

## Math 202 - Exam 2 (Spring 09)

T. Tlas

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- Please answer question 3 on the same sheet of paper on which it is written. Questions 1 and 2 have an extra sheet for you to write your answer on it. Any part of your answer written on the wrong page will not be graded.
  - When finished leave your work on your desk for it to be collected by the proctors.
  - There are 3 problems in total. The first question has several parts. Make sure that you attempt them all.
  - This is a closed book exam and no calculators are allowed.

...Together At Work

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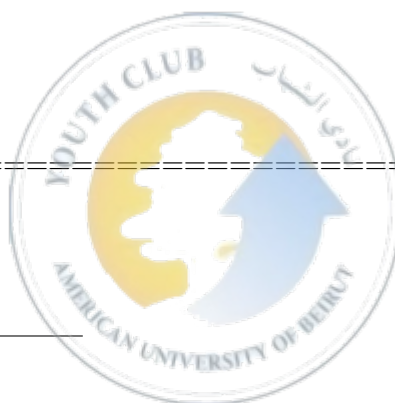
Name :

ID # :

Section Number :



"Providing AUB Students with a Quarter Campus Life"



Q1	
Q2	
Q3	
TOTAL	

### Problem 1

(15 points each) Solve the following IVPs:

i-

$$y''' - 3y'' + 2y' - e^x = 0 \quad ; \quad y(0) = 0 \quad , \quad y'(0) = 0 \quad , \quad y''(0) = 0$$

ii-

$$x^2 y'' + xy' + y = 0 \quad ; \quad y(1) = 0 \quad , \quad y'(1) = 1$$

iii-

$$y'' - 2y' + y - \frac{e^x}{1+x^2} = 0 \quad ; \quad y(0) = 0 \quad , \quad y'(0) = 0$$

iv-

$$y'' - e^{x-y'} = 0 \quad ; \quad y(0) = 1 \quad , \quad y'(0) = 0$$

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ADDITIONAL SHEET FOR PROBLEM 1 ANSWER



### Problem 2

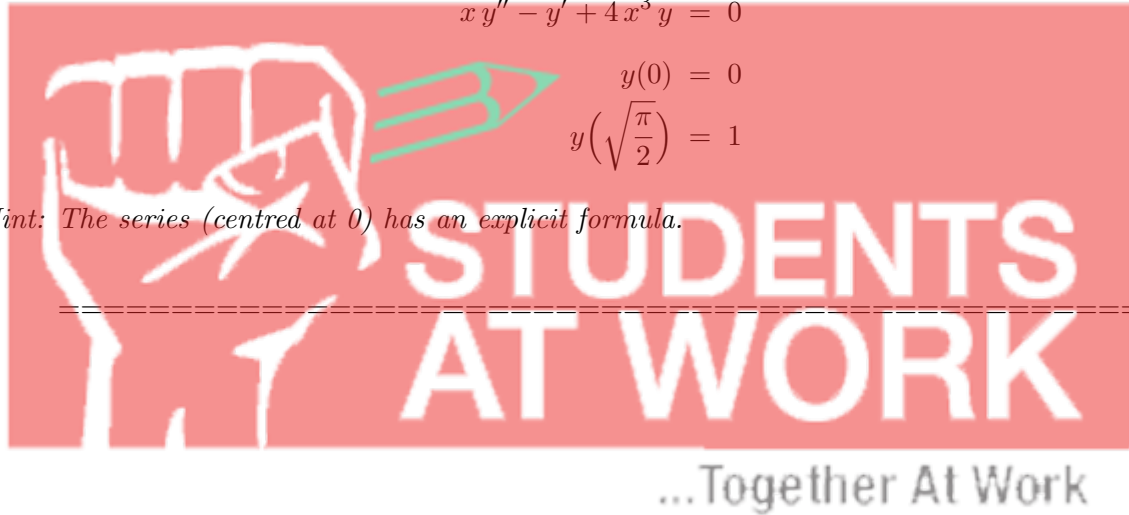
(30 points) Solve the following BVP:

$$x y'' - y' + 4x^3 y = 0$$

$$y(0) = 0$$

$$y\left(\sqrt{\frac{\pi}{2}}\right) = 1$$

*Hint: The series (centred at 0) has an explicit formula.*



ADDITIONAL SHEET FOR PROBLEM 2 ANSWER



### **Problem 3**

(10 points) Show that

$$\frac{2\nu}{x} J_\nu(x) = J_{\nu-1}(x) + J_{\nu+1}(x),$$

where  $J_\nu(x)$  is the Bessel function of the first kind of order  $\nu$  and is given by the following series

$$J_\nu(x) = \sum_{n=0}^{\infty} \frac{(-1)^n}{n! \Gamma(1 + \nu + n)} \left(\frac{x}{2}\right)^{2n+\nu}$$

