbers**Circles: 

Half lines: 

Lines: 

De Moivre’s theorem: 

Roots of unity: The roots of  are given by  for 

**Vectors and 3-D coordinate geometry**Cartesian equation of the line through the point *A* with position vector in direction is 

Cartesian equation of a plane is 

Vector product: 

The distance between skew lines is, where **a** and **b** are position vectors of points on each line and  is a mutual perpendicular to both lines

The distance between a point and a line is, where the coordinates of the point are and the equation of the line is given by 

The distance between a point and a plane is, where **b** is the position vector of the point and the equation of the plane is given by 

**Small angle approximations**  
where *θ* is small and measured in radians

**Trigonometric identities**  
  
  


**Hyperbolic functions**



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, 

**Simple harmonic motion*** *

# Content of Pure Core (Mandatory papers Y540 and Y541)

| **OCR Reference** | **Content Description**  (unshaded content is AS content) | **R** | **A** | **G** | **Notes** |
| --- | --- | --- | --- | --- | --- |
| **4.01 Proof** | | | | | |
| **4.01a** | a) Be able to construct proofs using mathematical induction.  *This topic may be tested using any relevant content including divisibility, powers of matrices and results on powers, exponentials and factorials.*  *e.g.*  *Prove that*  *for*  *.*  *Prove that*  *is divisible by 4 for*  *.*  *Prove that*  *for*  *.* |  |  |  |  |

