UNIVERSITY OF BOLTON

SCHOOL OF THE BUILT ENVIRONMENT & ENGINEERING

BSc (HONS) CIVIL ENGINEERING

SEMESTER ONE EXAMINATION 2009/2010

MATHEMATICS A

MODULE NO: BLT1009

Date: Thursday 21 January 2010 **Time: 10.00 am – 12.00 noon**

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.

School of the Built Environment & Engineering
BSc (Hons) Civil Engineering
Semester One Examination 2009/2010
Mathematics A
Module No. BLT1009

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

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

ii) $y = \dfrac{b\,d}{1 + a^3}$ (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:

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

Total 20 marks

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

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

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

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

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

ii) $y = \dfrac{3x}{x + 2}$ 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…

Question 2 continued

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

$y = 2x^3 - 8x^2 + 10x - 3$ (5 marks)

Total 20 marks

3. a) Find the following definite integrals:

i) $\int_1^4 (2x^3 - 3x^2)\,dx$ (3 marks)

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

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

b) Integrate the following expressions using simple algebraic substitution:

i) $\int 16(2x+3)^7\,dx$ (3 marks)

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

Please turn the page

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)

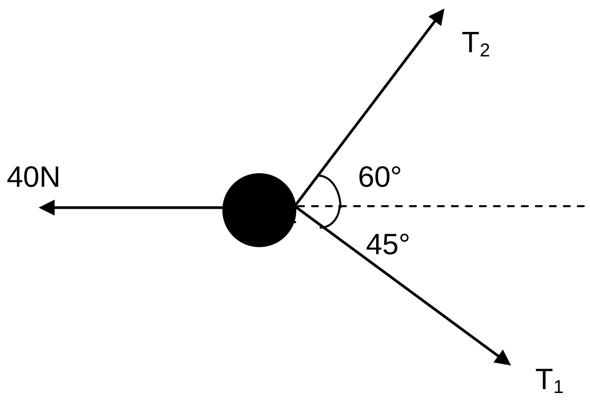
ii) $(2x + 5)^5$ (3 marks)

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

School of the Built Environment & Engineering
BSc (Hons) Civil Engineering
Semester One Examination 2009/2010
Mathematics A
Module No. BLT1009

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)	$k x$
x^n	$\frac{1}{n+1} x^{n+1}$
$\frac{1}{x}$	$\ln x$
e^x	e^x
e^{kx}	$\frac{e^{kx}}{k}$
$\sin x$	$-\cos x$
$\cos x$	$\sin x$
$\sin kx$	$-\frac{\cos kx}{k}$
$\cos kx$	$\frac{\sin kx}{k}$

Please turn the page

School of the Built Environment & Engineering
BSc (Hons) Civil Engineering
Semester One Examination 2009/2010
Mathematics A
Module No. BLT1009

Formula sheet (2 of 2)

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

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

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

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

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	

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