10. A plane Π contains the points $P\ (3, 2, -1)$, $Q\ (3, 0, -2)$ and $R\ (0, 3, 0)$, relative to a fixed origin O.

(a) Determine a vector equation of Π giving your answer in the form $\mathbf{r} = \mathbf{a} + \lambda\mathbf{b} + \mu\mathbf{c}$ where λ and μ are scalar parameters.

(3)

(b) Show that the vector $\mathbf{i} - 3\mathbf{j} + 6\mathbf{k}$ is perpendicular to Π.

(2)

(c) Hence determine a Cartesian equation of Π.

(2)

A children's climbing frame is placed on a lawn.
One of the bars of the frame is parallel to the lawn.

In a model of this situation

- the lawn is the plane Π
- the bar is a straight line passing through the points $S\ (1, -3, -5)$ and $T\ (-5, 7, 1)$
- the units are metres

(d) Determine a vector equation of the line that models the bar.

(2)

(e) State a limitation of the model.

(1)

(f) Determine, according to the model, the shortest distance from the lawn to the middle of the bar, giving your answer to the nearest cm.

(2)

Given that the shortest distance from the middle of the bar to the lawn is actually 1.7 m,

(g) use your answer to part (f) to evaluate the model, explaining your reasoning.

(1)