

**CORK INSTITUTE OF TECHNOLOGY
INSTITIÚID TEICNEOLAÍOCHTA CHORCAÍ**

Semester 2 Examinations 2009/10

**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 – Year1

B.Sc. in Analytical Chemistry & Quality Assurance – Year1

B.Sc. in Nutrition & Health Science – Year 1

B.Sc. in Pharmaceutical Biotechnology – Year 1

B.Sc. in Applied Physics & Instrumentation – Year 1

Programme Code:

SBIOS_7_Y1: SCHEM_7_Y1: SCHQA_8_Y1:

SHNSC_8_Y1: SPHB_8_Y1: SPHYS_7_Y1:

External Examiner(s): Dr. P. Kirwan

Internal Examiner(s): Ms. M Harley, Ms H. Lordan, Ms. F. Wood.

Instructions: Answer QUESTION 1 (compulsory - 30 marks)
and TWO other questions (35 marks each)

Duration: 2 Hours

Sitting: Autumn 2010

Requirements for this examination: Mathematical Tables

Note to Candidates: Please check the Programme Title and the Module Title to ensure that you have received the correct examination paper.

Q.1 Answer **each** of the following:

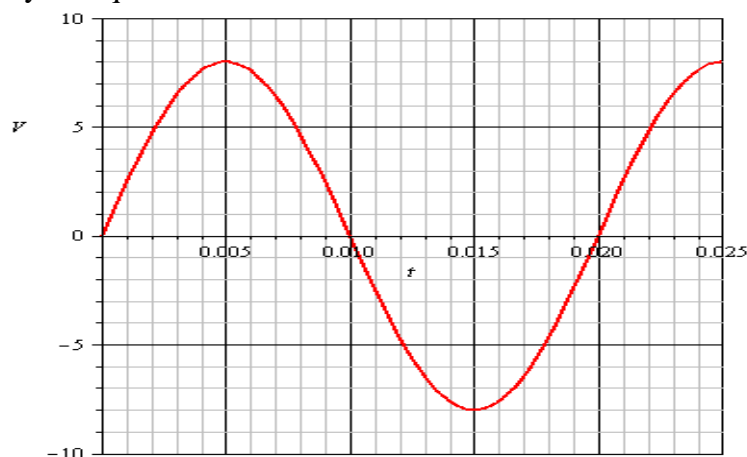
- (a) Evaluate $R = tE \left(\frac{v^2}{p^2} - \frac{1}{2k} \right)$ where
 $t = 0.01$, $E = 30 \times 10^6$, $v = 3.9$, $k = 3 \times 10^5$, $p = 980$.
 (5 marks)

- (b) Transpose the formulae $a = \sqrt{\frac{b}{b+c}}$ to make b the subject.
 (5 marks)

- (c) The temperature θ °C of an object at time t s is given by
 $\theta = 22 + 78e^{-0.2t}$.
 Determine (i) the temperature θ °C when $t = 20$ s
 (ii) the time t s when the temperature is 65 °C
 (5 marks)

- (d) A graph of T^2 versus L produces a straight line which passes through the points (0.9, 3.6) and (1.3, 5.2).
 Obtain an expression for T in terms of L .
 (5 marks)

- (e) 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 $t = 0.003$.



- (f) Solve for x in the equation $\frac{1}{x-1} - \frac{2}{x+2} = \frac{4}{x}$
 (5 marks)

Q2. (a) Use the laws of indices to simplify each of the following expressions:

(i) $\frac{(2m^2n)^3}{\sqrt[3]{8m^6n^{-3}}} \cdot \left(\frac{n}{m}\right)^2$ (4 marks)

(ii) $\frac{16^n}{2^n \cdot 8^{n-1}}$ (3 marks)

(b) Solve for t in each of the following equations:

(i) $7e^{-3t} = 2$ (3 marks)

(ii) $4^{2t} = 6^{t+1}$ (6 marks)

(iii) $\log_3(5+t) - \log_3(5-t) = 2$ (6 marks)

(c) Transpose the equation $p = 2\pi\sqrt{\frac{1}{d^2} - \frac{1}{e^2}}$ to make d the subject. (6 marks)

(d) The power P developed in an electrical circuit is given by $P = 10I - 8I^2$, where I is current in amperes. Determine the current necessary to produce a power of 2.5 watts in the circuit. (7 marks)

Q3. (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) $S = aT + bT^2$ where a and b are constants

(ii) $M = aN^b$ where a and b are constants

(10 marks)

(b) In an experiment the resistance, R , of copper wire of various diameters, d , was measured and the following readings were obtained:

d (mm)	0.19	0.21	0.27	0.32	0.37	0.46
R (ohm)	1.25	0.95	0.57	0.40	0.26	0.14

It is believed that R and d are related by an equation of the form

$$R = a + \frac{b}{d^2}$$

where a and b are constants.

(i) Show by plotting a graph of R against $\frac{1}{d^2}$ that the equation is satisfied.

(14 marks)

(ii) Use your graph to find the best values of a and b and state the linear Relationship.

(6 marks)

(iii) Determine the resistance of a wire of diameter 0.53mm.

(5 marks)

Q4. (a) A wave function is given by

$$v = 15 \sin\left(200\pi t - \frac{\pi}{5}\right)$$

where v is measures in volts and t is time in seconds.

- (i) State the amplitude, frequency, periodic time, and phase time of v . (5 marks)
- (ii) Find the initial voltage. (3 marks)
- (iii) Find the time in the first cycle when $v = 11$ volts. (6 marks)

(b) Express $5 \cos t - 12 \sin t$ as a single wave function of the form $r \sin(t + \alpha)$.

- (i) Hence solve the equation $5 \cos t - 12 \sin t = 4$. (8 marks)
- (ii) State the maximum value of the function and the value of t at which it occurs. (5 marks)

(c) Solve the equation $4 \cos^2 \theta = 7(1 - \sin \theta)$ for $0^\circ \leq \theta \leq 180^\circ$

Note: $\sin^2 \theta + \cos^2 \theta = 1$ (8 marks)