

System ①

$$x + y = 18$$

$$x - y = 20$$

$$19 + y = 18$$

$$-19 \quad -19$$

$$\boxed{y = -1}$$

$$\begin{array}{r} x + y = 18 \\ x - y = 20 \\ \hline \end{array}$$

$$2x = 38$$

$$\frac{2x}{2} = \frac{38}{2}$$

$$\boxed{x = 19}$$

Solution (19, -1)

$$\checkmark \checkmark 19 + -1 = 18 \checkmark \checkmark$$

$$19 - -1 = 20 \checkmark \checkmark$$

System (2)

$$12x + y = 120$$

$$\underline{-12x + 3y = -240}$$

$$12x + y = 120$$

$$\underline{-12x + 3y = -240}$$

$$4y = -120$$

$$\frac{4y}{4} = \frac{-120}{4}$$

$$\rightarrow \boxed{y = -30}$$

$$12x + -30 = 120$$

$$12x - 30 = 120$$

$$+30 \quad +30$$

$$\underline{12x = 150}$$

$$\frac{12x}{12} = \frac{150}{12}$$

$$\boxed{x = 12.5}$$

Solution
 $(12.5, -30)$

$$\checkmark 12(12.5) + -30 = 120$$

$$\checkmark \checkmark -12(12.5) + 3(-30) = -240$$

System (3)

$$x + y = 48$$

$$-x - y = 48$$

$$\begin{array}{r} x + y = 48 \\ -x - y = 48 \\ \hline \end{array}$$

$0 \neq 96$ False these are parallel lines

No solutions, inconsistent lines

✓ ✓ $x + y = 48$

~~$-x$~~ ~~$-x$~~

$$\boxed{y = -1x + 48}$$

✓ ✓ $-x - y = 48$

~~$+x$~~ ~~$+x$~~

$$\frac{-y = x + 48}{-1} \quad \frac{-1}{-1}$$

$$\boxed{y = -1x - 48}$$



these lines are parallel

System (4) -1 (12x + y = 24) →

$$12x + y = 24$$

$$12x + 3y = 96$$

$$12x + 3y = 96$$

$$\begin{array}{r} -12x - 1y = -24 \\ \hline 12x + 3y = 96 \end{array}$$

$$2y = 72$$

$$\frac{2y}{2} = \frac{72}{2}$$

$$y = 36$$

$$12x + 36 = 24$$

$$\begin{array}{r} 12x + 36 = 24 \\ -36 \quad -36 \\ \hline 12x = -12 \end{array}$$

$$12x = -12$$

$$\frac{12x}{12} = \frac{-12}{12}$$

$$x = -1$$

Solution
(-1, 36)

$$\checkmark \checkmark 12(-1) + 36 = 24$$

$$12(-1) + 3(36) = 96$$

System (5) $4(2.5x + y = 20) \rightarrow 10x + 4y = 80$

$$\begin{array}{r} 2.5x + y = 20 \\ -10x - 4y = -40 \\ \hline 10x + 4y = 80 \\ -10x - 4y = -40 \\ \hline 0 \neq 40 \end{array}$$

Since $0 \neq 40$ these are parallel lines

- (2) no solution
- (3) inconsistent lines

$$\begin{array}{r} \checkmark \checkmark \quad 2.5x + y = 20 \\ -2.5x \quad -2.5x \end{array}$$

$$\boxed{y = -2.5x + 20}$$

$$\begin{array}{r} -10x - 4y = -40 \\ +10x \quad -10x \end{array}$$

$$\begin{array}{r} -4y = +10x - 40 \\ \frac{-4y}{-4} = \frac{+10x}{-4} - \frac{40}{-4} \end{array}$$

$$\boxed{y = -2.5x + 10}$$

these are parallel

System

⑥

$$6x + y = 12$$

$$-2x + 3y = 24$$

$$6x + y = 12 \rightarrow$$

$$3(-2x + 3y = 24)$$

$$-6x + 9y = 72$$

$$10y = 84$$

$$\frac{10y}{10} = \frac{84}{10}$$

$$y = 8.4$$

$$6x + 8.4 = 12$$

$$-8.4 \quad -8.4$$

$$6x = 3.6$$

$$\frac{6x}{6} = \frac{3.6}{6}$$

$$x = 0.6$$

Solution (0.6, 8.4)

$$\checkmark \checkmark 6(0.6) + 8.4 = 12$$

$$-2(0.6) + 3(8.4) = 24$$

System (F)

