Factorisation: Splitting the Middle Term

Unit: Algebra - Student Practice Worksheet

Overview: Meera and Arjun raced to factorise $x^2 + 7x + 12$. Meera finished in one line. Arjun tried five different number pairs before he found the right one. "You didn't guess faster," Meera said. "You just weren't checking a rule first." She showed him the two questions that turn guessing into a two-step search.

Practice Questions (30 Total)

Section A - Easy

Q1. Four tiles for $x^2 + 7x + 12$. Factorised form?

- ☐ **A.** $(x + 2)(x + 6)$
- ☐ **B.** $(x + 12)(x + 1)$
- ☐ **C.** $(x + 3)(x + 4)$
- ☐ **D.** $(x + 7)(x + 12)$

Q2. To factorise $x^2 + 7x + 12$, what two conditions must the pair of numbers satisfy?

- ☐ **A.** Multiply to 12 and add to 7
- ☐ **B.** Add to 12 and multiply to 7
- ☐ **C.** Multiply to 7 and add to 12
- ☐ **D.** Both equal 7

Q3. Which pair of numbers multiplies to 12 and adds to 7?

- ☐ **A.** 2 and 6
- ☐ **B.** 3 and 4
- ☐ **C.** 1 and 12
- ☐ **D.** 6 and 1

Q4. Factorise $x^2 – x – 12$ using a split of the middle term.

$x^2 \quad -x \quad -12$

- [ ] **A.** (x + 3)(x – 4)
- [ ] **B.** (x – 3)(x + 4)
- [ ] **C.** (x + 12)(x – 1)
- [ ] **D.** (x – 6)(x + 2)

Q5. In $x^2 - x - 12$, what sign pattern must the two numbers have, since the constant is negative?

- [ ] **A.** Both positive
- [ ] **B.** Both negative
- [ ] **C.** Both zero
- [ ] **D.** Opposite signs

Q6. Which pair of numbers multiplies to 6 and adds to 7?

- [ ] **A.** 2 and 3
- [ ] **B.** 6 and 1
- [ ] **C.** 1 and 6
- [ ] **D.** 3 and 2

Q7. For $2x^2 + 7x + 3$, which two pieces do you multiply first?

$2x^2$ $+3$ first × last

- [ ] **A.** The two coefficients 2 and 7
- [ ] **B.** The first coefficient and the last term
- [ ] **C.** The two constants 7 and 3
- [ ] **D.** Nothing — just use 7 directly

Q8. After splitting the middle term, what technique finishes the factorisation?

- [ ] **A.** Expanding brackets
- [ ] **B.** Squaring both sides
- [ ] **C.** Dividing by x

- [ ] **D.** Factoring by grouping

Q9. For a quadratic $x^2 + bx + c$ with c positive, what must be true of the two numbers you find?

- [ ] **A.** They multiply to a negative number
- [ ] **B.** They share the same sign as b
- [ ] **C.** They are always both 1
- [ ] **D.** One is always zero

Q10. After factorising, how do you check, and why expanding is the reliable test?

- [ ] **A.** Check by expanding it back out
- [ ] **B.** Divide by the leading coefficient
- [ ] **C.** Substitute x=1 only
- [ ] **D.** Nothing further is needed

Section B - Medium

Q11. Factorise $x^2 + 8x + 15$.

$$x^2 + 8x + 15$$

- [ ] **A.** $(x + 3)(x + 5)$
- [ ] **B.** $(x + 1)(x + 15)$
- [ ] **C.** $(x + 8)(x + 15)$
- [ ] **D.** $(x + 5)(x + 15)$

Q12. Factorise $x^2 - 6x - 27$.

- [ ] **A.** $(x + 9)(x - 3)$
- [ ] **B.** $(x - 9)(x + 3)$
- [ ] **C.** $(x - 27)(x + 1)$
- [ ] **D.** $(x - 6)(x + 4)$

Q13. Factorise $x^2 - 2x - 15$.

- [ ] **A.** $(x - 3)(x + 5)$
- [ ] **B.** $(x + 3)(x - 5)$

- [ ] **C.** (x – 15)(x + 1)
- [ ] **D.** (x + 15)(x – 1)

Q14. Factorise $2x^2 - 5x - 3$ by splitting the middle term.

$$2x^2 - 5x - 3$$

- [ ] **A.** (2x – 1)(x + 3)
- [ ] **B.** (2x + 3)(x – 1)
- [ ] **C.** (2x – 3)(x + 1)
- [ ] **D.** (2x + 1)(x – 3)

Q15. Factorise $x^2 + 2x - 24$.