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| --- | --- | --- | --- | --- | --- |
| **4.01b** | b) Be able to construct proofs of a more demanding nature, including conjecture followed by proof.  *This topic may be tested using any relevant content including sums of series.*  *e.g. Prove that*  *for all*  .  *Prove that*  *for* *.*  *Prove that*  *for* *.*  *Prove that*  *for any real number*  *and*  *.*  *Prove that the n*th *derivative of*  *is*  *.* |  |  |  |  |
|  |  |  |  |  |  |
| **4.02 Complex Numbers** | | | | | |
| **4.02a** | a) Understand the language of complex numbers.  *Know the meaning of “real part”, “imaginary part”, “conjugate”, “modulus” and “argument” of a complex number.* |  |  |  |  |
| **4.02b** | b) Be able to express a complex number *z* in either the cartesian form , where , or modulus-argument form , where  is the modulus of *z* and *θ,* measured in radians, is the argument of *z*. |  |  |  |  |
| **4.02d** | d) Understand and be able to use the exponential form, , of a complex number. |  |  |  |  |
| **4.02c** | c) Understand and be able to use the notation:  *z*, , , , , .  *Includes knowing that a complex number is zero if and only if both the real and imaginary parts are zero.*  *The principal argument of a complex number, for uniqueness, will be taken to lie in either of the intervals*  *or* *. Learners may use either as appropriate unless the interval is specified.*  *In stage 1 knowledge of radians is assumed: see H240 section 1.05d.* |  |  |  |  |
| **4.02e** | e) Be able to carry out basic arithmetic operations  of complex numbers in both cartesian and modulus-argument forms.  *In stage 1 knowledge of radians and compound angle formulae is assumed: see H240 sections 1.05d and 1.05l.*  *Learners may use the results*  *and* *.* |  |  |  |  |
| **4.02f** | f) Convert between cartesian and modulus-argument forms. |  |  |  |  |
| **4.02g** | g) Know that, for a polynomial equation with real coefficients, complex roots occur in conjugate pairs. |  |  |  |  |
| **4.02h** | h) Be able to find algebraically the two square roots of a complex number.  *e.g. By squaring and comparing real and imaginary parts.* |  |  |  |  |
| **4.02i** | i) Be able to solve quadratic equations with real coefficients and complex roots. |  |  |  |  |
| **4.02j** | j) Be able to use conjugate pairs, and the factor theorem, to solve or factorise cubic or quartic equations with real coefficients.  *Where necessary, sufficient information will be given to deduce at least one root for cubics or at least one complex root or quadratic factor for quartics.* |  |  |  |  |
| **4.02k** | k) Be able to represent and interpret Argand diagrams.  *e.g. To represent and interpret complex numbers geometrically.*  *Understand and use the terms “real axis” and “imaginary axis”.* |  |  |  |  |
| **4.02m** | m) Understand the geometrical effects of multiplying and dividing two complex numbers.  *Includes raising complex numbers to positive integer powers.* |  |  |  |  |
| **4.02l** | l) Understand the geometrical effects of taking the conjugate a complex number, and adding and subtracting two complex numbers. |  |  |  |  |
| **4.02n** | n) Know and be able to use Euler’s formula  .  *e.g. To express, and work with, complex numbers in the forms* . |  |  |  |  |
| **4.02o** | o) Be able to illustrate equations and inequalities involving complex numbers by means of loci in an Argand diagram.  *i.e. Circle of the form* *, half-lines of the form* *, lines of the form* *,* *and* *,*  *and regions defined by inequalities in these forms.*  *To include the convention of dashed and solid lines to show exclusion and inclusion respectively.*  *No shading convention will be assumed. If not directed, learners should indicate clearly which regions are included.*  *In stage 1 knowledge of radians is assumed: see H240 section 1.05d.* |  |  |  |  |
| **4.02p** | p) Understand and be able to use set notation in the context of loci.  *e.g. The region*  *where* *,*  *and*  *may be represented by the set* *.*  *In stage 1 knowledge of radians is assumed: see H240 section 1.05d.* |  |  |  |  |
| **4.02q** | q) Understand de Moivre’s theorem and use it to find multiple-angle formulae and sums of series of involving trigonometric and/or exponential terms.  *Express trigonometrical ratios of multiple angles in terms of powers of trigonometrical ratios of the fundamental angle.*  *e.g.*  *.*  *Use expressions for*  *and*  *in terms of*  *or equivalent relationships.*  *e.g.*  *Express powers of*  *and*  *in terms of series of trigonometric ratios of multiples of the fundamental angle.*  *e.g.* *.* |  |  |  |  |
| **4.02r** | r) Be able to find the *n* distinct *n*th roots of  for  and know that they form the vertices of a regular *n*-gon on an Argand diagram.  *Answers may be asked for in either cartesian or modulus-argument form.* |  |  |  |  |
| **4.02s** | s) Be able to use complex roots of unity to solve geometric problems.  *e.g. To locate the roots of unity on an Argand diagram or to prove results about sums of roots of unity.* |  |  |  |  |
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| **4.03 Matrices** | | | | | |
