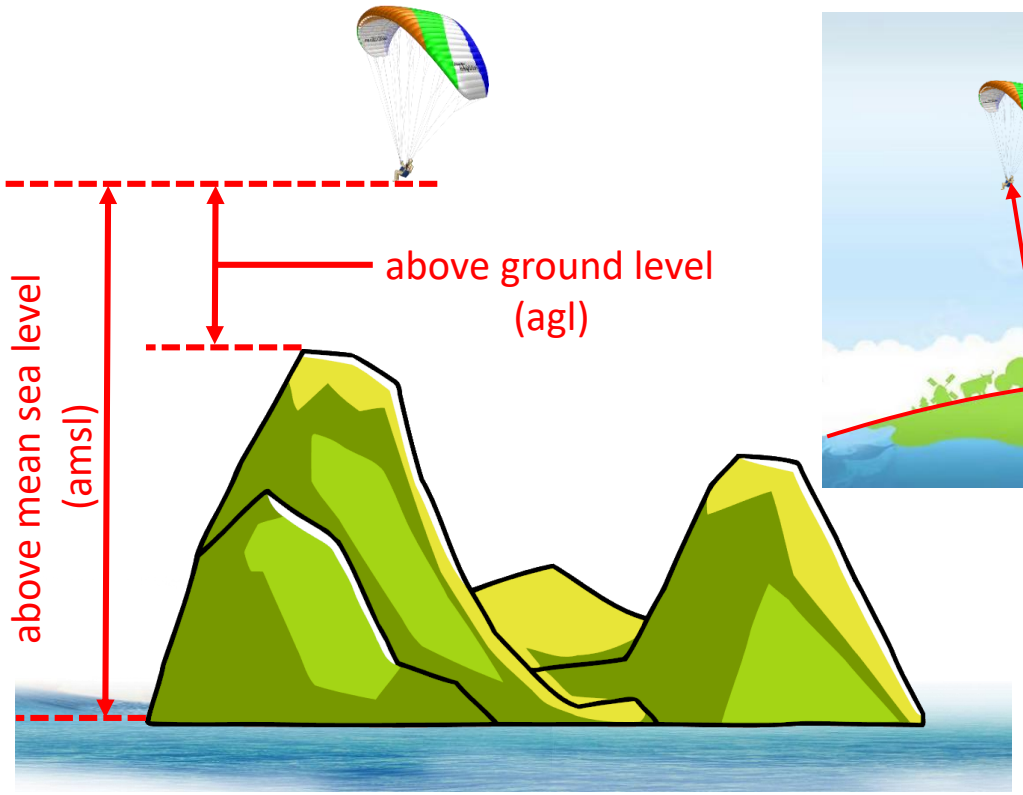
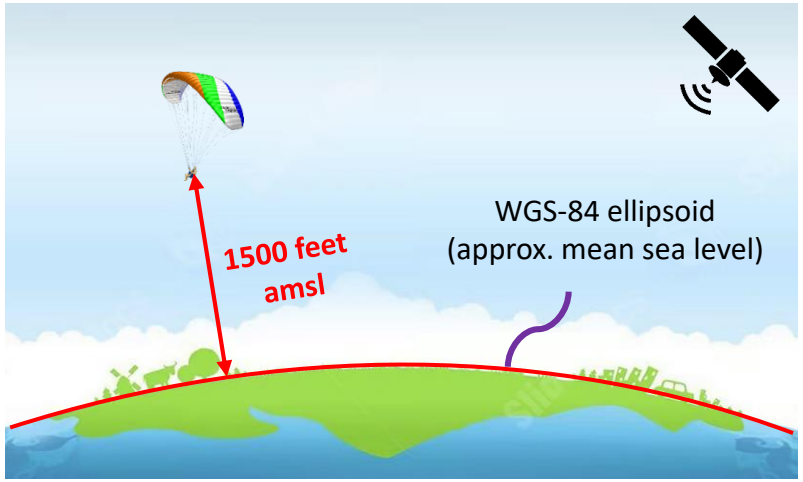
Flight Levels

A Guide for the Pilot Exam

We normally measure our height with reference to a fixed plain or point on the earths surface. That might be mean sea level (amsl), ground level (agl) or any other physical object we may choose. The reference plain represents zero height.





GPS altitude gives a height with reference to a mathematical reference plain (WGS- 84 ellipsoid) that is a good estimate for mean sea level and it is this height that we most commonly see on our instruments.

