



DIPLOMA PROGRAMME

MATHEMATICAL STUDIES SL

INFORMATION BOOKLET

For use by teachers and students, during the course and in the examinations

First examinations 2006

International Baccalaureate Organization

Buenos Aires

Cardiff

Geneva

New York

Singapore

*Diploma Programme
Mathematical Studies SL
Information Booklet*

International Baccalaureate Organization, Geneva, CH-1218, Switzerland

First published in November 2004

Updated January 2006

by the International Baccalaureate Organization
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Printed in the United Kingdom by Antony Rowe Ltd, Chippenham, Wiltshire.

CONTENTS

Formulae	1
Presumed knowledge	1
Topic 2—Number and algebra	1
Topic 3—Sets, logic and probability	2
Topic 4—Functions	2
Topic 5—Geometry and trigonometry	3
Topic 6—Statistics	4
Topic 7—Introductory differential calculus	4
Topic 8—Financial mathematics	5
Critical values of the χ^2 distribution (topic 6.9)	6

Formulae

Presumed knowledge

Area of a parallelogram	$A = (b \times h)$, where b is the base, h is the height
Area of a triangle	$A = \frac{1}{2}(b \times h)$, where b is the base, h is the height
Area of a trapezium	$A = \frac{1}{2}(a + b)h$, where a and b are the parallel sides, h is the height
Area of a circle	$A = \pi r^2$, where r is the radius
Circumference of a circle	$C = 2\pi r$, where r is the radius

Topic 2—Number and algebra

2.2	Percentage error	$\varepsilon = \frac{v_A - v_E}{v_E} \times 100\%$, where v_E is the exact value and v_A is the approximate value of v
2.5	The n^{th} term of an arithmetic sequence The sum of n terms of an arithmetic sequence	$u_n = u_1 + (n-1)d$ $S_n = \frac{n}{2}(2u_1 + (n-1)d) = \frac{n}{2}(u_1 + u_n)$
2.6	The n^{th} term of a geometric sequence The sum of n terms of a geometric sequence	$u_n = u_1 r^{n-1}$ $S_n = \frac{u_1(r^n - 1)}{r - 1} = \frac{u_1(1 - r^n)}{1 - r}$, $r \neq 1$
2.7	Solution of a quadratic equation	$ax^2 + bx + c = 0 \Rightarrow x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$, $a \neq 0$

Topic 3—Sets, logic and probability

3.8	Probability of an event A	$P(A) = \frac{n(A)}{n(U)}$
	Complementary events	$P(A') = 1 - P(A)$
3.10	Combined events	$P(A \cup B) = P(A) + P(B) - P(A \cap B)$
	Mutually exclusive events	$P(A \cup B) = P(A) + P(B)$
	Independent events	$P(A \cap B) = P(A) P(B)$
	Conditional probability	$P(A B) = \frac{P(A \cap B)}{P(B)}$

Topic 4—Functions

4.3	Equation of axis of symmetry	$x = -\frac{b}{2a}$
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Topic 5—Geometry and trigonometry

5.1	Distance between two points (x_1, y_1) and (x_2, y_2) Coordinates of the midpoint of a line segment with endpoints (x_1, y_1) and (x_2, y_2)	$d = \sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2}$ $\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2} \right)$
5.2	Equation of a straight line Gradient formula	$y = mx + c; \quad ax + by + d = 0$ $m = \frac{y_2 - y_1}{x_2 - x_1}$
5.4	Sine rule Cosine rule Area of a triangle	$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$ $a^2 = b^2 + c^2 - 2bc \cos A; \quad \cos A = \frac{b^2 + c^2 - a^2}{2bc}$ Area of a triangle = $\frac{1}{2} ab \sin C$, where a and b are adjacent sides, C is the included angle
5.5	Volume of a pyramid Volume of a cuboid Volume of a cylinder Area of the curved surface of a cylinder Volume of a sphere Surface area of a sphere Volume of a cone Area of the curved surface of a cone	$V = \frac{1}{3}(\text{area of base} \times \text{vertical height})$ $V = l \times w \times h$, where l is the length, w is the width, h is the height $V = \pi r^2 h$, where r is the radius, h is the height $A = 2\pi r h$, where r is the radius, h is the height $V = \frac{4}{3} \pi r^3$, where r is the radius $A = 4\pi r^2$, where r is the radius $V = \frac{1}{3} \pi r^2 h$, where r is the radius, h is the height $\pi r l$, where r is the radius, l is the slant height

