Worksheet - Linear equations and inequalities

Year: Year 10 · 20

Show your working.

Question 1

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

Non-calculator. Solve each equation. Check each answer by substituting back.

a. $3x + 7 = 25$
b. $5 - 2x = 13$
c. $\frac{x}{4} - 3 = 2$
d. $4(x - 3) = 20$

Question 2

Question 2 – Unknown on both sides *(Section A · Skills practice)*

Solve each equation. Collect the x terms on the side where the coefficient is bigger.

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

Question 3

Question 3 – Equations with fractions *(Section A · Skills practice)*

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

a. $\frac{x + 3}{2} = 7$
b. $\frac{2x - 1}{3} = 5$
c. $\frac{x}{2} + \frac{x}{3} = 10$
d. $\frac{3x + 1}{4} = \frac{x + 9}{2}$

Question 4

Question 4 – Solving inequalities *(Section A · Skills practice)*

Solve each inequality. Remember that multiplying or dividing by a negative number reverses the inequality sign.

a. $3x - 4 > 11$
b. $5 - 2x \geq 9$
c. $-3 < 2x + 1 \leq 9$
d. $4(x - 1) < 3x + 2$

Question 5

Question 5 – Integer solutions and number lines *(Section A · Skills practice)*

Use your answers to the inequalities to answer these questions.

a. List the integers that satisfy $-2 < x \leq 4$.
b. What is the largest integer that satisfies $3x + 2 < 20$?
c. What is the smallest integer that satisfies $2x - 7 \geq 1$?
d. Describe how you would show $x \leq -2$ on a number line.

Question 6

Question 6 – Forming equations from words *(Section A · Skills practice)*

Write an equation for each problem and solve it.

a. I think of a number, multiply it by 4 and subtract 9. The answer is 31.
b. Ben is x years old. His sister is 3 years older and his mother is 4 times as old as Ben. Their total age is 63.
c. Three consecutive whole numbers add up to 96.
d. A rectangle has length $(x + 5)$ cm and width x cm. Its perimeter is 38 cm.

Question 7

Question 7 – Comparing phone plans *(Section B · Real-life practice)*

Two mobile phone tariffs are shown. m is the number of minutes used in a month. Calculator allowed.

Plan	Monthly fee	Cost per minute
A	£12	3p
B	£5	10p

a. Write an expression, in pounds, for the monthly cost of each plan.
b. Form and solve an equation to find the number of minutes for which the two plans cost the same.

c. What is that cost?
d. Which plan is cheaper for a customer who uses 150 minutes? Explain.

Question 8

Question 8 – Fencing the garden *(Section B · Real-life practice)*

A rectangular garden has length $(3x - 2)$ metres and width $(x + 4)$ metres. The perimeter of the garden is 60 m.

a. Write and simplify an equation for the perimeter.
b. Solve it to find x.
c. Find the length and width of the garden and its area.
d. Fencing costs £14.50 per metre. How much does it cost to fence the whole perimeter?

Question 9

Question 9 – Taxi companies *(Section B · Real-life practice)*

Two taxi firms charge for a journey of d miles. City Cabs charge £2.40 plus £1.60 per mile. Quick Cars charge £3.80 plus £1.40 per mile.

a. Write an expression for the cost with each firm.
b. Find the distance at which both firms charge the same and the cost.
c. Which firm is cheaper for a 3-mile journey, and by how much?
d. Which firm is cheaper for a 12-mile journey, and by how much?

Question 10

Question 10 – Concert tickets *(Section B · Real-life practice)*

A school concert has adult tickets at £25 and child tickets at £15. A total of 120 tickets were sold and the takings were £2400.

a. Let a be the number of adult tickets. Write the number of child tickets in terms of a.
b. Form an equation for the total takings.
c. Solve it to find the number of adult tickets and child tickets.
d. The school wants takings of at least £2700 from 120 tickets. How many adult tickets must it sell at least?

