Reasoning and Problem Solving
Position and Direction – Year 4

About This Resource

This resource is aimed at Year 4 Expected and has been designed to give children the opportunity to consolidate the skills they have learned in Summer Block 6 Position and Direction.

The questions are based on a selection of the same 'small steps' that are addressed in the block, but are presented in a different way so children can work through the pack independently and demonstrate their understanding and skills.

Small Steps

Describe position
Draw on a grid
Move on a grid
Describe movement on a grid

National Curriculum Objectives

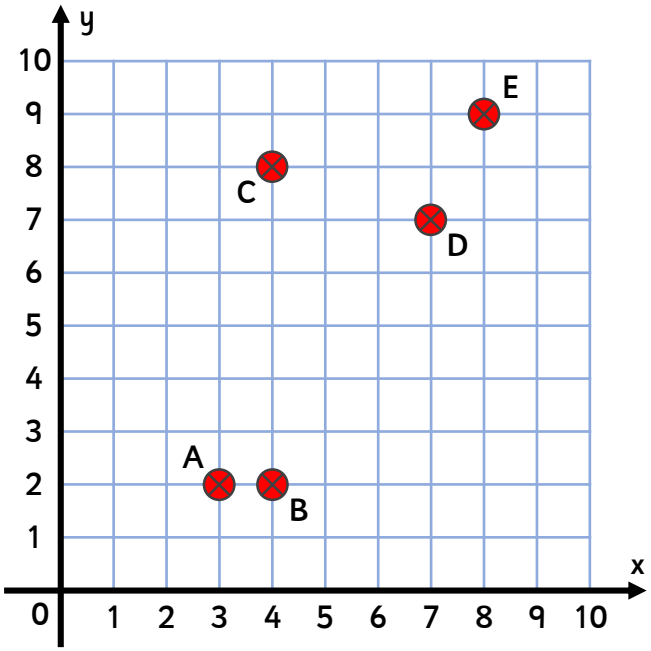
Mathematics Year 4 (4P3a) Describe positions on a 2-D grid as coordinates in the first quadrant
Mathematics Year 4 (4P3b) Plot specified points and draw sides to complete a given polygon
Mathematics Year 4 (4P2) Describe movements between positions as translations of a given unit to the left/right and up/down

Did you like this resource? Don't forget to review it on our website.

Reasoning and Problem Solving – Position and Direction – Year 4

Takanori needs to prepare for the *Shipwreckers* Grand Tournament. Last year he came second to his greatest rival, Brenda 'Bullseye' Baird. This year he is going to beat her any way he can. That is his plan, at least. He needs to come up with his tactics and practise his moves. He has been making plans on his laptop for weeks.

'RIKU!' Takanori shouts. His little brother has been playing around with Takanori's things again! Riku has written over one of Takanori's *Shipwreckers* plans!



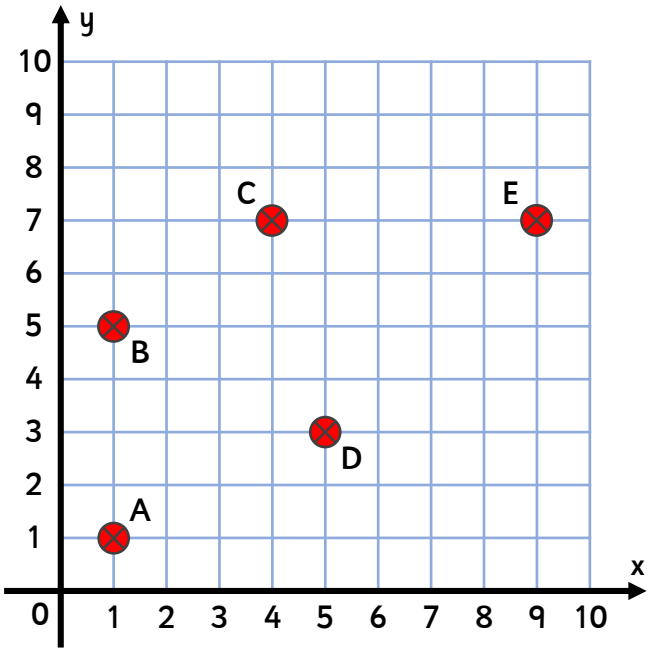
Shot Plan #6

Shot A: [illegible] (3,2)
Shot B: [illegible] (4,2)
Shot C: [illegible] (4,9)
Shot D: [illegible] (7,7)
Shot E: [illegible] (9,8)

Takanori had written his plan on the paper but Riku has scribbled it out and written what *he* thinks are the right coordinates.