Topic 6—Statistics

6.4	Interquartile range	$\text{IQR} = q_3 - q_1$ <p>Outliers are points with value either less than $q_1 - 1.5\text{IQR}$ or greater than $q_3 + 1.5\text{IQR}$</p>
6.5	Mean	$\bar{x} = \frac{\sum_{i=1}^k f_i x_i}{n}, \text{ where } n = \sum_{i=1}^k f_i$
6.6	Standard deviation	$s_n = \sqrt{\frac{\sum_{i=1}^k f_i (x_i - \bar{x})^2}{n}}, \text{ where } n = \sum_{i=1}^k f_i$
6.7	Pearson's product-moment correlation coefficient	$r = \frac{s_{xy}}{s_x s_y}, \text{ where } s_x = \sqrt{\frac{\sum_{i=1}^n (x_i - \bar{x})^2}{n}}, \quad s_y = \sqrt{\frac{\sum_{i=1}^n (y_i - \bar{y})^2}{n}}$ <p>and s_{xy} is the covariance</p>
6.8	Equation of regression line for y on x	$y - \bar{y} = \frac{s_{xy}}{s_x^2} (x - \bar{x})$
6.9	The χ^2 test statistic	$\chi_{\text{calc}}^2 = \sum \frac{(f_o - f_e)^2}{f_e}, \text{ where } f_o \text{ are the observed frequencies, } f_e \text{ are the expected frequencies}$

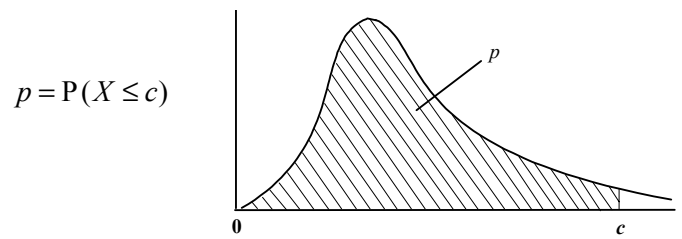
Topic 7—Introductory differential calculus

7.1	Derivative of $f(x)$	$y = f(x) \Rightarrow \frac{dy}{dx} = f'(x) = \lim_{h \rightarrow 0} \left(\frac{f(x+h) - f(x)}{h} \right)$
7.2	Derivative of ax^n	$f(x) = ax^n \Rightarrow f'(x) = nax^{n-1}$
	Derivative of a polynomial	$f(x) = ax^n + bx^{n-1} + \dots \Rightarrow f'(x) = nax^{n-1} + (n-1)bx^{n-2} + \dots$

Topic 8—Financial mathematics

8.2	Simple interest	$I = \frac{Crn}{100}$, where C = capital, $r\%$ = interest rate, n = number of time periods, I = interest
8.3	Compound interest	$I = C\left(1 + \frac{r}{100}\right)^n - C$, where C = capital, $r\%$ = interest rate, n = number of time periods, I = interest which is the special case $k = 1$ of $I = C\left(1 + \frac{r}{100k}\right)^{kn} - C$, where C = capital, $r\%$ = nominal interest rate, n = number of years, k = number of compounding periods in a single year and I = interest

