

Patterns in Mathematics

Word Problems — Worksheet 1 (Difficulty Level: Difficult)

Name:	Class:	Section:
Date:	Roll No.:	Marks: ____ / 20

Read each real-life problem carefully and solve it, showing your working.

1. A stadium is designing a triangular flag arrangement for a sports opening ceremony. Row 1 has 1 flag, row 2 has 3 flags, row 3 has 6 flags, following the triangular number pattern. If the organisers plan 12 rows, how many flags are needed in total for rows 11 and 12 combined?
2. A baker arranges cupcakes on trays in a square-number pattern for a wedding display: tray 1 has 1 cupcake, tray 2 has 4, tray 3 has 9, and so on. How many cupcakes will be on tray 7, and how many cupcakes in total from tray 1 to tray 7?
3. A city is laying hexagonal paving stones in a park following the hexagonal number pattern 1, 7, 19, 37, 61, If the contractor has already laid stones up to ring 4 (37 stones), how many more stones are needed to complete ring 6?
4. A mobile network company doubles the number of new towers it installs each year, starting with 3 towers in Year 1 (Powers-of-2 style growth: 3, 6, 12, 24, ...). How many towers will be installed in Year 5, and what is the total number of towers installed from Year 1 to Year 5?
5. An architect is designing a spiral staircase where the number of steps in each turn follows the counting-number-up-and-down pattern (1, $1+2+1$, $1+2+3+2+1$, ...), which always gives square numbers. If the 6th turn requires 36 steps, verify this using the pattern rule, and find how many steps the 7th turn will need.
6. A wedding hall decorator is hanging triangular bunting flags where the number of flags needed equals 6 times a triangular number plus 1 (giving hexagonal numbers). If the decorator uses the 5th triangular number (15), how many flags will be hung, and which term of the hexagonal sequence is this?

7. A farmer plants saplings in a triangular grid pattern near a canal. Each new row has one more sapling than the row before, starting with 1 sapling in row 1. If the farmer has planted a total of 55 saplings, how many complete rows has he planted?
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8. A company logo is designed using the Complete Graph pattern, where every pair of points is joined by a line. If the design team wants exactly 21 lines in the logo, how many points (K value) should they use? (Use the rule: number of lines = $n(n-1)/2$)
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9. A textile designer creates a fabric print using the Koch Snowflake pattern. The first shape (a triangle) has 3 line segments. At each step, every segment is replaced by 4 smaller segments ($3 \times 4 = 12$, $12 \times 4 = 48$, ...). How many line segments will the design have after 4 steps of the pattern?
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10. A charity is stacking donation boxes in a cube-number pattern for a display: level 1 has 1 box, level 2 has 8 boxes, level 3 has 27 boxes, following the cube pattern (n^3). How many boxes are needed at level 5, and what is the total number of boxes from level 1 to level 5?
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Answer Key — Worksheet 1

1. Row 11 = 66, Row 12 = 78. Total = $66 + 78 = 144$ flags
2. Tray 7 = 49 cupcakes. Total = $1+4+9+16+25+36+49 = 140$ cupcakes
3. Ring 6 total = 91. Additional stones needed = $91 - 37 = 54$ stones
4. Year 5 = 48 towers. Total = $3+6+12+24+48 = 93$ towers
5. 6th turn: $1+2+3+4+5+6+5+4+3+2+1 = 36 = 6^2$ (verified). 7th turn = $7^2 = 49$ steps
6. $15 \times 6 + 1 = 91$ flags, which is the 6th hexagonal number
7. 55 is the 10th triangular number ($1+2+\dots+10=55$), so he has planted 10 complete rows
8. $n(n-1)/2 = 21 \rightarrow n = 7$, so they should use K7 (7 points)
9. 3, 12, 48, 192, 768 — after 4 steps there will be 768 line segments
10. Level 5 = 125 boxes. Total = $1+8+27+64+125 = 225$ boxes

Patterns in Mathematics

Word Problems — Worksheet 2 (Difficulty Level: Difficult)

Name:	Class:	Section:
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Read each real-life problem carefully and solve it, showing your working.

1. A greenhouse arranges potted plants on shelves so that shelf 1 has 2 pots, shelf 2 has 4 pots, shelf 3 has 6 pots — following the even-number pattern. If the greenhouse has 15 shelves, how many pots are on the last shelf, and how many pots are there in total across all 15 shelves?
2. A stadium roof is supported by triangular steel frames, where the number of small triangles in the n th frame follows the pattern n^2 (1, 4, 9, 16, ...). If an engineer needs a frame with exactly 81 small triangles, which frame number should be built?
3. A software company's user base grows following the powers-of-3 pattern: 1 user in week 1, 3 users in week 2, 9 in week 3, and so on. In which week will the user base first exceed 500 users?
4. A wedding photographer arranges a group photo of guests in triangular rows so that the total number of guests up to row n is a triangular number. If 105 guests need to be seated in complete triangular rows, how many rows will be formed?
5. A construction company is building a hexagonal gazebo roof using the hexagonal number pattern for the tiles: 1, 7, 19, 37, If they have used 127 tiles so far, up to which ring have they completed the roof?
6. A store is running a doubling discount promotion: on day 1 the discount is ₹1 off, day 2 is ₹2 off, day 3 is ₹4 off, following powers of 2. A customer wants to know the total discount they would get if they shopped on all of the first 6 days. Find the total.
7. A pyramid-shaped display of oranges in a supermarket has 1 orange on top, then each layer below follows the pattern of square numbers (1, 4, 9, 16, ...) for the number of oranges in that layer. How many oranges are needed for a 6-layer pyramid in total?