$$\begin{aligned} 2x + 2y &= 10 \\ -3x - 5y &= -30 \end{aligned}$$

$$\begin{aligned} 3(2x + 2y = 10) &\rightarrow 6x + 6y = 30 \\ -6x - 10y &= -60 \\ \hline -4y &= -30 \end{aligned}$$

$$\frac{-4y = -30}{-4} \quad -4$$

$$\boxed{y = 7.5}$$

$$2x + 2(7.5) = 10$$

$$2x + 15 = 10$$

$$\frac{-15 \quad -15}{-15 \quad -15}$$

$$2x = -5$$

$$\frac{2x = -5}{2} \quad 2$$

$$\boxed{x = -2.5}$$

Solution

$$(-2.5, 7.5)$$

$$\checkmark \checkmark 2(-2.5) + 2(7.5) = 10$$

$$\checkmark \checkmark -3(-2.5) - 5(7.5) = -30$$

$$\begin{aligned} \text{System } \textcircled{A} \\ 2x + 2y = 10 \\ -3x - 5y = -30 \end{aligned}$$

$$\begin{aligned} 3(2x + 2y = 10) &\rightarrow \\ 2(-3x - 5y = -30) &\rightarrow \end{aligned}$$

$$\begin{aligned} 6x + 6y = 30 \\ -6x - 10y = -60 \end{aligned}$$

$$-4y = -30$$

$$-\frac{4y}{4} = \frac{-30}{4}$$

$$\boxed{y = 7.5}$$

$$5(2x + 2y = 10) \rightarrow$$

$$10x + 10y = 50$$

$$2(-3x - 5y = -30) \rightarrow$$

$$\frac{-6x - 10y = -60}{-6x - 10y = -60}$$

$$4x = -10$$

$$\frac{4x}{4} = \frac{-10}{4}$$

$$\boxed{x = -2.5}$$

$$\checkmark \checkmark 2(-2.5) + 2(7.5) = 10$$

$$\checkmark \checkmark -3(-2.5) - 5(7.5) = -30$$

Solution

$$\boxed{(-2.5, 7.5)}$$

System (8)

$$\begin{aligned} 2x + y &= 12 \\ 4x + 3y &= -180 \end{aligned}$$

$$\begin{aligned} -4(2x + y) &= -4(12) \rightarrow \\ 2(4x + 3y) &= 2(-180) \rightarrow \end{aligned}$$

$$\begin{array}{r} -8x - 4y = -48 \\ 8x + 6y = -360 \\ \hline 2y = -408 \end{array}$$

$$\frac{2y}{2} = \frac{-408}{2}$$

$$\boxed{y = -204}$$

$$\begin{aligned} 2x - 204 &= 12 \\ + 204 &+ 204 \end{aligned}$$

Solution
 $(108, -204)$

$$2x = 216$$

$$\frac{2x}{2} = \frac{216}{2}$$

$$\boxed{x = 108}$$

$$\begin{aligned} \checkmark \\ 2(108) - 204 &= 12 \\ 4(108) + 3(-204) &= -180 \end{aligned}$$

After
4479
 $15x + 20y = 300$

$$-10x - 4y = -80$$

$$\begin{aligned} 150x + 200y &= 30000 \\ -100x - 40y &= -1200 \end{aligned}$$

$$\frac{140y}{140} = \frac{18000}{140}$$

$$y = \frac{90}{7} = 12\frac{6}{7}$$

$$\begin{aligned} 10(15x + 20y) &= 3000 \\ 15(-10x - 4y) &= -80 \end{aligned}$$

9950x. Solution
(2.857, 12.857)

$$\begin{aligned} 4(15x + 20y) &= 300 \rightarrow \\ 20(-10x - 4y) &= -80 \rightarrow \end{aligned}$$

$$\begin{aligned} 60x + 80y &= 1200 \\ -200x - 80y &= -1600 \end{aligned}$$

$$\frac{-140x}{-140} = \frac{-400}{-140}$$

$$x = \frac{400}{140} = \frac{20}{7} = 2\frac{6}{7}$$

$$\begin{aligned} 11 \quad 5\left(\frac{20}{7}\right) + 20\left(\frac{90}{7}\right) &= 300 \checkmark \\ 11 \quad -10\left(\frac{20}{7}\right) - 4\left(\frac{90}{7}\right) &= -80 \checkmark \end{aligned}$$

