Worksheet - Solving linear equations and rearranging formulae

Year: Year 9 · 20

Show your working.

Question 1

Question 1 – One- and two-step equations *(Section A · Skills practice)*

Solve each equation by doing the same to both sides. Check your answer by substituting it back.

a. $3x + 5 = 20$
b. $4x - 7 = 17$
c. $5 - 2x = 11$
d. $\frac{x}{3} + 4 = 9$

Question 2

Question 2 – Equations with brackets *(Section A · Skills practice)*

Expand the brackets first, then solve.

a. $3(x + 4) = 27$
b. $2(3x - 1) = 22$
c. $4(x - 2) + 3 = 19$
d. $5(2x - 3) = 4(x + 3)$

Question 3

Question 3 – Unknowns on both sides *(Section A · Skills practice)*

Collect the x terms on one side (move the smaller x term) and the numbers on the other.

a. $5x + 3 = 2x + 18$
b. $7x - 4 = 3x + 12$
c. $4x + 9 = 6x - 1$
d. $3(x + 2) = x + 14$

Question 4

Question 4 – Equations with fractions *(Section A · Skills practice)*

Multiply every term by the denominator to clear the fraction. Solve each equation.

a. $\frac{x}{4} = 7$
b. $\frac{x+3}{2} = 8$
c. $\frac{2x-1}{3} = 5$
d. $\frac{x}{2} + \frac{x}{3} = 10$

Question 5

Question 5 – Changing the subject *(Section A · Skills practice)*

Rearrange each formula to make x the subject. Do the same operation to both sides.

a. $y = x + 5$
b. $y = 3x$
c. $y = 2x - 4$
d. Make l the subject of $A = lw$.

Question 6

Question 6 – Substituting into formulae *(Section A · Skills practice)*

Substitute the values into each formula and work out the answer.

a. $v = u + at$ with $u = 3$, $a = 2$, $t = 5$.
b. $A = \frac{1}{2}(a + b)h$ with $a = 4$, $b = 6$, $h = 3$.
c. $C = 2\pi r$ with $r = 5$ (to 1 decimal place).
d. $F = 1.8C + 32$ with $C = 15$.

Question 7

Question 7 – Think of a number *(Section B · Real-life practice)*

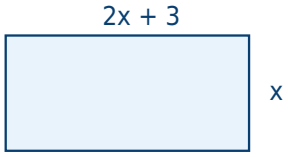
Two friends are playing a number game.

a. Ali thinks of a number, multiplies it by 3 and subtracts 7. The answer is 20. Form and solve an equation to find his number.
b. Bea thinks of a number, doubles it and adds 5. The answer is 12 more than her original number. Find her number.
c. Cal thinks of a number, adds 4 and multiplies by 5. The answer is 60. Find his number.
d. Check each of your answers.

Question 8

Question 8 – The rectangular garden *(Section B · Real-life practice)*

The length of a garden is $(2x + 3)$ metres and its width is x metres. The perimeter is 36 m.



a. Write an equation using the perimeter and solve it.
b. Find the length and width of the garden.
c. Find the area.
d. Turf costs £4.50 per square metre. Find the cost of covering the garden.

Question 9

Question 9 – Angles in a triangle *(Section B · Real-life practice)*

The three angles of a triangle are x°, $(2x + 10)^\circ$ and $(3x - 10)^\circ$.

a. Form an equation and solve it.
b. Write down the three angles.
c. Check that they add to 180°.
d. What type of triangle is it? Explain.

Question 10

Question 10 – Which taxi? *(Section B · Real-life practice)*

Taxi A charges £3 plus £1.50 per mile. Taxi B charges £1 plus £2 per mile.

a. Write each cost as an expression for m miles.
b. Form and solve an equation to find when the costs are the same.
c. What is the cost for that distance?
d. Which taxi is cheaper for a 10-mile journey? By how much?

Question 11

Question 11 – Tickets for the concert *(Section B · Real-life practice)*

At a school concert adult tickets cost £8 and child tickets cost £5. In total 40 tickets were sold for £260.

a. Let a be the number of adult tickets. Write the number of child tickets.
b. Form an equation for the total money and solve it.
c. How many of each ticket were sold?
d. The school hopes to raise £300 from 40 tickets. Is it possible? Explain.

