**1.** (1 point)

B [?] 1. Which differential equation below is in normal form?

A [?] 2. Which differential equation below is in differential form?

A. $(y+\sin(\theta))\,dy+y\theta\,d\theta=0$ ← Differential form

B. $y'''=ty''-t^3y'+y$ ← Normal form

*Answer(s) submitted:*

-
-

(incorrect)

1 "Multiplying" by $dx$

Differential Form

- We don't deal with this form too much
- Nice that it does not have a $\frac{dy}{dx}$

$2x\,dx+y\,dx+3x\,dy+4\,dx=0$

equivalent $\Leftrightarrow$

$(2x+y+4)dx+3x\,dy=0$

2 Solve for $\frac{dy}{dx}$

Normal Form

Bring everything on the right-hand side and divide by 3x

$\frac{dy}{dx}=-\frac{1}{3x}(2x+y+4)$

equivalent $\Leftrightarrow$

$\frac{dy}{dx}=-\frac{(2x+y+4)}{3x}$

**2.** (1 point)

Determine the order of the given differential equation and state whether the equation is linear or nonlinear.

$$(\sin\theta)y^{(7)}-(\cos\theta)y'=7$$

(a) The order of this differential equation is 7.

(b) The equation is [Choose/Linear/Nonlinear].

*Answer(s) submitted:* No powers greater than one, so this is a linear equation

-
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(incorrect)

**3.** (1 point)

Determine the order of the given differential equation and state whether the equation is linear or nonlinear.

$$\frac{d^4u}{dr^4}+\frac{du}{dr}+6u=\cos(r+u)$$

(a) The order of this differential equation is 4.

(b) The equation is [Choose/Linear/Nonlinear].

*Answer(s) submitted:* A power greater than one makes the equation non-linear.

-
-

(incorrect)

**Q4** Which of the following functions satisfies the differential equation $(x+1)y'-y+2\ln(1+x)=3$?

- A. $y=\ln(x+x^2)$
- B. $y=e^x$
- C. $y=x+2\ln(1+x)$

*Answer(s) submitted:*

- C

**Q5** Note that $\phi(x)=\ln(1+2x)$ satisfies the differential equation $(2x+1)\ln(1+2x)y'-2y=0$. On what interval is $\phi$ a solution for this differential equation?

- A. $(-\infty,\infty)$
- B. $(-1,\infty)$
- C. $(-\frac{1}{2},\infty)$
- D. $[-1,\infty)$
- E. $[-\frac{1}{2},\infty)$

*Answer(s) submitted:*

- C

(incorrect)

**6.** (1 point)

A [?] 1. Which statement of sets below best describes the domain of the function $f(x)=\frac{1}{1-x}$?

Q6

B ? 2. Which statement of sets below best describes the interval on which the function $f(x) = \frac{1}{1-x}$ is a solution to the differential equation $y' = y^2$?

A. $(-\infty, 1)$ or $(1, \infty)$ $1)\ f(x) = \frac{1}{1-x}$

B. $(-\infty, 1)$ and $(1, \infty)$ $2)\ f(x) = \frac{1}{1-x}$ is a solution to the differential equation $y' = y^2$

*Answer(s) submitted:*

- 
- 

(incorrect)

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Q7 The function $y = c_1 e^{3x} + c_2 x e^{3x}$ is a two-parameter family of solutions for which of the following differential equations?

A

- A. $y'' - 6y' + 9y = 0$
- B. $y' = y$
- C. $y'' + 6y' - 9y = 0$

*Answer(s) submitted:*

- 

(incorrect)

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**8.** (1 point)

Find the value $k$ such that $y = e^{kx}$ is a solution to the differential equation $7y' + 4y = 0$.

The value is $k = \underline{-4/7}$

*Answer(s) submitted:*

- 

(incorrect)

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**9.** (1 point) Find the two values of $k$ such that $y = x^k$ is a solution to the differential equation $xy'' + 9y' = 0$. The values are $k = \underline{0}$ and $k = \underline{\quad}$.

$y = x^k,\ y' = kx^k,\ y'' = k^2x^k$

$xy'' + 9y' = 0$

$\rightarrow \frac{x(k^2x^k)}{x^k} + \frac{9(kx^k)}{x^k} = \frac{0}{x^k}$

$\rightarrow x(k^2) + 9(k) = 0$

$xk + 9$

$xk$

*Answer(s) submitted:*

- 
- 

(incorrect)

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**10.** (1 point) Find the two values of $k$ such that the constant function $y = k$ is a solution to the differential equation $y' = y^2 - 10y + 21$. The values are $k = \underline{\quad}$ and $k = \underline{\quad}$.

*Answer(s) submitted:*

- 
- 

(incorrect)

$y = k,\ y' = 0$

$y' = k^2 - 10k + 21$

$0 = k^2 - 10k + 21$

*rewritten*

$k^2 - 10k + 21 = 0$

$(k-7)(k-3) = 0$

$\therefore k = 3, 7$

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**11.** (1 point) Find the two values of $k$ such that $y = x^k$ is a solution to the differential equation $xy'' + 9y' = 0$. The values are $k = \underline{\quad}$ and $k = \underline{\quad}$.

$y = x^k,\ y' = kx^k,\ y'' = k^2x^k$

$x(k^2x^k) + 9(kx^k) = 0$

*Answer(s) submitted:*

- 
- 

(incorrect)

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**12.** (1 point)

Let $y' = 2x$.

Find all values of $r$ such that $y = rx^2$ satisfies the differential equation. If there is more than one correct answer, enter your answers as a comma separated list.

$r = \underline{1}$ help (numbers)

*Answer(s) submitted:*

- 

(incorrect)

Let $y' = 2x$

$y = rx^2$

*Find $y'$ using power rule as*

$y' = \frac{d}{dx}(rx^2)$

$\rightarrow r\frac{d}{dx}(x^2)$

$\rightarrow r(2x)$

$\rightarrow 2rx$

* Plug-in $y' = 2rx$ in given differental equation $y' = 2x$ to obtain *

$2rx = 2x$

$\therefore r = 1$ ■



$y = e^{kx},\ y' = ke^{kx}$

$7y' + 4y = 0$

$7y' + 4y = 0 \Rightarrow 7(ke^{kx}) + 4(e^{kx}) = 0$

$\Rightarrow 7k7e^{kx} + 4e^{kx} = 0$

$\Rightarrow \frac{7k7e^{kx}}{e^{kx}} + \frac{4e^{kx}}{e^{kx}} = \frac{0}{e^{kx}}$

$\Rightarrow 7k + 4 = 0$

$\Rightarrow 7k = -4$

$\therefore k = -4/7$ ■

SUBJECT: DATE: / / PAGE NO:

$y=x^K$, $y'=Kx^K$, $y''=K^2x^K$

$y'=Kx^{K-1}$, $y''=K(K-1)x^{K-2}$

$y''=Kx^{K-2}(K-1)$

$xy''+9y'=0$

*Solve the characteristic equation*

$xy''+9y'=0$

$\to x(K^2x^K)+9(Kx^K)=0$

$\to K^2x^{2K}+9(Kx^K)=0$

$u^2+9=0$