- [ ] **A.** (x – 6)(x + 4)
- [ ] **B.** (x + 8)(x – 3)
- [ ] **C.** (x – 8)(x + 3)
- [ ] **D.** (x + 6)(x – 4)

Q16. Factorise $3x^2 + 11x + 6$.

- [ ] **A.** (3x + 3)(x + 2)
- [ ] **B.** (x + 2)(3x + 6)
- [ ] **C.** (3x + 2)(x + 3)
- [ ] **D.** (3x + 6)(x + 1)

Q17. Factorise $4x^2 + 4x - 3$.

$$4x^2 + 4x - 3$$

- [ ] **A.** (2x + 3)(2x – 1)
- [ ] **B.** (2x – 3)(2x + 1)
- [ ] **C.** (4x + 3)(x – 1)
- [ ] **D.** (4x – 3)(x + 1)

Q18. Factorise $5x^2 + 13x + 6$.

- [ ] **A.** (5x + 2)(x + 3)
- [ ] **B.** (5x + 6)(x + 1)
- [ ] **C.** (5x + 3)(x + 2)
- [ ] **D.** (5x + 1)(x + 6)

Q19. Factorise $x^2 - 9x + 20$.

- [ ] **A.** (x + 4)(x + 5)
- [ ] **B.** (x – 4)(x – 5)
- [ ] **C.** (x – 2)(x – 10)
- [ ] **D.** (x – 1)(x – 20)

Q20. Which pair multiplies to –6 and adds to –1, and why both conditions matter?

- [ ] **A.** 2 and -3
- [ ] **B.** -2 and 3
- [ ] **C.** 1 and -6
- [ ] **D.** 6 and -1

Section C - Challenge

Q21. Factorise $6x^2 + 5x - 6$.

$$6x^2 + 5x - 6$$

- [ ] **A.** (3x – 2)(2x + 3)
- [ ] **B.** (3x + 2)(2x – 3)
- [ ] **C.** (6x – 2)(x + 3)
- [ ] **D.** (6x + 3)(x – 2)

Q22. If $x^2 + bx - 20$ has integer factors and b is as small in magnitude as possible, what is b?

- [ ] **A.** 8
- [ ] **B.** 19
- [ ] **C.** 1
- [ ] **D.** -19

Q23. Factorise $8x^2 - 2x - 15$.

- A. (4x – 5)(2x + 3)
- B. (4x + 5)(2x – 3)
- C. (8x + 5)(x – 3)
- D. (8x – 5)(x + 3)

Q24. Area $6x^2+19x+10$, one side $2x+5$. Other side?

area $6x^2+19x+10$, side $2x+5$

- A. (3x + 5)
- B. (6x + 2)
- C. (3x + 2)
- D. (2x + 2)

Q25. Factorise $10x^2 + x - 3$.

- A. (5x – 3)(2x + 1)
- B. (10x + 3)(x – 1)
- C. (10x – 3)(x + 1)
- D. (5x + 3)(2x – 1)

Q26. Factorise $x^2 - 3x - 40$.

- A. (x + 8)(x – 5)
- B. (x – 4)(x + 10)
- C. (x + 4)(x – 10)
- D. (x – 8)(x + 5)

Q27. Factorise $9x^2 - 24x + 16$ and say if it is a perfect square.

$9x^2 - 24x + 16$

- A. $(3x - 4)^2$, a perfect square trinomial
- B. (3x + 4)(3x – 4), a difference of squares
- C. (9x – 4)(x – 4)

- [ ] **D.** (3x – 4)(3x + 6)

Q28. Factorise $12x^2 – 17x + 6$.

- [ ] **A.** (3x + 2)(4x + 3)
- [ ] **B.** (3x – 2)(4x – 3)
- [ ] **C.** (6x – 2)(2x – 3)
- [ ] **D.** (12x – 2)(x – 3)

Q29. Factorise $6x^2 – 7x – 3$ completely.

- [ ] **A.** (3x – 1)(2x + 3)
- [ ] **B.** (3x + 1)(2x – 3)
- [ ] **C.** (6x + 1)(x – 3)
- [ ] **D.** (6x – 1)(x + 3)

Q30. Pull $–1$ from $–x^2+5x+6$, then factor the quadratic fully.

- [ ] **A.** -(x – 6)(x + 1)
- [ ] **B.** -(x + 6)(x – 1)
- [ ] **C.** (x – 6)(x + 1)
- [ ] **D.** -(x – 5)(x + 6)

Answer Key

Q1: (C) (c) (x + 3)(x + 4). Using the pair 3 and 4, which multiply to 12 and add to 7.

Q2: (A) (a) Multiply to 12 and add to 7. Once found, those two numbers split the middle term.

