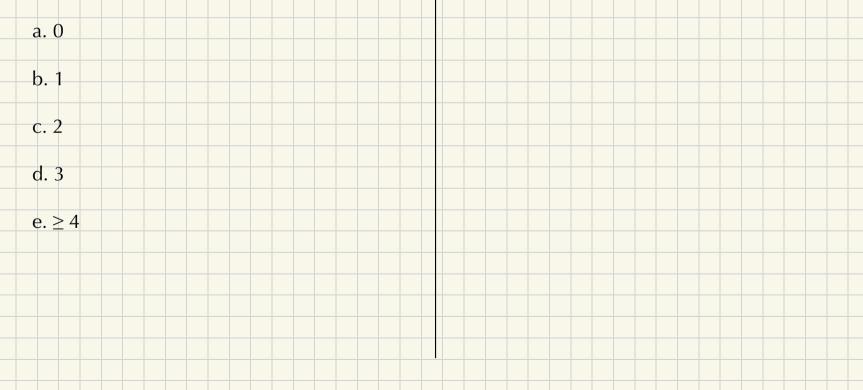
# Ore-class Warm-up!!!

How many methods have we learned so far to solve differential equations?



## Section 1.6: Substitution methods and exact

equations

- We learn to recognize several kinds of differential equation:
- homogeneous equations
- Bernoulli equations
- Equations where some special substitution works
- Higher order equations where the order can be reduced
- Exact equations

The first 4 of these can be dealt with by introducing a new variable v dependent on both y and x: v = g(x,y), where we can also write y = h(x,v). We then get dy/dx in terms of dv/dx.

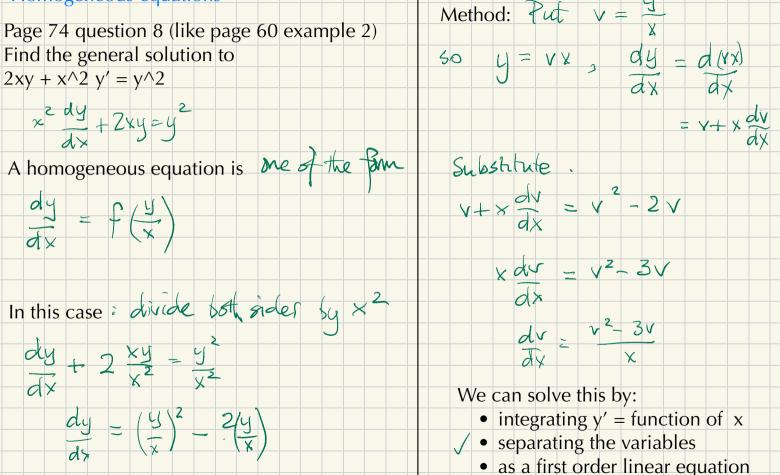
Exact equations are different!

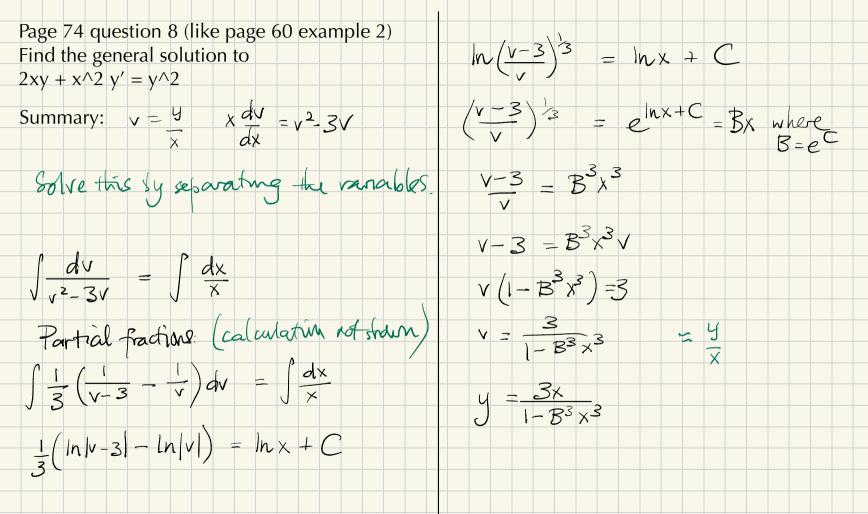
### Compare the methods we already learned:

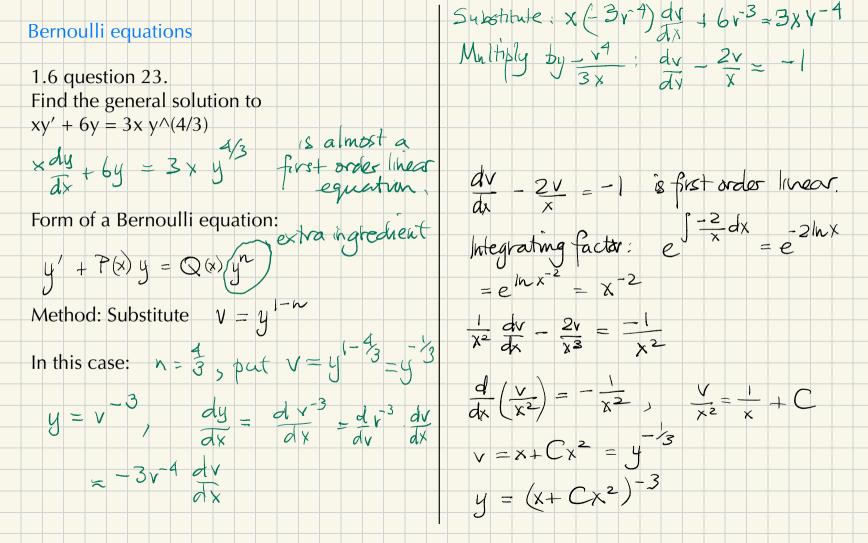
- y' = function of x
- separate the variables
- first order linear equations

subsitutute v=g(x,y)

