

**CORK INSTITUTE OF TECHNOLOGY
INSTITIÚID TEICNEOLAÍOCHTA CHORCAÍ**

Autumn Examinations 2008/09

**Module Title: Technological Mathematics 1
Technological Mathematics 1 (C.A.)**

Module Code: MATH 6013 : MATH 6016

School: School of Science

Programme Title:

B.Sc. in Applied Biosciences – Year 1
B.Sc. in Analytical & Pharmaceutical Chemistry – Year 1
B.Sc. in Applied Physics & Instrumentation – Year 1
B.Sc (Hons) in Computerised Instrument Systems – Year 1

Programme Code:

SBIOS_7_Y1
SCHEM_7_Y1
CR_SPHYS_7_Y1
CR_SCISY_8_Y1

External Examiner(s): Dr. P. Robinson
Internal Examiner(s): Ms. H. Lordan, Ms. F. Wood,
Ms. M. Harley

Instructions: Answer QUESTION 1 (worth 30 points) and
TWO other questions (worth 35 points each)

Duration: 2 HOURS

Sitting: Autumn 2009

Requirements for this examination: Mathematics Tables

Note to Candidates: Please check the Programme Title and the Module Title to ensure that you are attempting the correct examination.
If in doubt please contact an Invigilator.

Q.1

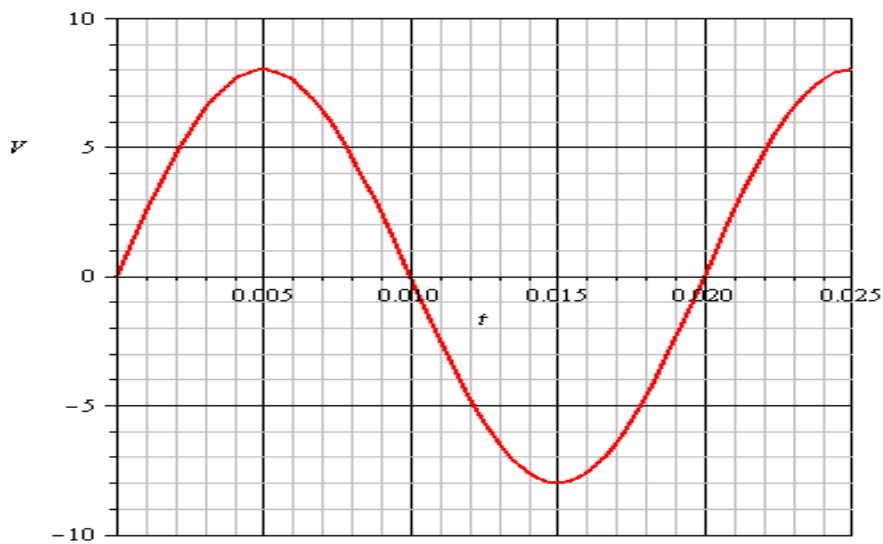
- (i) Evaluate $Z = \sqrt{R^2 + \left(\omega L - \frac{1}{\omega C}\right)^2}$ $R = 45$ $C = 4 \times 10^{-6}$
 $\omega = 2500$ $L = 0.02$ (5 marks)

- (ii) Transpose the following formulae to make t the subject
 $V = \frac{a+t^2}{a-t^2}$ (5 marks)

- (iii) Given the functions $y_1 = 12e^{-25t}$ and $y_2 = 10(1 - e^{-25t})$
 (a) evaluate y_2 when $t = 0.07$ (b) determine the time t when $y_1 = y_2$ (5 marks)

- (iv) A graph of $\left(\frac{s}{t}\right)$ versus t produces a straight line which passes through the points $(-0.01, 4.735)$ and $(0.06, 4.490)$. Obtain an expression for s in terms of t (5 marks)

- (v) The graph below shows V as a function of time t .
 State the amplitude, period and frequency of V . Hence express V in terms of t .
 Use your equation to determine V when $t = 0.09$



- (vi) Express $\frac{3x-8}{(2-3x)(3x-4)}$ as the sum of two partial fractions (5 marks)

Q.2 (a) Simplify the following giving answers with positive indices only.

$$(i) \quad \frac{3a^3}{5b^{-2}} \div \frac{6a^{-1}}{25b} \quad (ii) \quad \sqrt[3]{\frac{27x^{-9}}{y^{12}z^{-6}}}$$

(8 marks)

(b) $\log_2(x+6) + \log_2(x) = 3$

(8 marks)

(c) Given that $y = 12$ when $x = 10$ and $y = 22$ when $x = 15$, evaluate the constants a and n in the equation $y = ax^n$

(10 marks)

(d) The cosine rule states that $a^2 = b^2 + c^2 - 2bc \cdot \cos(A)$ where a is the side opposite the angle A . Evaluate b given that $A = 60^\circ$, $a = 9$, $c = 10$.

(9 marks)

Q.3 (a) Express each of the following equations in linear form, indicating what you would plot on each axis and how each constant may be evaluated:

(i) $V = Ae^{kt}$ A and k are constants

(ii) $V = at^2 + bt$ a and b are constants.

(10 marks)

(b) The period T of a simple pendulum is related to its length L by the formula $T = 2\pi\sqrt{\frac{L}{g}}$

Verify that this law applies to the data below by plotting a graph of T^2 against L .

T	1.7	1.8	2.0	2.2	2.3	2.4
L	0.7	0.8	1.0	1.2	1.3	1.4

Use your graph to determine the constant g .

Estimate T when $L = 0.9$ using (i) your graph (ii) your equation

(25 marks)

- Q.4 (a) The current i mA in a circuit is given by
 $i = 20\sin(100\pi t - \frac{\pi}{5})$ where t is the time in seconds
- (i) State the amplitude, frequency, period, phase angle and phase time of i .
 - (ii) Determine the initial current.
 - (iii) Determine the values of t for which i is first zero and when i first reaches it's maximum value.

(15 marks)

- (b) Express $3\sin t + 4\cos t$ as a single wave function of the form $r\sin(t + \alpha)$ where t, α are measured in radians.
Hence find a solution for t in the equation $3\sin t + 4\cos t = 2.2$.

(12 marks)

- (c) Find the solutions to the equation $12\sin^2(\theta) - 6 = \cos(\theta)$ where $0 \leq \theta \leq 180^\circ$

$$[\sin^2(\theta) + \cos^2(\theta) = 1]$$

(8 marks)