

The Mathematics Diagnostic Test

Mock Test and Further Information 2017

In welcome week, students will be asked to sit a short test in order to determine the appropriate lecture course, tutorial group, whether they appear to be underachieving on any particular topic and also to gauge the general mathematical profile of the group.

This test should **NOT** be seen as daunting in any sense.

We have found that many students wish to see a 'mock' test and other associated material. The resources mentioned below are provided on the following pages.

Pages 2-8	Mock Diagnostic Test
Page 9	Answers to Questions in Diagnostic Test
Pages 10-14	References to topics for similar Questions
Page 15	Electronic Questions on these topics

If you have any questions regarding this mock test, the diagnostic process, the transition to University mathematics etc, please contact

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MOCK VERSION

Mathematics Diagnostic Test 2017

This test exists to provide a profile of your mathematical strengths and weaknesses. Depending on your school, it may be used to assign you to a particular mathematics course or tutorial group or to determine whether you need to revise a particular topic. This test does NOT produce a mark for assessment.

Please use the minutes before the official start of the test to enter your details on the official answer sheet. Please write your name and ID number and tick the boxes for your school and for previous maths qualifications etc.

The test will last for 80 minutes. There are 48 multiple-choice questions with up to 8 potential answers. You should enter ONE answer for each question. In case of time-pressure, please concentrate on sections A to H i.e. questions 1 to 32.

Calculators : Only single line or double line, non-graphical calculators WITHOUT the ability to carry out calculus may be used. The Casio fx570 is specifically disallowed.

For ALL questions, note the following for choices A and B

A	I have not seen this material before
B	I have seen this before but I have forgotten

The actual test will be done on a computer but the questions are similar to this mock test.

MOCK VERSION

Section A

A1. If $y^9 \div y^4 = y^n$ which is the value of n .

A2. Solve the equation $5x + 11 = 36$ and give the value for x .

A3. Solve the simultaneous equations and give the value for x .

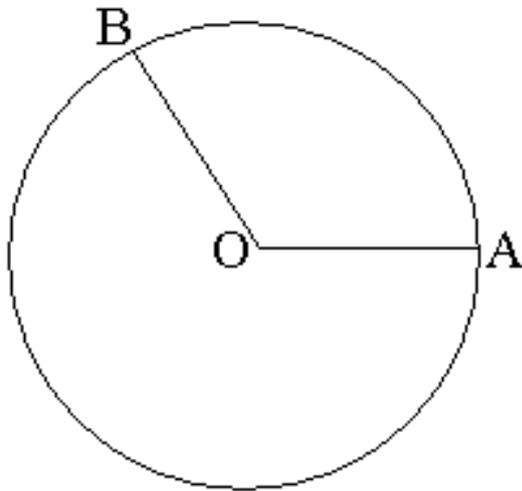
$$\begin{aligned} 3x - y &= -6 \\ 4x + 2y &= 2 \end{aligned}$$

A4. If $y = \frac{7}{x+2} - 1$, which of the following is an expression for x ?

	C	D	E	F	G	H
A1	2.25	5	6.75	13	36	Some other answer
A2	1	2	3	4	5	Some other answer
A3	-2	-1	0	1	2	Some other answer
A4	$\frac{7}{y+1} + 2$	$\frac{7}{y+1} - 2$	$\frac{7}{y-1} + 2$	$\frac{7}{y-1} - 2$	$-\frac{7}{y+1} - 2$	Some other answer

Section B

B5. To how many degrees does $\pi/5$ radians correspond ?



B6. In the circle above, if angle AOB is 2 radians and the length of OA is 3 units, what is the area of the minor sector AOB.

B7. If $\sin \theta = \frac{1}{2}$ and $\frac{5\pi}{2} < \theta < 4\pi$, what is the value of θ ?

B8. Simplify $\sin\left(\frac{3\pi}{2} + \theta\right)$

	C	D	E	F	G	H
B5	30	36	48	60	72	Some other answer
B6	2	π	6	6π	9π	Some other answer
B7	$\pi/6$	$5\pi/6$	$13\pi/6$	$17\pi/6$	$25\pi/6$	Some other answer
B8	$\sin \theta$	$-\sin \theta$	$\cos \theta$	$-\cos \theta$	$\sin \theta - \frac{3}{2}\pi$	Some other answer

Section C

C9. In the sequence $u_n = \frac{1}{2} \frac{n}{n+3}$, what is the value of u_5 ?

