

UNIVERSITY OF BOLTON

**SCHOOL OF THE BUILT ENVIRONMENT &
ENGINEERING – RAK CAMPUS**

BSc (HONS) CIVIL ENGINEERING

SEMESTER ONE EXAMINATION 2009/2010

MATHEMATICS A

MODULE NO: BLT1009

Date: Thursday 21 January 2010

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 "a".

i) $M = 3 \sqrt[3]{\frac{a^2}{ch}}$ (2 marks)

ii) $y = \frac{bd}{1+a^3}$ (3 marks)

b) Solve the following quadratic equations:

i) $x^2 + x - 30 = 0$ By factorisation (3 marks)

ii) $5x^2 + 7x - 6 = 0$ By factorisation (3 marks)

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

c) Separate the following into partial fractions:

$\frac{x+1}{x^2-8x+15}$ (6 marks)

Total 20 marks

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

i) $y = 5 \sqrt[4]{x^3} + \frac{2}{x^3}$ (3 marks)

ii) $y = 5 \sin 3x - 2e^{-3x}$ (3 marks)

b) Differentiate the following functions to find $\frac{dy}{dx}$

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

ii) $y = \frac{3x}{x+2}$ using the "quotient rule" (3 marks)

iii) $y = \ln(3x+4)$ using the "function of a function rule": (3 marks)

Question 2 continued over the page...

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Question 2 continued

- c) Find the maximum and minimum points of the following function:

$$y = 2x^3 - 8x^2 + 10x - 3 \quad (5 \text{ marks})$$

Total 20 marks

3. a) Find the following definite integrals:

i) $\int_1^4 (x^3 - 3x^2) dx \quad (3 \text{ marks})$

ii) $\int_1^2 \left(\frac{2}{x} - \frac{3}{x^2} \right) dx \quad (4 \text{ marks})$

iii) $\int_{\pi/3}^{2\pi/3} (\sin 2\theta + 2\cos 4\theta) d\theta \quad (4 \text{ marks})$

- b) Integrate the following expressions using simple algebraic substitution:

i) $\int 16e^{x+3} dx \quad (3 \text{ marks})$

ii) $\int \cos\left(3\theta - \frac{\pi}{6}\right) dx \quad (3 \text{ marks})$

- c) Find the area enclosed by the x axis from $x = -2$ to $x = 4$ and the curve $y = x^2 - 2x - 8$.
 (3 marks)

Total 20 marks

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4. a) Solve the following simultaneous equations:

i) $x - 3y = 11$
 $3x + y = 13$ (2 marks)

ii) $3x + 2y = 17$
 $2x + 5y = 26$ (3 marks)

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

i) $(x - 3)^4$ (2 marks)

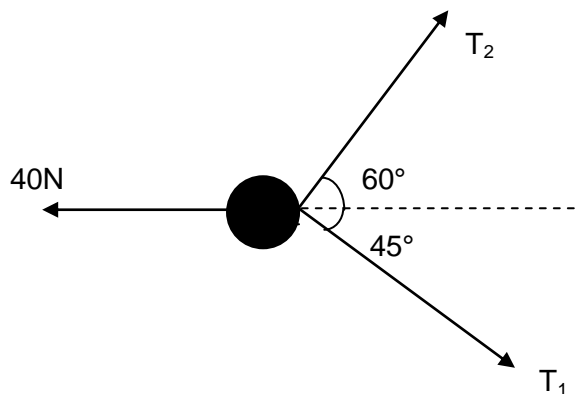
ii) $(2x + 5)^5$ (3 marks)

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

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

ii) $(4 - 3x)^3$ (3 marks)

d) Calculate the tension (T_1 and T_2) in the strings holding the sphere shown below assuming it is in equilibrium.



(4 marks)

Total 20 marks

END OF QUESTIONS

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Formula sheet (1 of 2)

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

$f(x)$	$\int f(x) dx$ all '+c'
2x	x^2
x	$\frac{1}{2} x^2$
k (constant)	kx
x^n	$\frac{1}{n+1} x^{n+1}$
$\frac{1}{x}$	$\ln x$
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 (2 of 2)

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

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

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

If y is a function of u , where u is a function of x , then $\frac{dy}{dx} = \frac{dy}{du} * \frac{du}{dx}$

Coefficients in the 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

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