Instructor's Manual

Mathematics for Economics and Business

Eighth edition

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SOLUTIONS TO PROBLEMS

CHAPTER 1

Linear Equations

Section 1.1 Introduction to algebra

Practice Problems

1. **(a)** –30 **(b)** 2 **(c)** –5

(d) 5 **(e)** 36 **(f)** –1

2. **(a)** –1 **(b)** –7 **(c)** 5

(d) 0 **(e)** –91 **(f)** –5

3. **(a)** 19 **(b)** 1500 **(c)** 32

(d) 35

4. **(a)** $x+9y$ **(b)** $2y+4z$

(c) not possible

(d) $8r^2+s+rs-3s^2$ **(e)** $-4f$

(f) not possible **(g)** 0

5. **(a)** $5z-2z^2$

(b) $6x-6y+3y-6x=-3y$

(c) $x-y+z-x^2-x+y=z-x^2$

6. **(a)** $7(d+3)$ **(b)** $4(4w-5q)$

(c) $3(3x-y+3z)$ **(d)** $5Q(1-2Q)$

7. **(a)** $\boldsymbol{x}^2-2\boldsymbol{x}+3\boldsymbol{x}-6=\boldsymbol{x}^2+\boldsymbol{x}-6$

(b) $x^2-xy+yx-y^2=x^2-y^2$

(c) $x^2+xy+yx+y^2=x^2+2xy+y^2$

(d) $5x^2 - 5xy + 5x + 2yx - 2y^2 + 2y$

$= 5x^2 - 3xy + 5x - 2y^2 + 2y$

8. **(a)** $(x + 8)\ (x - 8)$

(b) $(2x + 9)\ (2x - 9)$

Exercise 1.1 (p. 18)

1. **(a)** -20 **(b)** 3 **(c)** -4 **(d)** 1

(e) -12 **(f)** 5 **(g)** -5 **(h)** 3

(i) 30 **(j)** 4.

2. **(a)** -1 **(b)** -3 **(c)** -11 **(d)** 16

(e) -1 **(f)** -13 **(g)** 11 **(h)** 0

(i) -31 **(j)** -2

3. **(a)** -3 **(b)** 2 **(c)** 18 **(d)** -15

(e) -41 **(f)** -3 **(g)** 18 **(h)** -6

(i) -25 **(j)** -6.

4. **(a)** $2PQ$ **(b)** $8I$ **(c)** $3xy$ **(d)** $4qwz$

(e) b^2 **(f)** $3k^2$

5. **(a)** $19w$ **(b)** $4x - 7y$ **(c)** $9a + 2b - 2c$

(d) $x^2 + 2x$ **(e)** $4c - 3cd$ **(f)** $2st + s^2 + t^2 + 9$.

6. **(a)** 10 **(b)** 18 **(c)** 2000

(d) 96 **(e)** 70

7. **(a)** 1 **(b)** 5 **(c)** -6 **(d)** -16

(e) -30 **(f)** 44.

8. **(a)** 16.

(b) Presented with the calculation, -4^2, your calculator uses BIDMAS, so squares first to get 16 and then subtracts from zero to give a final answer, -16. To obtain the correct answer you need to use brackets:

9. **(a)** 9 **(b)** 21 no.

10. **(a)** 43.96 **(b)** 1.13 **(c)** 10.34 **(d)** 0.17

(e) 27.38 **(f)** 3.72 **(g)** 62.70 **(h)** 2.39

11. **(a)** $7x-7y$ **(b)** $15x-6y$ **(c)** $4x+12$ **(d)** $21x-7$

(e) $3x+3y+3z$ **(f)** $3x^2-4x$ **(g)** $y+2z-2x-6y+2z=-2x-5y+4z$

12. **(a)** $5(5c+6)$ **(b)** $9(x-2)$ **(c)** $x(x+2)$ **(d)** $4(4x-3y)$

(e) $2x(2x-3y)$ **(f)** $5(2d-3e+10)$

13. **(a)** $x^2+7x+10$ **(b)** a^2+3a-4 **(c)** $d^2-5d-24$

(d) $6s^2+23s+21$ **(e)** $2y^2+5y+3$ **(f)** $10t^2-11t-14$

(g) $9n^2-4$ **(h)** $a^2-2ab+b^2$

14. **(a)** $6x+2y$ **(b)** $11x^2-3x-3$ **(c)** $14xy+2x$

(d) $6xyz+2xy$ **(e)** $10a-2b$ **(f)** $17x+22y$

(g) $11-3p$ **(h)** x^2+10x

15. **(a)** $(x+2)(x-2)$ **(b)** $(Q+7)(Q-7)$ **(c)** $(x+y)(x-y)$

(d) $(3x+10y)(3x-10y)$

16. **(a)** $4x^2+8x-2$ **(b)** $3x^2+2x-3x^2-15x=-13x$

17. $S=1.2N+3000E+1000(A-21);\quad \$204,000$

18. **(a)** $C=80+60L+K$ **(b)** $C=10+1.25x$ **(c)** $H=5a+10b$ **(d)** $X=Cd+cm$