C10. In an arithmetic sequence, the third term is 7 and the constant difference is 4. What is the eighth term ?

C11. What is the sum of the first 12 terms of the arithmetic series $5 + 3 + 1 - 1 - 3 - \dots$?

C12. What is (to three decimal places) the sum to infinity of the series $4 + \frac{8}{5} + \frac{16}{25} + \frac{32}{125} + \dots$

	C	D	E	F	G	H
C9	$\frac{1}{5}$	$\frac{5}{16}$	$\frac{5}{13}$	$\frac{5}{2}$	5	Some other answer
C10	23	24	27	28	42	Some other answer
C11	-72	-61	0	5	72	Some other answer
C12	4	6.496	6.667	7.5	8.333	Some other answer

Section D

D13. If $f(x) = x^2 - 5x + 9$, find $f(6)$.

D14. If $f(x) = x + 5$ and $g(y) = 3y - 7$, which option is the combined function $g(f(x))$?

D15. If a function is defined by $y = f(x) = \frac{2}{x-3} + 1$, find the inverse function

D16. If $f(x) = |x + 2| - 1$, what is $f(-4)$?

	C	D	E	F	G	H
D13	5	12	15	21	36	Some other answer
D14	$3xy - 7x + 15y - 35$	$3x^2 + 8x - 35$	$x + 3y - 2$	$3x - 2$	$3x + 8$	Some other answer
D15	$\frac{3x+5}{x-1}$	$\frac{2}{x+1} - 3$	$\frac{2}{x-1} + 3$	$\frac{2}{x-3}$	$\frac{x}{2}$	Some other answer
D16	-3	-1	1	3	5	Some other answer

Section E

E17. Which option equals $(x - 3)(x^2 + 1)$

E18. The quadratic equation $2x^2 - 3x - 20 = 0$ has a negative root and a positive root. Which of the following is the positive root ?

E19. Find the coefficient of x^3 in the expansion of $(x - 2)^5$

E20. What is the remainder when $x^2 + 2x + 5$ is divided by $x - 3$?

	C	D	E	F	G	H
E17	$x^2 + 2x - 3$	$x^2 - 2x + 3$	$x^2 - 2x - 3$	$x^3 - 3x^2 + x - 3$	$x^3 + 3x^2 - x - 3$	Some other answer
E18	0	1	2	3	4	Some other answer
E19	-20	-10	-2	10	20	Some other answer
E20	-10	-5	0	5	10	Some other answer

Section F

F21. Find x if $\log_2 8 = x$ [Hint :- $8 = 2 \times 2 \times 2$]

F22. If $\log_a x = p$ and $\log_a y = q$, what is $\log_a x^3 y$?

F23. If $x = e^{2z}/y^2$, express z as a function of x and y .

F24. By taking logarithms, solve $5^x = 61$. In which range does x lie ?

	C	D	E	F	G	H
F21	2	3	16	64	256	Some other answer
F22	$(p + 3q) \log a$	$3pq$	$q^3 q$	$p^3 + q$	$3p + q$	Some other answer
F23	$\frac{xy^2}{2e}$	$\frac{\ln(xy^2)}{2e}$	$\ln x + \ln y$	$\frac{1}{2} \ln(xy^2)$	$\frac{1}{2} \ln x \ln y^2$	Some other answer
F24	$2.2 < x \leq 2.3$	$2.3 < x \leq 2.4$	$2.4 < x \leq 2.5$	$2.5 < x \leq 2.6$	$2.6 < x \leq 2.7$	Some other answer

Section G

G25. Which of the following is the derivative (with respect to x) of $3x^2$

G26. At what value of x does the function $y = 2x^2 - 12x + 3$ have a minimum

G27. Which of the following is the derivative (with respect to x) of $5 \ln x$

G28. Which of the following is the derivative (with respect to x) of $(2x - 1)^8$

	C	D	E	F	G	H
G25	$6x^2$	$9x^2$	$3x$	$6x$	$9x$	Some other answer
G26	$\frac{2}{3}$	2	3	4	12	Some other answer
G27	$4 \ln x$	$\ln x^5$	$5 \ln$	$5x \ln x - 5x$	$\frac{5}{x}$	Some other answer
G28	$2(2x - 1)^7$	$8(2x - 1)^7$	$16(2x - 1)^7$	7×2^7	8×2^7	Some other answer

Section H

H29. Which of the following is the integral (with respect to x) of $8x^3 - 2x$. Consider all answers to have a '+C' at the end.

