

## A2 Maths Checklists for C3, C4 and S1

### C3 PLC

Skills/ Knowledge/ Specification	R	A	G
<b>ALGEBRAIC FRACTIONS</b>			
Add, subtract, multiply and divide algebraic fractions, simplifying the answer			
Use algebraic long division to simplify improper algebraic fractions			
Work with identities containing algebraic fractions - evaluate coefficients			
<b>FUNCTIONS</b>			
Understand function notation and substitution into $f(x)$			
Identify the domain and range for a given function, possibly by using a graph sketch			
Substitute into or find an expression for $fg(x)$ or $gf(x)$ - known as composite functions			
Find an expression for the inverse function $f^{-1}(x)$ of a given function $f(x)$			
Know and use the domain/range match ups between $f(x)$ and $f^{-1}(x)$			
Solve equations involving $f(x)$ , $g(x)$ , $fg(x)$ , $f^{-1}(x)$ etc			
<b>THE EXPONENTIALS AND NATURAL LOGARITHM FUNCTIONS</b>			
Know that $e^x$ differentiated is $e^x$ (main definition of $e^x$ )			
Know and use that if $y = e^x$ then $x = \ln y$ or if $f(x) = e^x$ then $f^{-1}(x) = \ln x$			
Know the graphs of $e^x$ , $e^{-x}$ and $\ln x$ and be able to transform them eg $y = e^{3x+2}$			
Solve problems containing exponential or $\ln$ equations (see Ex 3B and 3C in C3 book)			
<b>NUMERICAL METHODS</b>			
Know how to show that the equation $f(x) = 0$ has a root in a given interval by sign change			
Use graph sketching to demonstrate the number and location of roots of an equation			
Rearrange $f(x) = 0$ into the form $x = g(x)$ to obtain an iterative equation $x_{n+1} = g(x_n)$			
Substitute $x_1, x_2, x_3$ etc into an iterative equation to obtain successive approximations			
Justify a root of $f(x) = 0$ to a given degree of accuracy by substituting upper and lower bounds for a sign change			
<b>TRANSFORMING GRAPHS</b>			
Sketch the graph of $y =  f(x) $ for a given $f(x)$			
Sketch the graph of $y =  f(x) $ or $y = f( x )$ from the graph of $y = f(x)$			
Know and apply the graph transformations covered in C2 to functions covered in C3			
Sketch two graphs of the form $y =  mx + c $ and determine the points of intersection			
Know all the trig properties/techniques covered in C2			
Know the definitions and graphs of $\sec x$ , $\operatorname{cosec} x$ and $\cot x$			
Know and prove the identities $\tan^2 x + 1 = \sec^2 x$ and $1 + \cot^2 x = \operatorname{cosec}^2 x$			
Solve trig equations containing one or more of $\sec$ , $\operatorname{cosec}$ and $\cot$			

Know the definitions and graphs of $\arcsin x$ , $\arccos x$ and $\arctan x$			
Use compound angle formulae [eg $\sin (A + B)$ ] to solve trig equations or to prove trig identities			
Prove and use the double angle formulae - learn them (inc 3 versions for $\cos 2x$ )			
<b>TRIGONOMETRY</b>			
Prove and use the half angle formulae			
Know how to write given trig expressions in the form $R \sin (x +/- a)$ or $R \cos (x +/- a)$			
Solve trig equations by using any of the above formulae/expressions			
<b>DIFFERENTIATION</b>			
Know and use all the differentiation techniques from C1 and C2			
Know and use $dy/dx = 1/ (dx/dy)$ and $dx/dy = 1/(dy/dx)$			
Know the differentials of $\sin [f(x)]$ , $\cos [f(x)]$ and $\tan [f(x)]$			
Know the differentials of $\sec [f(x)]$ , $\operatorname{cosec} [f(x)]$ and $\cot [f(x)]$			
Know and use the differentials of $e^{f(x)}$ and $\ln [f(x)]$			
Know and use the chain rule (or quick methods) to differentiate a function of a function			
Know and use the product rule			
Know and use the quotient rule			

## C4 PLC

Skills/ Knowledge/ Specification	R	A	G
<b>PARTIAL FRACTIONS</b>			
Know how to split into partial fractions involving up to three linear denominators			
Know how to split into partial fractions when one denominator has a repeated factor			
Use algebraic long division with improper algebraic fractions and then find partial fractions			
<b>THE BINOMIAL EXPANSION</b>			
Understand how to use the expansion $(1 + x)^n$ for negative and rational values of $n$			
Use $ x  < 1$ to identify range of validity for a given expansion eg $(1 + 3/2x)^{-2}$ then $ 3/2x  < 1$			
Expand expressions such as $(3-2x)^{1/2}$ using $(1 + x)^n$ appropriately			
Use given information to find $p$ and $n$ for $(1 + px)^n$ or $(a + px)^n$			
Expand expressions such as $(1 - 2x)(1 + 3x)^{-1/3}$			
Use partial fractions and then expand appropriately			
Identify and substitute a small value of $x$ into an expansion to approximate a value			
<b>DIFFERENTIATION</b>			
Know all the differentiation rules and techniques from C1, C2 and C3			
Differentiate a pair of parametric equations in order to find $dy/dx$			
Obtain $dy/dx$ for an implicit equation eg $y^3 - 3xy^2 + 5xy - 2x^2 = 50$			