Section 1.2 Further algebra

Practice Problems

1. **(a)** $\frac{3}{5}$ **(b)** $\frac{4}{5}$ **(c)** $\frac{1}{2y}$ **(d)** $\frac{1}{2+3x}$ **(e)** $\frac{1}{x-4}$

2. **(a)** $\frac{1}{2}\times\frac{3}{4}=\frac{1\times 3}{2\times 4}=\frac{3}{8}$

(b) $\frac{1}{\cancel{7}} \times \frac{1}{\cancel{14}_{2}} = \frac{1}{2}$

(c) $\frac{2}{3} \div \frac{8}{9} = \frac{\cancel{2}^{1}}{\cancel{3}_{1}} \times \frac{\cancel{9}^{3}}{\cancel{8}_{4}} = \frac{3}{4}$

(d) $\frac{8}{9} \div 16 = \frac{\cancel{8}^{1}}{9} \times \frac{1}{\cancel{16}_{2}} = \frac{1}{18}$

3. **(a)** $\frac{3}{7} - \frac{1}{7} = \frac{2}{7}$

(b) $\frac{1}{3} + \frac{2}{5} = \frac{5}{15} + \frac{6}{15} = \frac{11}{15}$

(c) $\frac{7}{18} - \frac{1}{4} = \frac{14}{36} - \frac{9}{36} = \frac{5}{36}$

4. **(a)** $\frac{5}{\cancel{x-1}} \times \frac{\cancel{x-1}}{x+2} = \frac{5}{x+2}$

(b) $\frac{x^2}{x+10} \div \frac{x}{x+1} = \frac{x^2}{x+10} \times \frac{x+1}{x} = \frac{x(x+1)}{x+10}$

(c) $\frac{4}{x+1} + \frac{1}{x+1} = \frac{4+1}{x+1} = \frac{5}{x+1}$

(d) $\frac{2}{x+1} - \frac{1}{x+2}$

$$= \frac{2(x+2)}{(x+1)(x+2)} - \frac{(1)(x+1)}{(x+1)(x+2)}$$

$$= \frac{(2x+4)-(x+1)}{(x+1)(x+2)} = \frac{(x+3)}{(x+1)(x+2)}$$

5. **(a)** $4x + 1 = 25$

$4x = 24$ (subtract 1 from both sides)

$x = 6$ (divide both sides by 4)

(b) $4x + 5 = 5x - 7$

$5 = x - 7$ (subtract $4x$ from both sides)

$12 = x$ (add 7 to both sides)

(c) $3(3-2x)+2(x-1)=10$

$9-6x+2x-2=10$ (multiply out brackets)

$7-4x=10$ (collect like terms)

$-4x=3$ (subtract 7 from both sides)

$x=-\frac{3}{4}$ (divide both sides by –4)

(d) $\frac{4}{x-1}=5$

$4=5(x-1)$ (multiply both sides by $x-1$)

$4=5x-5$ (multiply out brackets)

$9=5x$ (add 5 to both sides)

$\frac{9}{5}=x$ (divide both sides by 5)

(e) $\frac{3}{x}=\frac{5}{x-1}$

$3(x-1)=5x$ (cross-multiplication)

$3x-3=5x$ (multiply out brackets)

$-3=2x$ (subtract $3x$ from both sides)

$-\frac{3}{2}=x$ (divide both side by 2)

6. **(a)** 12 > 9 (true) **(b)** 12 > 6 (true)

(c) 3 > 0 (true) **(d)** same as (c)

(e) 2 > 1 (true) **(f)** –24 > –12 (false)

(g) –6 > –3 (false) **(h)** –2 > –1 (false)

(i) –4 > –7 (true).

