**Principal Assessor's report (Mathematics Higher Level) – 2001**

## General comments re entry numbers

The number of entries in 2001 was 20,836. There was no significant rise in entries from last year. I am surprised that the total of 20,836 has in fact not fallen. The introduction of Intermediate 2 should have provided an attractive alternative for at least a 1000 or so candidates who fail the Higher examination by a long way.

## General comments

There is no evidence to suggest that the general level of ability of this year's cohort is any different to that of previous years.

## Comments on candidate performance

### General comments

Candidates in general performed to expectation. The examination paper was designed to have a higher pass-mark than last year. The introduction of some easier marks at the beginning seemed to give the overall effect that was wanted although the scores on these questions were disappointing. However, candidates did not seem unduly harassed by the paper. Generally the quality of the paper was accepted as being of a reasonable standard.

The means for papers 1 and 2 were 54% and 56% respectively (40-60 is typical of Higher).

The number of candidates who were presented for Statistics remained on the low side (87) with about half of them passing. As with last year, candidates either passed well or did rather poorly.

## Areas of external assessment in which candidates performed well

## Paper 1

Only composition of functions attracted a very high average mark.

On the plus side many more parts of the syllabus attracted better than 50% averages indicating that candidates were better prepared for the examination as a whole.

## Paper 2

Only two questions stood out as being very well done – namely qu.1 (polynomials) and qu.5 (wave function).

On the plus side many more parts of the syllabus attracted better than 50% averages indicating that candidates were better prepared for the examination as a whole.

**Areas of external assessment in which candidates had difficulty**

**Paper 1**

It was disappointing to see such poor marks on qu.1 (st line and gradient), qu.3 (basic vector work) and qu.5. Qu.5 covered solving a trig equation (double angle and factorising and interpreting a graph.) Far too many candidates simply cancelled off the common factor and/or only found one solution to sin*x*=0.5, thereby being unable to interpret the graph correctly. The discrimination index for qu.5 clearly indicates that this skill (solving trig equations) is only being handled well by those scoring well in the test as a whole. It is nearly the same the discrimination index for qu.11c which was designed to test the prospective A-grade candidate. [Questions which are very easy or very difficult have generally a low discrimination index].

**Paper 2**

Of the earlier questions, qu.3 was poorly done with candidates either not interpreting 1.5% correctly or misunderstanding the idea of repayments altogether (amount owing just got bigger) or turning the question into a simple interest question. Qu.7a posed the 'usual' problems for candidates when they were asked for the equation of a line perpendicular to the *x*-axis. Qu.2 (equ of tgt) had an unusually high discrimination index for such an early question.

**Areas of common misunderstanding**

**Paper 1**
Qu.1 where the gradient was commonly taken to be 2 or –2.

**Paper 2**

Qu.3 where the rate of interest of 1.5% was taken as meaning 0.15

**Areas of difficulty in marking**

**Paper 2**

Qu 3b posed difficulties in deciding whether any marks at all could be awarded in cases when the percentage rate was vastly incorrect or when the recurrence relation used was meaningless.
Questions like qu.8 are also difficult to mark consistently especially when candidates try to break the area into eight different parts and make errors at the beginning.

**Feedback to centres**

Whilst very many candidates acquitted themselves well, the following areas would be worth targeting during 2001-2002. They mainly involved trigonometric work and proofs.

**Paper 1**

qu. 1 It was disappointing to see many candidates unable to extract the gradient from the given line.

ie •[1] $y = -\frac{2}{3}x + \frac{5}{3}$

•[2] $m = -\frac{2}{3}$

•[3] $y - (-1) = -\frac{2}{3}(x - 2)$

qu. 2 The "= 0" needs to be stated explicitly

ie

| | | |
|---|---|---|
| •[1] $(-5)^2 - 4 \times (k + 6)$ | or | •[1] $(-5)^2 - 4 \times (k + 6)$ |
| •[2] $b^2 - 4ac = 0$ | or | •[2] $(-5)^2 - 4 \times (k + 6) = 0$ |
| •[3] $k = \frac{1}{4}$ | or | •[3] $k = \frac{1}{4}$ |

qu. 3 The requirements for proving collinearity have been consistent for a number of years (see Item Bank). Candidates still do not complete the final step correctly.

eg

•[1] $\overrightarrow{AB} = \begin{pmatrix} 6 \\ 9 \\ 3 \end{pmatrix}$

•[2] $\overrightarrow{BC} = \begin{pmatrix} 8 \\ 12 \\ 4 \end{pmatrix} = \frac{4}{3}\overrightarrow{AB}$

•[3] a common point exists
a common direction exists
*so* A, B and C are collinear

qu. 5 The trig attempts were one of the most unsatisfactory areas. Here candidates either "lost" the factor cos $x$ (max 2/4) or lost the solution $x = 150$ (max ¾) from

- •[1] $2 \sin x \cos x - \cos x = 0$
- •[2] $\cos x\,(2 \sin x - 1) = 0$
- •[3] $\cos x = 0$, $\sin x = \frac{1}{2}$
- •[4] 90, 30, 150

or

- •[1] $2 \sin x \cos x - \cos x = 0$
- •[2] $\cos x\,(2 \sin x - 1) = 0$
- •[3] $\sin x = \frac{1}{2}$, $x = 30, 150$
- •[4] $\cos x = 0$, $x = 90$

qu. 6 As in qu. 2communication is important. Not stating the requirement that the derivative is zero loses a mark.