| **4.03a** | a) Understand the language of matrices.  *Understand the meaning of “conformable”, “equal”, “square”, “rectangular”, “m by n”, “determinant”, “zero” and “null”, ”transpose” and “identity” when applied to matrices.*  *Learners should be familiar with real matrices and complex matrices.* |  |  |  |  |
| **4.03b** | b) Be able to add, subtract and multiply conformable matrices; multiply a matrix by a scalar.  *Learners may perform any operations involving entirely numerical matrices by calculator.*  *Includes raising square matrices to positive integer powers.*  *Learners should understand the effects on a matrix of adding the zero matrix to it, multiplying it by the zero matrix and multiplying it by the identity matrix.* |  |  |  |  |
| **4.03c** | c) Understand that matrix multiplication is associative but not commutative.  *Understand the terms “associative” and “commutative”.* |  |  |  |  |
| **4.03d** | d) Be able to find and use matrices to represent linear transformations in 2-D.  *Includes:*   * *reflection in either coordinate axis and in the lines* * *rotation about the origin*   *(defined by the angle of rotation* *, where the direction of positive rotation is taken to be anticlockwise)*   * *enlargement centre the origin*   *(defined by the scale factor)*   * *stretch parallel to either coordinate axis*   *(defined by the invarient axis and scale factor)*   * *shear parallel to either coordinate axis*   *(defined by the invarient axis and the image of a tranformed point).*  *Includes the terms “object” and “image”.* |  |  |  |  |
| **4.03e** | e) Be able to find and use matrices to represent successive transformations.  *Includes understanding and being able to use the result that the matrix product* **AB** *represents the transformation that results from the transformations represented by* **B** *followed by the transformation represented by* **A***.* |  |  |  |  |
| **4.03f** | f) Be able to use matrices to represent single linear transformations in 3-D.  *3-D transformations will be confined to reflection in one of the planes*  *or rotation about one of the coordinate axes. The direction of positive rotation is taken to be anticlockwise when looking towards the origin from the positive side of the axis of rotation.*  *Includes the terms “plane of reflection” and “axis of rotation”.*  *In stage 1, knowledge of 3-D vectors is assumed: see H240 section 1.10b.* |  |  |  |  |
| **4.03g** | g) Be able to find invariant points and lines for a linear transformation.  *Includes the distinction between invariant lines and lines of invariant points.*  [*The 3-D transformations in section 4.03f are excluded.*] |  |  |  |  |
| **4.03h** | h) Be able to find the determinant of a  matrix with and without a calculator.  *Use and understand the notation*  *or*  *or* . |  |  |  |  |
| **4.03i** | i) Know that the determinant of a  matrix is the area scale factor of the transformation defined by that matrix, including the effect on the orientation of the image.  *Learners should know that a transformation preserves the orientation of the object if the determinant of the matrix which represents it is positive and that the transformation reverses orientation if the determinant is negative, and be able to interpret this geometrically.* |  |  |  |  |
| **4.03j** | j) Be able to calculate the determinant of a  matrix with or without a calculator. |  |  |  |  |
| **4.03k** | k) Know that the determinant of a  matrix is the volume scale factor of the transformation defined by that matrix, including the effect on the preservation of the orientation of the image.  *Learners should know that the sign of the determinant determines whether or not the corresponding transformation preserves orientation, but do not need to understand the geometric interpretation of this in 3-D.* |  |  |  |  |
| **4.03l** | l) Understand and be able to use singular and non-singular matrices.  *Includes understanding the significance of a zero determinant.* |  |  |  |  |
| **4.03m** | m) Know and be able to use the result that . |  |  |  |  |
| **4.03n** | n) Be able to find and use the inverse of a non-singular  matrix with and without a calculator. |  |  |  |  |
| **4.03o** | o) Be able to find and use the inverse of a non-singular  matrix with and without a calculator. |  |  |  |  |
| **4.03p** | p) Understand and be able to use simple properties of inverse matrices.  *e.g. The result that* *.* |  |  |  |  |
| **4.03q** | q) Understand and be able to use the connection between inverse matrices and inverse transformations. |  |  |  |  |
| **4.03r** | r) Be able to solve two or three linear simultaneous equations in two or three variables by the use of an inverse matrix, where a unique solution exists. |  |  |  |  |
| **4.03s** | s) Be able to determine, for two or three linear simultaneous equations where no unique solution exists, whether the equations have an infinite set of solutions (the equations are consistent) or no solutions (the equations are inconsistent).  [*Finding the solution set in the infinite case is excluded.*] |  |  |  |  |