7. **(a)** $2x < 3x + 7$

$-x < 7$ (subtract $3x$ from both sides)

$x > -7$ (divide both sides by –1 changing sense because $-1 < 0$)

(b) $21x - 19 \geq 4x + 15$

$17x - 19 \geq 15$ (subtract $4x$ from both sides)

$17x \geq 34$ (add 19 to both sides)

$x \geq 2$ (divide both sides by 17, leaving inequality unchanged because $17 > 0$)

Exercise 1.2 (p. 36)

1. **(a)** $\frac{1}{2}$ **(b)** $\frac{3}{4}$ **(c)** $\frac{3}{5}$ **(d)** $\frac{1}{3}$ **(e)** $\frac{4}{3} = 1\frac{1}{3}$

2. **(a)** $\frac{35}{100} = \frac{7}{20}$; **(b)** $\frac{56}{35} = 1\frac{3}{5}$

3. **(a)** $\frac{2x}{3}$ **(b)** $\frac{1}{2x}$ **(c)** $\frac{1}{ac}$ **(d)** $\frac{2}{3xy}$ **(e)** $\frac{3a}{4b}$.

4. **(a)** $\frac{2p}{2(2q+3r)} = \frac{p}{2q+3r}$ **(b)** $\frac{x}{x(x-4)} = \frac{1}{x-4}$ **(c)** $\frac{3ab}{3a(2a+1)} = \frac{b}{2a+1}$

(d) $\frac{14d}{7d(3-e)} = \frac{2}{3-e}$ **(e)** $\frac{x+2}{(x+2)(x-2)} = \frac{1}{x-2}$ (using the difference of two squares for the denominator)

5. $\frac{x-1}{2x-2} = \frac{x-1}{2(x-1)} = \frac{1}{2}$; other two have no common factors on top and bottom.

6. **(a)** $\frac{3}{7}$ **(b)** $-\frac{1}{3}$ **(c)** $\frac{3}{6} + \frac{2}{6} = \frac{5}{6}$

(d) $\frac{15}{20} - \frac{8}{20} = \frac{7}{20}$ **(e)** $\frac{3}{18} + \frac{4}{18} = \frac{7}{18}$ **(f)** $\frac{1}{6} + \frac{4}{6} = \frac{5}{6}$

(g) $\frac{5}{\cancel{6}_2} \times \frac{\cancel{3}^1}{4} = \frac{5}{8}$ **(h)** $\frac{\cancel{4}^2}{\cancel{15}_5} \times \frac{\cancel{3}^1}{\cancel{2}_1} = \frac{2}{5}$ **(i)** $\frac{7}{\cancel{8}_4} \times \frac{\cancel{2}^1}{3} = \frac{7}{12}$

(j) $\frac{\cancel{2}^1}{\cancel{75}_{15}} \times \frac{\cancel{5}^1}{\cancel{4}_2} = \frac{1}{30}$ **(k)** $\frac{2}{9} \times \frac{1}{3} = \frac{2}{27}$ **(l)** $\frac{3}{1} \times \frac{7}{2} = \frac{21}{2} = 10\frac{1}{2}$

7. $47\frac{1}{2} \div 1\frac{1}{4} = \frac{95}{2} \div \frac{5}{4} = \frac{\cancel{95}^{19}}{\cancel{2}_1} \times \frac{\cancel{4}^2}{\cancel{5}_1} = 38$

8. **(a)** $\frac{2}{3x} + \frac{1}{3x} = \frac{3}{3x} = \frac{1}{x}$ **(b)** $\frac{2}{\cancel{x}_1} \times \frac{\cancel{x}^1}{5} = \frac{2}{5}$ **(c)** $\frac{3}{x} - \frac{2}{x^2} = \frac{3x}{x^2} - \frac{2}{x^2} = \frac{3x-2}{x^2}$

(d) $\frac{7}{x}+\frac{2}{y}=\frac{7y}{xy}+\frac{2x}{xy}=\frac{7y+2x}{xy}$ **(e)** $\frac{a}{2}\div\frac{a}{6}=\frac{{}^{1}\cancel{a}}{{}_{1}2}\times\frac{\cancel{6}^{3}}{\cancel{a}_{1}}=3$

(f) $\frac{5c}{12}+\frac{5d}{18}=\frac{15c}{36}+\frac{10d}{36}=\frac{15c+10d}{36}$ **(g)** $\frac{x+2}{\cancel{y-5}_{1}}\times\frac{\cancel{y-5}^{1}}{x+3}=\frac{x+2}{x+3}$

(h) $\frac{4gh}{7}\div\frac{2g}{9h}=\frac{{}^{2}\cancel{4}gh}{7}\times\frac{9h}{\cancel{2}_{1}g}=\frac{18h^2}{7}$ **(i)** $\frac{t}{4}\div 5=\frac{t}{4}\times\frac{1}{5}=\frac{t}{20}$ **(j)** $\frac{{}^{1}\cancel{P}}{{}_{1}Q}\times\frac{Q^{1}}{\cancel{P}_{1}}=1$

9. (a) $x+2=7$

$x=5$ (subtract 2 from both sides)

