Sum of Numbers Going Up and Down

Unit: Number Play - Student Practice Worksheet

Overview: Pixel wrote 1+2+3+2+1 on the board — numbers climbing up, then climbing right back down. Kabir started adding term by term: 1+2=3, +3=6, +2=8, +1=9. Anaya just said '9 — that's 3 squared,' before Kabir had even added the third term.

Practice Questions (30 Total)

Section A - Easy

Q1. The mountain bars climb 1, 2, 3, 2, 1. What total do they show?

- ☐ **A.** 9
- ☐ **B.** 8
- ☐ **C.** 6
- ☐ **D.** 12

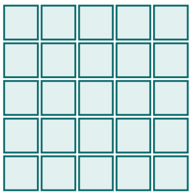
Q2. In an up-and-down sum like 1+2+...+n+...+2+1, what does the total always equal?

- ☐ **A.** n
- ☐ **B.** 2n
- ☐ **C.** n + 1
- ☐ **D.** n squared

Q3. What is 1+2+1?

- ☐ **A.** 3
- ☐ **B.** 4
- ☐ **C.** 6
- ☐ **D.** 5

Q4. The 5-by-5 grid is the up-and-down sum with peak 5. How many cells?



peak 5

5 by 5 = 25

- [ ] **A.** 25
- [ ] **B.** 20
- [ ] **C.** 30
- [ ] **D.** 24

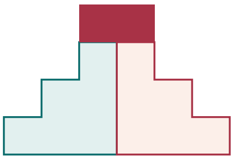
Q5. What shape does the up-and-down sum visually represent, according to Pixel?

- [ ] **A.** A circle
- [ ] **B.** A single straight line
- [ ] **C.** A pentagon
- [ ] **D.** A square, from two glued triangles

Q6. What is 1+2+3+4+5+6+5+4+3+2+1?

- [ ] **A.** 30
- [ ] **B.** 42
- [ ] **C.** 36
- [ ] **D.** 33

Q7. Two staircases share a peak of 4 and fill a square. What is the total?



peak 4 makes a square

- [ ] **A.** 14
- [ ] **B.** 20
- [ ] **C.** 16
- [ ] **D.** 12

Q8. What is the peak of the sequence 1+2+3+4+5+6+5+4+3+2+1?

- [ ] **A.** 5
- [ ] **B.** 6
- [ ] **C.** 11
- [ ] **D.** 36

Q9. What is 1?

- [ ] **A.** 1
- [ ] **B.** 0
- [ ] **C.** 2
- [ ] **D.** 4

Q10. Name the peak of 1+2+3+2+1 and square it. What squared number is that total?

- [ ] **A.** 4 squared
- [ ] **B.** 3 squared
- [ ] **C.** 2 squared
- [ ] **D.** 5 squared

Section B - Medium

Q11. The card marks peak 7. What is 7 x 7, the up-and-down total?

peak 7

7 x 7

- [ ] **A.** 49
- [ ] **B.** 42
- [ ] **C.** 56
- [ ] **D.** 45

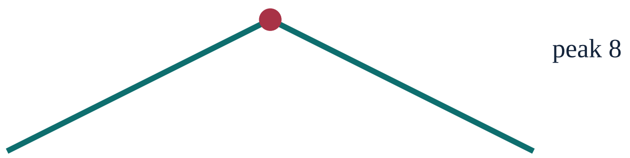
Q12. How many terms are in the up-and-down sequence with peak n, in general?

- [ ] **A.** 2n - 1
- [ ] **B.** 2n
- [ ] **C.** n
- [ ] **D.** n squared

Q13. If the peak of an up-and-down sum is 10, what is the total?

- [ ] **A.** 55
- [ ] **B.** 100
- [ ] **C.** 90
- [ ] **D.** 110

Q14. The line peaks at the red dot labelled 8. What is the up-and-down total?



- [ ] **A.** 72
- [ ] **B.** 56
- [ ] **C.** 60
- [ ] **D.** 64

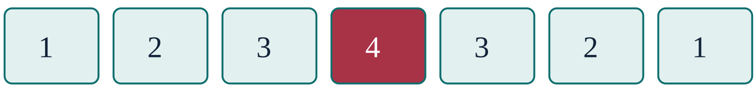
Q15. Kabir adds 1+2+3+4+3+2+1 term by term and gets 16. Anaya checks it instantly using the peak. What is her method?

- [ ] **A.** Multiply the number of terms by 2
- [ ] **B.** Add just the first and last terms
- [ ] **C.** Square the peak value, 4, to get 16
- [ ] **D.** Double the peak value

Q16. If an up-and-down sum totals 64, what was its peak?

- [ ] **A.** 7
- [ ] **B.** 9
- [ ] **C.** 8
- [ ] **D.** 16

Q17. Count the seven numbered boxes (peak 4 in maroon). How many terms?



- [ ] **A.** 8

- [ ] **B.** 4
- [ ] **C.** 6
- [ ] **D.** 7

Q18. Why does the two-triangles picture prove the formula works for every peak n, not just the examples tried?

- [ ] **A.** It only proves the formula for even values of n
- [ ] **B.** Because the same up-triangle-plus-down-triangle shape always fills a square of side n, regardless of the value of n
- [ ] **C.** It only proves the formula for n less than 10
- [ ] **D.** The picture does not actually prove anything general

Q19. If an up-and-down sum totals 81, what was its peak?

- [ ] **A.** 8
- [ ] **B.** 9
- [ ] **C.** 10
- [ ] **D.** 40

Q20. Peak 12: square it, and also think of 23 terms. What is the total?