Differentiate functions involving $ax$			
<b>VECTORS IN THREE DIMENSIONS</b>			
Find the vector for a line segment between two points and find its modulus			
Find the vector equation for a straight line through two given points			
Find the vector equation for a straight line through a given point and parallel to a given line			
Determine whether two lines intersect and find the point if they do intersect			
Use scalar product to find the angle between the directions of two vectors			
Use scalar product to find the angle between two lines given in vector form			
Calculate the angles, lengths and area for a triangle made with three given points			
Find the perpendicular distance from a point to a line			
<b>INTEGRATION</b>			
Know all the integration rules and techniques from C1 and C2			
Learn the integrals for the 6 trig functions of the type $\int \sin(ax + b) dx$			
Learn the integrals $\int e^{ax + b} dx$ and $\int (ax + b)^n dx$			
Learn how to do integrals of the form $\int f(x) [f(x)]^n dx$			
Learn how to do integrals of the form $\int f(x)/f(x) dx$			
Learn how to use partial fractions to set up integrals of the form $\int f(x)/f(x) dx$			
Learn the six integrals of the squares of trig functions eg $\int \cos^2 x dx$			
Learn how to do integration by parts NOT involving $\ln$			
Learn how to do integration by parts involving $\ln$			
Learn how to integration by substitution/change of variable			
Learn how to do integrals of the form $\int \sin 5x \cos 3x dx$			
Know how to evaluate definite integrals for any of the above types			
Use $A = \int y dx$ to find the area between a curve and the x axis			
Use $V = \pi \int y^2 dx$ to find the volume of revolution around the x axis			
<b>DIFFERENTIAL EQUATIONS</b>			
Know how to separate the variables into the form $\int f(x) dx = \int g(y) dy$			
Know how to integrate from the form $\int f(x) dx = \int g(y) dy$ to obtain a general solution			
Use given values to find the value of $c$ and thereby find a specific solution			
Know how to form and solve a differential equation for exponential growth or decay			
Use the chain rule to form a differential equation from three related rates of change			
<b>PARAMETRIC EQUATIONS</b>			
Eliminate the parameter to find an equation between $x$ and $y$			
Use the chain rule to find $dy/dx$ and then find a tangent, normal or stationary point			
Use $\int y dx = \int y (dx/dt) dt$ to find the area between a parametric curve and the x axis			
Use $\pi \int y^2 dx = \pi \int y^2 (dx/dt) dt$ to find the volume of revolution for a parametric curve			

## S1 PLC

<b>Skills/ Knowledge/ Specification</b>	R	A	G
<b>AVERAGES, MEASURES OF LOCATION and MEASURES OF SPREAD</b>			
Calculate the mean of discrete data (including grouped)			
Calculate an estimated mean for grouped continuous data			
Identify the median, quartiles and percentiles for discrete data			
Calculate the median, quartiles and percentiles for grouped continuous data			
Calculate and use range, IQR and semi-IQR			
Calculate the standard deviation of discrete data (including grouped)			
Calculate an estimate of standard deviation for grouped continuous data			
Know that variance is the square of standard deviation			
Know and apply the rules to calculate mean and standard deviation by coding			
Use a prescribed method to identify outliers			
<b>STATISTICAL GRAPHS</b>			
Use frequency density/area to construct a histogram			
Read information from a histogram and use it to calculate frequencies			
Construct and/or interpret a scatter diagram			
Construct and/or interpret a stem and leaf diagram (including back to back)			
Construct and/or interpret a box (and whisker)plot including showing outliers			
Construct and/or interpret a cumulative frequency graph			
<b>PROBABILITY</b>			
Use Number Venn diagrams to solve two category number problems			
Use Number Venn diagrams to solve three category number problems			
Use Number Venn Diagrams to read off probabilities			
Know the rule $P(A \cup B) = P(A) + P(B) - P(A \cap B)$			
Know $P(A') = 1 - P(A)$			
Use two category Probability Venn Diagrams to represent and to read probabilities			
Understand conditional probability			
Know the rule for calculating any specified conditional probability "and over second"			
Recognise when best to use a probability tree diagram			
Understand two way tables and possibility space diagrams			
Know that for independent events $P(A \cap B) = P(A) \times P(B)$			
Know that for mutually exclusive events $P(A \cap B) = 0$			
<b>CORRELATION and REGRESSION</b>			
Look up and use the formulas for $S_{xx}$ , $S_{yy}$ and $S_{xy}$			
Look up and use the formula for $r$ , the PMCC, substituting in $S_{xx}$ , $S_{yy}$ and $S_{xy}$			
Know that the PMCC of coded data is the same as for the original data			
Interpret the value of the PMCC as a measure of correlation			

Know the least squares regression line equation $y = a + bx$			
Look up and use the equations for a and b to find the least squares regression line			
Use coding and substitution to find the least squares regression line			
Substitute values into the least squares regression line			
Interpret the values of a and b in the least squares regression line			
<b>DISCRETE RANDOM VARIABLES</b>			
Know what is meant by a discrete random variable			
Understand and use the distributions $P(X=x)$ and $F(X)$			
Know and use the formula $E(X) = \sum xP(x)$			
Know and use the formula $VAR(X) = \sum x^2P(x) - (E(X))^2$			
Know and use the formula $E(aX + b) = aE(X) + b$			
Know and use the formula $VAR(aX + b) = a^2VAR(X)$			
Know what is meant by a discrete uniform distribution			
Know and use the $E(X)$ and $VAR(X)$ formulas for a discrete uniform distribution			
<b>THE NORMAL DISTRIBUTION</b>			
Understand the bell shaped curve and its link to probability			
Know how to calculate the value of z for any item of data in a normal distribution			
Use a positive z value to read a probability from the normal distribution table			
Use a negative z value to read a probability from the normal distribution table			
Use two z values to find a probability within a specified range			
Know how to read the normal distribution table in reverse			
Know how and when to use the Percentage Points table			
Use a given piece of information to find the mean or the standard deviation			
Use two given pieces of information to find the mean and the standard deviation			