That's A Lot of Rock!

Woodkirk Construction are planning to build a 4km long tunnel through the Pennines. It will need to be 10m at its highest point and 5m wide.

Here are three important points for the construction company to consider:

1. What shape should the cross section of the tunnel be?

2. How much rock will be removed?

3. How long will it take to remove the rock?

The mathematician in the company suggests a parabola for the shape of the cross section.

The scientist suggests the following measurements for the shape of the cross section.

Tunnel height (m)	Distance from centre (m)
0	2.4
3.5	2.0
6	1.6
7.5	1.2
9	0.8
9.8	0.4
10	0

Find three different estimates for the volume of rock removed from the tunnel using

1. The mathematician's idea and integration
2. The scientist's idea and numerical methods
3. The best fit parabola to the scientist's measurements and integration

State any assumptions you have made.

The rock was removed at a rate as described below

$$dv/dt = 33t^2 - 660t \qquad 0 \le t \le 10$$

$$dv/dt = -3300 \qquad t \ge 10$$

where v = the volume of rock remaining in the tunnel at time t (days)

Draw a graph of dv/dt against t
Describe key features of the graph and relate them to the tunnel and the rock.

Draw a graph of v against t
Describe key features of the graph and relate them to the tunnel and the rock.

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