| **4.03t** | t) Be able to interpret the solution or failure of solution of three simultaneous linear equations in terms of the geometrical arrangement of three planes.  *Learners should know and be able to identify the different ways in which two or three distinct planes can intersect in 3-D space, including cases where two or three of the planes are parallel.*  *Learners should understand and be able to apply the geometric significance of the singularity of a matrix in relation to the solution(s) or non-existence of them.*  *[Finding the line of intersection of two or more planes is excluded.]* |  |  |  |  |
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| **4.04 Further Vectors** | | | | | |
| **4.04a** | a) Understand and be able to use the equation of a straight line in 2-D and 3-D, in cartesian and vector form.  *Learners should know and be able to use the forms:*  *,*  *and* *, in 2-D, and*  *and*  *in 3-D.*  *Includes being able to convert from one form to another.* |  |  |  |  |
| **4.04b** | b) Understand and be able to use the equation of a plane in cartesian and vector form.  *Learners should know and be able to use the forms:*  *,* *,* *and* *.*  *Includes being able to convert from one form to another.* |  |  |  |  |
| **4.04c** | c) Be able to calculate the scalar product and use it both to calculate the angles between vectors and/or lines, and also as a test for perpendicularity.  *Includes the notation* . |  |  |  |  |
| **4.04d** | d) Be able to find the angle between two planes and the angle between a line and a plane. |  |  |  |  |
| **4.04e** | e) Be able to find, where it exists, the point of intersection between two lines.  *Includes determining whether or not lines intersect, are parallel or are skew.* |  |  |  |  |
| **4.04f** | f) Be able to find the intersection of a line and a plane. |  |  |  |  |
| **4.04g** | g) Be able to use the vector product to find a vector perpendicular to two given vectors.  *Includes the notation* .  *When the vector product is required, either a calculator or a formula may be used. The formula below will be given:*  .  *[The magnitude of the vector product is excluded.]* |  |  |  |  |
| **4.04h** | h) Be able to find the distance between two parallel lines and the shortest distance between two skew lines.  *For skew lines, the formula**, where* **a** *and* **b** *are the position vectors of points on each line and*  *is a mutual perpendicular to both lines, will be given. Either* *will be given, or it must be established from given information including by use of the vector product.* |  |  |  |  |
| **4.04i** | i) Be able to find the shortest distance between a point and a line.  *The formula*  *where the coordinates of the point are*  *and the equation of the line is given by* , *will be given.* |  |  |  |  |
| **4.04j** | j) Be able to find the shortest distances between a point and a plane.  *The formula* *where* **b** *is the position vector of the point and the plane is given by* *, will be given.* |  |  |  |  |
|  |  |  |  |  |  |
| **4.05 Further Algebra** | | | | | |
| **4.05a** | a) Understand and be able to use the relationships between the symmetric functions of the roots of polynomial equations and the coefficients.  *Up to, and including, quartic equations.*  *e.g. For the quadratic equation*  *with roots*  *and*  *,*  *and*  *.* |  |  |  |  |
| **4.05b** | b) Be able to use a substitution to obtain an equation whose roots are related to those of the original equation.  *Equations will be of at least cubic degree.* |  |  |  |  |
| **4.05c** | c) Extend their knowledge of partial fractions up to rational functions in which the denominator may include quadratic factors of the form  for , and in which the degree of the numerator may exceed the degree of the denominator.  *See H240 section 1.02y.* |  |  |  |  |
|  |  |  |  |  |  |
| **4.06 Series** | | | | | |
| **4.06a** | a) Understand and be able to use formulae for the sums of integers, squares and cubes and use these to sum related series.  *Formulae for*  *and*  *will be given, but learners may be asked to prove them.* |  |  |  |  |
| **4.06b** | b) Understand and be able to use the method of differences to find the sum of a (finite or infinite) series.  *Including the use of partial fractions.*  *e.g. Find* |  |  |  |  |
|  |  |  |  |  |  |
| **4.07 Hyperbolic Functions** | | | | | |
| **4.07a** | a) Understand and be able to use the definitions of the hyperbolic functions   and  in terms of exponentials.  *Including the domain and range of each function.* |  |  |  |  |
| **4.07b** | b) Know and be able to sketch the graphs of the hyperbolic functions. |  |  |  |  |
| **4.07c** | c) Know and be able to use the identity .  *Learners may be asked to derive or use other identities, but no prior knowledge of them is assumed.*  [*Prior knowledge of other identities is excluded.*] |  |  |  |  |
| **4.07d** | d) Be able to differentiate and integrate hyperbolic functions. |  |  |  |  |
| **4.07e** | e) Understand and be able to use the definitions of the inverse hyperbolic functions and their domains and ranges. |  |  |  |  |
| **4.07f** | f) Be able to derive and use expressions in terms of logarithms for the inverse hyperbolic functions.  *Includes the* *notation:* *,* *,*  *and* *,* *,* *.* |  |  |  |  |
|  |  |  |  |  |  |
| **4.08 Further Calculus** | | | | | |