If the instrument has a terrain model then it is able to use the GPS height and terrain height to calculate your height above ground.

Likewise, airspace heights are usually heights referenced to the ground or mean sea level however Flight Levels work differently.

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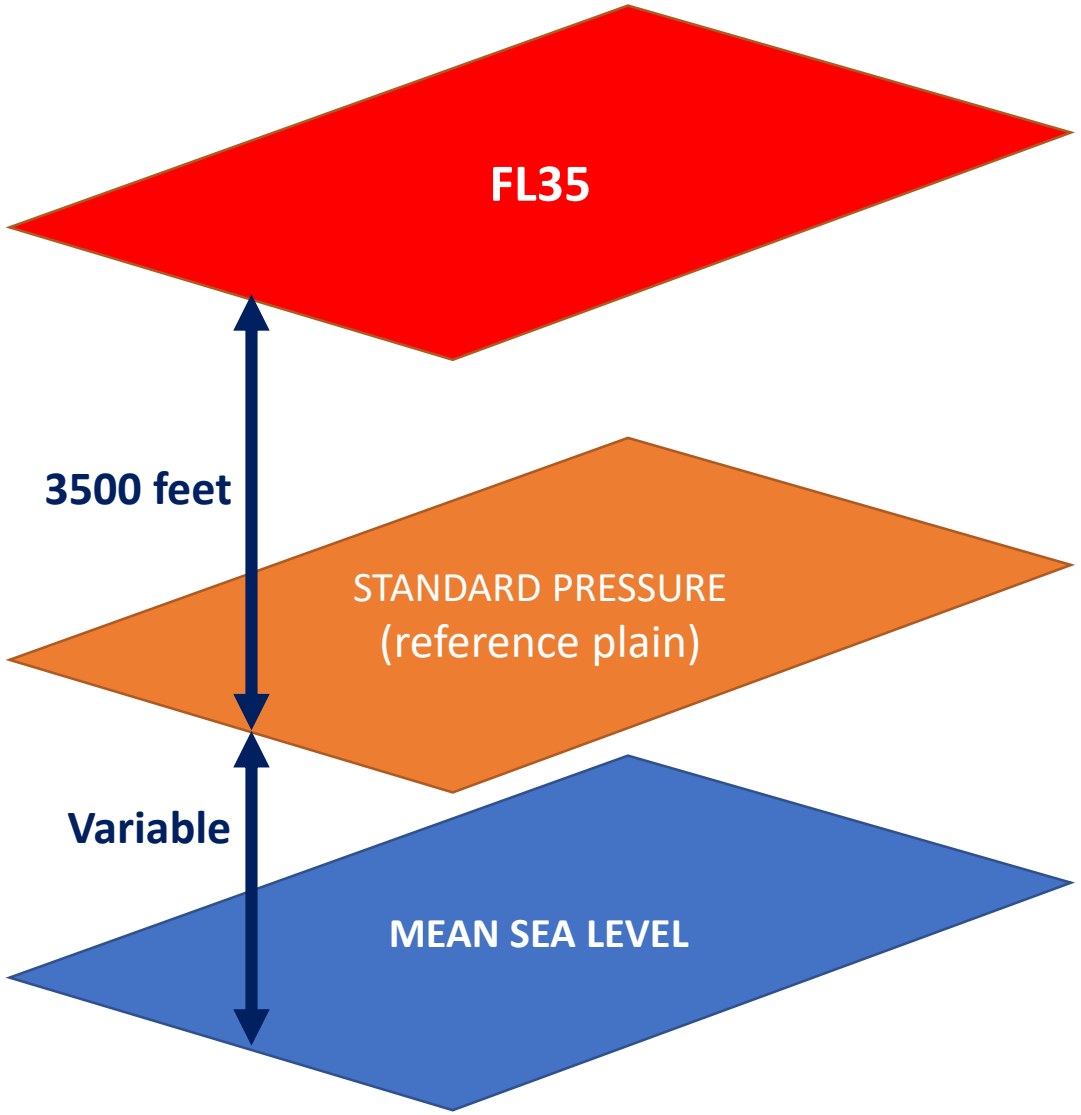

Flight levels are not referenced to any physical datum they are instead defined relative to a level in the atmosphere where the air pressure is 1013.2 mbar known as Standard Pressure. Strictly speaking flight levels are therefore an indication of pressure and not of altitude.

