

10 Seat belts are being tested by a car manufacturer. In the test, a car moving at a steady speed of 28 m s^{-1} collides with a wall and stops.

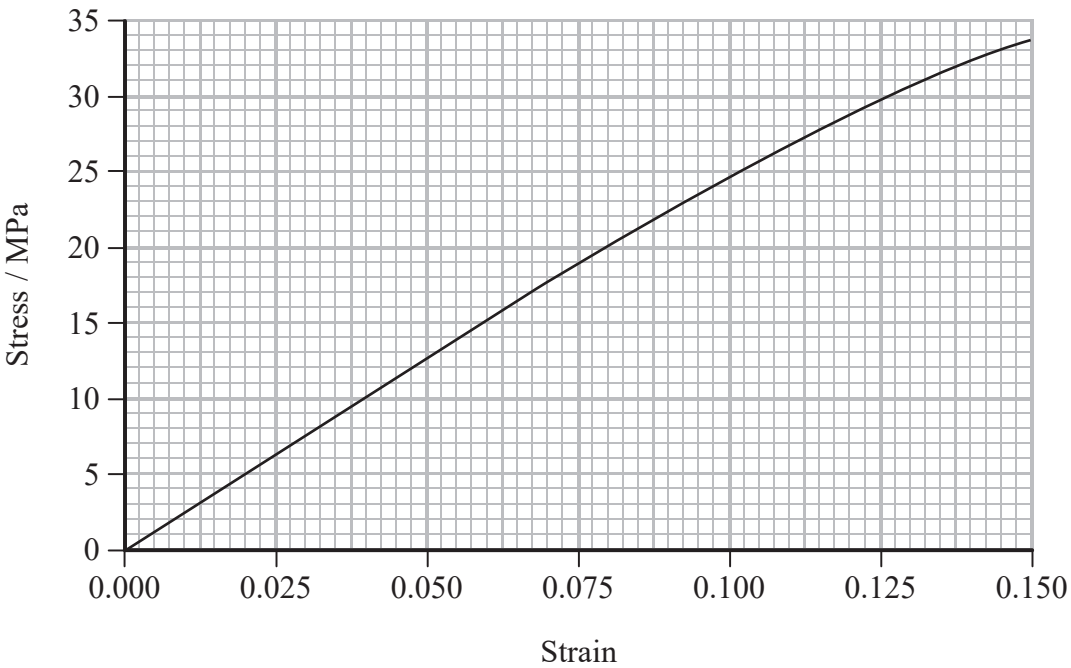
A crash-test dummy in the driving seat is wearing a seat belt made from polyester webbing. The seat belt has a cross-sectional area of 0.85 cm^2 and a total length of 2.0 m . A student suggests that in the collision the seat belt absorbs all the kinetic energy of the dummy.

(a) Show that the energy per unit volume that would have to be absorbed by the seat belt is about $2 \times 10^8\text{ J m}^{-3}$.

mass of dummy = 75 kg

(3)

(b) The graph shows how stress varies with strain for the seat belt.



(i) Show that the area under the graph represents the energy stored per unit volume in the seat belt.

(2)

(ii) Use the graph to determine whether the seat belt absorbs all the kinetic energy of the dummy from part (a).

In this collision, the maximum strain of the seat belt is 0.075

(3)