

UNIVERSITY OF BOLTON

**SCHOOL OF THE BUILT ENVIRONMENT &
ENGINEERING**

BSc (HONS) in CIVIL ENGINEERING

**SEMESTER ONE
EXAMINATION 2008/2009**

MATHEMATICS

MODULE NO: BLT1009

Date: Wednesday 21 January 2009

Time: 2.00 pm – 4.00 pm

INSTRUCTIONS TO CANDIDATES:

There are FOUR questions.

Answer ANY THREE questions.

All questions carry a Total of 20 marks.

Marks for parts of questions are shown in brackets.

This examination paper carries a maximum total of 60 marks.

All working must be shown. A numerical solution to a question obtained by programming an electronic calculator will not be accepted.

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1. a) Transpose the following formulae for "p".

i) $d = \sqrt[5]{\frac{2p^2}{5mn}}$ (2 marks)

ii) $s = \frac{2t^2}{3p^2 - 1}$ (3 marks)

b) Solve the following quadratic equations:

i) $x^2 + 4x - 21 = 0$ By factorisation (3 marks)

ii) $2x^2 - 7x + 6 = 0$ By factorisation (3 marks)

iii) $5x^2 - 7x - 3 = 0$ By formula (3 marks)

c) Separate the following into partial fractions:

$$\frac{5x + 6}{3x^2 + 4x - 4} \quad (6 \text{ marks})$$

Total 20 marks

2. a) Find the first and second derivatives of the following functions:

i) $y = 2\sqrt[3]{x^5} + \frac{3}{x^2}$ (3 marks)

ii) $y = 3e^{-4x} + 2 \cos 3x$ (3 marks)

b) Differentiate the following functions to find dy/dx:

i) $y = 5e^{2x} \sin 2x$ using the "product rule" (3 marks)

ii) $y = \frac{x^3 - 1}{\ln x}$ using the "quotient rule" (3 marks)

iii) $y = \sin(3x + 2)$ using the "function of a function rule" (3 marks)

c) Find the coordinates of the maximum and minimum points for the function $y = 4x^3 - 33x^2 + 72x - 30$ (5 marks)

Total 20 marks
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3. a) Evaluate the following definite integrals:

i) $\int_3^4 (x^3 + 4x^2) dx$ (3 marks)

ii) $\int_{-1}^2 \left(x^2 + \frac{2}{x^2} \right) dx$ (3 marks)

iii) $\int_{\pi/4}^{\pi/3} (\sin 2t + \cos 3t) dt$ (4 marks)

b) Integrate the following expressions using simple algebraic substitution:

i) $\int (6x + 3)^4 dx$ (3 marks)

ii) $\int 10x^3 (6x^4 + 3)^3 dx$ (3 marks)

c) Find the area enclosed by the x axis from $x = -3$ to $x = 4$ and the curve $y = x^2 - x - 12$. (4 marks)

Total 20 marks

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4. a) Solve the following simultaneous equations

i) $6a + b = 4$
 $3a + 2b = -1$ (2 marks)

ii) $5x - 4y = 23$
 $9x + 7y = 84$ (3 marks)

b) Use Pascal's triangle to expand the following:

i) $(x - 2)^3$ (2 marks)

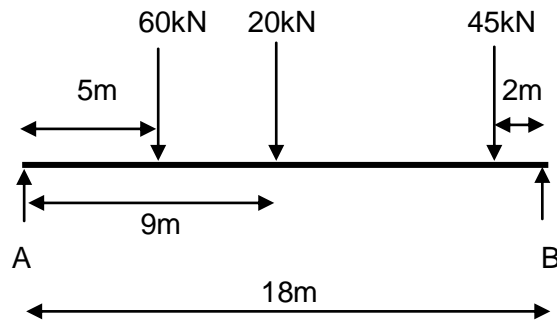
ii) $(3x + 5)^4$ (3 marks)

c) Expand each of the following using the binomial theorem:

i) $(1 - x)^4$ (3 marks)

ii) $(5 + 2x)^3$ (3 marks)

d) For the simply supported beam shown below determine the reactions at the supports A and B.



(4 marks)

Total 20 marks

END OF QUESTIONS

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Formula sheet

$y = f(x)$	$\frac{dy}{dx}$
Constant (k)	0
x	1
x^2	$2x$
x^n	nx^{n-1}
e^x	e^x
e^{kx}	ke^{kx}
$\sin x$	$\cos x$
$\cos x$	$-\sin x$
$\sin kx$	$k \cos kx$
$\cos kx$	$-k \sin kx$
$\tan kx$	$k \cdot \sec^2 kx$
$\ln kx$	$\frac{1}{x}$

$y = f(x)$	$\int y \, dx$ all '+c'
$2x$	x^2
x	$\frac{1}{2} x^2$
k (constant)	kx
x^n ($n \neq -1$)	$\frac{1}{n+1} x^{n+1}$
$\frac{1}{x}$	$\ln x$
e^x	e^x
e^{kx}	$\frac{e^{kx}}{k}$
$\sin x$	$-\cos x$
$\cos x$	$\sin x$
$\sin kx$	$-\frac{\cos kx}{k}$
$\cos kx$	$\frac{\sin kx}{k}$

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Formula Sheet (continued)

Coefficients in the Binomial expansion													
							1						
						1		1					
					1		2		1				
			1		3		3		1				
			1		4		6		4		1		
		1		5		10		10		5		1	
	1		6		15		20		15		6		1

$$(a + b)^n = a^n + na^{n-1}b + \frac{n(n-1)}{2!} a^{n-2}b^2 + \frac{n(n-1)(n-2)}{3!} a^{n-3}b^3 + \dots + b^n$$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$\text{If } y = u.v \text{ then } \frac{dy}{dx} = v \frac{du}{dx} + u \frac{dv}{dx}$$

$$\text{If } y = \frac{u}{v} \text{ then } \frac{dy}{dx} = \frac{v \frac{du}{dx} - u \frac{dv}{dx}}{v^2}$$

$$\text{If } y \text{ is a function of } u, \text{ and } u \text{ is a function of } x \text{ then } \frac{dy}{dx} = \frac{dy}{du} \cdot \frac{du}{dx}$$