Name:

Level 2 Further Maths

Simultaneous Equations with 3 Unknowns

Corbettmaths

Ensure you have: Pencil or pen

Guidance

1. Read each question carefully before you begin answering it.
2. Check your answers seem right.
3. Always show your workings

Revision for this topic

www.corbettmaths.com/more/further-maths/

1. Solve the simultaneous equations

$$x - y + 3z = 5 \quad -(1)$$
$$x + y + 6z = 12 \quad -(2)$$
$$3x - 2y + 2z = 10 \quad -(3)$$

(1) + (2) → (4)

$2x + 9z = 17 \quad -(4)$

2 × (2) + (3) → (5)

$2x + 2y + 12z = 24$

add $3x - 2y + 2z = 10$

$5x + 14z = 34 \quad -(5)$

5 × (4) − 2 × (5)

$10x + 45z = 85$

$10x + 28z = 68$

$17z = 17$

$z = 1$

Sub $z = 1$ into (5)

$5x + 14 = 34$

$5x = 20$

$x = 4$

Sub $x = 4$ & $z = 1$ into (1)

$4 - y + 3 = 5$

$7 - y = 5$

$y = 2$

check in (2)

$4 + 2 + 6 = 12$ ✓

$x =$ 4 $y =$ 2 $z =$ 1

(5)

2. Solve the simultaneous equations

$$2x + 3y + 5z = 21 \quad -(1)$$

$$3x + 6y + 15z = 51 \quad -(2)$$

$$5x + 4y + 10z = 37 \quad -(3)$$

$2 \times (1) - (2) \rightarrow (4)$

$4x + 6y + 10z = 42$

sub $3x + 6y + 15z = 51$

$x - 5z = -9 \quad -(4)$

$2 \times (2) - 3 \times (3) \rightarrow (5)$

$6x + 12y + 30z = 102$

sub $15x + 12y + 30z = 111$

$-9x = -9 \quad -(5)$

$x = 1$

sub $x = 1$ into (4)

$1 - 5z = -9$

$-5z = -10$

$z = 2$

$x =$ 1 $y =$ 3 $z =$ 2

(5)

sub $x = 1$ & $z = 2$ into (3)

$5 + 4y + 20 = 37$

$4y = 12$

$y = 3$

check in (1)

$2 + 9 + 10 = 21$ ✓

3. Solve the simultaneous equations

$$2x + 4y - z = 15 \quad -(1)$$

$$3x + 8y + z = 44 \quad -(2)$$

$$x + 2y + 2z = 15 \quad -(3)$$

(1) + (2) → (4)

$5x + 12y = 59 \quad -(4)$

2 × (2) − (3) → (5)

$6x + 16y + 2z = 88$

sub $x + 2y + 2z = 15$

$5x + 14y = 73 \quad -(5)$

(5) (4) → (6)

$5x + 14y = 73$

sub $5x + 12y = 59$

$2y = 14$

$y = 7$

$x =$ ..-5.. $y =$ ..7.. $z =$ ..3..

(5)

sub $y = 7$ into (5)

$5x + 98 = 73$

$5x = -25$

$x = -5$

sub $x = -5$ & $y = 7$ into (1)

$-10 + 28 - z = 15$

$18 - z = 15$

$z = 3$

check in (3)

$-15 + 56 + 3 = 44$ ✓

4. Solve the simultaneous equations

$$10x + 60y + 10z = 25 \quad -(1)$$

$$5x + 40y + 20z = 40 \quad -(2)$$

$$20x + 20y + 40z = 30 \quad -(3)$$

$2 \times (1) - (2) \rightarrow (4)$

$$20x + 120y + 20z = 50$$

sub $\quad 5x + 40y + 20z = 40$

$$15x + 80y = 10 \rightarrow (4)$$

$2 \times (3) - 2 \times (2) \rightarrow 5$

$$20x + 20y + 40z = 30$$

sub $\quad 10x + 80y + 40z = 80$

$$10x - 60y = -50 \rightarrow (5)$$

$2 \times (4) - 3 \times (5)$

$$30x + 160y = 20$$

sub $\quad 30x - 180y = -150$

$$340y = 170$$

$$y = \frac{1}{2}$$

sub $y = \frac{1}{2}$ into (4)

$$15x + 40 = 10$$

$$15x = -30$$

$$x = -2$$

sub $x = -2$ & $y = \frac{1}{2}$ into (1)

$$-20 + 30 + 10z = 25$$

$$10 + 10z = 25$$

$$10z = 15$$

$$z = 1.5$$

Check in (2)

$-10 + 20 + 30 = 40$ ✓

$x =$ ..-2.. $y =$ ..0.5.. $z =$ ..1.5..

