A1 marking scheme

Questions (or subquestions) are marked on a 6-value scale, and then multiplied by the indicated weight. Comments explaining a value less than 5 are found either on your paper, or on a list of "common errors" listed by the marker under that question.

1. (Total 15 points, part (a) has weight 1, part (b) has weight 2).

   E 1.1: Failure to link the sum of integers between 1 and n and therefore also the closed form, to the segments in a convincing way. It was not enough for students simply to state the connection without some reasonable argument. This same error also applied to question 1(b) for students who failed to convincingly associate their sum of squares calculation to the two-dimensional lattice. For both parts, many students simply stated the sums and then proved that their closed-forms were representations of the sums with only a single sentence linking the sums with the respective problems. Students who made this error on 1(a) received a maximum grade of 3/5 and those who made the error on 1(b) received a maximum of 6/10.

2. (Total 15 points, part (a) has weight 1, part (b) has weight 2).

   CE 2.1: Prove your observation. It is not enough to just state an open form formula and then prove that it is equal to some closed form formula. Similarly, it is not enough to state a closed form formula without proof.

   Marking scheme for Q2:

Value	**Description**
0	incorrect conjecture, no proof given
1	conjecture is incorrect, but some attempt at a proof
2	uses examples to justify conjecture, but no proof or incorrect proof open form conjecture is given, and the proof is missing parts
3	correct conjecture, but conjecture not justified, only proved that open form = closed form
4	correct conjecture, proof is nearly correct, but a small part is missing open form conjecture is given, but proof is correct
5	complete and correct.

3. (Total 15 points, part (a) has weight 1, part (b) has weight 2).

   Marking scheme for part (a) (total of 5 marks):

   - 3 marks for the correct conjecture, -2 for an incorrect but close conjecture.
   - 2 marks for a correct proof, -2 for an incorrect proof

   Marking scheme for part (b) (total of 10 marks)

- 5 marks for correct conjecture, -1 for a conjecture that is close, -2 for a conjecture that is not so close.
- 5 marks for a correct proof, -1 for a proof that is basically correct, but incorrect, -2 for a proof that is close but incorrect, -3 for a proof that is missing a crucial step.

4. (Total 15 points).

   Marking scheme:

Value	Description
0	no believable conjecture or proof
1	blank, or a few base cases checked without proof
2	a few base cases checked, a mistaken conjecture and no proof
3	some base cases checked, a possibly mistaken conjecture a proof that explains the induction step
4	correct conjecture, flawed proof
5	correct conjecture and proof

5. (Total 15 points).

   Common errors:

   E1: Must use the principle of well-ordering (PWO) on "natural" numbers, i.e. state clearly that $a, b \in \mathbb{N}$. Full marks even if you begin with the assumption that a and b are natural numbers. The proof should in fact consider $a < 0, b < 0$ and $a < 0, b > 0$, and $a > 0, b < 0$.

   E2: Need to prove that $\sqrt{5} \notin \mathbb{N}$. Poor attempt to prove $\sqrt{5} \notin \mathbb{Q}$ (rationals) considered an incomplete proof.

   E3: Solve the problem using non-integer solutions.

   E4: Using PWO on pairs (a, b) should use something like minimal a or minimal $a + b$. A list of solutions $\{(a_1, b_1), (a_2, b_2), \ldots, \}$ cannot assume both $a_1 < a_2 < \cdots$ and $b_1 < b_2 < \cdots$.

   E6: Many English grammatical and structural problems.

   E7: Need to look at the algebraic problem, which is more general than the geometric problem (the geometric problem will give you a hint, though).

6. (Total 15 points, part (a) weight 1, part (b) weight 2).

   Marking scheme:

   Part (a): -2 marks if part (ii) is missing or based on a weak claim. -3 marks if parts (ii) and (i) are missing.

   Code D1: Improperly written proof.

   Part (b): -2 marks if either (ii) or (iii) were missing. -3 marks if both (ii) and proof of part (i) not properly written.

7. (Total 15 points, part (a) weight 1, part (b) weight 2).

   C1: -1 if Fact 1 is applied to $a + b + c + \cdots + z$, and not just $a + b$.

   C2: Didn't prove second half.

   0 incorrect claims, not justified.

   3 Proved half correctly, left out other proof.

   4 Proved both claims correctly, but left out details.