

## ***Mathletics - online objective tests in mathematics***

**Web site** n/a

### **Description**

**OUTLINE:** The Mathletics program comprises a suite of mathematics tests for diagnostic, formative and summative assessment in commonly-taught areas of number, algebra and calculus from GCSE to year 2 undergraduate level. The aim is to provide an assessment environment where topic question libraries can be combined in various ways (pentathlon, decathlon etc.) and immediate feedback given. Most tests start with information and revision screens. Much of Mathletics was written by final-year project students using Question Designer for Windows, but is now being converted to QM Perception format and enhanced to use MathML and random values for parameters in questions.

**CONTEXT:** Mathletics is designed to be a context-free add-on to traditional or computer-based module delivery for developing mathematical "fitness". Therefore Mathletics does not teach new material, nor allow student experimentation, which is supposed to happen elsewhere. While much of the material is written with mathematics and engineering undergraduates in mind, the tests at GCSE and A levels will also be widely applicable, e.g. for mature returners and non-science students such as economists, and school pupils. Mathletics covers 175 topics and has some 4500 questions.

**DESCRIPTION:** Mathletics is designed to:

- Diagnose freshers' mathematical abilities and preparedness; inform the student; inform the lecturer/tutor (individual, group or whole-class profiles can be easily produced); get the student to revise their A-level notes before the first-year modules start hotting-up; suggest corrective action.
- Offer a substitute for some worksheets for many modules; each test may be repeated, offering a different choice of randomly-selected questions, so that practice for speed and accuracy is available, with instant feedback. Lecturers can monitor students closely and take corrective action, either individually, or as a class revisiting problem topics.
- Provide revision tests for students e.g. the differentiation decathlon.
- Provide formal (invigilated) exams and class tests; here feedback is suppressed, and questions may be answered in any order with questions being revisited, until the student is satisfied and presses "finish" or runs out of time; the answer file is then securely written, and the student is given his/her mark and informed of, and given feedback on, all incorrect answers.
- Provide a set of tests for admissions tutors to assess the current mathematical ability of a wide range of students with unconventional previous education, transfers from other courses, etc.
- Provide an informal resource for a wide range of students in basic arithmetic and algebra e.g. Health Studies where numeracy is vital but may not be formally taught. Mathletics covers topics in arithmetic, GCSE and A level algebra, complex numbers, differentiation, integration, vectors, matrices and determinants, functions and co-ordinate geometry, ordinary differential equations, statistics, some discrete

mathematics & Laplace transforms. It is under continuous development both in adding new topic areas, and in formulating student-responsive diagnostic tests in addition to blanket topic coverage; see <http://www.brunel.ac.uk/~mastmmg/> for a fuller description and current topic coverage.

**RESOURCE IMPLICATIONS:** Mathletics can be run on windows-based (3.1, 95 or NT) stand-alone or networked PCs with SVGA (VGA will not display equations properly). The tests are available free from the author and this is sufficient for formative testing where no marks files will be written. To assess students, the lecturer will also need:

- "Reporter" from Question Mark Computing (<http://www.qmark.com/>) which decrypts the files, performs statistical analysis and generates reports or exports to spreadsheets/databases.
- student write permission on a network. This potential security risk will need to be discussed with your network administrator. (This problem will not arise when running on stand-alone machines, but data collection will then be problematical.)

As mentioned above, Mathletics will become available via the Web sometime in the summer of 2002.

**STUDENT ASSESSMENT:** The questions are mostly multi-choice with distracters (displayed in a random order at each run) chosen by common mal-rule application, with appropriate feedback. Thus a student will not only know that he/she is wrong but will be told why. Multi-choice answers are also easily analysed by the lecturer. Other types of questions are also used such as hot-spot (point to the mistake in this mathematics), numeric (what is the value of this integral?), multi-choice (which of the following apply to this function?), and simple yes/no answers. The questions can allow multi-media buttons, which might, for example, display a calculator, or more advanced facilities, only when the question setter thinks it should be available. At Brunel University, Mathletics is used for diagnostics of 500-800 science or technology students, and as assigned tests for (90) mathematics and (120) foundations students and much informal use. Last academic year over 23,000 tests were taken at Brunel University alone, and it is in use in many other HE & FE institutions (and a few schools).

**EVALUATION:** Feedback from a wide range of Brunel students, collected via on-line questionnaires and informally, has been extremely positive; students require no training to use the software, data collection is robust and feedback to students is viewed as accurate. Display problems and a few mistakes in earlier versions have been corrected. For a review, see "Mathletics - a review" *Maths & Stats Vol 10 No 4* 39 by Joseph Kyle (downloadable from <http://tsn.mathstore.ac.uk/>)

**TEST RESULTS:** Results from previous years (see CTI Maths & Stats Newsletter V 7 # 3 Aug 1996) have indicated that computer-based diagnostics are broadly comparable with those from paper-based diagnostic tests, but are vastly easier, cheaper and quicker to produce. The main mathematical weaknesses were due to:

**ALGEBRAIC MANIPULATION**

**MISINTERPRETING THE MEANING OF THE QUESTION**

**UNFAMILIARITY** (the topic has been "written-off" by the student when preparing for A-level)

**KEY ADVICE:**

- Do award some module marks for Mathletics tests; otherwise only well-motivated students will actually complete the tests, whereas under-motivated students will think "What's in it for me" and fail to learn from the tests.
- Do ask your students to write down problem questions and discuss them in subsequent tutorials.
- Do try the software first logged in as a student. This will check that read/write permissions have been correctly set and that you can actually read their answer files.
- Do check the students are not cheating; group work can (perhaps should) be sanctioned, but using aids such as Derive to do the problems, and simply inputting the answer, is pointless.
- Don't eliminate paper-based tests and worksheets completely; if you do, students may have had little experience in solving problems and laying out mathematical arguments when faced with a blank sheet of paper in an exam.
- Don't expect Mathletics (or CAL systems in general) to rank order your students correctly. Good students might be bored and stop at 70%, whereas weaker students often retake tests until they get 100% simply to get marks as a buffer against anticipated poor exam performance (but without learning much more).

**Type of activity or material** CAL

**Content** GCSE, A-level, first and second year mathematics

**Skills developed** Basic (A-level common core) Mathematics

**Intended academic level** Mostly undergraduates at level zero and level 1

**Maximum number of students supported** Unlimited; at Brunel University last year some 600 students took over 23,000 tests

**Duration (student hours, classroom hours)** Private study plus lab sessions

**Factors which ensure activity is effective** Awarding marks and monitoring student answer files

**Materials available, in what form and from where** CD from author

**Further comments** It's free!

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