

**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  $\text{cm}^3$  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)

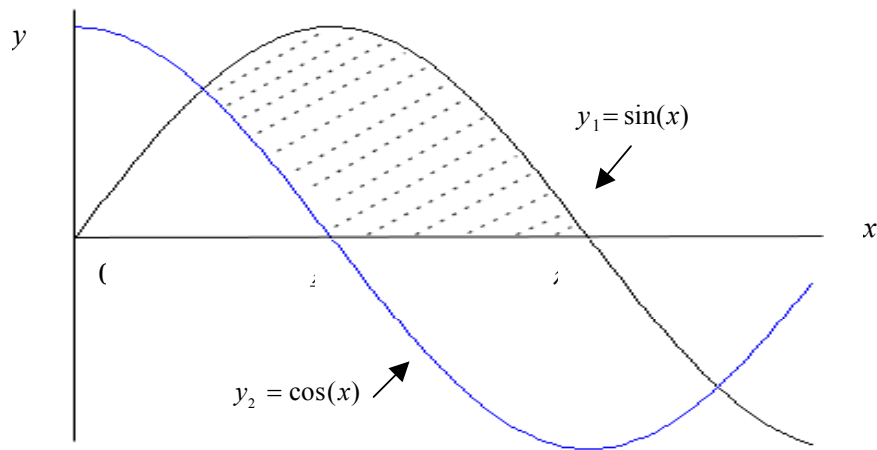


Fig.1.

(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)