1. Compare the shots marked on the grid to the coordinates written on the paper. Find and explain the mistakes Riku has made when writing down the coordinates.

Takanori corrects his brother's mistakes. Now it is time to come up with another shot plan. Takanori wants to make sure he can remember the plan so he can use it in the tournament. He marks the shots on a *Shipwreckers* grid. After that, he comes up with rules to help him remember the coordinates.



Shot Plan #7 Rules

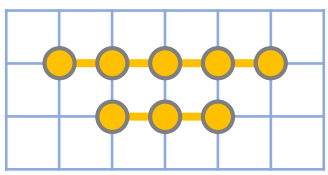
Coordinates must have:

- Odd numbers only
- No multiples of 3

2. Do the shots marked on the grid have coordinates which match Takanori's rules? If he has made any errors, explain them.

Takanori now needs to think about where he will place his ships on the grid. He wants to make sure they are well spread out so that Brenda will not be able to hit them easily.

He starts by thinking about placing just two ships. He needs to think of a rule which will spread them out as much as possible. *Shipwreckers* ships are marked as lines and circles. Here are the two ships he is using (they can be placed either horizontally or vertically on a *Shipwreckers* grid) and the ideas he has had for rules:



Rule idea #1

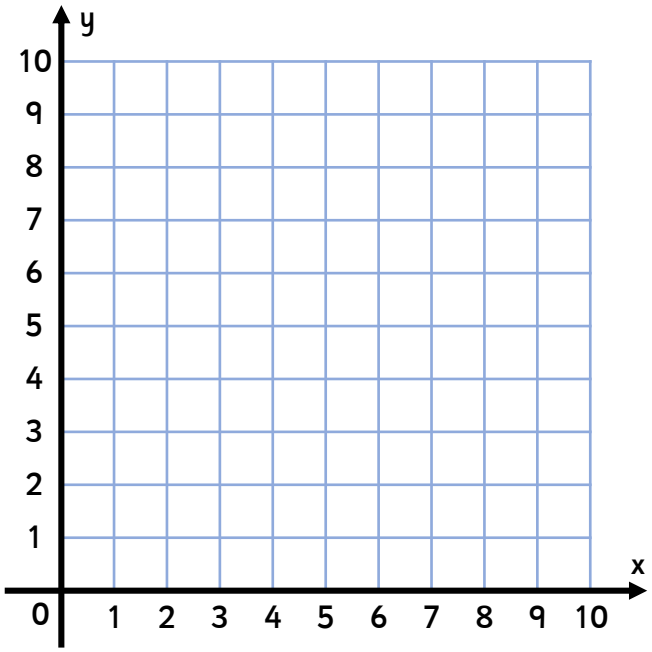
'All y-axis coordinates must be a multiple of 4.'

Rule idea #2

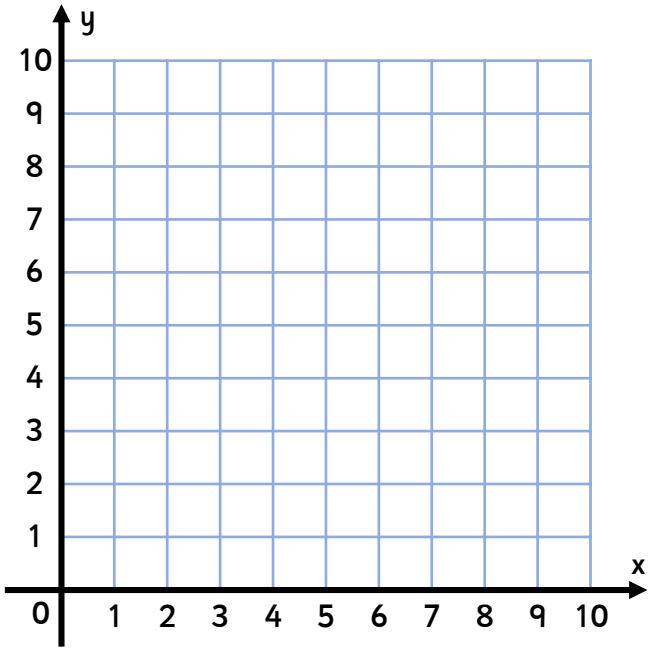
'All x-axis coordinates must be a multiple of 3.'