Q3: (B) (b) 3 and 4. 3×4=12 and 3+4=7 — both conditions satisfied together, unlike the other pairs which multiply correctly but don't add to 7.

Q4: (A) (a) (x + 3)(x – 4). 3 and –4 multiply to –12 and add to –1, matching $x^2 – x – 12$'s coefficients exactly.

Q5: (D) (d) Opposite signs. A negative product only happens when one number is positive and the other negative.

Q6: (C) (c) 1 and 6. 1×6=6 and 1+6=7 — this pair is used to split the middle term of $2x^2+7x+3$.

Q7: (B) (b) The first coefficient and the last term (2 and 3). This gives the target product (6) for the number-pair search when a is not 1.

Q8: (D) (d) Factoring by grouping. The split turns three terms into four, which then group into two matching-bracket pairs.

Q9: (B) (b) They share the same sign as b. A positive product means the two numbers have matching signs, and to also add up to b, that shared sign must match b's own sign.

Q10: (A) (a) Check by expanding it back out. This is the one reliable check that catches an arithmetic slip anywhere in the process.

Q11: (A) (a) (x + 3)(x + 5). 3 and 5 multiply to 15 and add to 8.

Q12: (B) (b) (x – 9)(x + 3). -9 and 3 multiply to -27 and add to -6.

Q13: (B) (b) (x + 3)(x – 5). 3 and –5 multiply to –15 and add to –2, matching $x^2 – 2x – 15$ exactly.

Q14: (D) (d) (2x + 1)(x – 3). First×last = -6; the pair 1 and -6 multiply to -6 and add to -5.

Q15: (D) (d) (x + 6)(x – 4). 6 and -4 multiply to -24 and add to 2.

Q16: (C) (c) (3x + 2)(x + 3). First×last = 18; the pair 2 and 9 multiply to 18 and add to 11, splitting to $3x^2+2x+9x+6 = x(3x+2)+3(3x+2)$.

Q17: (A) (a) (2x + 3)(2x – 1). First×last=-12; the pair 6 and -2 multiply to -12 and add to 4, splitting to $4x^2+6x–2x–3$.

Q18: (C) (c) (5x + 3)(x + 2). First×last=30; the pair 3 and 10 multiply to 30 and add to 13, splitting to $5x^2+3x+10x+6$.

Q19: (B) (b) (x – 4)(x – 5). -4 and -5 multiply to 20 and add to -9, both negative since c is positive and b is negative.

Q20: (A) (a) 2 and -3. 2×(-3)=-6 and 2+(-3)=-1, matching both conditions at once.

Q21: (A) (a) (3x – 2)(2x + 3). First×last=-36; the pair 9 and -4 multiply to -36 and add to 5, splitting to $6x^2+9x–4x–6$.

Q22: (C) (c) 1. Among all factor pairs of -20 (1&-20, 2&-10, 4&-5, and their sign-flips), 4 and -5 give the smallest-magnitude sum: 4+(-5)=-1, or -4+5=1 — the smallest magnitude achievable is 1.

Q23: (B) (b) (4x + 5)(2x – 3). First×last=-120; the pair 10 and -12 multiply to -120 and add to -2, splitting to $8x^2+10x–12x–15$.

Q24: (C) (c) (3x + 2). Check: $(2x+5)(3x+2) = 6x^2+4x+15x+10 = 6x^2+19x+10$, matching the given area.

Q25: (D) (d) (5x + 3)(2x – 1). First×last=-30; the pair 6 and -5 multiply to -30 and add to 1, splitting to $10x^2+6x–5x–3$.

Q26: (D) (d) (x – 8)(x + 5). -8 and 5 multiply to -40 and add to -3, matching $x^2 – 3x – 40$ exactly.

Q27: (A) (a) $(3x – 4)^2$, a perfect square trinomial. First×last=144; pair -12 and -12 multiply to 144 and add to -24, and since both halves match, it's really a perfect square in disguise.

Q28: (B) (b) (3x – 2)(4x – 3). First×last=72; the pair -8 and -9 multiply to 72 and add to -17, splitting to $12x^2–8x–9x+6$.

Q29: (B) (b) (3x + 1)(2x – 3). First×last=-18; the pair 2 and -9 multiply to -18 and add to -7, splitting to $6x^2+2x–9x–3$.

Q30: (A) (a) -(x – 6)(x + 1). Pull out -1 first to get $-(x^2–5x–6)$, then factorise $x^2–5x–6$ using -6 and 1, which multiply to -6 and add to -5.

You've got this! Keep learning and shining! - Ruchi Math Coaching