

## § 1.2: Constructing Models to Solve Problems.

Ex)

Formulas.

102 imm3ru  
104 2lrnrh  
106 5nteh8

Ideal Gas Law.

$$pV = NkT$$

- $p$  is pressure of gas
- $V$  is volume of gas
- $N$  is the number of molecules
- $k$  is Boltzmann's constant ( $\sim 1.4 \cdot 10^{-23} \text{ N}\cdot\text{m/K}$ )
- $T$  is the temperature of the gas

$$P = 100,000 \text{ N/m}^2 = 10^5 \text{ N/m}^2$$

$$T = 72^\circ\text{F} \approx 295 \text{ K}$$

$$V = 1 \text{ m}^3$$

$$\frac{pV}{kT} = \frac{NkT}{kT} \Rightarrow N = \frac{pV}{kT}$$

$$= \frac{(10^5 \text{ N/m}^2)(1 \text{ m}^3)}{(1.4 \cdot 10^{-23} \text{ N}\cdot\text{m/K})(295 \text{ K})}$$

$$N = \frac{10^5 \cancel{\text{N}} \cdot \cancel{\text{m}}}{413 \cancel{\text{N}} \cdot \cancel{\text{m}} \cdot 10^{-23}}$$

$$= \frac{1}{413} \cdot \frac{10^5}{10^{-23}}$$

$$= 0.0024 \cdot \frac{10^5}{10^{-23}}$$

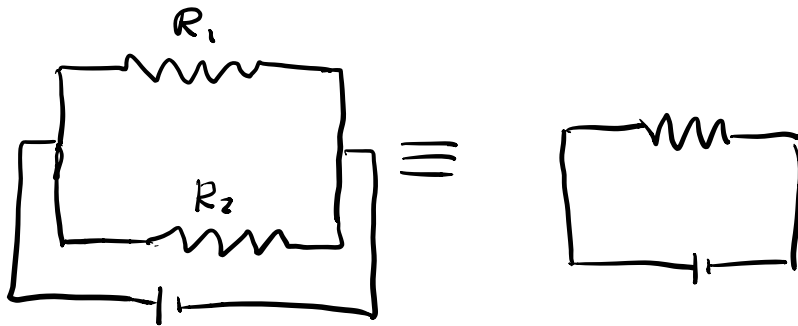
$$= 0.0024 \cdot 10^{28}$$

$$= 2.4 \cdot 10^{25}$$

Milkyway has  
roughly  $10^{11}$  stars.

More air molecules in  
1 cubic meter than  
# of stars in our galaxy.

Ex) Resistors in Parallel



$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$$

$$\left(\frac{1}{R} - \frac{1}{R_1}\right) = \left(\frac{1}{R_2}\right)^{-1}$$

know  $R_1 = 100 \Omega$

and  $R = 90 \Omega$

$$\frac{1}{\frac{1}{R} - \frac{1}{R_1}} = R_2 = \frac{1}{\frac{1}{R} - \frac{1}{R_1}} \cdot \frac{RR_1}{RR_1}$$

$$= \frac{RR_1}{\frac{RR_1}{R} - \frac{RR_1}{R_1}}$$

$$R_2 = \frac{RR_1}{R_1 - R} = \frac{RR_1}{R_1 - R}$$

$$= \frac{(90 \Omega)(100 \Omega)}{100 \Omega - 90 \Omega}$$

$$= \frac{9000 \Omega^2}{10 \Omega} = 900 \Omega$$

## Constructing Your Own Models

#45) Alex hauled a load of pipe from Fairbanks to Deadhorse in a record time of 11 hrs 15 min. From Fairbanks to Coldfoot he averaged 50 mph. Because of a blizzard, he averaged 10 mph less from Coldfoot to Deadhorse. If Coldfoot is the half-way point, what is the distance from Fairbanks to Coldfoot.

	(FB)	(CF)	(DH)
	x mi		x mi
	Rate	Time	Distance
FB → CF	50 mph	$\frac{x}{50}$ hrs	x mi
CF → DH	40 mph	$\frac{x}{40}$ hrs	x mi
		11.25 hr	

$$200 \left( \frac{x}{50} + \frac{x}{40} \right) = (11.25) 200$$

$$4x + 5x = 2250$$

$$9x = 2250$$

$$x = 250 \text{ mi}$$

Distance from Fairbanks to Coldfoot is 250 mi

#54) A pharmacist needs to obtain a 70% alcohol solution. How many ounces of a 30% alcohol solution should be mixed with 40 ounces of an 80% solution to obtain a 70% solution?

$$\boxed{\begin{array}{c} 30\% \\ x \text{ oz} \end{array}} + \boxed{\begin{array}{c} 80\% \\ 40 \text{ oz} \end{array}} = \boxed{\begin{array}{c} 70\% \\ (40+x) \text{ oz} \end{array}}$$

$$\text{Alcohol } 0.3x + 0.8(40) = 0.7(40+x)$$

$$0.3x + 32 = 28 + 0.7x$$

$$4 = 0.4x$$

$$8 = x$$

Need to add 8oz of 30% solution.

Ex) Dwight and Mose own a beat farm. If Dwight can harvest 100 beats per hour and together they can harvest 3000 beats in 12 hours how long would it have taken Mose to harvest the beats alone?

Let  $x$  be the rate at which Mose harvests beats.

	Rate	Time	Work
Mose	$x$ beats/hr	12 hr	$12x$ beats
Dwight	100 beats/hr	12 hr	1200 beats
			3000 beats

$$12x + 1200 = 3000$$

$$12x = 1800$$

$$x = 150$$

Mose harvests 150 beats per hour.

$$\frac{3000 \text{ beats}}{150 \text{ beats/hr}} = \boxed{20 \text{ hrs}}$$