Pascall's Triangle and the Binomial Theorem (8 pers)

Mathematics 1 Outcome 1a

Pd	Lesson, Outline, Approach etc.	Nelson MIA - AH M1	TeeJay Publishers
1	Introduction to Pascal's Triangle via routes along a set of roads leading to $(a + b)^n$ $n = 1, 2, 3, \ldots$	$(2x+1)^5$, $(4x-1)^3$, $(2x-\frac{1}{x})^5$, $(3x^2+1)^6$.	$(x+5)^6$, $(x+\frac{1}{x})^4$, etc + Pg3, Ex1, Qu2
2	Define n! = n(n-1)(n-2)….3.2.1 (calculator) Define ${}^nC_r$ as choosing r from n; ${}^nC_r = \binom{n}{r} = \frac{n!}{r!(n-r)!}$; Show quick way of finding :- $\binom{10}{3} = \frac{10!}{3!7!} = \frac{10\times9\times8}{3\times2\times1} \times \left(\frac{7\times6\times5\times4\times3\times2\times1}{7\times6\times5\times4\times3\times2\times1}\right) = 120$ Go over $\binom{n}{r} = \binom{n}{n-r}$; and $\binom{n}{r-1} + \binom{n}{r} = \binom{n+1}{r}$	Pge 7, Ex 2B Qu 1a, 2, 4a,b 5a, 6a, 7a,b (d)	
3	Look at $\binom{4}{0}=1, \binom{4}{1}=4, \binom{4}{2}=6, \binom{4}{3}=4, \binom{4}{4}=1$ and compare with Pascal's triangle. Introduce to Binomial Theorem $\Rightarrow (a+b)^n = \binom{n}{0}a^n + \binom{n}{1}a^{n-1}b^1 + \binom{n}{2}a^{n-2}b^2 + \ldots\ldots\binom{n}{n}b^n$	Pge 9, Ex 3A Qu 1a-d 2a(i), (iii), & b	Pge 5, Ex 2, Qu 1
4	Expand $(1 + 2x - 3x^2)^5$ up to term in x^3	$(1-x+x^2)^6$ up to x^3, x^3, $(x^2+4x+1)^7$ up	$(2+x-3x^2)^5$ up to to x^2
5	Define General term $T_{r+1} = \binom{n}{r}a^{n-r}b^r$ and its importance in finding particular terms like the term in x^7 in $(3+2x)^{12}$ or the term independent of x in $\left(2x+\frac{1}{x}\right)^{10}$	Pge 9, Ex 3A Qu 3a-d, 4f	
6	Show how to find term in x^3 in expn of $(1 + 3x - 2x^3)(1 + 2x)^7$ Use "Rainbows"	Pge 11, Ex 3B Qu 1a, c, 4a,b, 5a, 6	
7	Obtain $(0{\cdot}97)^6$ correct to 3 decimal places	Pge 13, Ex 4 Qu 1	Pge 5, Ex2 Qu 2-4(b)
8	Checkup and Round-up		
	Cumulative total = 8 periods		

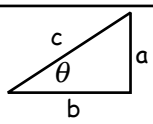
Mathematics 1 Outcome 1b

Partial Fractions (4/5 periods)