(5)

5. Solve the simultaneous equations

$$x + y + z = 1 \quad -(1)$$

$$4x - 3y + 4z = 32 \quad -(2)$$

$$x - 10y - 2z = 27 \quad -(3)$$

(1) − (3) → (4)

$x + y + z = 1$

sub $x - 10y - 2z = 27$

$11y + 3z = -26 \quad \rightarrow (4)$

4 × (1) − (2) → (5)

$4x + 4y + 4z = 4$

sub $4x - 3y + 4z = 32$

$7y = -28$

$y = -4$

sub $y = -4$ into (4)

$-44 + 3z = -26$

$3z = 18$

$z = 6$

Sub $y = -4$ & $z = 6$ into (1)

$x - 4 + 6 = 1$

$x + 2 = 1$

$x = -1$

$x = \ -1 \ \ y = \ -4 \ \ z = \ 6$

(5)

Check in (2)

$-4 + 12 + 24 = 32$ ✓

6. Solve the simultaneous equations

$$6x + 8y - 2z = 750 \quad -(1)$$

$$18x - 2y + 4z = 1100 \quad -(2)$$

$$4x - 4y + 2z = 100 \quad -(3)$$

$2 \times (1) - (3)$

$$36x - 4y + 8z = 2200$$
$$4x - 4y + 2z = 100$$

$$32x + 6z = 2100 \quad -(4)$$

$2 \times (3) + (1)$

$$8x - 8y + 4z = 200$$
$$6x + 8y - 2z = 750$$

$$14x + 2z = 950 \quad -(5)$$

$3 \times (5) - (4)$

$$42x + 6z = 2850$$
$$32x + 6z = 2100$$

$$10x = 750$$
$$x = 75$$

sub $x = 75$ into (5)

$$1050 + 2z = 950$$
$$2z = -100$$
$$z = -50$$

sub $x = 75$ & $z = -50$ into (1)

$$450 + 8y + 100 = 750$$
$$8y = 200$$
$$y = 25$$

$x = \ 75 \ \ y = \ 25 \ \ z = \ -50$

(5)

7. Solve the simultaneous equations

$$7x + 5y + 4z = 23 \quad -(1)$$

$$21x - 10y + 6z = -4 \quad -(2)$$

$$7x + 15y - 2z = -15 \quad -(3)$$

$3 \times (1) \Rightarrow \quad 21x + 15y + 12z = 69 \quad -(4)$

$3 \times (3) \Rightarrow \quad 21x + 45y - 6z = -45 \quad -(5)$

(4) − (2) ⇒ (6)

$$21x + 15y + 12z = 69$$
$$\text{sub} \quad 21x - 10y + 6z = -4$$
$$25y + 6z = 73 \quad -(6)$$

(5) − (4) ⇒ (7)

$$21x + 45y - 6z = -45$$
$$\text{sub} \quad 21x + 15y + 12z = 69$$
$$30y - 18z = -114 \quad -(7)$$

$3 \times (6) \Rightarrow (8)$

$$75y + 18z = 219 \quad -(8)$$
$$\text{add} \quad 30y - 18z = -114$$
$$105y = 105$$
$$y = 1$$

sub $y = 1$ into (6)

$25 + 6z = 73$

$6z = 48$

$z = 8$

sub $y = 1$ & $z = 8$ into (1)

$7x + 5 + 32 = 23$

$7x = -14$

$x = -2$

check in (2)

$-42 - 10 + 48 = -4$ ✓

$x = -2$ $y = 1$ $z = 8$

(5)

8. Solve the simultaneous equations

$$y - x + 2z = 2.1 \quad -(1)$$

$$3x - 2z - y + 2.5 = 0 \quad -(2)$$

$$8z + 10y + 5x = 4.5 \quad -(3)$$

$-x + y + 2z = 2.1$ $\quad 3x - y - 2z = -2.5$ $\quad 5x + 10y + 8z = 4.5$

$(1) + (2) \Rightarrow (4)$

$2x = -0.4$

$x = -0.2$

$4 \times (2) + (3) \Rightarrow (5)$

$12x - 4y - 8z = -10$

add $5x + 10y + 8z = 4.5$

$17x + 6y = -5.5 \quad -(5)$

sub $x = -0.2$ into (5)

$-3.4 + 6y = -5.5$

$6y = -2.1$

$y = -0.35$

sub $x = -0.2$ & $y = -0.35$ into (1)

$0.2 - 0.35 + 2z = 2.1$

$-0.15 + 2z = 2.1$

$z = 1.125$

check in (2)

$x = -0.2$ $\quad y = -0.35$ $\quad z = 1.125$

(5)

$-0.6 + 0.35 - 2.25 = -2.5$

$-2.5 = -2.5$ ✓