3. Draw two ships on each grid, as far apart as the rules allow. Which rule will let Takanori place his ships the furthest apart?

Rule idea #1

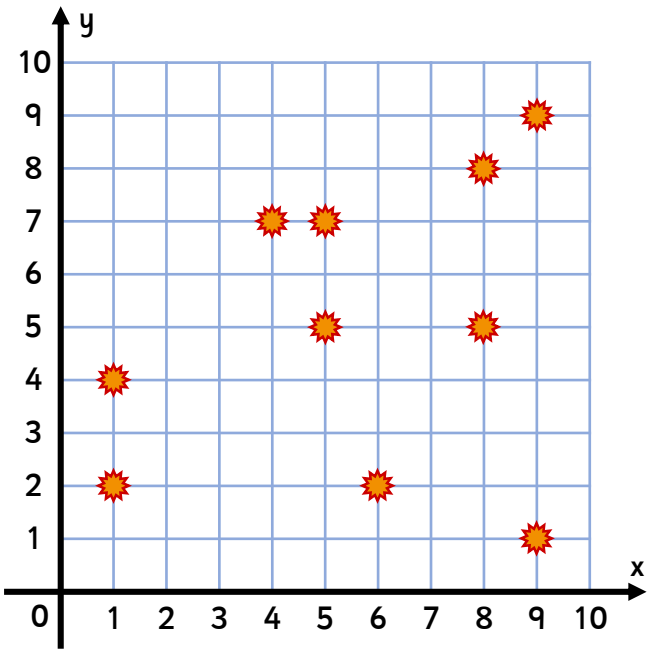


Rule idea #2



Takanori now wants to find 'safe zones' which avoid Brenda's favourite shots.

4. Plot the coordinates on the grid and join them up with lines to mark each zone. Which set of coordinates marks out a zone where none of Brenda's shots land?



Safe Zone ideas

Set A: (2,9) (4,9) (5,8) (3,6)

Set B: (7,9) (10,10) (10,8) (8,6)

Set C: (1,1) (2,3) (8,4) (4,1)

Set ____ marks out a 'safe zone' where none of Brenda's shots land.

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It is now the day of the Grand Tournament! Takanori's first opponent is Jason 'Just Missed' Johnson. The game is very close. Jason has five shots left to sink Takanori's ships. It's time to say the coordinates he is shooting at. He must hit with every shot!

Jason 'Just Missed' Johnson

The first shot will hit (4,5).
Translate the first shot 3 left and 1 up to find where the second shot hits.
Translate the second shot 6 right and 4 down to find where the third shot hits.
Translate the third shot 2 left and 6 up to find where the fourth shot hits.
Translate the fourth shot 4 right and 2 down to find where the final shot hits.

Takanori and Jason's computers work out the coordinates that Jason's shots hit...