Pd	Lesson, Outline, Approach etc.	Nelson MIA - AH M1	TeeJay Publishers
1	Define Rational Function as $f(x) = \frac{P(x)}{Q(x)}$ where $P(x)$ and $Q(x)$ are polynomials and show that $\frac{1}{x+1} + \frac{3}{x-2} = \frac{4x+1}{(x+1)(x-2)}$ => in reverse $\frac{4x+1}{(x+1)(x-2)} = \frac{1}{x+1} + \frac{3}{x-2}$ (Partial Fractions)	Pge 18 Ex 2 Qu 1, 5, 12, 18, 19 22, 25	Page 7 Ex 1 Qu 1a, b, c
2	Deal with repeated fractions in denominator :- $\frac{x^2-7x+9}{(x+2)(x-1)^2} = \frac{A}{x+2} + \frac{B}{x-1} + \frac{C}{(x-1)^2}$ etc.	Pge 19 Ex 3 Qu 1, 3, 5, 10 14, 18	Pge 8 Ex 2
3	Deal with irreducible quadratic factor in denominator:- $\frac{3x^2+2x+1}{(x+1)(x^2+2x+2)} = \frac{A}{x+1} + \frac{Bx+C}{x^2+2x+2}$ etc.	Pge 20 Ex 4 Qu 1, 5, 7, 9, 11* * needs polyl rem theorem	Pge 9 Ex 3
4	Go over need to "divide out" if degree of numerator is greater than or equal to that of denominator :- $\frac{x^3+4x^2-x+2}{x^2+x} = x+3+\frac{2}{x} - \frac{6}{x+1}$ etc **([A/B]**	Pge 22 Ex 6 Qu 1 a, b, e, j, l	
5	**Review**		
	Cumulative total = 13 periods		

Differential Calculus (8/9 pers)

Mathematics 1 Outcome 2a

Pd	Lesson, Outline, Approach etc.	Nelson MIA - AH M1	TeeJay Publishers
1	First Principals => $f'(x) = \lim_{h\to 0} \frac{f(x+h)-f(x)}{h}$ Go over finding $f'(x)$ for $f(x) = 4x^2$, x^3+2, $\frac{5}{x}$ etc (Not tested formally, but should understand)	Page 29 Ex 1A Qu 1, 4, 5, 7	Page 11, Ex 1
2.	Go over basic S5 rules for differentiation and show importance of "chain rule"	Page 32 Ex 3A Qu 1a,d 2a,c,d 3a, 4a, 6a	Page 12 Ex 2 Page 13 Ex 3
3.	Introduce "Product Rule"	Page 32 Ex 4A Qu 1, 2b, 3 Page 36 Ex 4B Qu 1b, 3, 4	Page 14 Ex 4
4.	Introduce "Quotient Rule"	Page 37 Ex 5A Qu 1, 2, 3, 4, 6 Page 38 Ex 5B Qu 1 - 3	Page 15 Ex 5
5	Define secantθ = secθ = $\frac{c}{b} = \frac{1}{\cos\theta}$ etc.  use Graphics calcr to sketch graphs of secθ Look at simple properties => $\lvert\sec\theta\rvert \geq 1$ Show $\frac{d}{dx}(\tan x) = \sec^2 x$, $\frac{d}{dx}(\sec x) = \sec x \tan x$ $\frac{d}{dx}(\cos ecx) = -\cos ecx \cot x$, $\frac{d}{dx}(\cot x) = -\cos ec^2 x$	Page 40 Ex 7 Qu 1, 2, 3a,c,e,g, 4a	Page 18 Ex 6 Qu 1-4
6	Remind about Exponential function $f(x) = a^x$ (and e^x) Differentiate from 1st P => $f'(e^x) = e^x$ use spreadsheet to show $\lim_{h\to 0} \frac{e^h - 1}{h} = 1$ Prove also that $\frac{d}{dx}(\ln x) = \frac{1}{x}$	Page 43 Ex 8A Qu 1a,c,e, 2a, 3e 4a-c, 5b,d, 6a,d	$f(x) = e^{2x}$, e^{x^2} x^2e^x, $e^{\sin x}$
7	Go over $\frac{d}{dx}(\ln 2x)$, $\frac{d}{dx}(\ln x^2)$, $\frac{d}{dx}(\ln(\cos x))$ Remind $e^{\ln x} = \ln(e^x) = x$	Page 43, Ex 8A Qu 1b,d 2b,c,d 3a,b,c 4d,e 5a,c,e 6b,c,e (If time => Ex 4B Qu 1)	Page 18, Ex 6
8.	Define $\frac{d^2y}{dx^2}$, $\frac{d^3y}{dx^3}$, $\frac{d^4y}{dx^4}$, $f''(x), f'''(x)$ etc. 2nd derivative test for nature of stationary points	Page 46 Ex 9A Qu 1, 2, 3, 4, 6	
9.	Review **Cumulative total = 22 periods**		

