1) Bill drives 400 miles at 50 miles per hour. For how long does he drive?

2) Kiera bought some CD's and DVD's She bought 14 disks and paid $184. If CDs cost $12 and DVDs $20 how many of each did she buy?

3) Tony has a jar with nickels, dimes and quarters. The nickels and dimes total $40. The dimes and quarters total $55. The nickels and quarters total $35. How many of each does she have?

1) $400 = 50t$
$t = 50^{-1} \cdot 400 = 8$

2) $D + C = 14$
$20D + 12C = 184$

$-12D - 12C = -168$
$8D = 16$

$-12D - 12C = -168$
$D = 2$
$-12C = -144$
$D = 2$
$C = 12$
$D = 2$
$D = 2$
$C = 12$

3) $.05N + .1D = 40$
$.1D + .25Q = 55$
$.05N + .25Q = 35$

$$\begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix} \begin{pmatrix} 5 & 10 & 0 \\ 0 & 10 & 25 \\ 5 & 0 & 25 \end{pmatrix}$$

dd de do de do

$$\begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix}$$

Vector equations

$D + C = 14$
$20D + 12C = 184$

$$\begin{pmatrix} 1 & 1 \\ 20 & 12 \end{pmatrix} \begin{pmatrix} D \\ C \end{pmatrix} = \begin{pmatrix} 14 \\ 184 \end{pmatrix}$$

$RHS = \begin{pmatrix} -12 & 0 \\ 0 & 1 \end{pmatrix} \begin{pmatrix} 14 \\ 184 \end{pmatrix} = \begin{pmatrix} -168 \\ 184 \end{pmatrix}$

$LHS = \begin{pmatrix} -12 & 0 \\ 0 & 1 \end{pmatrix} \begin{pmatrix} 1 & 1 \\ 20 & 12 \end{pmatrix} \begin{pmatrix} D \\ C \end{pmatrix}$

$= \begin{pmatrix} -12 & -12 \\ 20 & 12 \end{pmatrix} \begin{pmatrix} D \\ C \end{pmatrix}$

$$\begin{pmatrix} 1 & 1 \\ 20 & 12 \end{pmatrix}\begin{pmatrix} D \\ C \end{pmatrix} = \begin{pmatrix} 14 \\ 184 \end{pmatrix}$$

$$\begin{pmatrix} -12 & -12 \\ 8 & 0 \end{pmatrix}\begin{pmatrix} D \\ C \end{pmatrix} = \begin{pmatrix} 168 \\ 16 \end{pmatrix}$$

$$\begin{pmatrix} 1 & 1 \\ 20 & 12 \end{pmatrix}\begin{pmatrix} D \\ C \end{pmatrix} = \begin{pmatrix} 14 \\ 184 \end{pmatrix} \quad \text{multiplied both sides by } \begin{pmatrix} -12 & 0 \\ -12 & 1 \end{pmatrix}$$

$$\begin{pmatrix} -12 & -12 \\ 8 & 0 \end{pmatrix}\begin{pmatrix} D \\ C \end{pmatrix} = \begin{pmatrix} -168 \\ 16 \end{pmatrix} \quad \text{multiply by } \begin{pmatrix} 1 & 0 \\ 0 & 1/8 \end{pmatrix}$$

$$\begin{pmatrix} -12 & -12 \\ 1 & 0 \end{pmatrix}\begin{pmatrix} D \\ C \end{pmatrix} = \begin{pmatrix} -168 \\ 2 \end{pmatrix} \quad \text{multiply } \begin{pmatrix} 1 & 12 \\ 0 & 1 \end{pmatrix}$$

$$\begin{pmatrix} 0 & -12 \\ 1 & 0 \end{pmatrix}\begin{pmatrix} D \\ C \end{pmatrix} = \begin{pmatrix} -144 \\ 2 \end{pmatrix} \quad \text{multiply } \begin{pmatrix} -1/12 & 0 \\ 0 & 1 \end{pmatrix}$$

$$\begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}\begin{pmatrix} D \\ C \end{pmatrix} = \begin{pmatrix} 12 \\ 2 \end{pmatrix} \quad \text{multiply } \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}$$

$$\begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}\begin{pmatrix} D \\ C \end{pmatrix} = \begin{pmatrix} 2 \\ 12 \end{pmatrix}$$

$$\begin{pmatrix} D \\ C \end{pmatrix} = \begin{pmatrix} 2 \\ 12 \end{pmatrix}$$

$$\begin{pmatrix} -3/20 & 1/8 \\ 4/12 & -1/8 \end{pmatrix} = \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}\begin{pmatrix} -1/12 & 0 \\ 0 & 1 \end{pmatrix}\begin{pmatrix} 1 & 12 \\ 0 & 1 \end{pmatrix}\begin{pmatrix} 1 & 0 \\ 0 & 1/8 \end{pmatrix}\begin{pmatrix} -12 & 0 \\ -12 & 1 \end{pmatrix}$$

$$\begin{pmatrix} -3/20 & 1/8 \\ 4/12 & -1/8 \end{pmatrix}\begin{pmatrix} 1 & 1 \\ 20 & 12 \end{pmatrix} = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$$

$$\begin{pmatrix} 1 & 1 \\ 20 & 12 \end{pmatrix}\begin{pmatrix} D \\ C \end{pmatrix} = \begin{pmatrix} 14 \\ 184 \end{pmatrix}$$

matrix → $A\ x = C$ ← vector

Solve by multiplying both sides by A^{-1} $\begin{pmatrix} 0 & 1 \\ 0 & 1 \end{pmatrix}$ $\begin{pmatrix} 1 & -1 \\ 0 & 1 \end{pmatrix}$

$$\begin{pmatrix} 1 & 0 \\ -20 & 1 \end{pmatrix}\begin{pmatrix} 1 & 1 \\ 20 & 12 \end{pmatrix} = \begin{pmatrix} 1 & 1 \\ 0 & -8 \end{pmatrix}$$

$$\begin{pmatrix} 1 & 0 \\ 0 & -1/8 \end{pmatrix}\begin{pmatrix} 1 & 1 \\ 0 & -8 \end{pmatrix} = \begin{pmatrix} 1 & 1 \\ 0 & 1 \end{pmatrix}$$

$$\begin{pmatrix} 1 & -1 \\ 0 & 1 \end{pmatrix}\begin{pmatrix} 1 & 1 \\ 0 & 1 \end{pmatrix} = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$$

$$\begin{pmatrix} 1 & -1 \\ 0 & 1 \end{pmatrix}\begin{pmatrix} 1 & 0 \\ 0 & -\frac{1}{8} \end{pmatrix}\begin{pmatrix} 1 & 0 \\ -20 & 1 \end{pmatrix}$$

$$= \begin{pmatrix} 1 & -1 \\ 0 & 1 \end{pmatrix}\begin{pmatrix} 1 & 0 \\ \frac{5}{2} & -\frac{1}{8} \end{pmatrix}$$

$$= \begin{pmatrix} -\frac{3}{2} & \frac{1}{8} \\ \frac{5}{2} & -\frac{1}{8} \end{pmatrix}$$