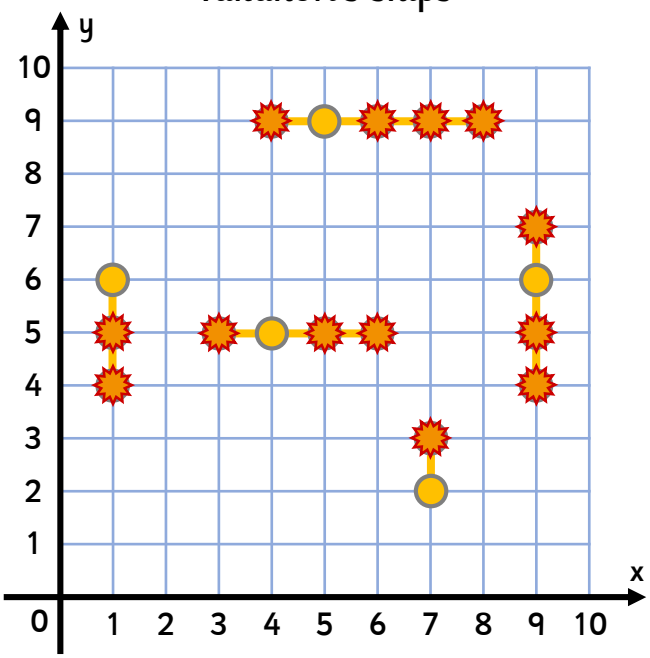
ERROR

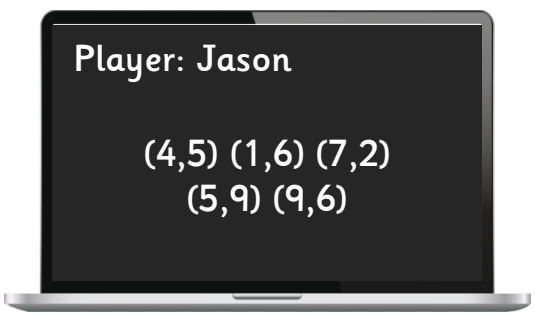
RESULTS DO NOT MATCH

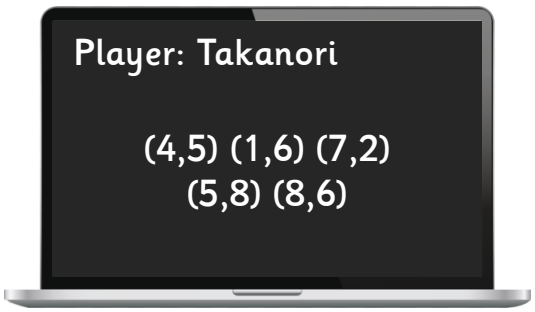
The two computers have found different coordinates! That is not right! The tournament referees come to look at Jason's shots and Takanori's ship grid.

5. Look at the shots Jason said. Look at Takanori's ship grid. Look at the coordinates on each computer. Has either player's computer got the coordinates right? Do all of Takanori's ships get sunk?

Takanori's ships







There seems to be all sorts of errors with the computers at the tournament!

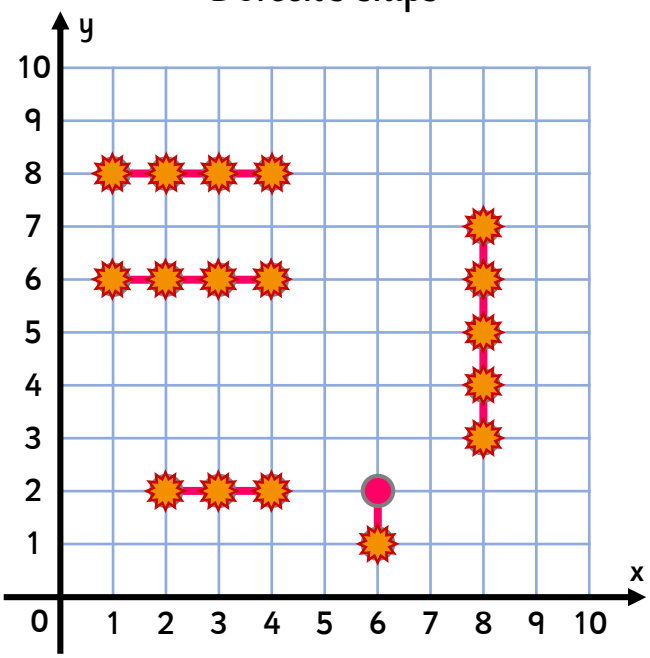
In his next game, Takanori plays Doreen 'Direct Hit' Dillinger. He says his final five shots to try and sink Doreen's last ship but the computer only records the coordinates of the last shot he takes! The referees have to work backwards to find where the other shots hit.

Takanori

I can't remember where my first shot hit.
I do remember that I translated the first shot 4 left and 2 down to find where the second shot hit.
I translated the second shot 6 right and 5 up to find where the third shot hit.
I translated the third shot 2 left and 7 down to find where the fourth shot hit.
I translated the fourth shot 3 right and 1 down to find where the fifth shot hit and that was at (9,1).

6. Use Doreen's ship grid and Takanori's description to fill in the table with the coordinates of Takanori's shots. Does Takanori sink all of Doreen's ships?