Applications of Differential Calculus (5/6 pers)

Mathematics 1 Outcome 2b

Pd	Lesson, Outline, Approach etc.	Nelson MIA - AH M1	TeeJay Publishers
1/2	Go over x (displacement) (s in Physics) $v = \frac{dx}{dt}$ = speed (velocity) $a = \frac{dv}{dt} = \frac{d^2x}{dt^2}$ = acceleration	Page 51 Ex 1 Qu 1a, b, d, f, 2a, c, e 3, 4, 6, 7, 8, 10, 12	Page 20 Ex 7
	Home exercise 1 on all topics to date		
3/4	Go over "local maxima/minima" Don't go into in anything like depth of MIA Book Cover "split domain" functions (piece-wise) Basically find max / min in a closed interval (a, b] etc Study (i) local max/min, (ii) end points (not "a" above) and (iii) "critical points" and 2nd derivative test (where appropriate) for nature. (pg56)	Page 56 Ex 2 Qu 1, 3 a,c,e,g,i page 60 Ex 3 Qu 1 a,c,e, 5 a-d	Page 24 Ex 8
5	Optimisation - as for Fifth Year work with new differentiable functions Chose examples carefully from Nelson	Page 63 Ex 4A Choose 5 or 6 examples from Ex 4A/4B (hard)	Page 25 Ex 9
6	Review		
	Cumulative total = 28 periods		

Integral Calculus (10/11 periods)

Mathematics 1 Outcome 3

Pd	Lesson, Outline, Approach etc.	Nelson MIA - AH M1	TeeJay Publishers
1	Go over idea of "anti-derivative" and area under a curve (See page 69 for explanation of area) + special rule for integration:- $\int (ax+b)^n dx = etc.$	Page 70 Ex 1A and 1B	Page 29 Ex 1
2	$\int e^x dx = e^x + c$, $\int \frac{1}{x} dx = \ln x + c$, $\int \sec^2 x dx = \tan x + c$ $\int e^{ax+b} dx = \frac{1}{a} e^{ax+b} + c$, $\int \frac{1}{ax+b} dx = \frac{1}{a} \ln(ax+b) + c$ etc	Page 72 Ex 2A + some of 2B if time	Page 31 Ex 2 Page 33 Ex 3 (some)
3.	Integration by substitution Simple ones by inspection More complicated - substitution will be given Go over :- $\int 4x(x^2+5)dx$, $\int 12x^2\sqrt{x^3-5}dx$, $\int 4\sin x \cos^3 x dx$	page 74 Ex 3 Qu's - odd numbers	Page 36 Ex 4
4	Integration by Substitution part 2 - substitutions given Go over $\int \frac{\ln x}{x} dx$, given $u = \ln x$ Go over $\int \sqrt{4-x^2} dx$, given $x = 2\sin u$ and $dx = 2\cos u du$	Page 75 Ex 4A Qu's - Odd Numbers	Page 37 Ex 5 Page 38 Ex 6
5	Show $\int \sin^5 x dx = \int \sin x \sin^4 x dx = \int \sin x (1-\cos^2 x)^2 dx$ 2nd half of period go over definite integration and changing the limits for the new variables.	Page 76 Ex 4B Qu 1-5 Page 77 Ex 5A odd no's + 1 or 2 from Ex 5B	
6	Special case $\int \frac{f'(x)}{f(x)} dx = \ln\|f(x)\| + c$ Go over $\int \frac{x^2}{x^3-1} dx$, $\int \frac{e^{3x}}{e^{3x}+1} dx$, $\int \tan x dx$ etc	page 80 Ex 6A Qu 1 c,d, 10 + few more Some of Ex 6B if time	
7	Areas under curves and between curves (rev^n of S5 work)		Page 40 Ex 7 Page 41 Ex 8
8	Areas between curves and y -axis		page 42 Ex 9
9	Volumes of solids of revolution	Page 89 Qu 4, 5, 10	Page 44 Ex 10
10	Go over motion :- $\int a(t)dt = v(t)$ and $\int v(t)dt = x(t)$ See examples on page 88	Page 88 Ex 10A Qu 1, 2, 4, 6, 7, 8 (Rest of Ex 10A + some of Ex 10B if time)	
11	Review		
	Cumulative total = 39 periods		

