

40 pts. **Problem 1.** Solve the following initial value problem:

$$\frac{dy}{dx} = y^2 x^3, \quad y = 2 \text{ when } x = 1.$$

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40 pts. **Problem 2.** Find the general solution of the first order linear equation

$$\frac{dy}{dx} + \frac{3}{x}y = x^2.$$

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40 pts. **Problem 3.** A cup of coffee at a temperature of  $90^\circ$  Celsius is brought into a room with a temperature of  $20^\circ$ . After 5 minutes the temperature of the coffee is  $80^\circ$ . Use Newton's law of cooling

$$\frac{dT}{dt} = -k(T - T_m), \quad k > 0.$$

to find the temperature of the coffee as a function of time. How long will it take the coffee to reach a temperature of  $22^\circ$ ?

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40 pts. **Problem 4.** In each part, find the general solution of the differential equation.

A.  $(D - 1)(D - 2)^2(D - 3)^3y = 0$

B.  $(D - 4D + 13)^2y = 0$

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40 pts. **Problem 5.** In each part, **use the method of undetermined coefficients** to find the general solution of the differential equation.

A.  $(D^2 - 3D + 2)y = x$

B.  $(D^2 - 3D + 2)y = e^x$ .

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40 pts. **Problem 6.** Use the **method of variation of parameters** to find the general solution of the equation

$$(D^2 - 2D + 1)y = \frac{e^x}{x}.$$

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# EXAM

Exam 2

Math 3322, Fall 2006

November 9, 2006

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- Write all of your answers on separate sheets of paper. You can keep the exam questions when you leave. You may leave when finished.
- You **must** show enough work to justify your answers. Unless otherwise instructed, give exact answers, not approximations (e.g.,  $\sqrt{2}$ , not 1.414).
- This exam has 6 problems. There are **240 points total**.

Good luck!