

# Cork Institute of Technology

## Higher Certificate in Science in Applied Biology – Stage 1

(NFQ – Level 6)

Summer 2006

### Mathematics & Computing

(Time: 3 Hours)

#### Instructions

Answer **FIVE** questions.

Answer **FOUR** questions from Section A and  
**ONE** question from Section B.

Use separate answer books for each Section.

All questions carry equal marks.

Examiners: Dr. K. Murphy

Ms. I. Foley

Ms. H. Lordan

Mr. D. O'Shea

### Section A

Q1 (a) Using the laws of indices, simplify

(i) 
$$\frac{\sqrt{8x^2yz^5}}{(2xy)^2z^{-1}} \div \frac{3x}{2yz^2}.$$

(ii) 
$$\frac{128}{24^{n+1}} \times \frac{3^{-n}}{12^{2-n}}.$$
 (8 marks)

(b) Solve for  $x$ :

(i)  $\log(x-1) + \log(2x+3) = 1.$

(ii)  $3^{5x+1} = 7^{1-x}.$

(iii)  $\log_3 7 = x.$  (6 marks)

(c) (i) Transpose the formula  $V_0 = \frac{A}{\sqrt{1 - \frac{v^2}{k^2}}}$  to make  $k$  the subject.

(ii) Calculate the value of  $k$  when  $V_0 = 1.45 \times 10^4$ ,  $A = 4.92 \times 10^3$ ,  $v = 2.06 \times 10^{-3}$ .

(6 marks)

Q2. (a) By use of the remainder theorem, solve the equation

$$2x^3 - x^2 - 7x + 6 = 0. \quad (6 \text{ marks})$$

(b) Graph  $y = 3e^{0.2t}$  from  $t = 0$  to  $t = 3$  using intervals of 0.5. From the graph find

(i)  $t$  when  $y = 3.3$  and

(ii)  $y$  when  $t = 1.7$ . (6 marks)

(c) A chemical substance decays according to the law  $M = M_0 e^{-kt}$ .

$M$  is the mass present at any time  $t$  in minutes and  $M_0$  is the initial mass at  $t = 0$  and  $k$  is a constant. For a particular substance the mass present after 3.5 minutes is 7.84g and the mass present after 15 minutes is 2.74g. Calculate the constant  $k$ ,

(i) the initial mass  $M_0$  and

(ii) the mass present after one hour. (8 marks)

Q3. (a) Write each of the following in linear form where  $a$  and  $b$  are constants in all cases.

State what is to be plotted on each axis and what the constants represent.

(i)  $p = 8 + at^3 + bt^2$

(ii)  $h = ae^{bg}$

(iii)  $y = \frac{x}{a + bx}$  (9 marks)

(b) The following table gives values of  $p$  and  $q$  that are believed to be related by the law  $p = ab^q$ , where  $a$  and  $b$  are constants.

p	4.5	7.4	11.2	15.8	39	68
q	0.6	1.3	1.9	2.4	3.7	4.5

(i) Verify the law is as stated.

(ii) Find the approximate values for the constants  $a$  and  $b$ .

(iii) Hence state the law. (11 marks)

Q4. (a) Draw a rough sketch of each of the following, over one complete cycle.

(i)  $y = 4 \cos 3\theta$

(ii)  $y = 10 \sin(2\theta - 30^\circ)$  (6 marks)

(b) Solve the triangle abc given  $a = 8\text{m}$ ,  $b = 12$  and  $C = 100^\circ$ . (8 marks)

(c) Solve the equation:  $12\sin^2 A - \cos A - 6 = 0$ , for  $0^\circ \leq A \leq 360^\circ$ . (6 marks)

Q5. The following table gives data that was obtained during an experiment

x	0 - 4	5 - 9	10 - 14	15 - 19	20 - 24	25 - 29
f	1	14	23	21	15	6

(a) Taking the mid-interval values, calculate the mean ( $\bar{x}$ ) and standard deviation ( $\sigma$ ) from the mean. (8 marks)

(b) Represent information on a cumulative frequency table. Hence draw the cumulative frequency curve (ogive). (8 marks)

(c) From the ogive estimate the median, the upper quartile, the lower quartile and the inter-quartile range. (4 marks)

Q6. (a) Differentiate from first principles:  $y = x^2 - 4x + 5$ . (5 marks)

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

(i)  $\frac{2}{7x^4} - 5e^{3x} + \sqrt{x^3} + \ln 2x$

(ii)  $\frac{\sqrt{x^2 + 5}}{(3x^4 - 7)}$

(iii)  $e^{3x} \sin 4x$  (9 marks)

(c) A bacteria culture undergoes a period of growth and decay before it develops into a steady growth. If the number of bacteria  $y$  in the culture is given by  $y = 2t^3 - 9t^2 + 12t + 4$  with  $t$  in hours.

(i) Find the values of  $t$  for which the early maximum and minimum populations occur.

(ii) Calculate the populations at these two times. (6 marks)

Q7. (a) Determine each of the following integrals:

(i)  $\int (4x^{-5} + 3\sqrt{x} + \sin 5x - 6e^{-2x}) dx$

(ii)  $\int_2^4 (2x - 5)^2 dx$

(iii)  $\int \frac{4x^5 - x^7 + 2x^4}{x^6} dx$

(iv)  $\int_0^3 (3x^2 - 4x)^2 (6x - 4) dx$  (12 marks)

(b) Find the area enclosed by the curve  $y = 2x^2 - 3x$ , the  $x$ -axis and the ordinates  $x = 2$  and  $x = 5$ . Sketch the curve. (8 marks)

## Section B

### Answer Q8 or Q9

- Q8 (a) What is computer memory? What are RAM and ROM? Write a brief explanation of both and outline how they differ from each other. (8 marks)
- (b) Explain 3 of the following terms:  
Machine/ Processing Cycle;  
Solid State Storage;  
Instruction Set;  
Output Devices;  
Multitasking. (6 marks)
- (c) What is a hard disk? What do you look for when measuring the performance of a hard disk? (6 marks)
- Q9 (a) Describe a LAN network, include the different types of LANs and explain the Star topology (include a diagram). (8 marks)
- (b) Explain 3 of the following terms:  
Byte;  
Cold Boot;  
Software Upgrade;  
Protocols;  
Web Browser. (6 marks)
- (c) What is an operating system? What are the functions of an operating system? Give 3 examples of operating systems currently in use today. (6 marks)