Functions and Graphs (6/7 pers) - Graphics Calc^S

Mathematics 1 Outcome 4

Pd	Lesson, Outline, Approach etc.	Nelson MIA - AH M1	TeeJay Publishers
1	Revise Function work from Higher + go over inverse function and how to find f^{-1}. Show also related graphs of inverses	Page 97 Ex 1 orally Page 100 Ex 3 Qu 1 a,e,g,h 2 e,c,g + 3	
2	Inverse Trig Functions $y = \sin^{-1} x$ etc Go over graphs of $\cos^{-1} x$, $\tan^{-1} x$, e^x, $\lvert f(x)\rvert$ & domains Go over EVEN and ODD functions	Page 102 Ex 2 Qu 1 & 2 Page 99 Ex 1 Qu 2, 5, 6, 7 Page 108 Ex 8 Qu 3	page 68 Qu 1 Page 68 Qu 5
3	Vertical asymptotes of rational functions $f(x) = \frac{g(x)}{h(x)}$ V.A. occurs at $x = a$ if $h(a) = 0$ Discuss what happens as $x \to a^+$ and a^-. Remind to divide if deg $g(x) \geq$ deg $h(x)$	Page 109 Ex 9 Qu 1	Page 50 Ex 1
4	Horizontal asymptotes if deg $g(x) \leq$ deg $h(x)$ and sloping asymptotes if deg $g(x) =$ deg $h(x) + 1$	Page 110 Ex 10 Qu 1 a, b, g, f, k, l	Page 52 Ex 2
5	Sketch graphs of $f(x)$ using V.A, H.A. S.A, T.Pt, Roots and y-intercept	Page 112 Ex 11 Qu 1 a, c, e, g, i, k, m	page 57 Ex 3
6	Related Graphs - from $f(x)$, sketch $f(x - a)$ $af(x)$ $f(ax)$ $f(x) + a$, $f'(x)$, $f^{-1}(x)$ etc	Page 114 Ex 12A Select carefully from Page 117	Page 68 Ex 3
7	Review		
	Cumulative total = 46 periods		

Matrices - Systems of Equations (4/5 pers)

Mathematics 1 Outcome 5

Pd	Lesson, Outline, Approach etc.	Nelson MIA - AH M1	TeeJay Publishers
	Some of the Matrix work from Maths 3 can be incorporated in this chapter if you wish to save time later e.g. inverse of a 2 x 2 matrix, det A and inverse of a 3 x 3		
1/2	Define a matrix, element, order, transpose etc Solve a system of equations (2 x 2 and 3 x 3) in matrix form by row operations to reduce :- $\left[\begin{array}{ccc:c} a & b & c & n \\ d & e & f & p \\ g & h & i & q \end{array}\right]$ to $\left[\begin{array}{ccc:c} a & b & c & n \\ 0 & j & k & r \\ 0 & 0 & m & s \end{array}\right]$ and hence find the solution Gaussian Elimination - Augmented form etc	Page 127 Ex 4A Qu 1 and 2	Page 78 Ex 1
3	Show that some systems have infinite solutions and some have none e.g. $x + y + z = 6$ $2x + y - 2z = -2$ $3x + 2y - z = 4$ (infinite set) $x + y + z = 6$ $2x + y - 2z = -2$ $3x + 2y - z = 3$ (no solns - inconsistent)	page 130 Ex 5 Qu 1 a - c, 2	
4	Ill Conditioning (occurs when small change in value of a coefficient(s) results in large change in solution.	Page 137 Qu 2	page 79 Ex 2
5	Review		
	For Session 2001-2002 **End of Mathematics 1** **Cumulative total = 51 periods** **Assuming 5 periods per week and 2 weeks in June, this unit should end around Thursday 31st October.** **=>3 periods revision (including specimen NAB3) + 1 period for test = 55 periods** **TEST around Friday 2nd November**	**Actual Test Date =**	