H30. Which of the following is the integral (with respect to x) of $5e^x$. Consider all answers to have a '+C' at the end.

H31. Which of the following is the integral $\int_1^3 x dx$

H32. What is the area under the curve $y = x^2 + x$ but above the x -axis for $1 \leq x \leq 2$.

	C	D	E	F	G	H
H29	$2x^4 - x^2$	$4x^4 - 2x^2$	$8x^4 - 2x^2$	$\frac{8}{3}x^3 - 2x$	$4x^3 - 2x$	Some other answer
H30	$5 \ln x$	$5e^{5x}$	$5e^x$	$\frac{5e^x}{x+1}$	$\frac{5e^{x+1}}{x+1}$	Some other answer
H31	2	4	5	8	10	Some other answer
H32	$\frac{1}{2}$	$\frac{5}{6}$	$\frac{14}{3}$	$\frac{11}{4}$	$\frac{23}{6}$	Some other answer

Section I

I33. Which of the following is a simplified version of $\frac{2x^2 + 2x - 4}{x + 2}$?

- C : $2(x - 1)$ D : $2(x + 2)$
 E : $2x + 1 - 4$ F : $2x^2 + x - 6$
 G : $\frac{x^2 + x - 2}{(x + 2)}$ H : None of the above

I34. If $\frac{x + 7}{(x - 3)(x + 2)}$ can be expressed in partial fractions as $\frac{A}{x - 3} + \frac{B}{x + 2}$, what is the value of A ?

I35. Which of the following is the most appropriate partial fractions for $\frac{2x - 7}{(x - 1)(x + 3)^2}$?

- C : $\frac{P}{x - 1} + \frac{Q}{x + 3}$ D : $\frac{P}{x - 1} + \frac{Q}{x + 3} + \frac{R}{(x + 3)^2}$
 E : $\frac{P}{x - 1} + \frac{Q}{(x - 1)^2} + \frac{R}{x + 3}$ F : $\frac{Px + Q}{x - 1} + \frac{Rx + S}{x + 3}$
 G : $\frac{Px + Q}{x - 1} + \frac{Rx + S}{x + 3} + \frac{Tx + V}{(x + 3)^2}$ H : None of the above

I36. In the series expansion in ascending powers of x for $(1 - 2x)^{5/2}$, what is the coefficient of x^3 ?

	C	D	E	F	G	H
I33	C	D	E	F	G	Some other answer
I34	1	2	3	4	5	Some other answer
I35	C	D	E	F	G	Some other answer
I36	-15	$-\frac{5}{2}$	$-\frac{4}{3}$	$-\frac{3}{2}$	$\frac{5}{16}$	Some other answer

Section J

J37. Which of the following is the derivative (with respect to x) of $4 \sin^3 x$

J38. Which of the following is the derivative (with respect to x) of xe^x

J39. Which of the following is the derivative (with respect to x) of $\frac{\sin x}{x}$

- C : $\frac{x \cos x - \sin x}{x^2}$ D : $\frac{\sin x - x \cos x}{x^2}$
 E : $\frac{x \sin x - \cos x}{x^2}$ F : $\frac{x \sin x - \cos x}{\sin^2 x}$
 G : $\frac{x \cos x - \sin x}{\sin^2 x}$ H : None of the above

J40. If $y + 2x \sin y = e^x$, find the derivative $\frac{dy}{dx}$ at the point $x = 0, y = 1$. In which range does $\frac{dy}{dx}$ lie ?

	C	D	E	F	G	H
J37	$12 \sin^2 x \cos x$	$12 \cos^2 x \sin x$	$12 \sin^2 x$	$12 \cos^2 x$	$4 \cos^3 x$	Some other answer
J38	xe^x	$xe^x + e^x$	$xe^x - e^x$	$xe^x - e^x + 1$	$\frac{x^2}{2}e^x - e^x$	Some other answer
J39	C	D	E	F	G	Some other answer
J40	-0.7 to -0.6	-0.6 to -0.5	-0.5 to -0.4	-0.4 to -0.3	-0.3 to -0.2	Some other answer

Section K

K41. Which of the following is $\int \sec^2 3x \, dx$?