(b) $3x=18$

$x=6$ (divide both sides by 3)

(c) $\frac{x}{9}=2$

$x=18$ (multiply both sides by 9)

(d) $x-4=-2$

$x=2$ (add 4 to both sides)

(e) $2x-3=17$

$2x=20$ (add 3 to both sides)

$x=10$ (divide both sides by 2)

(f) $3x+4=1$

$3x=-3$ (subtract 4 from both sides)

$x=-1$ (divide both sides by 3)

(g) $\frac{x}{6}-7=3$

$\frac{x}{6}=10$ (add 7 to both sides)

$x=60$ (multiply both sides by 6)

(h) $3(x-1)=2$

$3x-3=2$ (multiply out brackets)

$3x=5$ (add 3 to both sides)

$x=\frac{5}{3}=1\frac{2}{3}$ (divide both sides by 3)

(i) $4 - x = 9$

$-x = 5$ (subtract 4 from both sides)

$x = -5$ (divide both sides by −1)

(j) $6x + 2 = 5x - 1$

$x + 2 = -1$ (subtract $5x$ from both sides)

$x = -3$ (subtract 2 from both sides)

(k) $5(3x + 8) = 10$

$15x + 40 = 10$ (multiply out brackets)

$15x = -30$ (subtract 40 from both sides)

$x = -2$ (divide both sides by 15)

(l) $2(x - 3) = 5(x + 1)$

$2x - 6 = 5x + 5$ (multiply out brackets)

$-3x - 6 = 5$ (subtract $5x$ from both sides)

$-3x = 11$ (add 6 to both sides)

$x = \frac{-11}{3} = -3\frac{2}{3}$ (divide both sides by -3)

(m) $\frac{4x - 7}{3} = 2$

$4x - 7 = 6$ (multiply both sides by 3)

$4x = 13$ (add 7 to both sides)

$x = \frac{13}{4} = 3\frac{1}{4}$ (divide both sides by 4)

(n) $\frac{4}{x + 1} = 1$

$4 = x + 1$ (multiply both sides by $x + 1$)

$3 = x$ (subtract 1 from both sides)

(o) $5 - \frac{1}{x} = 1$

$5 = 1 + \frac{1}{x}$ (add $\frac{1}{x}$ to both sides)

$4 = \frac{1}{x}$ (subtract 1 from both sides)

$4x = 1$ (multiply both sides by x)

$x = \frac{1}{4}$ (divide both sides by 4)

10. (a), (d), (e), (f).

11. **(a)** $2x > x + 1$

$x > 1$ (subtract x from both sides)

(b) $7x + 3 \le 9 + 5x$

$2x + 3 \le 9$ (subtract $5x$ from both sides)

$2x \le 6$ (subtract 3 from both sides)

$x \le 3$ (divide both sides by 2)

(c) $x - 5 > 4x + 4$

$-3x - 5 > 4$ (subtract $4x$ from both sides)

$-3x > 9$ (add 5 to both sides)

$x < -3$ (divide both sides by -3)

(d) $x - 1 < 2x - 3$

$-x - 1 < -3$ (subtract $2x$ form both sides)

$-x < -2$ (add 1 to both sides)

$x > 2$ (divide both sides by -1)

12. $\frac{4}{x^2 y} \div \frac{2x}{y} = \frac{{}^{2}\cancel{4}}{x^{\cancel{2}} y} \times \frac{\cancel{y}}{\cancel{2}_{1} x} = \frac{2}{x^3}$

13. **(a)** $6(2 + x) = 5(1 - 4x)$

$12 + 6x = 5 - 20x$ (multiply out brackets)

$12 + 26x = 5$ (add $20x$ to both sides)

$26x = -7$ (subtract 12 from both sides)

$x = -\frac{7}{26}$ (divide both sides by 26)

(b) $3x + 6 \ge 5x - 14$

$-2x + 6 \ge -14$ (subtract $5x$ from both sides)

$-2x \ge -20$ (subtract 6 from both sides)

$x \le 10$ (divide both sides by -2)

Section 1.3 Graphs of linear equations

Practice Problems

1. From Figure S1.1 note that all five points lie on a straight line.

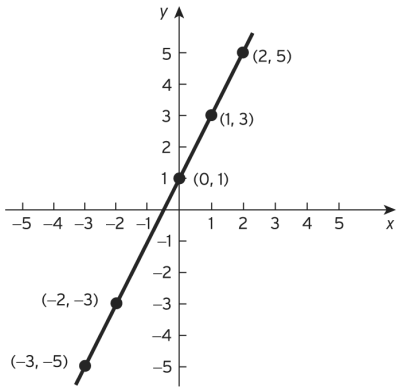

Figure S1.1

2.

