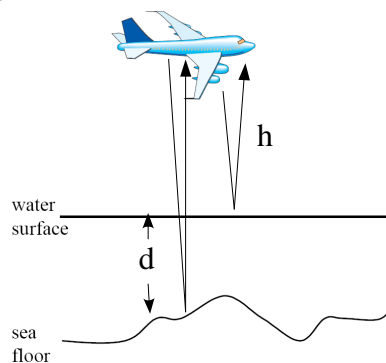


- 2.
- Vertically. The electrons in the receiving antennae will oscillate in the antennae in the same plane as the electric fields (therefore the same as the sending antennae) so having the antennae in the same orientation is optimal.
 - The plane formed by the vertical direction and the direction of wave propagation.
 - 9.01×10^7 Hz

d) $\lambda = \frac{v}{f} = \frac{3.00 \times 10^8}{9.01 \times 10^7} = 3.33\text{m (3 s.f.)}$

3. The signal strength of city channels in the country and country channels in the city are too weak to be pleasant to watch but can be strong enough that they could interfere with each other. This interference is minimised by polarising each at right angles to the other (two waves with planes of polarisation at right angles will not interfere).

4. a) One laser pulse is reflected from the surface of the water and another from the bottom of the body of water. If the speed of light in water is known, then the difference in time taken can be used to calculate the depth of the water, since speed = distance / time taken.



b) $t_w = \frac{t_b - t_s}{2} = \frac{2.89 \times 10^{-6} - 2.61 \times 10^{-6}}{2} = 1.40 \times 10^{-7} \text{ s}$

$d = 2.25 \times 10^8 \times 1.40 \times 10^{-7} = 31.5\text{m (3 s.f.)}$

c) The aircraft needs to be able to detect the light returning, and the following are some reasons why the laser light needs to be strong in order to achieve this:

- particles suspended in the water tend to scatter the light in all directions, reducing the amount of laser light making it to the bottom and back
- water tends to absorb light that passes through it
- the seabed absorbs light (especially so if it has a dark colour)
- the irregularities on the water surface and the bottom of the body of water allow a portion of the light to return to the aircraft, however this only represents a portion of the light, the rest goes in other directions
- the laser beam needs to have a wide radius so it can provide enough light at a low intensity but not be dangerous, and the laser must sufficiently power such a beam