Question 12

Question 12 – Cooking the turkey *(Section B · Real-life practice)*

A recipe says that the cooking time T minutes for a turkey of mass w kg is $T = 40w + 20$.

a. Find the time for a 5 kg turkey in hours and minutes.
b. Rearrange the formula to make w the subject.
c. A turkey is cooked for 300 minutes. Find its mass.
d. The turkey must be put in the oven so it is ready at 17:30. When should a 6 kg turkey go in?

Question 13

Question 13 – The flight *(Section B · Real-life practice)*

The formula $d = st$ links distance d, speed s and time t.

a. Make t the subject and s the subject.
b. A plane flies 1 800 km at 600 km/h. Find the time.
c. The same flight takes 2.5 hours on another day. Find the speed.
d. The plane's fuel use is 3 000 litres per hour. Find the fuel for the first flight.

Question 14

Question 14 – Pocket money *(Section B · Real-life practice)*

Sam gets £x per week. Alex gets £3 more per week than Sam. Together they receive £17 per week.

a. Write an expression for Alex's pocket money.
b. Form an equation and solve it.
c. How much does each get?
d. They each save everything for 8 weeks. How much have they saved together?

Question 15

Question 15 – Solve and check *(Section C · Problem solving)*

Solve each equation. Show every step and check by substituting.

	Equation
(a)	$7x - 3 = 2x + 22$
(b)	$3(2x + 1) = 4x + 15$
(c)	$\dfrac{x + 5}{3} = x - 1$
(d)	$2(x - 3) - 3(x - 4) = 5$

a. Solve (a).
b. Solve (b).
c. Solve (c).
d. Solve (d).
e. In which equation did you have to multiply to remove a fraction first?

Question 16

Question 16 – Rearranging formulae table *(Section C · Problem solving)*

The table has four formulae. Rearrange each to make the letter in the final column the subject, then use the values to find it.

Formula	Subject	Values
$v = u + at$	a	$v = 25,\ u = 5,\ t = 4$
$P = 2(l + w)$	l	$P = 30,\ w = 6$
$A = \frac{1}{2}bh$	h	$A = 30,\ b = 12$
$y = mx + c$	x	$y = 17,\ m = 4,\ c = 5$

a. Rearrange each formula.
b. Use the values to find each answer.
c. Check one of your answers by substituting.
d. Explain why you cannot find h from $A = \frac{1}{2}bh$ if $b = 0$.

Question 17

Question 17 – Comparing phone plans *(Section C · Problem solving)*

Plan A costs £15 per month plus 2p per minute. Plan B costs £5 per month plus 5p per minute. The cost of m minutes of calls is shown below.

Minutes m	0	100	200	400
Plan A (£)	15	17	19	23
Plan B (£)	5	10	15	25

a. Write the costs as formulae in pounds, with m in minutes.
b. Form an equation and solve it to find when the plans cost the same, to the nearest minute.
c. Which plan is cheaper for 400 minutes? For 100 minutes?
d. The family uses 250 minutes a month. Which plan should they choose and how much do they save over a year?

Question 18

Question 18 – When are Celsius and Fahrenheit equal? *(Section C · Problem*

solving)

The formula $F = 1.8C + 32$ converts temperatures from degrees Celsius to degrees Fahrenheit.

a. Find C when $F = 212$ (the boiling point of water).
b. Find C when $F = -4$.
c. Make C the subject of the formula.
d. Find the temperature at which the two scales show the same number.
e. Explain why this temperature is the same on both scales.

Question 19

Question 19 – The sports field *(Section C · Problem solving)*

A rectangular field is 20 m longer than it is wide. The perimeter is 140 m.

a. Let the width be x m. Write an expression for the length.
b. Form an equation for the perimeter and solve it.
c. Find the dimensions and the area.
d. Fencing costs £6.50 per metre. Find the cost to fence the whole field.
e. A gate 3 m wide is left in the fence. What is the new cost?

Question 20

Question 20 – Challenge: ages and fractions *(Section D · Challenge)*

Ben is b years old. His mother is four times as old as Ben. In 6 years she will be three times as old as Ben.

a. Write an equation and solve it to find Ben's age.
b. Find his mother's age now and in 6 years.
c. Solve $\dfrac{3x+1}{2} - \dfrac{x-2}{3} = \dfrac{7}{2}$.
d. Check your answer to part (c) by substituting.
e. Make x the subject of $y = \dfrac{3x+1}{2}$.