| **4.08a** | a) Be able to find the Maclaurin series of a function, including the general term. |  |  |  |  |
| **4.08b** | b) Recognise and be able to use the Maclaurin series for  , , ,  and , and functions based on these.  *The interval of validity should be understood.*  [*Proof of the interval of validity and use of non-real values of x are excluded.*] |  |  |  |  |
| **4.08c** | c) Be able to evaluate improper integrals where either the integrand is undefined at a value in the range of integration or where the range of integration is infinite.  *e.g.*  *or* |  |  |  |  |
| **4.08d** | d) Be able to derive formulae for and calculate volumes of solids of revolution.  *To include solids generated using either coordinate axis as the axis of rotation, and the volume of a solid formed by rotation of a region between two curves.*  *This includes curves defined parametrically.* |  |  |  |  |
| **4.08e** | e) Understand and be able to evaluate the mean value of a function.  *Includes the use of: mean value* *.* |  |  |  |  |
| **4.08f** | f) Be able to integrate using partial fractions.  *See Further Algebra section 4.05c and H240 section 1.02y for permitted forms.* |  |  |  |  |
| **4.08g** | g) Be able to derive and use the derivatives of ,  and , ,  and . |  |  |  |  |
| **4.08h** | h) Be able to integrate functions of the form: , ,  and  and use an appropriate inverse trigonometric or hyperbolic substitution for the evaluation of associated definite or indefinite integrals. |  |  |  |  |
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| **4.09 Polar Coordinates** | | | | | |
| **4.09a** | a) Understand and be able to use polar coordinates (using the convention ) and be able to convert between polar and cartesian coordinates. |  |  |  |  |
| **4.09b** | b) Be able to sketch polar curves, with *r* given as a function of  *Identify significant features of polar curves such as symmetry, and least and greatest values of r.*  *Includes use of trigonometric functions.* |  |  |  |  |
| **4.09c** | c) Be able to find the area enclosed by a polar curve.  *Be able to use the formula* *.* |  |  |  |  |
|  |  |  |  |  |  |
| **4.10 Differential Equations** | | | | | |
| **4.10a** | a) Understand the difference between, and be able to find, general and particular solutions to differential equations.  *Includes understanding that the general solution will include arbitrary constant(s) and that the particular solution may be found from initial or boundary conditions.* |  |  |  |  |
| **4.10b** | b) Be able to use differential equations in modelling in kinematics and in other contexts.  *Includes use of Newton’s second law of motion and the language of kinematics including the notation*  *and* .  *Includes problems involving variable force.*  *Problems may include formulating differential equations which leaners cannot solve analytically.*  [*Problems involving either variable mass or the form*  *are excluded.*] |  |  |  |  |
| **4.10c** | c) Be able to find and use an integrating factor  to solve differential equations of the form  .  *Includes recognising when it is appropriate to do so, rearranging into the given form when necessary.* |  |  |  |  |
| **4.10d** | d) Be able to solve differential equations of the form , where *a* and *b* are constants, by using the auxiliary equation.  *Include rearranging into the given form when necessary.*  *Learners should be able to interpret the sign of the discriminant of the auxiliary equation and how it determines the form of the complementary function.*  *Including the cases when the roots of the auxiliary equation are:*  *(i) distinct and real,*  *(ii) repeated,*  *(iii) complex.* |  |  |  |  |
| **4.10e** | e) Be able to solve differential equations of form , where *a* and *b* are constants, by solving the homogeneous case and adding a particular integral to the complementary function (in cases where  is a polynomial, exponential or trigonometric function).  *Includes cases where the form of the complementary function affects the choice of trial integral for the particular integral.*  *Includes cases where the form of the particular integral is given.* |  |  |  |  |
| **4.10f** | f) Be able to solve the equation for simple harmonic motion (SHM)  and relate the solution to the motion.  *Includes use of the formula*  *and* *in*  *modelling situations.*  *Learners may quote these formulae without proof when not asked to derive it or to solve the SHM equation.* |  |  |  |  |
| **4.10g** | g) Be able to model damped oscillations using second order differential equations and interpret their solutions.  *The terms “underdamping”, “overdamping” and “critical damping” should be known and understood informally.* |  |  |  |  |
| **4.10h** | h) Be able to analyse and interpret models of situations with one independent variable and two dependent variables as a pair of coupled, simultaneous, first order differential equations, and be able to solve them.  *e.g. Predator-prey models, continuous population models, industrial processes.*  *Includes solution by eliminating one variable to produce a single second order equation.*  *Systems will be of the form:*  ,  *or easily reducible to this form.* |  |  |  |  |



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