We know that air pressure, at the earths surface, varies from day to day and even hour to hour. Consequently the height, with reference to mean sea level, where the air pressure is 1013mb will vary also and any airspace referenced to it will also be effected.

Flight levels are:-

- a method of defining the floor and/or ceiling of an airspace
- prefixed with the letters FL, such as FL450 or FL30
- allocated in steps of 500 feet
- specified in 100s of feet i.e. FL450 = 45000 feet and FL30 = 3000 feet (just add two zeros to convert to feet)
- referenced to a pressure rather than a physical plane or object on the earths surface

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Paraglider pilots are mostly likely to encounter Flight Levels when they are used to define the floor of an airspace.

In order that we do not infringe airspace we need to know how to calculate the height of a Flight Level defined airspace and there will be at least one question on the pilot exam related to the subject.

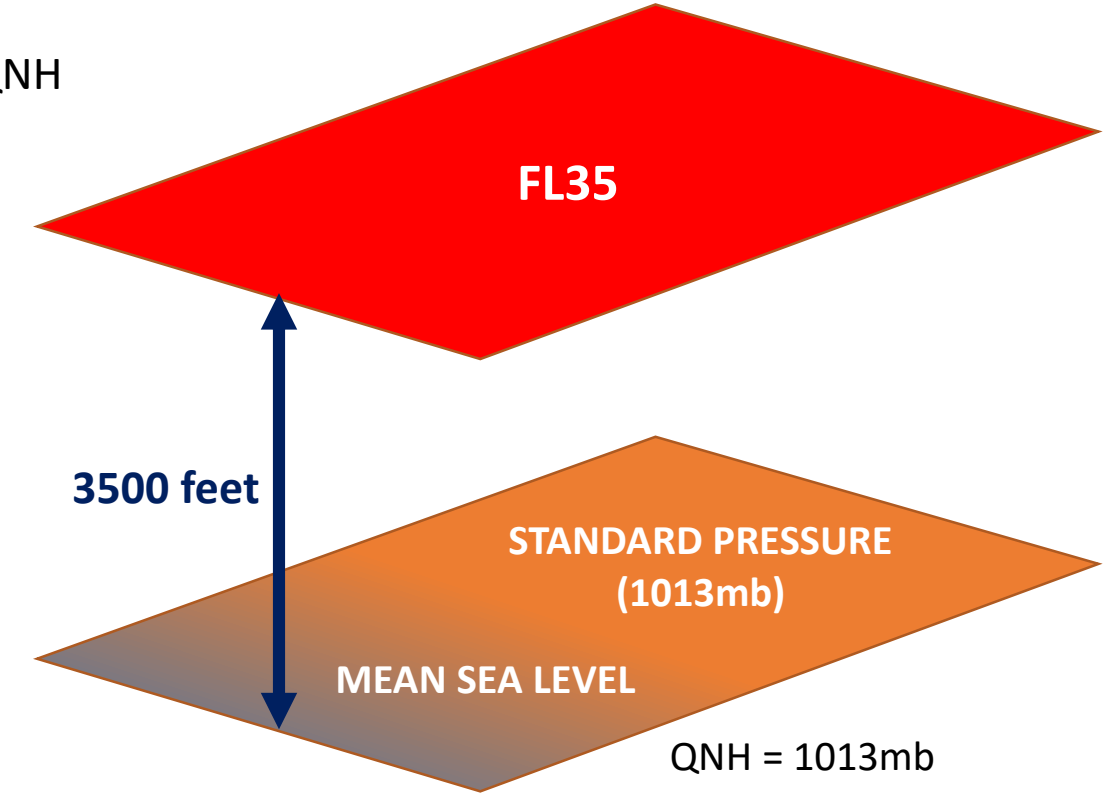
Note:- The air pressure at sea level is more commonly referred to as QNH

Lets start with a simple example:-

- The mean sea level air pressure (QNH) is 1013mb
- There is airspace above us with a floor of FL35

What height amsl is the airspace floor?

Answer:-
This is the simplest example of a Flight Level question as standard pressure happens to be the same as QNH i.e. standard pressure is at mean sea level and the airspace is therefore 3500 feet amsl.



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Lets see what happens on a day when high pressure is in charge:-
QNH = 1025mbar
At what height amsl is the FL35 floor now?

