

ID#: _____

Name: _____

Multiple Choice Questions

Mark your answers *on the official answer sheet on the last page* and ***detach it***. It will be collected *after 60 minutes*.

1. Consider the linear differential equation

$$xy' + (x + 1)y = 3x^2e^{-x}.$$

One possible integrating factor for the equation is

- (a) xe^x
- (b) e^x
- (c) $x + \ln|x|$
- (d) None of these.

2. For which value of k is the differential equation

$$(x^k + y^k)dx + 2xydy = 0$$

of the type $dy/dx = F(y/x)$ (homogeneous)?

- (a) $k = 0$
- (b) $k = 1$
- (c) $k = 1/2$.
- (d) None of these.

3. Consider the non-homogeneous linear equation $\frac{d^2y}{dx^2} + 3\frac{dy}{dx} + y = x^{-2}e^x$. A particular solution to this equation can be obtained:

- (a) only by the method of undetermined coefficients;
- (b) only by the method of variation of parameters;
- (c) by both, the method of undetermined coefficients, and method of variation of parameters;
- (d) by neither of these methods.

4. The mass-spring system described by

$$y'' + by + 4y = 0, \quad y(0) = 1, y'(0) = 0$$

is in the state of *underdamped* motion if

- (a) $b > 4$
 - (b) $0 < b < 4$
 - (c) $b = 4$
 - (d) None of these.
5. The minimum value of the radius of convergence of a power series solution about $x_0 = 1$ for the equation

$$(1 + x^3)y'' + (1 + x)y = 0$$

is

- (a) 0
- (b) $1/2$
- (c) 1
- (d) 2.
- (d) ∞ .

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Long Answer Questions***You must show all your work.***

6. Solve the initial-value problem:

$$y^{-3}dy - (y^{-2} + e^{2x})dx = 0, \quad y(0) = 1.$$

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7. Find the general solution to the equation

$$y'' + 2y' + y = e^{-x} \ln(x^n), \quad n \text{ being a real number, } x > 0.$$

8. Find the first three nonzero coefficients of the power series expansion about $x_0 = 0$ for the solution of the initial value problem

20
marks

$$5y'' - (x - 1)y' = x^2 + x, \quad y(0) = 1, \quad y'(0) = 0.$$