Estimating areas

F2J

- Estimate areas of irregular shapes
- Estimate areas bounded by straight lines

Links within J925
F2A1d, e, f, k, F2B1d, 2a, F2E1b, F2N1a

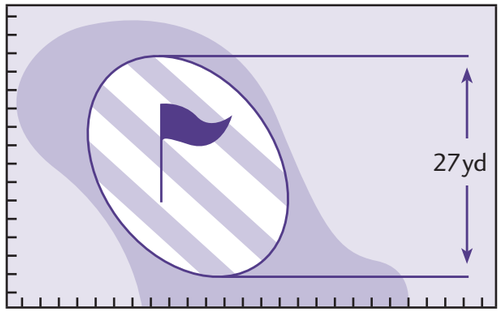
Starter activity

This is a plan of the fourth hole at West Hove Golf Club.

This is a plan of the green.
The scale is 5mm = 1 yard.

From top to bottom, the green is 27 yards, as shown.

Brian, the Green Keeper, needs to buy feed to treat the green. He needs to apply 28g to every square yard of the green. How much feed should he order to feed this green once?



Key points

- Area is measured using squares of a defined size.
- Units are yards and grams. Golf course distances are given using yards whilst goods are sold in grams and kilograms. A yard is about an adult pace (this could be demonstrated). The area will be in square yards and quantities in kg.
- **The scale** means that each 5mm (½cm) represents 1 yard on the real green.
- The amount of feed is dependent on the area of the green to be treated.
- The area and, hence, the amount needed will be an estimate. This may be an over or underestimate, depending on the method chosen.

Teaching notes

This task will take at least 30 minutes and could be a whole lesson.

- Equipment: a ruler, pencil and copy of the green.
- The "green" is the striped part of the diagram.
- The context gives a "functional" element and a reason for knowing the area of the green.
- It may be useful to have a "units chart" showing length in m; area in m²; volume in m³. Repeat for yards.
  Also 1000 g = 1 kg.
- Project the task on the screen.
- Class work in pairs, each learner with a copy of the green.
- "How far is it from the top of the green to the bottom?" Explore answers and the use of scale.
- Ask students to provide a strategy to answer the question.
- Explore strategies. Many will suggest drawing squares on the grid using the pips (or feint grid) and then counting whole and part squares. (To focus on the purpose of the work you may choose to use the green with a feint grid, although drawing squares is intended to reinforce their purpose.) Other appropriate methods would be
  - ➤ To "cut off triangles" from the surrounding rectangle and subtract the areas of these from the surrounding area.
  - ➤ To draw large rectangles within the green and calculate the areas of these and then count squares and part squares in the remaining area.
- Different pairs could use different strategies and then compare answers. (Cutting out the paper and weighing is probably not appropriate for this task, as this is not available in the examination hall.)
- Give a time limit for calculations and pull the group together. Compare answers. The area should be approximately 460 square yards and requires around 13 kg of feed for one application.
- **Consider**
  - ➤ Problems with units. (Changing ½ cm scale to yards. Not using square yards)
  - ➤ Convergence (or not) of answers. (Estimates vary wildly)
  - ➤ Decisions about counting part squares and the effect this has on the final answer.
  - ➤ The meaning of "estimate". (This is not a guess but based on evidence of counting squares.)
  - ➤ Learner justifications for under or over estimate and the implications. (The green keeper will want to be sure to have enough feed and will want, probably, to over-order, *but not by too much*. There are, of course, another 17 holes!)
  - ➤ Checking how reasonable the answers are. (Work out surrounding rectangle and roughly what fraction of this the green forms.)

Extension ideas

The manufacturer of the feed sells it in 25 kg containers.

It is recommended that feed be applied every 12 weeks throughout spring and summer.

The cost of one container is £23.

There are 18 holes on a golf course.

What will be the annual cost of treating the whole golf course for a year?

Assume spring and summer are half the year or 26 weeks → 3 feedings.

Assume each green is the same size → overall area = 460 × 18 = 8280 yd².

Amount of feed →
8280 × 28 = 231 840 g
or 232 kg per feed or
232 × 3 = 696 kg

This is 696 ÷ 25 = 27.84 →
28 containers costing £644 each year.

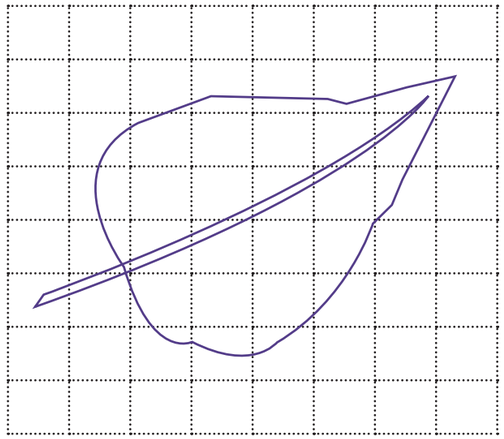
Misconceptions

- Misuse of scale by dividing, rather than multiplying, by the scale factor.
- Thinking that "estimate" means "guess".
- Misinterpreting calculator answers (pence for £)

Worked examples

EXAMPLE 1

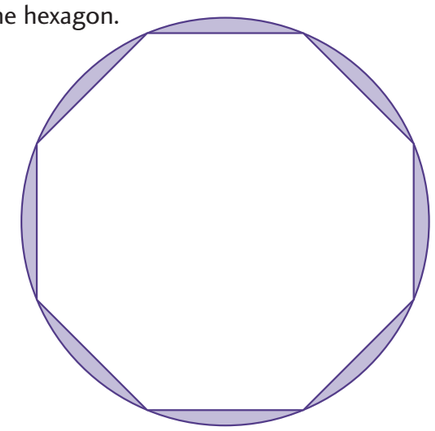
Estimate the area of this leaf.
A one-centimetre grid is drawn over the leaf.