- [ ] **A.** 144
- [ ] **B.** 132
- [ ] **C.** 78
- [ ] **D.** 156

Section C - Challenge

Q21. The card shows peak 15. What is 15 x 15?

peak 15	15 x 15

- [ ] **A.** 225
- [ ] **B.** 120
- [ ] **C.** 210
- [ ] **D.** 240

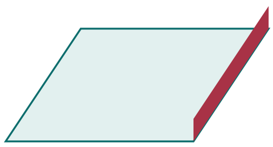
Q22. Compare sum(1 to n) [ordinary sum, not up-and-down] with the up-and-down total for the same peak n. Which grows faster as n increases?

- ☐ **A.** The ordinary sum grows faster
- ☐ **B.** They always stay exactly equal
- ☐ **C.** The up-and-down total grows faster
- ☐ **D.** Neither grows as n increases

Q23. An up-and-down sum has 19 terms. What is its peak, and what is its total?

- ☐ **A.** Peak 19, total 361
- ☐ **B.** Peak 10, total 100
- ☐ **C.** Peak 9, total 81
- ☐ **D.** Peak 20, total 400

Q24. The tilted square has side 20 (400 cells). How many up-and-down terms is that?



side 20, so 400 cells
terms = 2x20 - 1

- ☐ **A.** 39
- ☐ **B.** 40
- ☐ **C.** 20
- ☐ **D.** 38

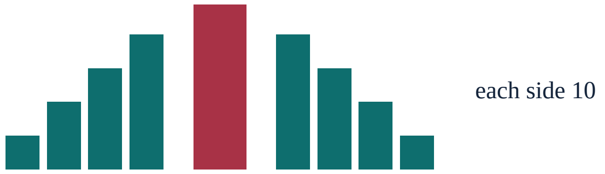
Q25. Using the peak-and-two-triangles view, express n squared as peak plus twice a triangular sum.

- ☐ **A.** n x 2
- ☐ **B.** 2n - 1 only
- ☐ **C.** n + 2 x (sum of 1 to n-1)
- ☐ **D.** n divided by 2

Q26. What is the up-and-down total for peak 20?

- ☐ **A.** 210
- ☐ **B.** 380
- ☐ **C.** 420
- ☐ **D.** 400

Q27. Peak 5 is the tall middle bar. Each side staircase is 1+2+3+4. What is each side worth?



- [ ] **A.** 12 each
- [ ] **B.** 10 each
- [ ] **C.** 25 each
- [ ] **D.** 5 each

Q28. Why is recognising the 'peak, squared' shortcut more useful than memorising individual up-and-down sums?

- [ ] **A.** It only works for peaks smaller than 10
- [ ] **B.** It instantly generalises to any peak, however large, without needing separate memorised cases
- [ ] **C.** Memorising cases is always faster
- [ ] **D.** The shortcut and memorising give different, unrelated answers

Q29. What is 1+2+...+11+...+2+1 (peak 11)?

- [ ] **A.** 110
- [ ] **B.** 132
- [ ] **C.** 100
- [ ] **D.** 121

Q30. Peak 6 should total 36. If the peak is counted twice, how much too big is the answer?

- [ ] **A.** 6
- [ ] **B.** 12
- [ ] **C.** 36
- [ ] **D.** 1

Answer Key

Q1: (A) (a) 9. The peak is 3, and 3 squared is 9.

Q2: (D) (d) n squared.

Q3: (B) (b) 4. The peak is 2, and 2 squared is 4.

Q4: (A) (a) 25. The peak is 5, and 5 squared is 25.

Q5: (D) (d) A square, from two glued triangles.

Q6: (C) (c) 36. The peak is 6, and 6 squared is 36.

Q7: (C) (c) 16. The peak is 4, and 4 squared is 16.

Q8: (B) (b) 6. It is the single largest number, appearing once in the middle.

Q9: (A) (a) 1. A single-term sequence with peak 1 gives 1 squared, which is 1.

Q10: (B) (b) 3 squared. The peak of this sequence is 3.

Q11: (A) (a) 49. The peak is 7, and 7 squared is 49.

Q12: (A) (a) 2n - 1. The climb has n terms and the descent has n-1 more (since the peak is shared, not repeated).

Q13: (B) (b) 100. 10 squared is 100.

Q14: (D) (d) 64. The peak is 8, and 8 squared is 64.

Q15: (C) (c) Square the peak value, 4, to get 16.

Q16: (C) (c) 8. 8 squared is 64.

Q17: (D) (d) 7. It climbs 1,2,3,4 (4 terms) then descends 3,2,1 (3 more terms), giving 7 in total.

Q18: (B) (b) Because the same up-triangle-plus-down-triangle shape always fills a square of side n, regardless of the value of n.

Q19: (B) (b) 9. 9 squared is 81.

Q20: (A) (a) 144. 12 squared is 144.

Q21: (A) (a) 225. 15 squared is 225.

Q22: (C) (c) The up-and-down total (n squared) grows faster than the ordinary sum (about half of n squared). n squared eventually outpaces n(n+1)/2 for large n.

Q23: (B) (b) Peak 10, total 100. Using 2n-1=19 gives n=10, and 10 squared is 100.

Q24: (A) (a) 39. The peak is 20 (since 20 squared is 400), and 2(20)-1 = 39 terms.

Q25: (C) (c) n + 2 x (sum of 1 to n-1). The peak counted once, plus the two matching triangular staircases on either side of it.

Q26: (D) (d) 400. 20 squared is 400.

Q27: (B) (b) 10 each, since 1+2+3+4=10 on each side. Removing the peak (5) from the total of 25 leaves 20, split evenly into two triangular sums of 10.

Q28: (B) (b) It instantly generalises to any peak, however large, without needing separate memorised cases.

Q29: (D) (d) 121. 11 squared is 121.

Q30: (A) (a) 6. Counting the peak an extra time adds exactly one more copy of the peak value, 6, to the correct total.

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