Solutions

$\left(\frac{20}{7}, 12\frac{6}{7}\right)$
 $\left(\frac{20}{7}, \frac{90}{7}\right)$

System (10)

$$\begin{aligned} 2x + 7y &= 14 \\ 5x + 3y &= -15 \end{aligned}$$

approximate
(-5.069, 3.448)

$$\begin{aligned} -5(2x + 7y) &= 14 \rightarrow -10x - 35y = -70 \\ 2(5x + 3y) &= -15 \rightarrow 10x + 6y = -30 \end{aligned}$$

$$\begin{aligned} -29y &= -100 \\ \frac{-29y}{-29} &= \frac{-100}{-29} \end{aligned}$$

$$\boxed{y = \frac{100}{29} = 3 \frac{13}{29}}$$

$$\begin{aligned} -3(2x + 7y) &= 14 \rightarrow -6x - 21y = -42 \\ 7(5x + 3y) &= -15 \rightarrow 35x + 21y = -105 \end{aligned}$$

Solution

$$\left(-5 \frac{2}{29}, 3 \frac{13}{29}\right)$$

$$\begin{aligned} 29x &= -147 \\ \frac{29x}{29} &= \frac{-147}{29} \rightarrow \end{aligned}$$

$$\boxed{\begin{aligned} x &= \frac{-147}{29} \\ x &= -5 \frac{2}{29} \end{aligned}}$$

$$\left(-\frac{147}{29}, \frac{100}{29}\right)$$

$$\begin{aligned} \checkmark \checkmark 2\left(-\frac{147}{29}\right) + 7\left(\frac{100}{29}\right) &= 14 \checkmark \\ \checkmark \checkmark 5\left(-\frac{147}{29}\right) + 3\left(\frac{100}{29}\right) &= -15 \checkmark \end{aligned}$$

System (11)

$$\begin{aligned} 18x + 2y &= 36 \\ -10x - 5y &= -240 \end{aligned}$$

approx solution

$$\begin{aligned} 10(18x + 2y) &= 360 \rightarrow \\ 18(-10x - 5y) &= -240 \rightarrow \end{aligned}$$

$$\begin{array}{r} 180x + 20y = 360 \\ -180x - 90y = -240 \\ \hline -70y = -1040 \end{array}$$

$$-70y = \frac{-39160}{-70}$$

$$y = 56 \frac{4}{7} = 39 \frac{6}{7}$$

} new system has opposites

$$\begin{aligned} 5(18x + 2y) &= 36 \rightarrow \\ 2(-10x - 5y) &= -240 \rightarrow \end{aligned}$$

$$\begin{array}{r} 90x + 10y = 180 \\ -20x - 10y = -480 \\ \hline 70x = -300 \end{array}$$

} new system has opposites

$$\checkmark 18\left(\frac{-30}{7}\right) + 2\left(\frac{396}{7}\right) = 36$$

$$\checkmark -10\left(\frac{-30}{7}\right) - 5\left(\frac{396}{7}\right) = -240$$

$$\frac{70x}{70} = \frac{-300}{70}$$

$$x = \frac{-30}{7} = -4 \frac{2}{7}$$

Solution to System

$$\left(\frac{-30}{7}, \frac{396}{7}\right)$$

$$\left(-4 \frac{2}{7}, 56 \frac{4}{7}\right)$$

System (2) $-4(2x + 9y = -18) \rightarrow -12x - 54y = 108$
 $2(6x + 4y = -24) \rightarrow 12x + 8y = -48$

 $-46y = 60$

\checkmark
 $2(-\frac{32}{23}) + 9(\frac{30}{23}) =$
 $6(-\frac{32}{23}) + 9(\frac{30}{23}) =$

$$-\frac{46y}{-46} = \frac{60}{-46}$$

$$y = \frac{60}{-46} = -\frac{30}{23}$$

$$-4(2x + 9y = -18) \rightarrow$$

$$9(6x + 4y = -24) \rightarrow$$

$$-8x - 36y = 72$$

$$54x + 36y = 216$$

$$46x = -144$$

$$\frac{46x}{46} = \frac{-144}{46} \rightarrow x = \frac{-144}{46} = -\frac{72}{23}$$

Solution $(-\frac{72}{23}, \frac{30}{23})$
 $(-\frac{72}{23}, -\frac{30}{23})$

Approx solution $(-3.130, 1.304)$