Doreen's ships



Shot 1	
Shot 2	
Shot 3	
Shot 4	
Shot 5	(9,1)

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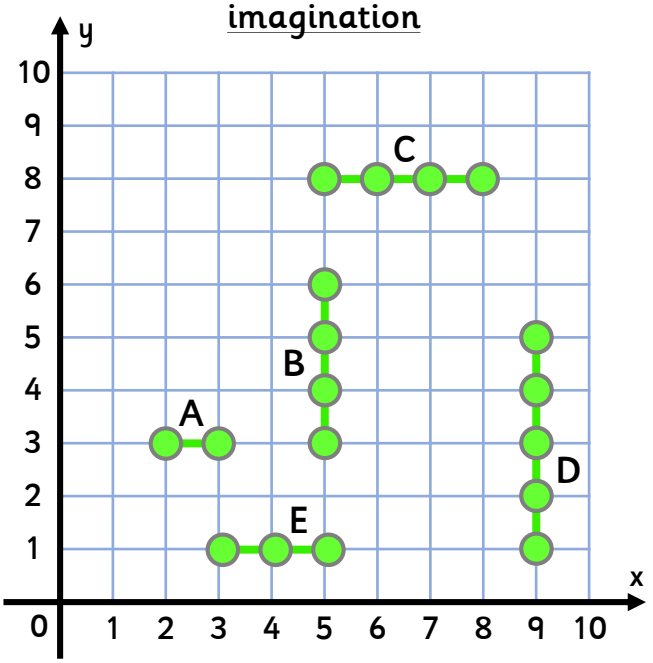
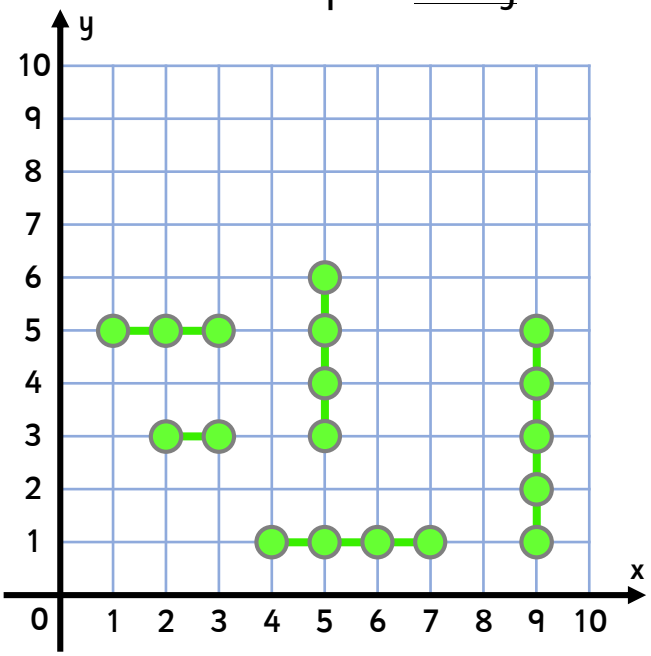
Takanori has beaten Jason and Doreen and is now in the final! His opponent is his biggest rival and the reigning champion. It's Brenda! Takanori has been practising for this match for a whole year!

The first thing Takanori has to do is guess where Brenda has placed her ships on her *Shipwreckers* grid. He imagines her grid.

