Unit 4
Lesson 7

Variation Word Problems

Unit 4 - Radical & Rational Functions

Date_____ Pd

Lesson 7 → Types of Variations

DIRECT VARIATION: Linear function with a y-intercept of 0. In a direct variation, both of the quantities are either increasing or both are decreasing.

There are two methods for solving a direct variation problem:

Slope

1) Equation of Variation: $y = kx$ where k is called the **constant of variation**

2) Proportion: $\frac{y_1}{x_1} = \frac{y_2}{x_2}$

The distance that a body near Earth's surface will fall from rest varies directly as the **square** of the number of seconds it has been falling. If a boulder falls from a cliff a distance of $122.5\ m$ in $5\ seconds$, approximately how far will it fall in $8\ seconds$?

Method 1

$y = kx$

$d = ks^2$

$122.5 = k(5)^2$

$\frac{122.5}{25} = \frac{25k}{25}$

$k = 4.9$

$d = (4.9)(8)^2$

$d = 313.6\ m$

Method 2

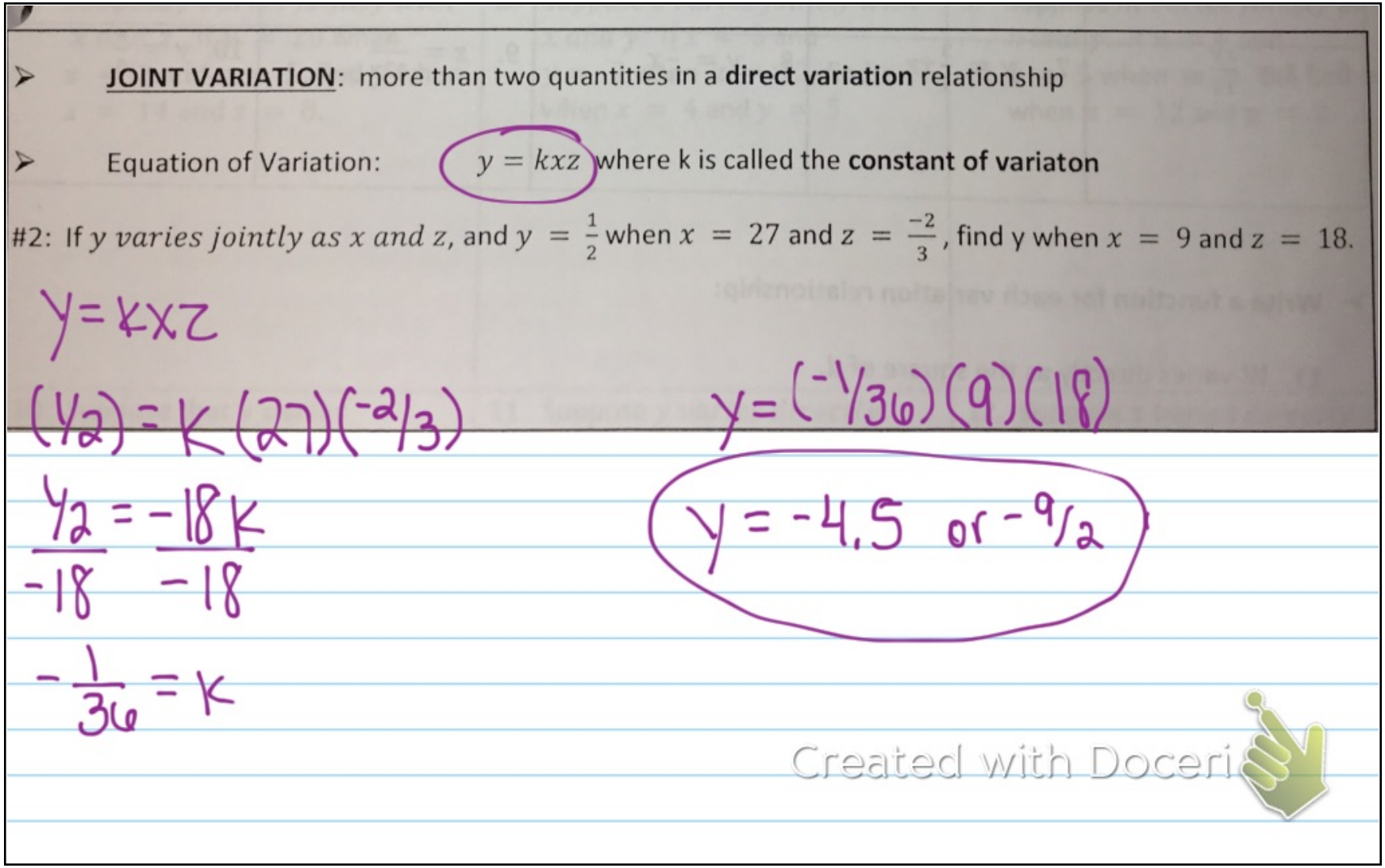
$\frac{d}{t^2}$:

$\frac{122.5}{5^2} \quad \frac{d}{8^2}$

$7840 = 25d$

$\frac{7840}{25} \quad \frac{25d}{25}$

$d = 313.6\ m$



- **JOINT VARIATION**: more than two quantities in a **direct variation** relationship
- Equation of Variation: $y = kxz$ where k is called the **constant of variaton**

#2: If y *varies jointly as* x *and* z, and $y = \frac{1}{2}$ when $x = 27$ and $z = \frac{-2}{3}$, find y when $x = 9$ and $z = 18$.