K42. Using a trigonometric identity, the integral $\int \sin^2 2x \, dx$ can be shown to equal $f(x) + \text{trig term} + C$. Which of the following could $f(x)$ equal ?

K43. Use the substitution $u = 2 + \sin x$ to find $\int_0^{\pi/2} \frac{\cos x}{2 + \sin x} \, dx$.
 In which range does the integral lie ?

K44. Using integration by parts, find $\int xe^{3x} \, dx$. Which of the following does it equal ?

- C : $\frac{1}{3}xe^{3x} - \frac{1}{9}e^{3x} + C$ D : $\frac{1}{3}xe^{3x} + \frac{1}{9}e^{3x} + C$
 E : $xe^{3x} - \frac{1}{3}e^{3x} + C$ F : $xe^{3x} + \frac{1}{3}e^{3x} + C$
 G : $\frac{1}{3}x^2e^{3x} - \frac{1}{9}xe^{3x} + C$ H : None of the above

	C	D	E	F	G	H
K41	$\frac{1}{3} \sec^3 3x + C$	$\frac{1}{9} \sec^3 3x + C$	$\frac{1}{3} \tan^2 3x + C$	$\frac{1}{3} \cot^2 3x + C$	$\frac{1}{3} \tan 3x + C$	Some other answer
K42	2	$\frac{x}{2}$	$\frac{3x}{2}$	$\frac{x^2}{2}$	$\frac{x^2 - 1}{2}$	Some other answer
K43	0 to 0.1	0.1 to 0.2	0.2 to 0.3	0.3 to 0.4	0.4 to 0.5	Some other answer
K44	C	D	E	F	G	Some other answer

Section L

L45. Given that $\underline{a} = 2\underline{i} - 3\underline{j} + \underline{k}$ and $\underline{b} = 3\underline{i} + 3\underline{j} - 2\underline{k}$, which of the following is the vector $\underline{a} + \underline{b}$
 C : $5\underline{i} - \underline{k}$ D : $5\underline{i} + \underline{j} - \underline{k}$
 E : $-\underline{i} - 6\underline{j} + 3\underline{k}$ F : $2\underline{i} + 2\underline{j} - 3\underline{k}$
 G : $5\underline{i} - 3\underline{j} + 2\underline{k}$ H : None of the above

L46. For the vectors in L45, which is a unit vector parallel to \underline{a}
 C : $-\frac{2}{14}\underline{i} + \frac{3}{14}\underline{j} + \frac{1}{14}\underline{k}$ D : $\frac{2}{14}\underline{i} - \frac{3}{14}\underline{j} + \frac{1}{14}\underline{k}$
 E : $-\frac{2}{\sqrt{14}}\underline{i} + \frac{3}{\sqrt{14}}\underline{j} - \frac{1}{\sqrt{14}}\underline{k}$ F : $\frac{2}{\sqrt{14}}\underline{i} + \frac{3}{\sqrt{14}}\underline{j} - \frac{1}{\sqrt{14}}\underline{k}$
 G : $-\frac{2}{\sqrt{14}}\underline{i} + \frac{3}{\sqrt{14}}\underline{j} + \frac{1}{\sqrt{14}}\underline{k}$ H : None of the above

L47. For the vectors in L45, which of the following is the scalar product $\underline{a} \cdot \underline{b}$

L48. Which of the following is the vector from $(-3, 4, 2)$ to $(1, 1, 6)$
 C : $-4\underline{i} + 3\underline{j} - 4\underline{k}$ D : $4\underline{i} - 3\underline{j} + 4\underline{k}$
 E : $-2\underline{i} + 5\underline{j} + 8\underline{k}$ F : $2\underline{i} - 5\underline{j} - 8\underline{k}$
 G : $-\underline{i} + 2.5\underline{j} + 4\underline{k}$ H : None of the above

	C	D	E	F	G	H
L45	C	D	E	F	G	Some other answer
L46	C	D	E	F	G	Some other answer
L47	$3\underline{i} + 7\underline{j} + 15\underline{k}$	$6\underline{i} - 9\underline{j} - 2\underline{k}$	-5	25	36	Some other answer
L48	C	D	E	F	G	Some other answer