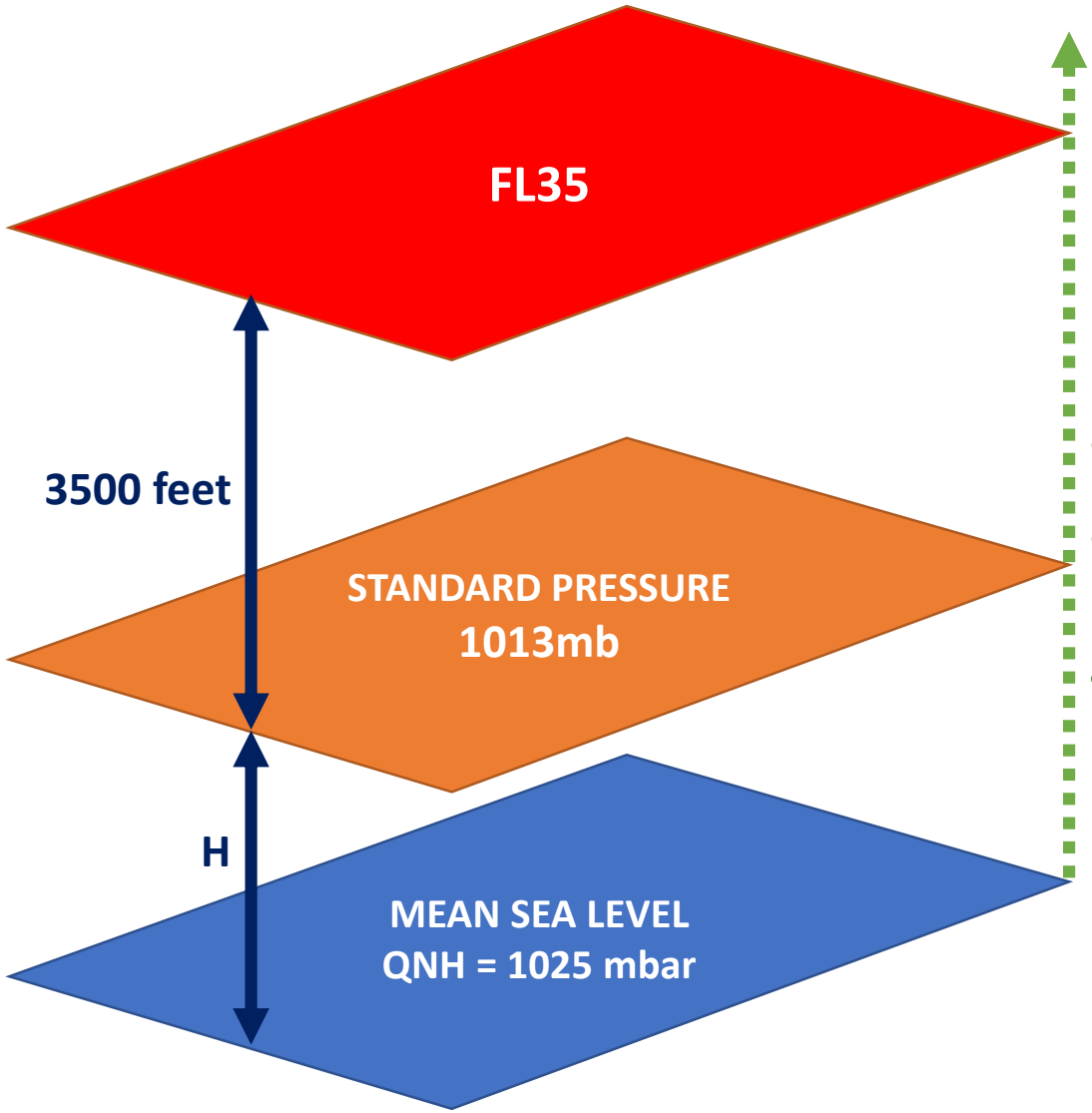
We know that the air pressure at sea level (QNH) is 1025mbar and that **air pressure decreases with altitude**.

Therefore the plane where the pressure is 1013mb (standard pressure) will be at some height (H) above sea level as shown in the diagram.

H can be calculated because we know that for every 30 feet we rise (or fall) the air pressure will change by 1mb.

