

Name: _____ key _____

Show all work clearly and in order. Please box your answers. 10 minutes.

1. Fill in the following table with the missing classification information:

DE	order	linear/nonlinear
$4xy''' + 2xy' - y = 0$	3	linear
$\left(\frac{d^5 y}{dx^5}\right)^2 + \left(\frac{y}{x}\right) = \sin(x)$	5	nonlinear
$\sin(x)y^{(4)} + \ln(x)y' = \cos(x)$	4	linear

2. Verify that
- $y = \cos(4x)$
- is a solution to the differential equation
- $y'' + 16y = 0$
- .

$$y' = -4\sin(4x)$$

$$y'' = -16\cos(4x)$$

$$\text{LHS} = y'' + 16y$$

$$= -16\cos(4x) + 16(\cos(4x))$$

$$= 0$$

$$= \text{RHS} \quad \checkmark$$

3. Find the value(s) of
- m
- so that
- $y = e^{mx}$
- is a solution to the differential equation
- $3y' + 5y = 0$
- .

$$y' = me^{mx}$$

$$3y' + 5y = 0 \quad \text{becomes}$$

$$3me^{mx} + 5e^{mx} = 0$$

$$e^{mx}(3m + 5) = 0$$

$$e^{mx} \neq 0, \text{ so } 3m + 5 = 0 \Rightarrow \boxed{m = -\frac{5}{3}}$$