

Linear- reciprocal properties of states of matter

Linear relationships

$$\frac{X_1}{X_2} = \frac{Y_1}{Y_2}$$

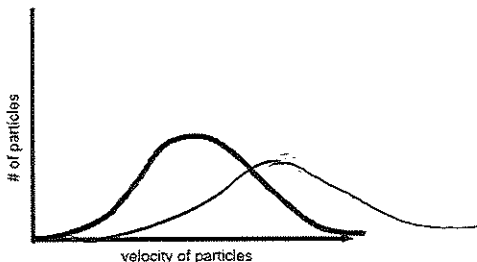
This is factor label!

Reciprocal relationships

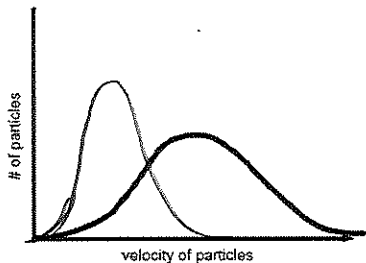
$$X_1 Y_1 = Y_2 X_2$$


Video answers

1. Two separate ridged 2.2L containers, O₂ and the other F₂ at 25C are warmed to 50C. Answer the following questions;
 - a. All of the oxygen atoms are traveling the same speed in the 25C container. Justify or nullify
 - b. The space between particles does not change due to increase in temperature. Justify or nullify.
 - c. Below you find a Maxwell's distribution of particles of a sample of O₂ at 25C. Add a second line representing the same sample at 50C.



- d. Below you find a Maxwell's distribution of particles of a sample of O₂ at 25C. Add a second line representing the F₂ at 25C.



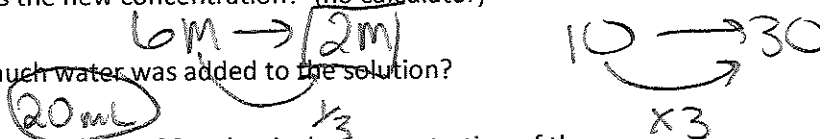
F₂ ↓ mass so moving faster
 ← These have the same temperature.

- e. Student hypothesis: The pressure in the O₂ containers is higher due a larger frequency of collisions. Justify or nullify.
 - f. Student hypothesis: The pressure in the warmed containers is double the pressure of the cooler container. Justify or nullify.
- O₂ is moving slower. P is equal
- No, need to double temp
 25 → 50 is not double

2. A 10mL solution of 6M hydrochloric acid is diluted to 30mL with distilled water.

a. What is the new concentration? (no calculator)

b. How much water was added to the solution?



3. A beaker contains 0.5M Na_2SO_4 , what is the concentration of the

a. $[Na^+] = 1M$

b. $[SO_4^{2-}] = 0.5M$

4. A 20mL solution of 0.20M NaCl reacts with 20mL 0.20M $Pb(NO_3)_2$ causing precipitation of $PbCl_2$.

a. Write out a balanced reaction. $2NaCl + Pb(NO_3)_2 \rightarrow PbCl_2 + 2NaNO_3$

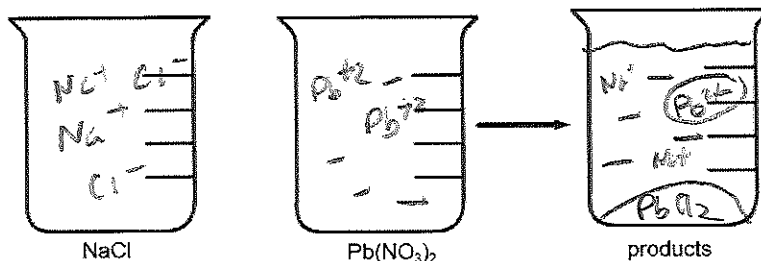
b. Which ion is the limiting ion? Cl^-

c. Determine the concentration of the following solutions (no calculator)

	Before	After
i. Na^+	0.2	0.1
ii. Cl^-	0.2	0
iii. Pb^{2+}	0.2	0.05
iv. NO_3^{-1}	0.4	0.2

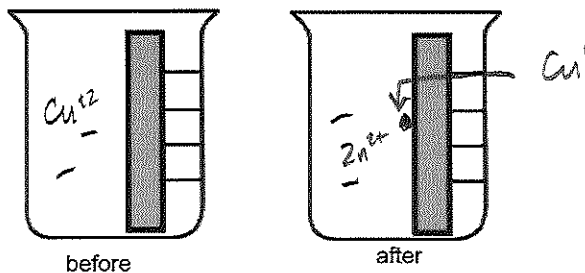
Handwritten notes: $0.2 \rightarrow 0.1$ used half

d. In the beakers below draw a proportional before and after beakers.



5. A reaction of 50.0mL of 0.25M $Cu(NO_3)_2$ is added to a beaker with a 50g piece of zinc.

a. Draw a proportional diagram of the before and after for this reaction.



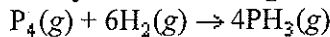
6. At STP, how many liters of oxygen are required to react completely with 3.6 liters of hydrogen to form water?

a. 1.8 L b. 2.0 L c. 3.6 L d. 2.4 L



$P = 30.975 \text{ g/mol}$ $P_4 = 123.88$

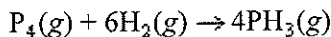
7. Consider the reaction below. Exactly 6.2 g of phosphorus gas and 4.0 g of hydrogen gas are pumped into a reaction vessel. How many moles of each gas is initially available?



- a. 0.2 mol P_4 and 2 mol H_2
- b. 0.05 mol P_4 and 2 mol H_2
- c. 0.05 mol P_4 and 4 mol H_2
- d. 0.05 g P_4 and 4 g H_2

$6.25 \cdot \frac{1 \text{ mol}}{123.88 \text{ g}} = 0.05 \text{ mol}$
 $4 \text{ g} \cdot \frac{1 \text{ mol}}{2 \text{ g}} = 2 \text{ mol}$

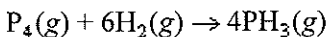
8. Consider the same reaction (below). If 6.2 g of phosphorus reacts with 4.0 g of hydrogen to form PH_3 , which reactant is limiting?



- a. P_4
- b. H_2
- c. PH_3
- d. neither reactant is limiting
- e. more information is needed

$2 \cdot \frac{1}{6} = 0.33 \text{ mol } P_4 \text{ needed}$
 $0.05 \cdot \frac{6}{1} = .3$

9. What is the maximum number of grams of PH_3 that can be formed when 6.2 g of phosphorus reacts with 4.0 g of hydrogen to form PH_3 ?



- a. 1.16 g
- b. 7.0 g
- c. 3.5 g
- d. 45 g

only possible

Think conservation of mass
 $P_4 = 6.2 \text{ g}$
 $H_2 = \text{just all } H_2$

10. A hydrocarbon is burned producing 20L of CO_2 and 40L of H_2O . Which of the following hydrocarbons could be the reactant?

- a. CH_4
- b. C_6H_6
- c. C_2H_4
- d. C_2H_6

$1 CO \quad 2 H_2O$
 $1 C = 4 H$