

**CORK INSTITUTE OF TECHNOLOGY
INSTITIÚID TEICNEOLAÍOCHTA CHORCAÍ**

Semester 2 Examinations 2009/10

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 – Year1

B.Sc in Analytical Chemistry & Quality Assurance – Year1

B.Sc in Nutrition & Health Science – Year 1

B.Sc in Pharmaceutical Biotechnology – Year 1

Programme Code:

SBIOS_7_Y1

SCHEM_7_Y1

SCHQA_8_Y1

SHNSC_8_Y1

SPHB_8_Y_1

External Examiner(s): Dr. Pádraig Kirwan

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

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

Duration: 2 Hours

Sitting: Summer 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.

Q1. Answer **each** of the following:

- (a) In a chemical reaction the amount of starting material (C) in cm^3 left after t minutes is given by $C = 50e^{-0.005t}$. Determine
- the amount of reactant present after 30 minutes and
 - the rate of change of reactant after 40 minutes.

(5 marks)

- (b) A prism has a square base of side x cm and a height of 8 cm. Find its volume V in terms of x . Find $\frac{dV}{dx}$. If x changes from 4 cm to 3.98 cm what is the % change in volume V ?

(5 marks)

- (c) Evaluate $\int_1^2 \frac{2x^3 - 5x^2 + 3x}{x^2} dx$

(5 marks)

- (d) The velocity v of a body t seconds after a certain instant is $(2t^2 + 5)\text{m sec}^{-1}$. Find by integration how far it moves in the interval from $t=1$ to $t=5$ s.

(5 marks)

- (e) The arithmetic mean of the results of an exam for fifty students is 57%. The top 12 students have a mean mark of 76%. Find the mean mark of the remaining students.

(5 marks)

- (f) A sample was analysed for calcium concentration and the results for the analyses were as follows: 7.6, 7.8, 7.8, 8.0 ppm. Calculate the standard deviation.

(5 marks)

Q2.(a) Differentiate $f(x) = x^2 - 5x + 6$ from first principles.

(7 marks)

(b) Differentiate each of the following by rule:

(i) $y = e^{3x} \cos 2x$

(ii) $y = \frac{x^2 + 3x}{2x + 3}$

(iii) $y = \sqrt{2x^3 - 4x^2 + 6x}$

(16 marks)

(c) Find the critical values on the curve $f(x) = 2x^3 - 15x^2 + 24x - 6$. Using the second derivative distinguish between the maximum value, minimum value and the point of inflexion. Sketch the curve.

(12 marks)

Q3.(a) Determine each of the following integrals:

(i) $\int_2^3 \left(\frac{1}{x^2} + 5 \right) (x-5) dx$

(ii) $\int_{1.5}^2 e^{7-4x} dx$

(iii) $\int_1^3 \frac{3-x}{6x-x^2} dx$

(21 marks)

(b) Fig.1. shows the graphs of $y_1 = \sin(x)$ and $y_2 = \cos(x)$ on the same axes.

(i) Show that y_1 and y_2 intersect at $x = \frac{\pi}{4}$.

(ii) Hence find the shaded area bounded by the two graphs.

(iii) What is the bounded area between the curves in the interval $x = \frac{\pi}{4}$ and $x = \frac{5\pi}{4}$?

(No further integration necessary)

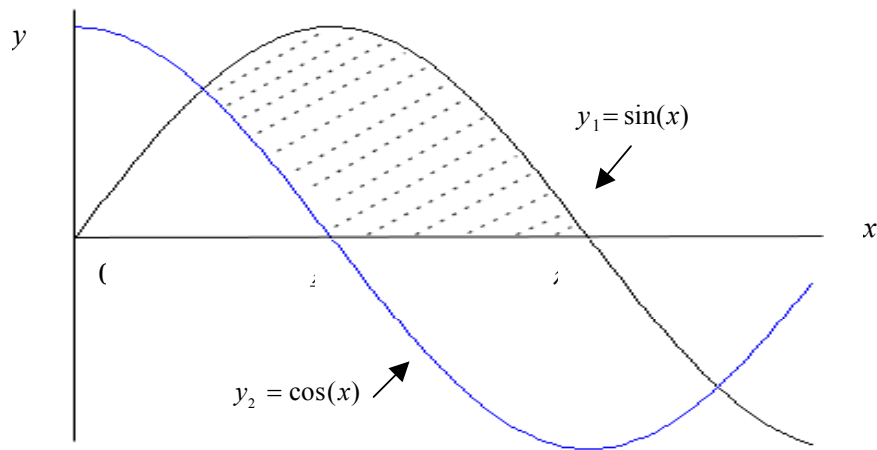


Fig.1.

(14 marks)

- Q4. Experiments to determine the concentration of potassium bromate in samples of wheat flours were carried out. The results for 45 such experiments are tabulated as follows:

Mass of potassium bromate (mg/kg flour)	No. of Samples
22.0 but less than 22.5	1
22.5 but less than 23.0	2
23.0 but less than 24.0	9
24.0 but less than 26.0	14
26.0 but less than 28.0	17
28.0 but less than 31.0	2

- (a) Calculate the mean mass of potassium bromate (\bar{x}) per sample and the standard deviation (s) from the mean.

(14 marks)

- (b) Prepare a cumulative frequency table and hence plot the corresponding cumulative frequency polygon. Use your graph to estimate:

- (i) the median value of the mass. How does this value compare with that of the mean value obtained in part (a)?

- (ii) the percentage of results falling in the range $(\bar{x} - s)$ to $(\bar{x} + s)$.

(15 marks)

- (c) Write notes on each of the following:

- (i) quartile values
(ii) skewed distribution

(6 marks)