8. In a robotics competition, teams are connected by communication lines so that every pair of teams has a direct line (a Complete Graph). If there are 8 teams, how many communication lines are needed in total?
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9. A jeweller arranges beads on a triangular pendant frame using the triangular number pattern. The 7th pendant design uses 28 beads. The jeweller wants to know: if two consecutive pendant designs are combined, do they always give a square number of beads? Verify using the 6th (21 beads) and 7th (28 beads) designs.
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10. A city plans a fireworks show where the number of shells fired in each minute follows the odd-number pattern (1, 3, 5, 7, ...). By the end of minute n , the total shells fired equals n^2 . If the total shells fired by the end of the show is 225, how many minutes did the show last, and how many shells were fired in the very last minute?
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Answer Key — Worksheet 2

1. Shelf 15 = 30 pots. Total = $2+4+\dots+30 = 2 \times (1+2+\dots+15) = 2 \times 120 = 240$ pots
2. $n^2 = 81 \rightarrow n = 9$, so the 9th frame should be built
3. Powers of 3: 1,3,9,27,81,243,729 — week 7 (729 users) is the first week to exceed 500
4. 105 is the 14th triangular number ($14 \times 15 / 2 = 105$), so 14 rows will be formed
5. 127 is the 6th hexagonal number, so they have completed up to ring 6
6. $1+2+4+8+16+32 = ₹63$ total discount
7. $1+4+9+16+25+36 = 91$ oranges
8. $n(n-1)/2 = 8 \times 7 / 2 = 28$ communication lines
9. $21 + 28 = 49 = 7^2$, a square number — the rule is verified
10. $225 = 15^2$, so the show lasted 15 minutes; the last minute fired the 15th odd number = 29 shells

Patterns in Mathematics

Word Problems — Worksheet 3 (Difficulty Level: Difficult)

Name:	Class:	Section:
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Read each real-life problem carefully and solve it, showing your working.

1. A construction crane stacks concrete pipe sections so that section 1 has 1 pipe, section 2 has 3, section 3 has 6, following the triangular number pattern. The site manager has 45 pipes in stock. How many complete sections can be built, and how many pipes will remain unused?
2. A tech startup's server capacity doubles every quarter, starting at 5 GB in Quarter 1. Using the powers-of-2 growth pattern, find the server capacity in Quarter 6 and the total capacity added over all 6 quarters.
3. A textile mill weaves a carpet border using the Koch Snowflake pattern, starting with 3 segments and multiplying by 4 at each step. After how many steps will the number of segments first exceed 1000?
4. An event organiser is setting up a hexagonal seating arrangement around a central stage using the hexagonal number pattern, where the total chairs used up to ring n is 1, 7, 19, 37, 61, 91, 127, 169, 217, 271, If 300 chairs are available, up to which complete ring can the organiser seat guests, and how many chairs are left over?
5. A satellite company launches an increasing number of satellites each year following the cube-number pattern (1, 8, 27, 64, ...). Find the total number of satellites launched from year 1 to year 4, and how many more satellites will be launched in year 5 compared to year 4.
6. A stadium's fireworks finale fires shells so the cumulative total after minute n equals n^2 (odd-number pattern). The show director wants exactly 400 shells fired by the end. For how many minutes should the finale run, and how many shells are fired in the final minute?
7. A school builds a triangular pyramid of sports trophies for the assembly hall, where layer n from the top holds n^2 trophies (square-number pattern per layer, similar to stacked triangles). If the pyramid has 5 layers, how many trophies are needed in total, and how many more trophies does layer 5 need compared to layer 3?

8. An online gaming platform connects players in tournament lobbies as a Complete Graph so every player can chat with every other player directly. If a lobby needs exactly 45 chat connections, how many players are in the lobby? (Use $n(n-1)/2$ = number of connections)
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9. A farmer stacks hay bales in a field so that row 1 (top) has 1 bale, row 2 has 4, row 3 has 9, following the square-number pattern. If the farmer wants a stack with a total of exactly 204 bales using complete rows only, how many rows should be stacked, and how many bales remain over the exact total needed for those rows?
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10. A city's population of a rare bird species is being tracked, and researchers notice the count follows the Virahāṅka (Fibonacci-type) pattern: 12, 12, 24, 36, 60, 96, If this pattern continues, what will be the count in the 8th year, and by how much did the population grow from year 6 to year 8?
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Answer Key — Worksheet 3

1. 45 is the 9th triangular number exactly ($9 \times 10 / 2 = 45$), so 9 complete sections can be built with 0 pipes remaining
2. Capacities: 5, 10, 20, 40, 80, 160. Quarter 6 = 160 GB. Total = $5 + 10 + 20 + 40 + 80 + 160 = 315$ GB
3. 3, 12, 48, 192, 768, 3072 — after 5 steps the count reaches 3072 segments, the first value to exceed 1000
4. Ring 10 uses 271 chairs (the largest hexagonal number not exceeding 300), leaving $300 - 271 = 29$ chairs unused
5. Total years 1–4 = $1 + 8 + 27 + 64 = 100$ satellites. Year 5 = 125, Year 4 = 64, difference = $125 - 64 = 61$ more satellites
6. $400 = 20^2$, so the finale should run 20 minutes; the last minute fires the 20th odd number = 39 shells
7. Total = $1 + 4 + 9 + 16 + 25 = 55$ trophies. Layer 5 (25) – Layer 3 (9) = 16 more trophies
8. $n(n-1)/2 = 45 \rightarrow n = 10$, so there are 10 players in the lobby
9. Cumulative squares: 1, 5, 14, 30, 55, 91, 140, 204 — 8 rows give exactly 204 bales, so 8 rows with 0 bales remaining
10. Sequence: 12, 12, 24, 36, 60, 96, 156, 252. Year 8 = 252. Growth from year 6 (96) to year 8 (252) = $252 - 96 = 156$