$y = kxz$

$(1/2) = k(27)(-2/3)$

$\frac{1/2}{-18} = \frac{-18k}{-18}$

$-\frac{1}{36} = k$

$y = (-1/36)(9)(18)$

$y = -4.5$ or $-9/2$

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➢ **INVERSE VARIATION:** Rational function with vertical and horizontal asymptotes. In an inverse variation, one of the quantities is increasing while the second quantity is decreasing.

➢ Equation of Variation: $y = \frac{k}{x}$ where k is called the **constant of variation**

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#3: The time of a trip varies inversely as the speed of the car. If a car being driven at 55 *mph* takes 2 *hours* to get from Wake Forest to Greensboro, how fast is the car traveling if the trip takes 2.5 *hours*?

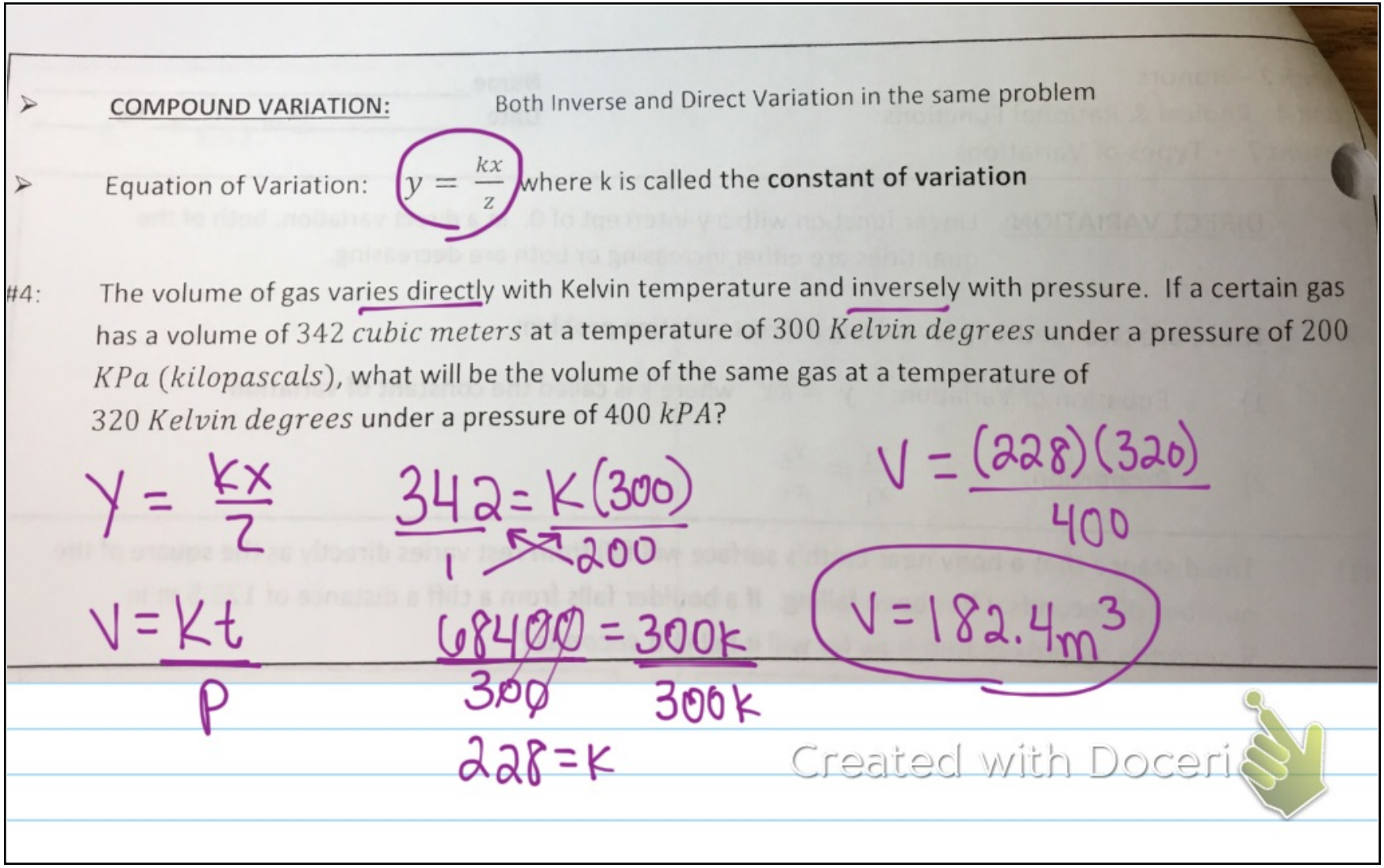
$y = \frac{k}{x}$ $\quad \frac{2.5}{1} = \frac{110}{s}$

