Palindromic Numbers

Unit: Number Play - Student Practice Worksheet

Overview: Anaya read 121 forwards. Then she read it backwards. Same number. Kabir tried it with 123 — forwards and backwards gave two different numbers entirely. One of those numbers had a name, and the other one didn't.

Practice Questions (30 Total)

Section A - Easy

Q1. The two teal boxes match from both ends. Which palindromic number is shown?

- ☐ **A.** 121
- ☐ **B.** 123
- ☐ **C.** 120
- ☐ **D.** 125

Q2. The first step of the reverse-and-add process is to:

- ☐ **A.** Divide the number by 2
- ☐ **B.** Multiply the number by itself
- ☐ **C.** Reverse the number's digits
- ☐ **D.** Subtract 1 from the number

Q3. Which of these is NOT a palindromic number?

- ☐ **A.** 1331
- ☐ **B.** 1234
- ☐ **C.** 1221
- ☐ **D.** 1111

Q4. The arrow reverses the digits of 47. What lands in the peach box?

- [ ] **A.** 47
- [ ] **B.** 40
- [ ] **C.** 7
- [ ] **D.** 74

Q5. The number 196 is famous in mathematics because:

- [ ] **A.** No one has proven if it reaches a palindrome
- [ ] **B.** It is the largest known palindrome
- [ ] **C.** It is the smallest palindrome
- [ ] **D.** It cannot be reversed

Q6. 47 + 74 equals:

- [ ] **A.** 111
- [ ] **B.** 121
- [ ] **C.** 131
- [ ] **D.** 141

Q7. The letter boxes of MADAM match from both ends. Why is this a palindrome?

- [ ] **A.** It has 5 letters
- [ ] **B.** It starts and ends with M
- [ ] **C.** It reads the same forwards and backwards
- [ ] **D.** It is a common name

Q8. What is a palindromic number?

- [ ] **A.** A number that is always even
- [ ] **B.** A number with three digits

- [ ] **C.** A number that cannot be reversed
- [ ] **D.** A number that reads the same forwards and backwards

Q9. Is 305 a palindrome?

- [ ] **A.** Yes
- [ ] **B.** Only sometimes
- [ ] **C.** All 3-digit numbers are palindromes
- [ ] **D.** No

Q10. Is 202 a palindrome?

- [ ] **A.** No, it does not match
- [ ] **B.** Only if reversed twice
- [ ] **C.** Yes, it reads the same both ways
- [ ] **D.** Cannot be determined here

Section B - Medium

Q11. The teal bar shows one reverse-and-add step. What palindrome is the result?

$$47 + 74 = 121$$

- [ ] **A.** 121
- [ ] **B.** 111
- [ ] **C.** 47
- [ ] **D.** 74

Q12. Why does Ms. Rao call 196 'genuinely unsolved' rather than just a hard example?

- [ ] **A.** Because 196 is not actually a real number
- [ ] **B.** No one has proven it either does or does not reach a palindrome
- [ ] **C.** Because no one has ever tried the process on 196
- [ ] **D.** Because 196 already is a palindrome

Q13. Anaya took 68 through reverse-and-add. After round 1 (68+86), what number did she get?

- [ ] **A.** 121

- [ ] **B.** 154
- [ ] **C.** 605
- [ ] **D.** 1111

Q14. How many reverse-and-add rounds does this 68 chain take to reach a palindrome?

68 + 86 = 154

154 + 451 = 605

605 + 506 = 1111

- [ ] **A.** 1
- [ ] **B.** 2
- [ ] **C.** 3
- [ ] **D.** 4

Q15. Which single-digit numbers are automatically palindromes?

- [ ] **A.** None of them
- [ ] **B.** Only even numbers
- [ ] **C.** Only 0
- [ ] **D.** All of them

Q16. Apply reverse-and-add to 23. What is the result?

- [ ] **A.** 32
- [ ] **B.** 23
- [ ] **C.** 65
- [ ] **D.** 55

Q17. The form aba means the first and last digits match. How many 3-digit palindromes exist (first digit 1–9, middle 0–9)?

a b a

- [ ] **A.** 100
- [ ] **B.** 9
- [ ] **C.** 90
- [ ] **D.** 81

Q18. If a two-digit number's two digits are already equal (like 33), is it already a palindrome?

- [ ] **A.** Yes
- [ ] **B.** No, it still needs reverse-and-add
- [ ] **C.** Only if the digits are both even
- [ ] **D.** Only if the number is bigger than 50

Q19. Apply reverse-and-add to 15. What is the result?

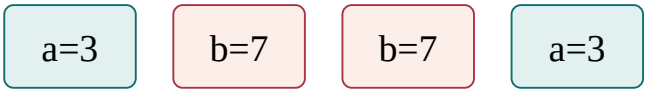
- [ ] **A.** 66
- [ ] **B.** 15
- [ ] **C.** 51
- [ ] **D.** 16

Q20. Is 1000 a palindrome?

- [ ] **A.** Yes
- [ ] **B.** No
- [ ] **C.** Only 4-digit numbers ending in 0 are
- [ ] **D.** Only if you add a leading zero

Section C - Challenge

Q21. The boxes show a=3, b=7 in the pattern a-b-b-a. What 4-digit palindrome is that?



