**Activity 1: Worksheet answers**

# Practice question 1

**Step 1:** **Plot the data.**

This was done for you.

**Step 2:** **Divide the base width into equal intervals.**

The base width is 10 m. The number of intervals is 5.

Therefore, the interval width is 10 ÷ 5 = 2 m.

(See graph below.)

**Step 3: Identify the ordinates on the graph**

A graph showing the cross-section of land.
The x-axis goes from 0 to 10, split into 1 metre intervals. It is labelled: distance across embankment (m)
The y-axis goes from 0 to 3. It is labelled height above datum level (m).

The graph is a line graph in red called "existing terrain" starting at the point 0, 0. It connects to 1, 0, then 2, 0, and so on up to 10, 0.
There is a horizontal blue dashed line, called "proposed finished embankment level" from 1 on the y-axis across the width of the graph, hitting points 0, 1 then 2, 2, then 4, 3, then 6, 3, then 8, 2 and finally 10, 1.

The intervals are labelled 1-5 every two metres, with the associated y values labelled at 0, 2, 4, 6, 8 and 10.  

**Step 4:** **Find the heights of the ordinates.**

**Step 5: Use the trapezoidal rule to calculate the area of cut and fill.**

interval width = 2

first ordinate = 1

sum of middle ordinates = 2 + 3 + 3 + 2 = 10

last ordinate = 1

m2

**Step 6: Calculate the total volume of fill material required.**

Total volume of fill material required = 22 × 15 = 330 m3

# Practice question 2

**Step 1: Plot the embankment onto graph paper using the values in the table.**

**A graph showing the cross-section of land.
The x-axis goes from 0 to 12, split into 1 metre intervals. It is labelled: position across embankment (m).
The y-axis goes from 0 to 5. It is labelled height above datum level (m).

The graph is a line graph in blue called "proposed finished embankment level" starting at the point 0, 2.5. It connects to 2, 3, then 4, 5, then 6, 5, then 8, 5, then 10, 3 and finally 12, 2.5.**

**Step 2: Divide the base width into equal intervals.**

The base width is 12 m. The number of intervals is 6.

Therefore, the interval width is = 12 ÷ 6 = 2 m

**Step 3: Identify the ordinates on the graph.**

These should be labelled as to .

**Step 4: Find the heights of the ordinates:**

**Step 5: Use the trapezoidal rule to calculate the area of cut and fill.**

first ordinate = 2.5

sum of middle ordinates = 3 + 5 + 5 + 5 + 3 = 21

last ordinate = 2.5

m2

m2

# Practice question 3

**Step 1: Plot the embankment onto graph paper using the values in the table.**

**A graph showing the cross-section of land.
The x-axis goes from 0 to 18, split into 2 metre intervals. It is labelled: position across road (m).
The y-axis goes from 0 to 4.5. It is labelled height above datum level (m).

The graph is a line graph in blue called "existing level" starting at the point 0, 3.5. It connects to 2, 4, then 4, 3.5, then 6, 3.25, then 8, 3 then 10, 2, then 12, 1.5, then 14, 1 and finally 16, 1.
There is a horizontal red line, called "proposed new road level" from 0 on the y-axis across the width of the graph.Step 2: Divide the base width into equal intervals.**

The base width is 10 m. The number of intervals is 8.

Therefore, the interval width is 16 ÷ 8 = 2 m.

**Step 3: Identify the ordinates on the graph**

These should be labelled as to .

**Step 4: Find the heights of the ordinates.**

The areas of cut are positive values as they are above the proposed new level.

The areas of fill are negative values as they are below the proposed new level.

**Step 5: Use the trapezoidal rule to calculate the area of cut and fill.**

first ordinate = 0.5

sum of middle ordinates = 1 + 0.5 + 0.25 + 0 – 1 – 1.5 – 2 = –2.75

last ordinate = –2

m2

The result is negative, which means that more material is needed than there is on the site. The earthworks contractor will need to bring 7.0 m2 of earth per metre width of road (7.0 m3) to the site.

**Step 6: Calculate the total amount of soil to be added.**

7 × 9 = 63 m3