Mathematics Department C4 SOW

Specification	Reference	Notes/Extra Material
1. Algebra and Functions • Rational functions. • Partial fractions (denominators not more complicated than repeated linear terms)	Heinemann Chapter 1 **Section 1:1 to 1.5** - Exercises 1A, 1B, 1C,1D & 1E **Summary of key points**	Partial fractions to include denominators such as $(ax + b)(cx + d)(ex + f)$ and $(ax + b)(cx + d)^2$ The degree of the numerator may equal or exceed the degree of the denominator. Applications to integration, differentiation and series expansions. Quadratic factors in the denominator such as $(x^2 + a)$, $a>0$ are **<u>not</u>** required. **Mixed Exercise 1F** **Revision Exercise 1**
2. Coordinate geometry in the (x, y) plane • Parametric equations of curves and conversion between Cartesian and parametric forms.	Heinemann Chapter 2 **Sections 2.1 – 2.4** - Exercises 2A , 2B, 2C,& 2D **Summary of key points**	Candidates should be able to find the area under a curve given its parametric equations. Candidates will **<u>not</u>** be expected to sketch a curve from its parametric equations. **Mixed Exercise 2E** **Revision Exercise 2**

3. Sequences & Series • **Binomial series for any rational *n*.**	Heinemann Chapter 3 **Sections 3.1 to 3.3** - Exercises 3A,3B & 3C **Summary of key points**	For I x I < b/a, candidates should eb able to obtain the expansion of $(ax + b)^n$, and the expansion of rational functions by decomposition into partial fractions. **Mixed Exercise 3D** **Revision Exercise 3**
4. Differentiation • Differentiation of simple functions defined implicitly or parametrically • Exponential growth and decay. • Formation of simple differential equations.	Heinemann Chapter 4 **Sections 4.1 to 4.2** - Exercises 4A & 4B **Section 4.3** - Exercises 4C **Sections 4.4 to 4.5** - Exercises 4D, & 4E **Summary of key points**	The finding of equations of tangents and normal's to curves given parametrically or implicitly is required. Knowledge and use of the result d/dx (a^x) = a^x In a is expected. Questions involving connected rates of change may be set. **Mixed Exercise 4F** **Revision Exercise 4**

5. Integration	Heinemann Chapter 6	
• Integration of e^x, 1/x, sin x, cos x.	**Sections 6.1** - Exercise 6A	To include integration o standard functions such as sin 3x, $\sec^2 2x$, tan x, e^{5x}, 1/2x. Candidates should recognise integrals of the form $\int \frac{f'(x)}{F(x)}\,dx = \ln f(x) + c$ Candidates are expected to be able to sue trigonometric identities to integrate, for example, $\sin^2 x$, $\tan^2 x$, $\cos^2 3x$
• Evaluation of volume of revolution	**Sections 6.9** - Exercise 6I	$\Pi \int y^2\,dx$ is required but not $\Pi \int x^2\,dy$. Candidates should be able to find a volume of revolution, given parametric equations.
• Simple cases of integration by substitution and integration by parts. These methods as the reverse processes of the chain and product rules respectively.	**Sections 6.2, 6.3, 6.6, 6.7** - Exercises 6B, 6C 6F & 6G	Except in the simplest of cases the substitution will be given. The integral $\int \ln x\,dx$ is required. More than one application of integration by parts may be required, for example $\int x^2 e^x\,dx$.
• Simple cases of integration using partial fractions.	**Sections 6.4 & 6.5** - Exercises 6D & 6E	Integration of rational expressions such as those arising from partial fractions, e.g. $\frac{2}{3x+5}$, $\frac{3}{(x-1)^2}$ Note that the integration of other rational expressions, such as $\frac{x}{x^2+5}$ and $\frac{2}{(2x-1)^4}$ is also required.

• Analytical solution of simple first order differential equations with separable variables. • Numerical integration of functions	**Sections 6.10 & 6.11** - Exercises 6j & 6K **Sections 6.8** - Exercise 6H **Summary of key points**	General and particular solutions will be required. Application of the trapezium rule to functions covered in C3 & C4. Use of increasing number of trapezia to improve accuracy and estimate error will be required. Questions will not require more than 3 iterations. Simpson's rule is **<u>not</u>** required. **Mixed Exercise 6L** **Revision Exercise 6**
6. Vectors • Vectors in two and three dimensions • Magnitude of a vector • Algebraic operations of vector addition and multiplication by scalars, and their geometrical interpretations. • Position vectors.	Heinemann Chapter 5 **Sections 5.1 to 5.7** - Exercise 5A, 5B, 5C, 5D, 5E, 5F & 5G	Candidates should be able to find a unit vector in the direction of **a**, and be familiar with $\lvert a \rvert$ $\overrightarrow{OB} - \overrightarrow{OA} = \overrightarrow{AB} = \mathbf{b} - \mathbf{a}$

• The distance between two points • Vector equations of lines	 **Sections 5.8 to 5.9** - Exercises 5H & 5I	The distance d between two points (x_i, y_i, z_i) and (x_2, y_2, z_2) is given by $d^2 = (x_1 - x_2)^2 + (y_1 - y_2)^2 + (z_1 - z_2)^2$ To include the forms $\mathbf{r} = \mathbf{a} + r\mathbf{b}$ and $\mathbf{r} = \mathbf{c} + t(\mathbf{d} - \mathbf{c})$ Intersection, or otherwise of two lines.
The scalar product. Its use for calculating the angle between two lines.	**Sections 5.10** - Exercises 5J **Summary of key points**	Candidates should know that for $\overrightarrow{OA} = \mathbf{a} = a_i\, i + a_2\, j + a_3\, k$ and $\overrightarrow{OB} = \mathbf{b} = b_i\, i + b_2\, j + b_3\, k$ then $\mathbf{a} \cdot \mathbf{b} = a_1b_1 + a_2b_2 + a_3b_3$ and $\cos AOB = \dfrac{\mathbf{a} \cdot \mathbf{b}}{\lvert\mathbf{a}\rvert\,\lvert\mathbf{b}\rvert}$ Candidates should know that if **a.b =** o, and that **a** and **b** are non-zero vectors, then **a** and **b** are perpendicular. **Mixed Exercise 5K** **Revision Exercise 5**