Point	Check	
(–1,2)	2(–1) + 3(2) = –2 + 6 = 4	✓
(–4,4)	2(–4) + 3(4) = –8 + 12 = 4	✓
(5,–2)	2(5) + 3(–2) = 10 – 6 = 4	✓
(2,0)	2(2) + 3(0) = 4 + 0 = 4	✓

The graph is sketched in Figure S1.2.

The graph shows that (3, –1) does not lie on the line. This can be verified algebraically:

$2(3) + 3(-1) = 6 - 3 = 3 \neq 4$

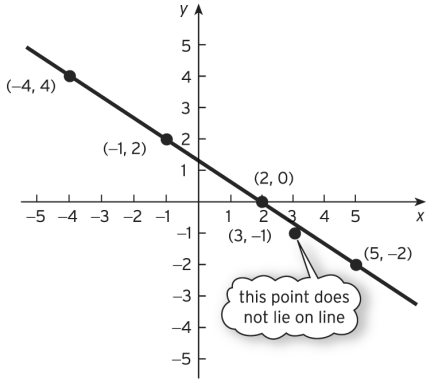

Figure S1.2

3. $3x - 2y = 4$

$3(2) - 2y = 4$ (substitute $x = 2$)

$6 - 2y = 4$

$-2y = -2$ (subtract 6 from both sides)

$y = 1$ (divide both sides by -2)

Hence (2,1) lies on the line.

$3x - 2y = 4$

$3(-2) - 2y = 4$

$-6 - 2y = 4$ (substitute $x = -2$)

$-2y = 10$ (add 6 to both sides)

$y = -5$ (divide both sides by -2)

Hence (–2, –5) lies on the line.

The line is sketched in Figure S1.3.

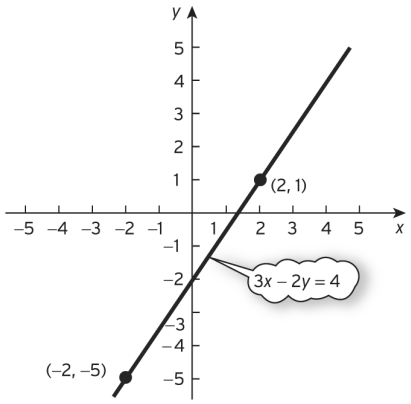

Figure S1.3

4. $x - 2y = 2$

$0 - 2y = 2$ (substitute $x = 0$)

$-2y = 2$

$y = -1$ (divide both sides by -2)

Hence (0, –1) lies on the line.

$x - 2y = 2$

$x - 2(0) = 2$ (substitute $y = 0$)

$x - 0 = 2$

$x = 2$

Hence (2,0) lies on the line.

The graph is sketched in Figure S1.4.

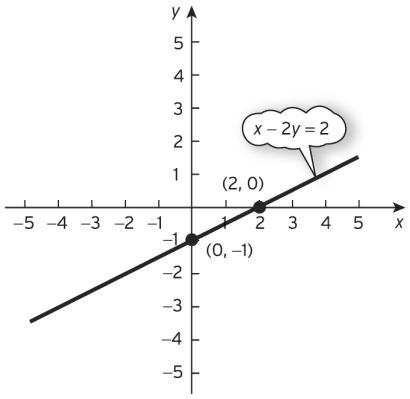

Figure S1.4

5. From Figure S1.5 the point of intersection is (1, –1/2).

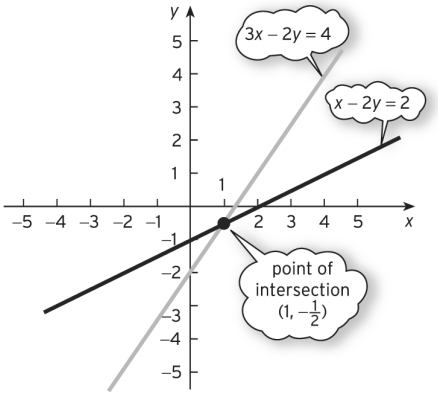

Figure S1.5

6. **(a)** a = 1, b = 2. The graph is sketched in Figure S1.7.

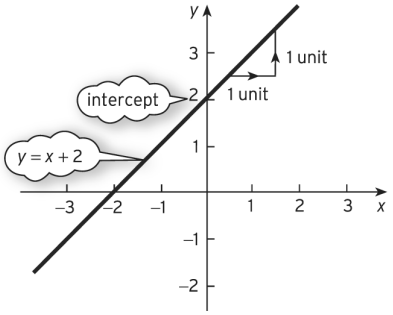

Figure S1.7