ie

- •[1] •[2] ] $36x^2 - 4x^3$
- •[3] $\frac{dP}{dx} = 0$
- •[4] $x = 0$ or 9
- •[5] nature table about $x = 0$ and $x = 9$

or

- •[1] •[2] ] $36x^2 - 4x^3$
- •[3] $36x^2 - 4x^3 = 0$
- •[4] $x = 0$ or 9
- •[5] nature table about $x = 0$ and $x = 9$

qu. 7 Once past the composition of functions many candidates let themselves down either by not expanding correctly (from given formulae!) or by incorrectly transposing from mark 6 to mark 7.

ie $\sin\left(x + \frac{\pi}{4}\right)$

•[3] $\sin x \cos \frac{\pi}{4} + \cos x \sin \frac{\pi}{4}$

$= \sin x \times \frac{1}{\sqrt{2}} + \cos x \times \frac{1}{\sqrt{2}}$

•[4] $g(h(x)) = \frac{1}{\sqrt{2}} \cos x - \frac{1}{\sqrt{2}} \sin x$

•[5] $\frac{1}{\sqrt{2}} \sin x - \frac{1}{\sqrt{2}} \cos x - \frac{1}{\sqrt{2}} \cos x - \frac{1}{\sqrt{2}} \sin x = 1$

•[6] $\frac{2}{\sqrt{2}} \sin x = 1$

$\sqrt{2} \sin x = 1$

$\sin x = \frac{1}{\sqrt{2}}$

•[7] $x = \frac{\pi}{4}, \frac{3\pi}{4}$

qu. 11 Communication marks were lost at the last mark where candidates did not give enough evidence of the proof.

ie

| | |
|---|---|
| •[1] $r_P = \sqrt{16+25-9} = \sqrt{32} = 4\sqrt{2}$ | or •[1] $C_P = (4,5)$ |
| •[2] $r_P + r_Q = 4\sqrt{2} + 2\sqrt{2} = 6\sqrt{2}$ | •[2] $C_PC_Q = \sqrt{6^2+6^2} = \sqrt{72}$ |
| •[3] $C_P = (4,5)$ | •[3] $r_P = \sqrt{16+25-9} = \sqrt{32} = 4\sqrt{2}$ |
| •[4] $C_PC_Q = \sqrt{6^2+6^2}$ $\sqrt{36\times 2}$ | •[4] $r_P + r_Q = 4\sqrt{2} + 2\sqrt{2} = 6\sqrt{2} =$ |
| $= \sqrt{6^2\times 2}$ | $= \sqrt{72}$ and "so touch" |
| $= 6\sqrt{2}$ and "so touch" | |

When asked to prove a result, candidates should be encouraged to write all the steps. In other words working needs to be stated, not done mentally –

•[4] $C_PC_Q = \sqrt{6^2+6^2} = 6\sqrt{2}$ and "so touch"

**Paper 2**

qu. 3 The recurrence relation requires both $u_{n+1} = 1.015u_n$ - 300 and a starting value, $u_0$=2500.

This year it was accepted that $u_0$ = £2500 could be implied by the start of (b) where $u_1$ = £2337.50.

qu. 5 Wave function.

This type of question has been consistently marked in exactly the same way (see Item Bank) yet some candidates are still very careless about how much they write down. This is repeated here

- •[1] $k \cos x \cos a - k \sin x \sin a$ **explicitly stated**
- •[2] $k \cos a = 8$ and $k \sin a = 6$ **explicitly stated**
- •[3] $k = 10$
- •[4] $a = 36.9$

qu. 9 Whilst it is unnecessary, it is quite in order to replace $A_0$ by a value.

| Instead of | | we can write | |
|---|---|---|---|
| •[1] | $2A_0 = A_0\, \ell^{k\times 1.5}$ | •[1] | $2\times 10 = 10 \times \ell^{k\times 1.5}$ |
| •[2] | *e.g.* $1.5k = \ln 2$ | •[2] | *e.g.* $1.5k = \ln 2$ |
| •[3] | $k = 0.46$ | •[3] | $k = 0.46$ |

qu. 10 It was quite common for candidates to be unable to proceed further after integrating or not to communicate that he/she has decided not to integrate.

ie $\frac{dy}{dx} = 3\sin(2x)$ or $\frac{dy}{dx} = 3\sin(2x)$

$y = \int 3\sin(2x)\ dx = -\frac{3}{2}\cos(2\times\frac{5}{12}\pi) + c$ $y = \frac{3}{2}\cos(2x) + c$

*and go no further*

Whilst in the first case it is worth 2 marks it is very difficult to decide which mistake has been made in the second case – has the candidate integrated incorrectly or differentiated incorrectly. The marking scheme required a correct integration or at least an indication that integrating was to be used.

ie $\bullet^1$ -3 cos (2$x$)

$\bullet^2$ $\times\frac{1}{2}$

$\bullet^3$ $\sqrt{3} = -\frac{3}{2}\cos(2\times\frac{5}{12}\pi) + c$

$\bullet^4$ $c = \frac{1}{4}\sqrt{3}$

qu. 11 Another proof where the evidence shown was often incomplete.
Starting with $y = k(x+1)(x-p)$, the second mark can only be obtained by showing the Substitution of (0, $p$) into $y = k(x+1)(x-p)$. Working for $\bullet^3$ needs to be shown however trivial this seems.

ie $\bullet^1$ $y = k(x+1)(x-p)$

$\bullet^2$ substitution of (0, $p$) leading to $k$ = -1

$\bullet^3$ $y = -1(x+1)(x-p)$ & complete.

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