Question 11

Question 11 – Hiring the minibuses *(Section B · Real-life practice)*

A school trip has 212 pupils and 8 teachers. Each coach seats 48 people and costs £350 to hire.

a. Write an inequality for the number of coaches n needed.
b. Solve it and find the smallest whole number of coaches.
c. Find the cost for that number of coaches.
d. The school can only spend £1500. What is the biggest number of coaches it can hire, and how many people could it carry?

Question 12

Question 12 – Saving for a console *(Section B · Real-life practice)*

Mia has £35 and saves £8 each week. A games console costs £150.

a. Write an expression for her savings after w weeks.
b. Write an inequality to show when she can afford the console.
c. Solve it to find the smallest whole number of weeks.
d. Her uncle gives her £20. How many weeks does she save then?

Question 13

Question 13 – Gym membership *(Section B · Real-life practice)*

Fit4U charges a joining fee of £30 and £18 per month. Gymzone has no joining fee and charges £25 per month.

a. Write an expression for the total cost of each gym after m months.
b. Solve $30 + 18m < 25m$.
c. After how many whole months is Fit4U cheaper overall?
d. Alisha wants a 12-month membership. How much does she save with the cheaper gym?

Question 14

Question 14 – The isosceles roof *(Section B · Real-life practice)*

A roof truss is an isosceles triangle. The apex angle is $(x + 30)^\circ$ and each base angle is $(2x - 5)^\circ$.

a. Write an equation using the angle sum of a triangle.
b. Solve the equation to find x.
c. Find the three angles.
d. Check that the angles add up to 180°.

Question 15

Question 15 – The square and the rectangle *(Section C · Problem solving)*

A square has side $(x + 3)$ cm. A rectangle has length $(2x - 1)$ cm and width $(x + 2)$ cm. The square and the rectangle have the same perimeter.

a. Write an equation for equal perimeters and simplify.
b. Solve it to find x.
c. Find the side of the square and the dimensions of the rectangle.
d. Which has the bigger area, and by how much?

Question 16

Question 16 – Will the café make a profit? *(Section C · Problem solving)*

A café sells each hot drink for £3. Each day it pays £60 for rent and staff, and each drink costs £1.20 to make.

a. Write an expression for the profit when d drinks are sold in a day.
b. Form and solve an inequality to find the least number of drinks needed to make a profit.
c. The owner wants a profit of at least £100 a day. How many drinks is that?
d. If the café sells 80 drinks, what is the profit, and is the target reached?

Question 17

Question 17 – Higher: quadratic inequalities *(Section C · Problem solving)*

Higher tier. Solve each inequality by factorising, sketching the graph and reading off the values.

a. $x^2 - 5x + 6 < 0$
b. $x^2 \geq 16$
c. $x^2 - 2x - 8 > 0$
d. List the integers that satisfy $x^2 < 10$.

Question 18

Question 18 – Higher: integer points in a region *(Section C · Problem solving)*

Higher tier. A region R is defined by the three inequalities $x \geq 1$, $y \leq 5$ and $y > x$.

a. Describe the boundary lines and say which ones are solid and which are dashed.
b. List the integer points (x, y) in R with $x = 1$.
c. List all the integer points in R.
d. How many integer points are there? Explain whether $(3, 3)$ is in R.

Question 19

Question 19 – Number puzzles with fractions *(Section C · Problem solving)*

Solve these equations and puzzles.

a. $\dfrac{2x+1}{3} = \dfrac{x-4}{2}$
b. $\dfrac{x}{3} + \dfrac{x-2}{5} = 2$
c. I think of a number, add 7 and divide by 3. The answer is 5 less than my number. What is my number?
d. Check your answer to part (c) by substituting.

Question 20

Question 20 – Challenge: consecutive even numbers *(Section D · Challenge)*

Three consecutive even numbers are written as n, $n+2$ and $n+4$.

a. The sum of the largest two numbers is 22 more than the smallest. Find the numbers.
b. Show that the sum of any three consecutive even numbers is a multiple of 6.
c. Find the range of values of k for which $3x + k = 12$ has a positive solution.
d. Find the largest integer k for which the equation in part (c) has a positive whole number solution that is also even.