END OF TEST

Answers to the questions are as given below

A1	D	B5	D	C9	D	D13	E	E17	F	F21	D
A2	G	B6	H	C10	E	D14	G	E18	G	F22	G
A3	D	B7	F	C11	C	D15	E	E19	H	F23	F
A4	D	B8	F	C12	E	D16	E	E20	H	F24	F

G25	F	H29	C	I33	C	J37	C	K41	G	L45	C
G26	E	H30	E	I34	D	J38	D	K42	D	L46	D
G27	G	H31	D	I35	D	J39	C	K43	G	L47	E
G28	E	H32	G	I36	D	J40	C	K44	C	L48	D

Reference to topics for similar questions

Each section (of this test and of the September test) consists of 4 questions on a given topic. In practice, there are more than 4 possible question types for each topic. The areas which may come up on the September test are listed below for each topic. Later there follows a set of references to further information on the areas of subject matter.

Section A : Pre A-level algebra

1. Putting numbers in simple formula
2. Simple linear equation
3. Calculation of indices for a product
4. Calculation of indices for a quotient
5. Calculation of indices for a power
6. Re-arrange a formula
7. Two simultaneous equations
8. Rationalise a surd
9. Simple inequations

Section B : Geometry and Trigonometry

1. Conversion between degrees and radians
2. Lengths of arcs
3. Areas of sectors
4. Simple right-angle trigonometry
5. Values of sec, csc and cot
6. Sine rule
7. Cosine rule
8. Simple trig identities
9. Finding θ from a trig ratio and a range of θ .
10. Coordinate systems
11. Equation of a straight line
12. Parallel and perpendicular lines
13. Conversions between polar and rectangular systems.
14. Geometry of circles

Section C : Series

1. Finding a term from a general form
2. Finding common difference
3. Sum of arithmetic sequence
4. Other manipulations with arithmetic sequences/series
5. Finding common ratio (geometric series)
6. Sum of terms of geometric series
7. Sum to infinity
8. Other manipulations with geometric series

Section D : Functions

1. Evaluate a simple function
2. Composite Function
3. The modulus function
4. Inverse Function
5. Properties of $f(x \pm a)$ on the basis of $f(x)$
6. Properties of $f(ax)$ on the basis of $f(x)$
7. Odd and Even functions
8. Domain of function

Section E : Polynomials

1. Multiplying out brackets
2. Factorisation of quadratics
3. Complete the square
4. Solve quadratic equation
5. Factorise a cubic
6. Binomial Expansion
7. Remainder on division when one polynomial is divided by another

Section F : Logarithms and Exponentials

1. Log of a number to a given base.
2. Laws of logarithms
3. Solve $a^x = b$ for given a and b .
4. Manipulations involving $y = A + be^{cx}$.
5. Graphs of $\log x$ and e^x .

Section G : Differentiation

1. Differentiation of a polynomial
2. Location of maxima and minima
3. Differentiation of $\log_e x$, e^x , $\sin x$, $\cos x$.
4. Chain rule for differentiation
5. Product Rule
6. Quotient Rule
7. Gradient of Tangent
8. Second Derivative.

Section H : Integration

1. Integrate a Polynomial
2. Integrate simple trig expressions
3. Integrate an exponential
4. Definite integrals
5. Manipulate and expression into polynomial and integrate
6. Area under a curve
7. Area between curves.

Section I : Further Algebra

1. Algebraic Simplification of rational functions
2. Simple Partial Fractions
3. Form of Partial Fractions for repeated terms in denominator
4. The Binomial Series
5. For of Partial Fractions when numerator is of equal or greater degree than denominator.

Section J : Further Differentiation

1. Differentiation of more difficult trigonometric expressions
2. The Product Rule
3. The Quotient Rule
4. Parametric form of functions
5. Parametric differentiation
6. Implicit differentiation

Section K : Further Integration

1. Integration of $\sin^2 px$ and $\cos^2 px$
2. Integration of $\tan^2 px, \sec^2 px, \csc^2 px, \cot^2 px$
3. Integration by substitution
4. volumes of revolution
5. Integration by parts

Section L : Vectors

1. Vectors in component form
2. Addition/subtraction of vectors
3. Multiplication of vector by scalar
4. Magnitude of Vector
5. Vectors from point to point
6. Unit Vectors parallel to given vectors
7. The Scalar Product
8. Vector equation of lines

The areas below give some references to further reading for sections A to L.

