UNIVERSITY COLLEGE LONDON

University of London

EXAMINATION FOR INTERNAL STUDENTS

For The Following Qualifications:-

B.A. *B.Eng.* *B.Sc.* *M.Sci.*

Mathematics A1A: Elementary Mathematics 1

COURSE CODE	:	**MATHA01A**
UNIT VALUE	:	**0.50**
DATE	:	**12-MAY-03**
TIME	:	**14.30**
TIME ALLOWED	:	**2 Hours**

TURN OVER

All questions may be attempted but only marks obtained on the best **five** *solutions will count.*
The use of an electronic calculator **is** *permitted in this examination.*

1. Simplify the following expressions:

   (a) $(x-y)\,(x^3+y\,x^2+y^2\,x+y^3+x+y)$,

   (b) $\left(\dfrac{x^3\,\sqrt[3]{z}}{y}\right)^2\left(\dfrac{1}{\sqrt{z}}\,y^{10}\right)$,

   (c) $(a+b+c)^2-(a-b+c)^2$.

2. (a) Find the points where the curve $y=x^2-9x+14$ meets the x-axis.

   (b) Find the equation of a straight line through the points $(1,13)$ and $(-1,7)$ and find the shortest distance of this line to the origin.

3. (a) Define the trigonometric functions $\sin\theta$, $\cos\theta$, $\tan\theta$ and $\cot\theta$ for a *general* angle θ. Assuming the formula $\sin(\theta+\phi)=\sin\theta\cos\phi+\cos\theta\sin\phi$ show that $\sin(\theta+\pi/2)=\cos\theta$ and $\cos(\theta+\pi/2)=-\sin\theta$. Deduce the formula for expanding $\cos(\theta+\phi)$ in terms of the functions $\cos\theta$, $\cos\phi$, $\sin\theta$ and $\sin\phi$

   (b) Find exact values for the following:

   (i) $\cos 20\pi$, (ii) $\cos\dfrac{9\pi}{4}$, (iii) $\sin\dfrac{5\pi}{3}$,
   (iv) $\cos\dfrac{7\pi}{6}$.

4. Differentiate the following with respect to x:

   (a) $(x^4+x^2+2x+3)(4x+1)$,

   (b) $\dfrac{x^4+2x+2}{x^2+3x+4}$,

   (c) $\log x^3+\cos x^2$,

   (d) $\cos(x-1/x^2)$.

5. Write the following expressions in the form $a + ib$ where a and b are real numbers

(a) $(2+4i)(5+3i)$, (b) $\dfrac{2+4i}{5+6i}$, (c) $e^{i\pi/3}$,

(d) $\left(\dfrac{1}{2} + i\dfrac{\sqrt{3}}{2}\right)^8$.

6. (a) State the Binomial Theorem for the expansion of $(a+b)^n$. Expand $(1+x)^7$ in powers of x.

(b) Write down Maclaurin's formula for expanding a function $f(x)$ as a power series in x and use it to find the power series for $\log\sqrt{1+x^2}$ up to the x^4 term.

7. A house is situated in a uniform, trackless jungle 2 km from a straight road. A cable company wishes to lay a cable from the house to a sub-station 6 km along the road. If it costs twice as much to lay a cable through jungle as it does along the road find where the cable should meet the road for the cost to be a minumum.

(Hint: Think of the road as the x-axis, the house at the point $(0,2)$, the sub-station at $(6,0)$ and $(x,0)$ as the point where the cable meets the road. You need to find the value of x that will give the least cost.)