210

$t = \frac{k}{s}$ $\quad \frac{2.5s}{2.5} = \frac{110}{2.5}$

$\frac{2}{1} = \frac{k}{55}$ $\quad s = 44$ mph

$110 = k$



➢ **COMPOUND VARIATION:** Both Inverse and Direct Variation in the same problem

➢ Equation of Variation: $y = \frac{kx}{z}$ where k is called the **constant of variation**

#4: The volume of gas varies directly with Kelvin temperature and inversely with pressure. If a certain gas has a volume of 342 *cubic meters* at a temperature of 300 *Kelvin degrees* under a pressure of 200 *KPa (kilopascals)*, what will be the volume of the same gas at a temperature of 320 *Kelvin degrees* under a pressure of 400 *kPA*?

$Y = \frac{kx}{z}$

$V = \frac{kt}{p}$

$\frac{342}{1} = \frac{k(300)}{200}$

$\frac{68400}{300} = \frac{300k}{300k}$

$228 = k$

$V = \frac{(228)(320)}{400}$

$V = 182.4 m^3$

1. $y = \frac{9}{x}$ inverse $k=9$	2. $z = 5xy$ Joint $k=5$	3. $y = \frac{8x}{z}$ Compound $k=8$	4. $y = 2x$ Direct $k=2$	5. $xy = 12$ $y = \frac{12}{x}$ inverse $k=12$
6. $z = \frac{xy}{15}$ $z = \frac{1}{15} \cdot x \cdot y$ $k = 1/15$	7. $y = \frac{3}{4}xz$ Joint $k = 3/4$	8. $y = \frac{1}{3}x$ Direct $k = 1/3$	9. $z = \frac{x}{12y}$ Compound $k = 1/12$	10. $y = \frac{x}{5}$ $k = 1/5 \cdot x$ direct

Joint

$y = \frac{3xz}{4}$

$z = \frac{1}{12} \cdot \frac{x}{y}$

Write a function for each variation relationship:

11. W varies directly as the square of d.

$W = kd^2$

12. V varies inversely as J.

$V = \frac{k}{J}$

13. V varies inversely as p and directly as T.

$V = \frac{kT}{P}$

14. F varies jointly as A and the square of v.

$F = kAv^2$

15. L varies directly as the fourth power of d and inversely as the square root of h.

$L = \frac{kd^4}{\sqrt{h}}$ $\quad$ $L = \frac{kd^4}{h^{1/2}}$

HW: Page 28-29

1. If y *varies directly as* x and $y = 15$ when $x = 3$, find y when $x = 12$.

$y = kx$ $\quad y = 5(12)$

$\frac{15}{3} = \frac{3k}{3}$ $\quad y = 60$

$5 = k$

2. If y *varies directly as* x and $x = 36$ when $y = 4$, find x when $y = 24$.

$y = kx$ $\quad \frac{24}{9} = \frac{(1/9)(x)}{9}$

$\frac{4}{36} = \frac{36k}{36}$ $\quad 216 = x$

$1/9 = k$

3. If y *varies directly as* x^2 and $y = 12$ when $x = 4$, find y when $x = 6$.

$y = kx^2$ $\quad y = (3/4)6^2$

$\frac{12}{16} = \frac{16k}{16}$ $\quad y = 27$

$3/4 = k$

4. If y *varies inversely as* x and $y = 2$ when $x = 8$, find x when $y = 14$.

$y = \frac{k}{x}$ $\quad 14 = \frac{16}{x}$

$2 = \frac{k}{8}$ $\quad \frac{14x}{14} = \frac{16}{14}$

$16 = k$ $\quad x = 8/7$

5. *If* y *varies inversely as* x and $x = 7$ when $y = 21$, find y when $x = 42$.

$y = \frac{k}{x}$ $\quad y = \frac{147}{42}$

$21 = \frac{k}{7}$ $\quad y = 3.5$

$147 = k$

6. If y *varies inversely as* x^3 and $y = 6$ when $x = \frac{-3}{4}$, find y when $x = 3$.

$y = \frac{k}{x^3}$ $\quad y = \frac{-81}{3^3}$

$6 = \frac{k}{(-3/4)^3}$ $\quad y = -3/32$

$-81/32 = k$

Suppose y *varies jointly with*

8. Suppose z *varies jointly with*

9 Suppose m *varies jointly as*