

# Cork Institute of Technology

Higher Certificate in Science in Applied Biology – Stage 1

(National Certificate in Science in Applied Biology - Stage 1)

(NFQ – Level 6)

Summer 2005

## 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

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### Section A

Q1. (a) Using the laws of indices

(i) Simplify: 
$$\sqrt[3]{\frac{27a^5bc^{-8}}{64a^{-4}b^4c^4}}$$

(ii) Solve for  $x$ : 
$$9^{2x-3} = 3^{x+2} \times 27^{2-x}$$

(6 marks)

(b) Solve for  $x$  in each of the following:

(i)  $\log 5 + \log 72 - \log 40 = 2 \log x$

(ii)  $\log_4(2x+3) + \log_4(x-2) = 1$

(iii)  $3^{2x-1} = 2^{3x-2}$

(8 marks)

(c) Given the formula 
$$y = \sqrt{\frac{AK}{P} - \frac{B}{Q}}$$

(i) Make A the subject of this formula.

(ii) Evaluate  $y$  when  $A = 7.2 \times 10^{-1}$ ,  $K = 6.2 \times 10^{-1}$ ,  $P = 3 \times 10^{-3}$ ,  $B = 4.136 \times 10^1$

and  $Q = 4.8 \times 10^{-1}$ .

(6 marks)

Q2. (a) Draw graphs of  $Y_1 = 3e^{0.3x}$  and  $Y_2 = 5e^{-0.2x}$  on the same axes, for values of  $x$  between 0 and 3 using intervals of 0.5. Hence or otherwise solve the equation  $3e^{0.3x} = 5e^{-0.2x}$ .  
(8 marks)

(b) The size ( $N$ ) of a certain culture of bacteria after  $t$  days is given by  $N = Ae^{kt}$  where  $A$  and  $k$  are constants. If  $A = 580$  and  $k = 0.55$ , find:

- (i)  $N$  when  $t = 3$ ,
- (ii)  $t$  when  $N = 8,500$ .  
(7 marks)

(c) Solve for  $x$ :  $3e^x + e^{-x} - 3.5 = 0$ .  
(5 marks)

Q3. (a) Solve for  $x$  in the following cubic equation:

$$x^3 - 10x^2 + 17x + 28 = 0 \quad (6 \text{ marks})$$

(b) Solve for  $x$  and  $y$ :

$$\frac{3}{x} - \frac{2}{y} = 0$$

$$\frac{1}{x} + \frac{4}{y} = 14 \quad (6 \text{ marks})$$

(c) The height ( $S$ ) metres of an object fired vertically upwards from ground level at time ( $t$ ) seconds is given by  $S = 90t - 17t^2$

- (i) At what times will the object be 60m above ground level?
- (ii) After how many seconds will the object be back at ground level?
- (iii) What will be the maximum height reached by the object?

(8 marks)

Q4 (a) Write each of the following in linear form where  $a$  and  $b$  are constants in all cases:

(i)  $s = \sqrt{\frac{a}{t}} + b$

(ii)  $s = at^b$

(iii)  $s = 10 + at^2 + bt$

(9 marks)

(b) The mass ( $m$ ) of a substance is believed to dissolve in one litre of water at temperature ( $t^\circ C$ ) according to the law  $m = ae^{bt}$ .  $m$  was measured at various temperatures and the following results were obtained.

$t^\circ C$	30	40	50	60	80
$m$ (kg)	62.73	72.88	84.68	98.38	132.80

Write the equation in linear form. Plot a suitable graph to show that the law is true and find approximate values for constants  $a$  and  $b$ .

(11 marks)

Q5 (a) Convert (i)  $160^\circ$  to radians.

(ii) 4.2 radians to degrees and minutes.

(iii)  $\frac{2\pi}{3}$  radians to degrees.

(6 marks)

(b) Given side  $a = 3.8\text{m}$ , side  $b = 3.65\text{m}$  and angle  $A = 72^\circ$ , solve the triangle.

(8 marks)

(c) Solve the equation:  $4\sin(A - 30^\circ) = 3$  giving all solutions in the range  $0^\circ$  to  $360^\circ$ .

(6 marks)

Q6 The percentage carbon content of 30 samples of a powder are given in the following table:

% carbon	1.0-1.4	1.5-1.9	2.0-2.4	2.5-2.9	3.0-3.4	3.5-3.9
Number of samples	1	7	12	6	3	1

- (a) Taking the middle class value calculate the mean  $\bar{x}$  and the standard deviation  $\sigma$ . (8 marks)
- (b) Represent the information on a histogram. From the histogram read off the mode and the median. (8 marks)
- (c) Estimate the number of samples that have a carbon content greater than 2.3%. (4 marks)

Q7. (a) Differentiate from first principles

$$y = 3x^2 + 2x - 10 \quad (5 \text{ marks})$$

(b) Differentiate each of the following

(i)  $y = 10\sqrt{x} + 3 + 5e^{3x} + \cos 4x$

(ii)  $y = (8x - 3)^2 \ln(4x + 1)$

(iii)  $y = \frac{\sin 5x}{\sqrt{10x - 5}}$  (9 marks)

(c) The distance (  $S$  ) metres moved by an object in time (  $t$  ) seconds is given by

$$s = 2t^3 + 3t^2 - 6t + 2$$

- (i) Express the velocity and acceleration in terms of  $t$ .
- (ii) Find the velocity and acceleration initially.
- (iii) Find the velocity and acceleration after 5 seconds.

(6 marks)

Q8 (a) Determine each of the following integrals:

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

(ii)  $\int_0^2 (x - 3)^2 dx$

(iii)  $\int \frac{x^3 - 4x^2 + 2}{x} dx$

(iv)  $\int_1^2 (4x^2 - 3x)^3 (8x - 3) dx$  (12 marks)

- (b) Using integration find the area enclosed by the curve  $y = 9 - x^2$  and the  $x$ -axis. Sketch the curve. (8 marks)

## Section B

- Q9 (a) What is RAM? What is ROM? List the purposes of each? (8 marks)
- (b) Most software falls into one of three categories. Name and describe these three categories, and give an example of each. (6 marks)
- (c) What is an algorithm? Write an algorithm for posting a letter. (6 marks)
- Q10(a) Explain 4 of the following terms:
- Bit;
  - Internet;
  - LAN;
  - Peripheral
  - Software Compatibility
- (8 marks)
- (b) Given the URL **<http://www.irlgov.ie/aras/history.htm>** identify the different sections of the web address and explain what each section represents. (6 marks)
- (c) Give the advantages and disadvantages of electronic mail (e-mail) over traditional mail. (6 marks)