#### Homogeneous equations







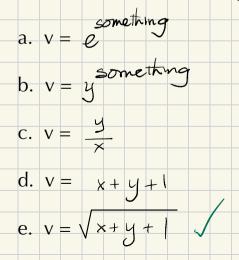
#### Special substitutions

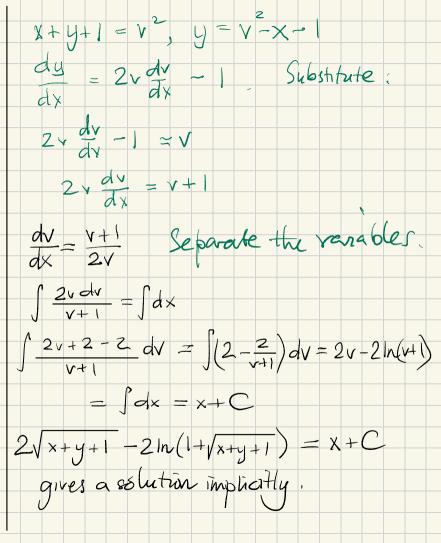
Questions from Section 1.6: solve the equations

16.  $y' = \sqrt{(x+y+1)}$ 

28.  $x e^{y} y' = 2(e^{y} + x^{3} e^{2x})$ 

Solution to 16. We are going to make a substitution v = something. What should it be?

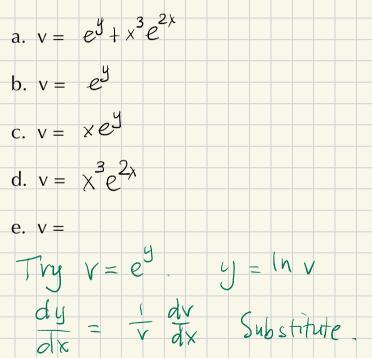




Questions from Section 1.6: solve the equation

28. 
$$x e^{y} q' = 2 \left( e^{y} + x^{3} e^{2x} \right)$$

What substitution should we make?



 $XV - \frac{1}{\sqrt{dx}} = 2\left(v + x^3 e^{2x}\right)$  $= 2 (V + x^2 e^{2x})$ dv dx

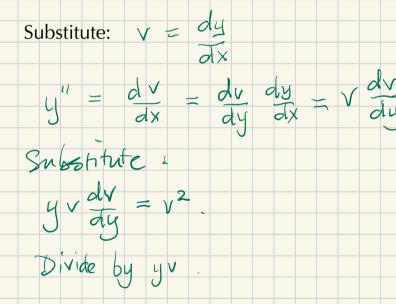
 $\frac{2v}{x} = 2x^2 e^{2x}$ 

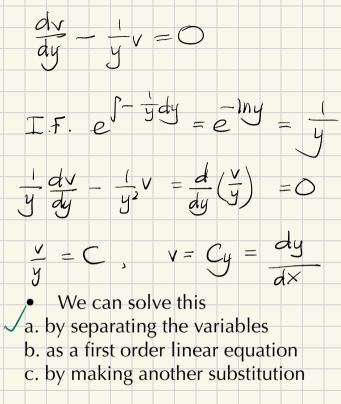
We can solve this a. by separating the variables b. as a first order linear equation c. by making another substitution

### Reducing the order of a differential equation

Section 1.6 question 44. Solve  $y y'' = (y')^2$ 

Solution: it's significant that there is no term in x in the equation.

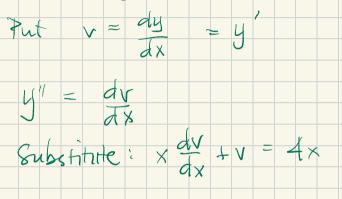


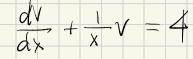


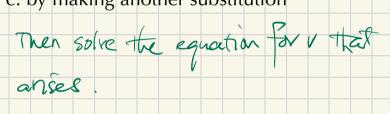
y = Bet with two constants: B,C

Section 1.6 question 46: Solve x y'' + y' = 4x

This time it's significant there is no term in y.







# Pre-class Warm-up!!!

How would you solve the following equation?

 $2xy + x^2 y' = y^2$ 

- a. by integrating y' = function of x
- b. separate the variables
- c. as a first order linear equation  $v = \frac{y}{x}$   $\sqrt{d}$ . as a homogeneous equation  $y/42v = v^{2}$
- $\sqrt{e}$ . as a Bernoulli equation  $y' + \frac{z}{x}y = \frac{y^2}{x^2}$ 
  - f. make a special substitution
  - g. reduce the order

What about  $xy^2 + 3y^2 - x^2y' = 0$ 

$$xy' + 2y = 6x^2 \sqrt{y}$$

 $\mathbf{y}' = \sqrt{(\mathbf{x} + \mathbf{y})}$ 

#### Exact equations

How do we find a function f(x,y) so that