Brenda's ships in Takanori's imagination



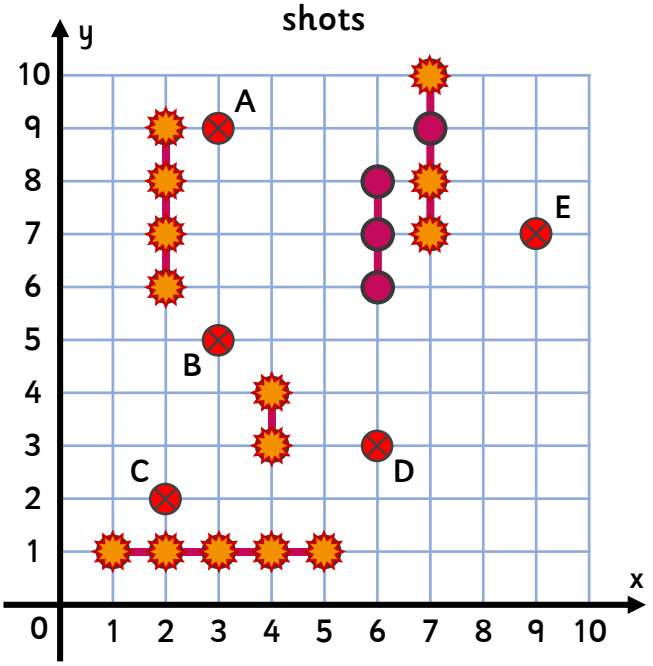
Brenda's ships in reality



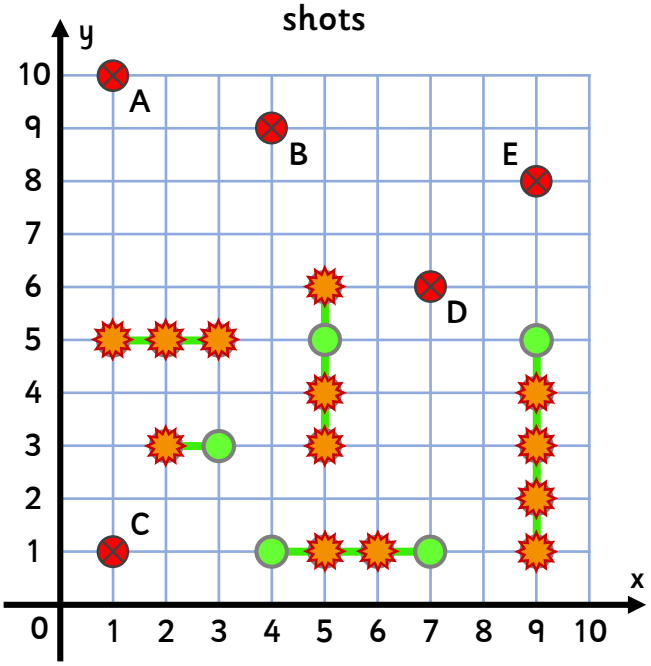
7. Look at the placement of Brenda's ships in Takanori's imagination and in reality. Describe the translations that would need to occur for Takanori's imagined grid to match Brenda's actual grid.

A little while later, the end of the game is in sight! In the final turn of a championship game, players get the chance to change their last shots. Both Brenda and Takanori decide to change where they hit! It all comes down to this!

Takanori's ships with Brenda's shots



Brenda's ships with Takanori's shots



8. Using the numbers below, complete each player's translations so that all of Takanori's shots hit Brenda's ships and two of Brenda's shots miss!

9, 8, 7, 6, 5, 4, 3, 1

Brenda's shot translations

Shot A: 3 right, 3 down

Shot B: ___ right, 4 up

Shot C: 4 right, ___ up

Shot D: 1 right, ___ up

Shot E: ___ left, 1 up

Takanori's shot translations

Shot A: 6 right, ___ down

Shot B: ___ right, 4 down

Shot C: ___ right, 4 up

Shot D: 4 left, 3 down

Shot E: 5 left, ___ down

Boom! Bang! Bang! Crash! Kaboom!

Takanori's five shots smash into Brenda's ships, sinking them all! Some of Brenda's shots splash harmlessly into the water, missing Takanori's ships. Takanori has won! He is the *Shipwreckers* Grand Champion!

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1. Riku has written the coordinates for Shot C as (4,9) when they should be (4,8), so he has counted the y-axis value incorrectly. Riku has written the coordinates for Shot E as (9,8) when they should be (8,9) so he has written the coordinates the wrong way round, with the y-axis value first.

2. Shot C has coordinates containing an even number (4,7). Shot D has coordinates containing a multiple of three (5,3), as does Shot E (9,7).

3. For 'Rule idea #1', any pair of ships drawn horizontally across the y-axis 4 and 8 gridlines are correct. For 'Rule idea #2', any pair of ships drawn vertically along the x-axis 3 and 9 gridlines are correct. 'Rule idea #2' will let Takanori place his ships the furthest apart.

4. C

5. No, neither player's computer has got the coordinates right. No, not all of Takanori's ships are sunk.

6. Yes, Takanori sinks all of Doreen's ships.

Shot 1	(6,6)
Shot 2	(2,4)
Shot 3	(8,9)
Shot 4	(6,2)
Shot 5	(9,1)

7. Ship C needs to be translated 1 left, 7 down. Ship E needs to be translated 2 left, 4 up.

8. If two of Brenda's shots miss but the rest hit, the answer is correct. All of Takanori's shots must hit.

Brenda's shot translations

Shot A: 3 right, 3 down
Shot B: 3 right, 4 up
Shot C: 4 right, 5 up
Shot D: 1 right, 6 up
Shot E: 3 left, 1 up

Takanori's shot translations

Shot A: 6 right, 9 down
Shot B: 1 right, 4 down
Shot C: 8 right, 4 up
Shot D: 4 left, 3 down
Shot E: 5 left, 7 up