Therefore:-
H = (difference in mbar between QNH and standard pressure) x 30 feet
= (1025 – 1013) x 30
= 12 x 30 = 360 feet

<u>FL35 will be 3500+360 = 3860 feet amsl</u>



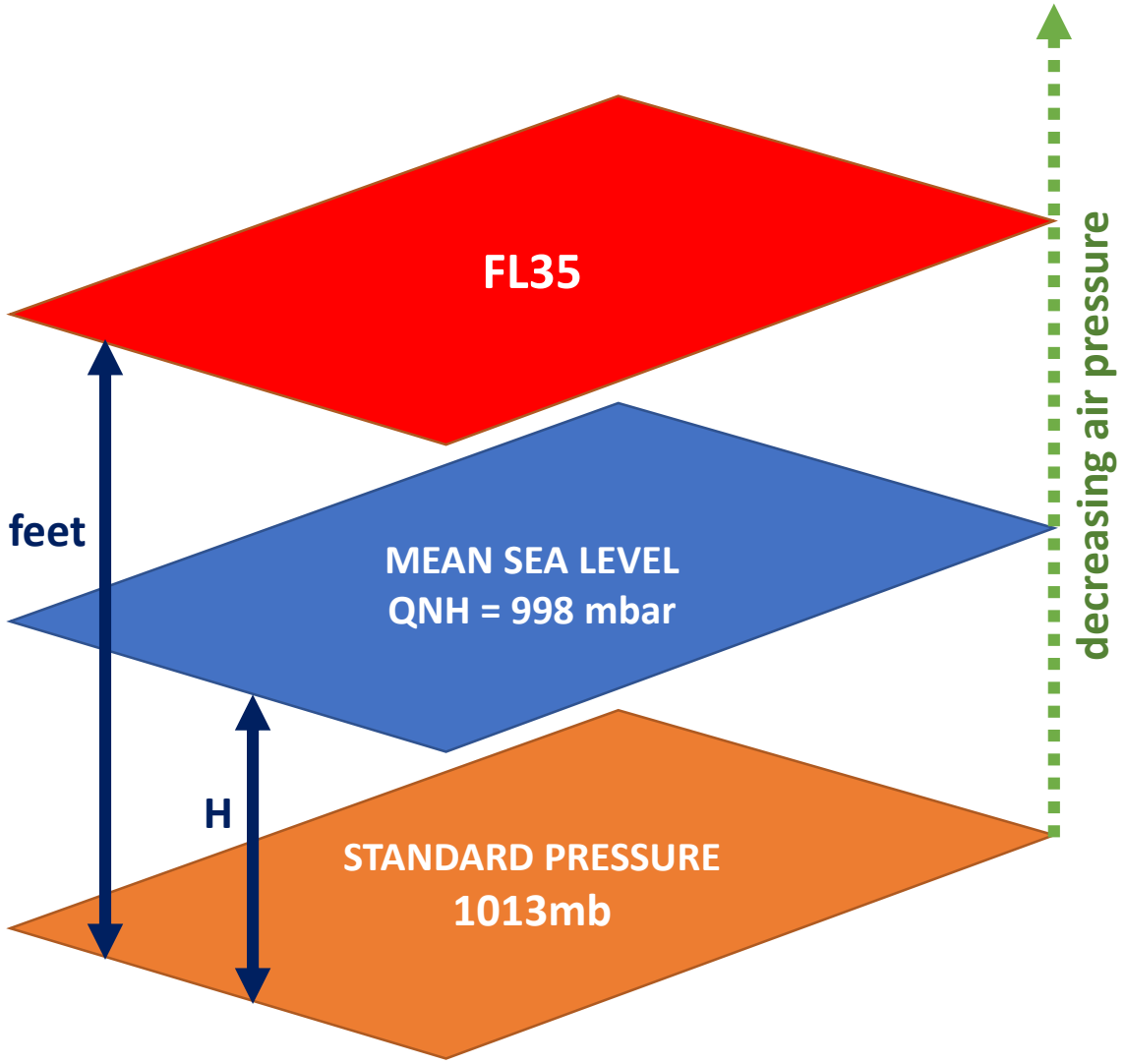
On a low pressure day things look very different:-
QNH = 998mbar
At what height amsl is the FL35 floor now?

In this case the plane where the pressure is 1013mb (standard pressure) will be at some height (H) below sea level as shown in the diagram.

We can use the same calculation as previously to determine H.

Therefore:-
H = (difference in mbar between QNH and standard pressure) x 30 feet
= (1013 – 998) x 30
= 15 x 30 = 450 feet
We need to remember that, in this case, H must be subtracted from FL35…….

