Question 14 (7 marks)

A small drone is launched and, after hovering in an initial position, it flies in a straight line under the control of its operator. The position of the drone from the operator is given by

$$\underset{\sim}{r}(t) = \begin{bmatrix} 100 + 0.5t \\ 0.6t \\ 50 - 0.02t \end{bmatrix}$$ metres, where t is the time in seconds it has been flying in a straight line.

The top of a mobile phone tower is positioned at $200\underset{\sim}{i} + 150\underset{\sim}{j} + 30\underset{\sim}{k}$ relative to the operator i.e. the mobile phone tower is 30 metres tall.
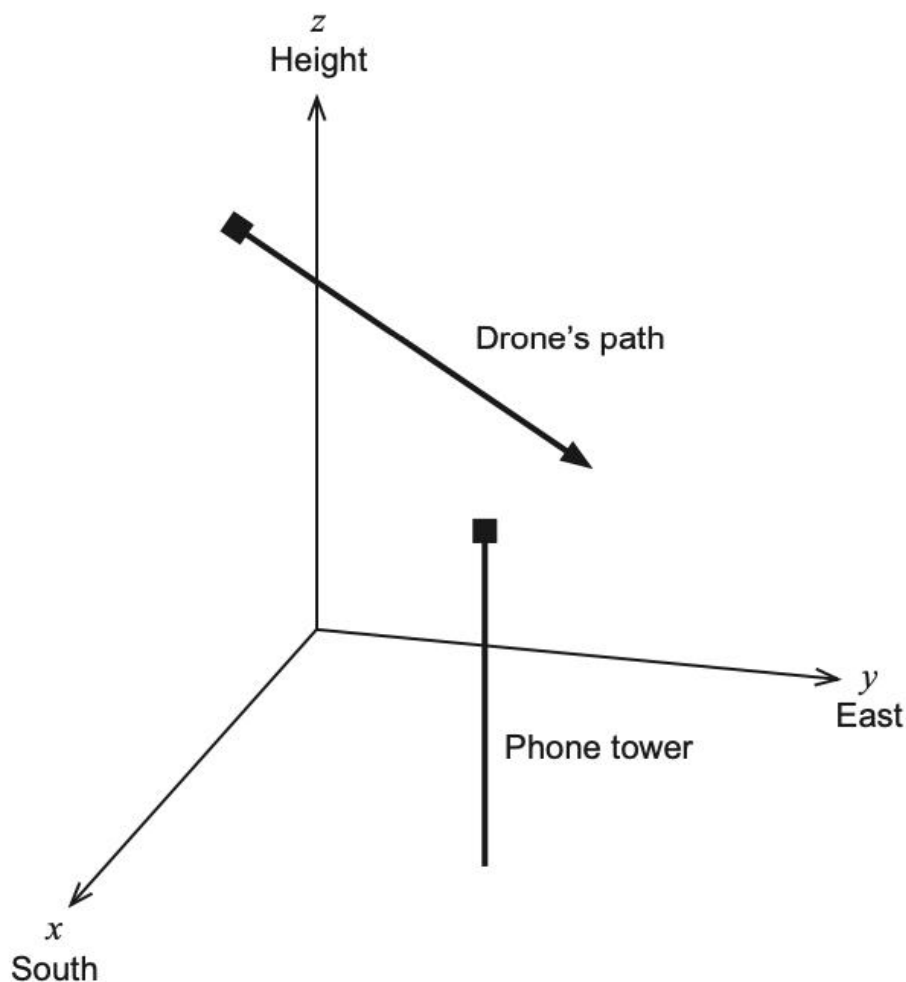
(a) After two minutes of flight, how high is the drone above the ground? (2 marks)

(b)   Write the expression for the position vector of the drone from the top of the phone tower after t seconds.   (1 mark)

The operator knows that the drone will not strike the mobile phone tower. However, the operator does not know that the drone will cause interference when it is less than 50 metres from the top of the tower.

(c)   Determine whether the drone will cause interference to the mobile phone tower and, if so, for how long will this occur, correct to the nearest second.   (4 marks)