

Higher Certificate in Science in Applied Biology – Stage 1
(National Certificate in Science in Applied Biology – Stage 1)

(NFQ – Level 6)

Autumn 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

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Section A

Q1. (a) Using the laws of indices simplify :

(i) $\sqrt{\frac{49a^2b^{-1}c^4}{36a^{-2}b^5c^2}}$

(ii) $\frac{7^{2-x}21^{3x+1}}{49^{x+1}27^{x+2}}$ (6 marks)

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

(i) $\log(15x - 10) - \log(x + 2) = \log 25$

(ii) $\log_3(x + 2) + \log_3(3 - 2x) = 1$

(iii) $7^{2x+3} = 11^{x-1}$ (9 marks)

(c) Given the formula : $I = \frac{nE}{R + nr}$

(i) Make n the subject of this formula.

(ii) Evaluate I when $n = 6$, $E = 1.8$, $R = 2.4$, and $r = 0.5$.

(5 marks)

Q2. (a) Solve for x : $30 = 70(1 - e^{-0.48x})$ (4 marks)

(b) Graph the function $y = 8(1 - e^{-0.5x})$ for values of x between 0 and 7, using intervals of 1. Using the graph, find :

(i) y when $x = 4.7$

(ii) x when $y = 5.4$ (10 marks)

(c) Two quantities x and y are related by the equation $y = ae^{-kx}$, where a and k are constants. Given that $a = 1.7 \times 10^4$ and $k = 0.42$, find :

(iii) y when $x = 2.5$

(iv) x when $y = 12,000$. (6 marks)

Q3. (a) Solve for x and y :

$$\frac{x-1}{3} + \frac{y+2}{2} = 3$$

$$\frac{1-x}{6} + \frac{4-y}{2} = \frac{1}{2}$$

(6 marks)

(b) Solve for x :

$$8x^3 - 10x^2 - 11x - 2 = 0$$

(7 marks)

(c) A tennis court measures 24m by 11m. A path of constant width surrounds the court. If the total area of the tennis court and the path is $1,080 \text{ m}^2$, find the width of the path. (7 marks)

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

(i) $C = aN^3 + bN^2$

(ii) $R = aV^b$

(iii) $n = ae^{bt}$ (9 marks)

(b)	L	2.17	2.40	2.96	3.26	3.83
	T	3	3.7	5.6	6.8	9.4

These values obey a law of the form $T = aL^b$. Write the equation in linear form. Show by plotting $\log T$ against $\log L$ that the law is true and find approximate values for constants a and b . (11 marks)

Q5. (a) Solve the equation $10\sin^2 x + \sin x - 3 = 0$ for $0^\circ \leq x \leq 360^\circ$. (6 marks)

(b) Use the cosine rule to find the smallest angle in a triangle of sides 5cm, 6cm and 9 cm. (6 marks)

(c) Sketch the curve $y = 5\sin(2x + 30^\circ)$ for values of x from 0° to 360° . Indicate the amplitude, frequency and phase angle. Take particular care at $x = 0^\circ$. (8 marks)

Q6. The heights of 30 students were recorded to the nearest cm and recorded as follows:

Height (cm)	166-170	171-175	176-180	181-185	186-190	191-195
Number of Students	2	7	8	5	4	3

(a) Taking the mid-interval value calculate the mean (\bar{x}) and standard deviation (σ) from the mean. (8 marks)

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

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

Q7. (a) Differentiate from first principles

$$y = 2x^2 - 5x + 1$$

(5 marks)

(b) Differentiate each of the following

$$(i) \quad y = \frac{x^4}{2} + \frac{4}{5x^2} + 4\sqrt{x} + \sin 10x$$

$$(ii) \quad y = 5 \cos(3x + 2) \ln(4x^2 + 3)$$

$$(iii) \quad y = \frac{(x^2 - 5x + 2)^2}{5e^{4x}}$$

(9 marks)

(c) Test the following function for critical points (maximum, minimum and point of inflexion): $y = x^3 - 10x^2 + 17x + 28$

(6 marks)

Q8 (a) Determine each of the following:

$$(i) \quad \int (4x^7 - \frac{5}{2x^3} - 17\sqrt{x} + 10e^x) dx$$

$$(ii) \quad \int_0^{\pi} \cos 5x dx$$

$$(iii) \quad \int_0^2 (4x - 10)^2 dx$$

$$(iv) \quad \int (2x^2 + 3)^2 4x dx$$

(14 marks)

(b) If $\frac{dy}{dx} = 4x^3 + 2x + 7$ find y in terms of x given that $x = 0, \quad y = 8$.

(6 marks)

Section B

- Q9 (a) What is a CPU? What are the functions the CPU performs in a computer?
(8 marks)
- (b) Explain 3 of the following terms:
Algorithm;
ASCII;
Byte;
RAM.
(6 marks)
- (c) Computer peripherals include both input and output devices. Give examples of input and output devices and how they are used.
(6 marks)
- Q10(a) System Software is one of the three fundamental categories of computer software. The system software on a computer includes the operating system and utility programs. List the functions of both the operating system and utility programs.
(8 marks)
- (b) Explain 3 of the following terms:
Gigabyte;
LAN;
Software Compatibility;
URL.
(6 marks)
- (c) Give the advantages and disadvantages of electronic mail (e-mail) over traditional mail.
(6 marks)