

CORK INSTITUTE OF TECHNOLOGY
INSTITIÚID TEICNEOLAÍOCHTA CHORCAÍ

Semester 2 Examinations 2007/08

Module Title: Calculus & Statistics

Module Code: MATH 6002

School: School of Science

Programme Title:

B.Sc in Applied Biosciences – Year 1

B.Sc in Analytical & Pharmaceutical Chemistry – Year 1

Programme Code:

SBIOS_7_Y1

SCHEM_7_Y1

External Examiner(s): Dr. P. Robinson

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

Instructions: **Answer Question 1 (worth 30 marks) and
Two other questions (worth 35 marks each)**

Duration: **2 HOURS**

Sitting: Autumn 2008

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.
If in doubt please contact an Invigilator.

- Q1. (a) Find (i) the slope of the tangent to the curve $y = x^2 - 7x$ at $x = 2$.
(ii) At what point is slope = 0?
(5 marks)

- (b) The mass (M) in g of a bacteria t seconds after starting an experiment is given by $M = 120e^{0.002t}$. Find the rate at which the mass is increasing when $t = 5$ minutes.
(5 marks)

- (c) Evaluate $\int_1^3 (2x + 3)(x - 1)dx$
(5 marks)

- (d) Determine $\int (\sin 3x + e^{2x})dx$
(5 marks)

- (e) The mean (\bar{x}) of six numbers is 4.2. If a seventh number 2.8 is included. Find the new mean.
(5 marks)

- (f) Find the standard deviation (s) from the mean of 3, 5, 7 and 9.
(5 marks)

Q2. (a) Differentiate from first principles $y = x^2 - 5$.

(7 marks)

(b) Differentiate each of the following with respect to the variable:

(i) $y = \frac{3}{2}x^2 - \frac{4}{5x^3} + \sin 2x$

(ii) $M = e^{-2t} \ln(5t)$

(iii) $s = \frac{x^2 - 3x}{\sqrt{4x}}$

(16 marks)

(c) Examine the function $y = 3x^3 + 6x^2 + 3x - 2$ for stationary points. Identify the nature of each and hence sketch the function.

(12 marks)

Q3 (a) Determine each of the following integrals:

(i) $\int_1^2 \frac{t^3 - 4t^2 + 3t}{t} dt$

(ii) $\int_2^3 \frac{x+3}{x^2+6x-5} dx$

(iii) $\int_1^3 (4x+3)^5 dx$

(21 marks)

(b) Find the area bounded by the curve $y = x^2 + 3$, the x axis and the ordinates $x = 1$ and $x = 4$.

(14 marks)

Q4 The activity of an enzyme (units/gram protein) in samples of liver tissues infected with hepatitis was examined and the following results obtained:

Enzyme Activity	3.00-3.26	3.27-3.53	3.54-3.80	3.81-4.07	4.08-4.34	4.35-4.61
No. of Tissues	3	15	17	12	8	5

(a) Calculate the mean enzyme activity (\bar{x}) and the standard deviation (s) from the mean.

(16 marks)

(b) Represent the information on a histogram.

(7 marks)

(c) Estimate (i) the median
(ii) the mode and
(iii) the number of tissues in the range $(\bar{x} - s)$ to $(\bar{x} + s)$.

(12 marks)

Standard Integrals

$f(x)$	$\int f(x)dx$
x^n	$\frac{x^{n+1}}{n+1} \quad n \neq -1$
$\frac{1}{x}$	$\ln x$
e^x	e^x
e^{ax}	$\frac{1}{a} e^{ax} \quad a = \text{constant}$
$\sin x$	$-\cos x$
$\cos x$	$\sin x$

Statistical Formulae

$$\text{Mean } (\bar{x}) = \frac{\sum fx}{\sum f} \qquad \text{Standard Deviation } s = \sqrt{\frac{\sum f(x-\bar{x})^2}{\sum f}}$$

Assumed Mean Method:

$$\text{Mean } (\bar{x}) = a + c \left(\frac{\sum f(d/c)}{\sum f} \right) \qquad \text{Standard Deviation } s = c \sqrt{\frac{\sum f(d/c)^2}{\sum f} - \left(\frac{\sum f(d/c)}{\sum f} \right)^2}$$

Standard Results of Differentiation

$y = f(x)$	$\frac{dy}{dx} = f'(x)$	
x^n	nx^{n-1}	
$\ln x$	$\frac{1}{x}$	
e^x	e^x	
e^{ax}	ae^{ax}	$a = \text{constant}$
$\sin x$	$\cos x$	
$\cos x$	$-\sin x$	
$\tan x$	$\sec^2 x$	
$u.v$	$u \frac{dv}{dx} + v \frac{du}{dx}$... Product Rule
$\frac{u}{v}$	$\frac{v \frac{du}{dx} - u \frac{dv}{dx}}{v^2}$... Quotient Rule