**Activity 1 Worksheet: Using the trapezoidal rule to calculate the materials for a road embankment**

# Practice question 1

You are constructing a road embankment with a cross-sectional base width of 10 metres as shown below. The embankment will be 15 metres long. Calculate the amount of fill needed to construct the embankment.

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 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.

Remember to work through each step in turn.

**Step 1**: Plot the x- and y-coordinates on graph paper.

**Step 2**: Divide the base width of the cross-section into equal intervals.

**Step 3**: Label the points where you will measure the ordinates.

**Step 4**: Find the heights of each ordinate.

**Step 5**: Calculate the area of fill required using the trapezoidal rule.

**Step 6:** Work out the total amount of material needed by multiplying the area of the cross-section by the length of the embankment.

# Practice question 2

Using the trapezoidal rule, calculate the area of another road embankment with a base width of 12 metres divided into 6 equal intervals. The heights are as given in the table. You can assume that the existing ground level is at 0 metres.

|  |  |
| --- | --- |
| **Position (m)** | **Proposed height (m)** |
| 0 | 2.5 |
| 2 | 3 |
| 4 | 5 |
| 6 | 5 |
| 8 | 5 |
| 10 | 3 |
| 12 | 2.5 |

Hint: Remember to work through each step in turn, starting by sketching the embankment.

# Practice question 3

You are designing a road that must pass through uneven terrain. To create a level road, you will need to cut soil from higher areas and fill soil to lower areas. The cross-section of the terrain along a 16-metre stretch of road is given in the table.

Use the trapezoidal rule to calculate how much material will need to be removed from site to create a suitable road. The road will be 9 metres wide.

|  |  |  |
| --- | --- | --- |
| **Position (m)** | **Existing elevation (m)** | **Desired elevation (m)** |
| 0 | 3.5 | 3 |
| 2 | 4 | 3 |
| 4 | 3.5 | 3 |
| 6 | 3.25 | 3 |
| 8 | 3 | 3 |
| 10 | 2 | 3 |
| 12 | 1.5 | 3 |
| 14 | 1 | 3 |
| 16 | 1 | 3 |

Hint: Remember when sketching the road on graph paper to also add in the proposed road level. You will need this to work out the areas of cut and fill.