Read the four boxes in order

- [ ] **A.** 3737
- [ ] **B.** 7337
- [ ] **C.** 3377
- [ ] **D.** 3773

Q22. A student claims every number reaches a palindrome within 3 rounds of reverse-and-add. Is this claim provably true?

- A. Yes, it has been mathematically proven for all numbers
- B. No — this is exactly the kind of claim that remains unproven for numbers like 196
- C. Yes, but only for numbers under 100
- D. No number ever reaches a palindrome

Q23. Apply reverse-and-add to 59. How many rounds does it take to reach a palindrome, and what is it?

- A. 3 rounds, 1111
- B. 1 round, 154
- C. 2 rounds, 605
- D. 1 round, 121

Q24. 100 reversed as digits is 0, 0, 1. What number is that, and why does 100 fail the palindrome test?

$100 \rightarrow 0, 0, 1$

as a number: 1

- A. 001, which as a number is simply 1
- B. 100, unchanged
- C. 1000, with an extra zero added
- D. It cannot be reversed at all

Q25. Anaya notices every number she tries eventually reaches a palindrome within 10 rounds. Does this prove all numbers do?

- A. Yes, testing enough examples always counts as a proof
- B. Yes, because 10 rounds is the mathematically proven maximum
- C. No — testing many examples is evidence, not a proof covering every number
- D. No, because reverse-and-add is not a real mathematical process

Q26. How many 2-digit palindromes exist (numbers like 11, 22, …, 99)?

- A. 10
- B. 90

- [ ] **C.** 99
- [ ] **D.** 9

Q27. After round 2 on 154 (154+451), what number resulted? Use the same chain as 68.

$$68 + 86 = 154$$

$$154 + 451 = 605$$

$$605 + 506 = 1111$$

- [ ] **A.** 154
- [ ] **B.** 605
- [ ] **C.** 506
- [ ] **D.** 1111

Q28. What makes the reverse-and-add process a genuine piece of real mathematical research rather than just a classroom trick?

- [ ] **A.** It always produces the same answer for any number
- [ ] **B.** It connects to a real unsolved problem mathematicians still study
- [ ] **C.** It was invented specifically for this textbook
- [ ] **D.** It only works for numbers under 1000

Q29. After reversing 100, Kabir adds 100 + 1. What does he get, and is it a palindrome?

- [ ] **A.** 101, which is a palindrome
- [ ] **B.** 100, unchanged
- [ ] **C.** 1000
- [ ] **D.** 001

Q30. Which of these famous numbers besides 196 is also suspected to never reach a palindrome via reverse-and-add?

- [ ] **A.** All two-digit numbers
- [ ] **B.** Every even number
- [ ] **C.** Numbers such as 295 and 394
- [ ] **D.** The number 121 itself

Answer Key

Q1: (A) (a) 121. The first and last digits match, so the number reads the same forwards and backwards.

Q2: (C) (c) Reverse the digits of the number first.

Q3: (B) (b) 1234 reversed is 4321, a different number.

Q4: (D) (d) 74 — the digits swap places.

Q5: (A) (a) It's an unsolved open question whether repeated reverse-and-add ever turns 196 into a palindrome.

Q6: (B) (b) 121, which is itself a palindrome.

Q7: (C) (c) It reads identically forwards and backwards, same as a palindromic number.

Q8: (D) (d) A number that reads the same forwards and backwards, like 121 or 1331.

Q9: (D) (d) No — 305 reversed is 503, a different number.

Q10: (C) (c) Yes — 202 reversed is still 202.

Q11: (A) (a) 121. 47 + 74 = 121, which reads the same both ways.

Q12: (B) (b) It's genuinely unproven despite huge computational effort.

Q13: (B) (b) 154. 68 + 86 = 154.

Q14: (C) (c) 3 rounds: 68→154→605→1111. The peach bar is the last, palindrome step.

Q15: (D) (d) All single-digit numbers are trivially palindromes, since there's nothing to reverse.

Q16: (D) (d) 55. 23 reversed is 32; 23+32=55, itself a palindrome.

Q17: (C) (c) 90. 9 choices for a (1–9) times 10 choices for b (0–9).

Q18: (A) (a) Yes — reversing 33 gives 33 again.

Q19: (A) (a) 66. 15 reversed is 51; 15+51=66.

Q20: (B) (b) No — 1000 reversed is 0001, which as a written number is 1, not 1000.

Q21: (D) (d) 3773. Read the four boxes in order: 3, 7, 7, 3.

Q22: (B) (b) No — 196 and similar numbers keep this an open question.

Q23: (A) (a) 3 rounds, 1111. 59+95=154; 154+451=605; 605+506=1111.

Q24: (A) (a) Reversing 100 gives 001, which as a written number is 1, not 100. Leading zeros are dropped.

Q25: (C) (c) No — a real proof must cover every possible number, which remains unresolved.

Q26: (D) (d) 9. Only 11, 22, 33, 44, 55, 66, 77, 88, 99.

Q27: (B) (b) 605. 154 + 451 = 605. This is the middle step of the 68/59 chain.

Q28: (B) (b) It connects to the real, unresolved Lychrel number question.

Q29: (A) (a) 101, which is a palindrome. Reverse-and-add uses the numerical reverse 1, not the three-digit string 001.

Q30: (C) (c) Several other numbers (like 295, 394) are similarly suspected Lychrel-like candidates.

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