Critical values of the χ^2 distribution (topic 6.9)



p	0.005	0.01	0.025	0.05	0.1	0.9	0.95	0.975	0.99	0.995
$\nu = 1$	0.00004	0.0002	0.001	0.004	0.016	2.706	3.841	5.024	6.635	7.879
2	0.010	0.020	0.051	0.103	0.211	4.605	5.991	7.378	9.210	10.597
3	0.072	0.115	0.216	0.352	0.584	6.251	7.815	9.348	11.345	12.838
4	0.207	0.297	0.484	0.711	1.064	7.779	9.488	11.143	13.277	14.860
5	0.412	0.554	0.831	1.145	1.610	9.236	11.070	12.833	15.086	16.750
6	0.676	0.872	1.237	1.635	2.204	10.645	12.592	14.449	16.812	18.548
7	0.989	1.239	1.690	2.167	2.833	12.017	14.067	16.013	18.475	20.278
8	1.344	1.646	2.180	2.733	3.490	13.362	15.507	17.535	20.090	21.955
9	1.735	2.088	2.700	3.325	4.168	14.684	16.919	19.023	21.666	23.589
10	2.156	2.558	3.247	3.940	4.865	15.987	18.307	20.483	23.209	25.188
11	2.603	3.053	3.816	4.575	5.578	17.275	19.675	21.920	24.725	26.757
12	3.074	3.571	4.404	5.226	6.304	18.549	21.026	23.337	26.217	28.300
13	3.565	4.107	5.009	5.892	7.042	19.812	22.362	24.736	27.688	29.819
14	4.075	4.660	5.629	6.571	7.790	21.064	23.685	26.119	29.141	31.319
15	4.601	5.229	6.262	7.261	8.547	22.307	24.996	27.488	30.578	32.801
16	5.142	5.812	6.908	7.962	9.312	23.542	26.296	28.845	32.000	34.267
17	5.697	6.408	7.564	8.672	10.085	24.769	27.587	30.191	33.409	35.718
18	6.265	7.015	8.231	9.390	10.865	25.989	28.869	31.526	34.805	37.156
19	6.844	7.633	8.907	10.117	11.651	27.204	30.144	32.852	36.191	38.582
20	7.434	8.260	9.591	10.851	12.443	28.412	31.410	34.170	37.566	39.997
21	8.034	8.897	10.283	11.591	13.240	29.615	32.671	35.479	38.932	41.401
22	8.643	9.542	10.982	12.338	14.041	30.813	33.924	36.781	40.289	42.796
23	9.260	10.196	11.689	13.091	14.848	32.007	35.172	38.076	41.638	44.181
24	9.886	10.856	12.401	13.848	15.659	33.196	36.415	39.364	42.980	45.559
25	10.520	11.524	13.120	14.611	16.473	34.382	37.652	40.646	44.314	46.928
26	11.160	12.198	13.844	15.379	17.292	35.563	38.885	41.923	45.642	48.290
27	11.808	12.879	14.573	16.151	18.114	36.741	40.113	43.195	46.963	49.645
28	12.461	13.565	15.308	16.928	18.939	37.916	41.337	44.461	48.278	50.993
29	13.121	14.256	16.047	17.708	19.768	39.087	42.557	45.722	49.588	52.336
30	13.787	14.953	16.791	18.493	20.599	40.256	43.773	46.979	50.892	53.672
40	20.707	22.164	24.433	26.509	29.051	51.805	55.758	59.342	63.691	66.766
50	27.991	29.707	32.357	34.764	37.689	63.167	67.505	71.420	76.154	79.490
60	35.534	37.485	40.482	43.188	46.459	74.397	79.082	83.298	88.379	91.952
70	43.275	45.442	48.758	51.739	55.329	85.527	90.531	95.023	100.425	104.215
80	51.172	53.540	57.153	60.391	64.278	96.578	101.879	106.629	112.329	116.321
90	59.196	61.754	65.647	69.126	73.291	107.565	113.145	118.136	124.116	128.299
100	67.328	70.065	74.222	77.929	82.358	118.498	124.342	129.561	135.807	140.169

ν = number of degrees of freedom