- HELM : Resource of .pdf files Helping Engineers Learn Mathematics. Enter via <http://www.maths.manchester.ac.uk/study/undergraduate/information-for-current-students/service-teaching/helm/>
- K.A. Stroud “Engineering Mathematics” 7th Edition, Palgrave Macmillan
- A. Croft and R. Davison “Foundation Maths” 6th Edition, Pearson
- S-Cool : web-based resource : Enter via the maths page <http://www.s-cool.co.uk/a-level/maths>
- Other Resources : e.g. A-level guides. Of course, different students will have done different syllabuses so please use which seems best to you.

Section A : Arithmetic and Algebra

- HELM : Section 1
- Stroud : F1, F2, F3, F5
- Croft : Chapters 5,7
- S-Cool : Basic Algebra
- Others

Section B : Geometry and Trigonometry

- HELM : Section 4
- Stroud : F9, 23
- Croft : Chapters 22-24
- S-Cool : Coordinate Geometry, Trigonometry
- Others

Section C : Sequences and Series

- HELM : Section 16
- Stroud : 10,11
- Croft : Chapter 12
- S-Cool : Sequences and Series
- Others

Section D : Functions

- HELM : Section 2
- Stroud : F10
- Croft : Chapter 9
- S-Cool : Functions
- Others

Section E : Polynomials

- HELM : Section 3
- Stroud : F2, F3, F6

- Croft : Chapter 6, 8, 11
- S-Cool : Advanced Algebra
- Others

Section F : Exponentials and Logarithms

- HELM : Section 6
- Stroud : F2, F11
- Croft : Chapter 19, 20
- S-Cool : Functions
- Others

Section G : Differentiation

- HELM : Section 11,12
- Stroud : F12, 7
- Croft : Chapter 34, 35
- S-Cool : Differentiation
- Others

Section H : Integration

- HELM : Section 13
- Stroud : F13, 16
- Croft : Chapter 36, 37
- S-Cool : Integration
- Others

Section I : Further Algebra

- HELM : Section 3
- Stroud : F8
- Croft : Chapter 9
- S-Cool : Advanced Algebra
- Others

Section J : Further Differentiation

- HELM : Section 11
- Stroud : 7,8
- Croft : Chapter 34, 35
- S-Cool : Differentiation
- Others

Section K : Further Integration

- HELM : Section 13
- Stroud : 16

- Croft : Chapter 36, 37
- S-Cool : Integration
- Others

Section L : Vectors

- HELM : Section 9
- Stroud : 6
- Croft : Chapter 26
- S-Cool : Vectors, Lines and Planes
- Others

Electronic Questions

The University has also prepared a selection of electronic questions on the above topics. To access these questions, please go to the page mathvle.eps.manchester.ac.uk and then click on 'Pre-Diagnostic Practice for First Year'. You will need to register so click on "create a new account" and follow the instructions there. Note that these instructions involve clicking on a link which will be sent to you in an e-mail message.

Note that you will have to type in your manchester e-mail address and receive the e-mail on this account. If you have not yet set up your manchester e-mail, you should access the page <http://www.itservices.manchester.ac.uk/students/it-account/> and follow the instructions there.

You will be prompted for an 'enrolment key'. The enrolment key is "diagnostic" (all lower-case letters). Having done this, you will be able to choose a topic and look at some of the questions.

When looking at a question, enter your answer and wait for the computer to let you know how it has interpreted your answer. You can edit your answer again or you can click 'check' and the computer will now process your answer. You can have a second attempt within each quiz and please bear in mind that you can try each quiz as many times as desired.

These electronic questions serve several purposes

1. A question can be tried a fairly large number of times with different coefficients etc.
2. The answer and feedback are instant
3. The feedback may well contain references to WHY a particular answer is wrong rather than just the correct answer.

Please feel free to have a look at the quizzes. You can try the questions as many times as you wish (There is a penalty of 0.5 for each wrong answer, or 1 for true or false questions) and you can come back for a fresh attempt as many times as desired. Please note that nobody is going to assign any marks on the basis of these questions ; they are purely for practice.

If you experience any difficulties with these electronic questions, or if you would like to ask something, please contact Dr Colin Steele (colin.steele@manchester.ac.uk, Tel 0161 306 3632)