Whole squares $8cm^2$
Compound squares $7cm^2$
Total area $15cm^2$
Check
Surrounding grid = 5 by 6 = $30cm^2$
The leaf is about half of the grid so the answer seems right.

EXAMPLE 2

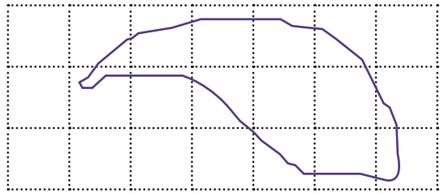
Estimate the shaded area between the circle and the hexagon.



There are no whole squares.
Curved edge parts need around 3 to form a whole square.
Compound squares $9cm^2$
Check: Bottom shaded sector is roughly 1.5 squares and 6 × 1.5 = 9
Calculation.
(Only for able students)
Circle = $\pi r^2 \approx 50cm^2$
Hexagon = $3.5 \times 2 \times \frac{(8 + 4)}{2} = 42cm^2$

EXAMPLE 3

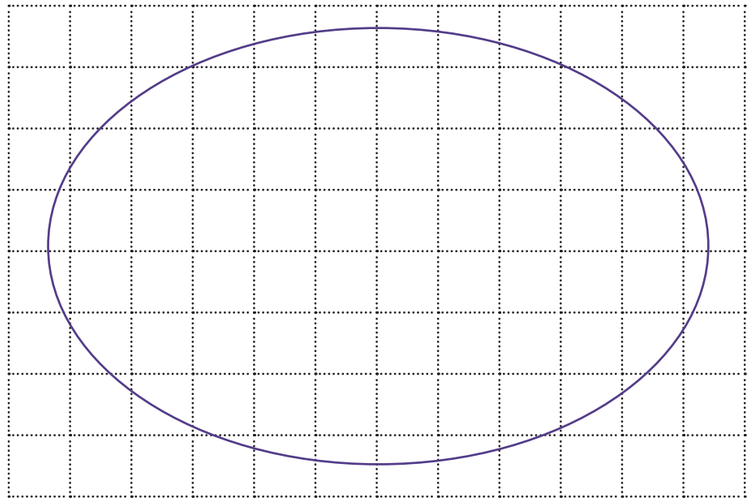
This brooch is to be made in fine gold that is 1 mm thick.
A gold sheet 1 mm thick is 5 cm long and 2 cm wide and costs £840. Estimate the value of the gold used in the brooch.



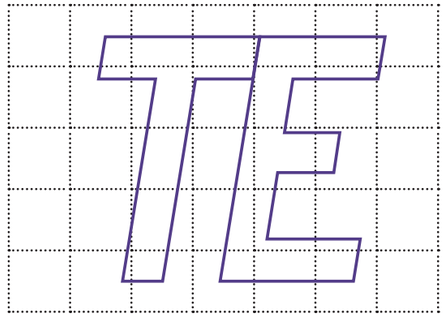
Whole squares $1\ cm^2$
Compound squares $5.5\ cm^2$
Total area $6.5\ cm^2$
$5 \times 2 = 10\ cm^2$
840 ÷ 10 = £84 per cm^2
Value of brooch = £84 × 6.5 = £546
Check, surrounding rectangle is 5 × 3 or $15cm^2$. This is less than half.

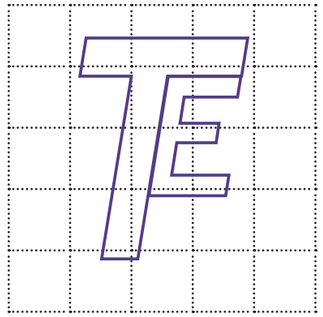
Exercise

1 Estimate the area of this ellipse, drawn on a one-centimetre grid.

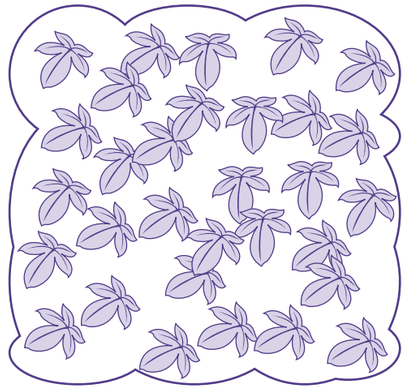


2 Each of these 2mm thick silver logos are to be made for presentation at a company dinner.
A sheet of silver that is 10cm wide, 20cm long and 2mm thick costs £225.
How much money would the company save if they made the cheaper logo?





3 Mike's dad has given him this small plot of land to grow potatoes on.
Mike plants 6 potato plants to each square metre.
Mike's grandfather tells him that he can expect 2kg of potatoes from each plant.
Mike's mum buys 8kg of potatoes each week.
If Mike gets the potatoes he expects, could he provide all the potatoes that the family needs for a year?
Explain why your answer may not be what actually happens.



Scale 1 cm represents 1 m