<u>FL35 will be 3500-450 = 3050 feet amsl</u>



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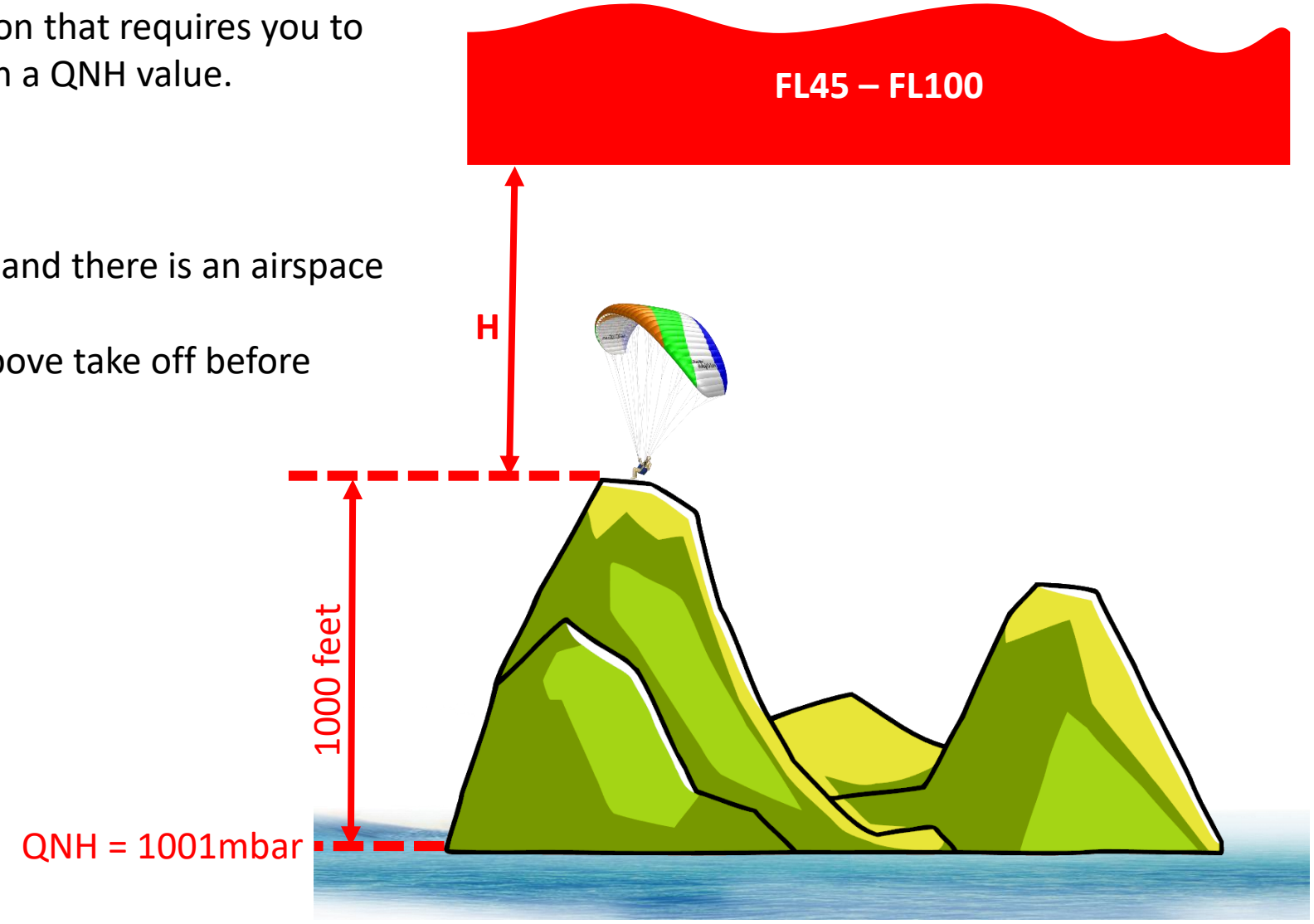
The pilot exam will contain at least one question that requires you to calculate the variation in a flight level based on a QNH value.

An example could be:-

You are standing on take off at 1000 feet amsl and there is an airspace floor at FL45 above you.
If QNH = 1001mbar how high can you climb above take off before entering airspace?

Things to remember:-

- Standard pressure = 1013mbar
- Air pressure decreases with altitude
- 1mbar change in air pressure = 30 feet



Solution

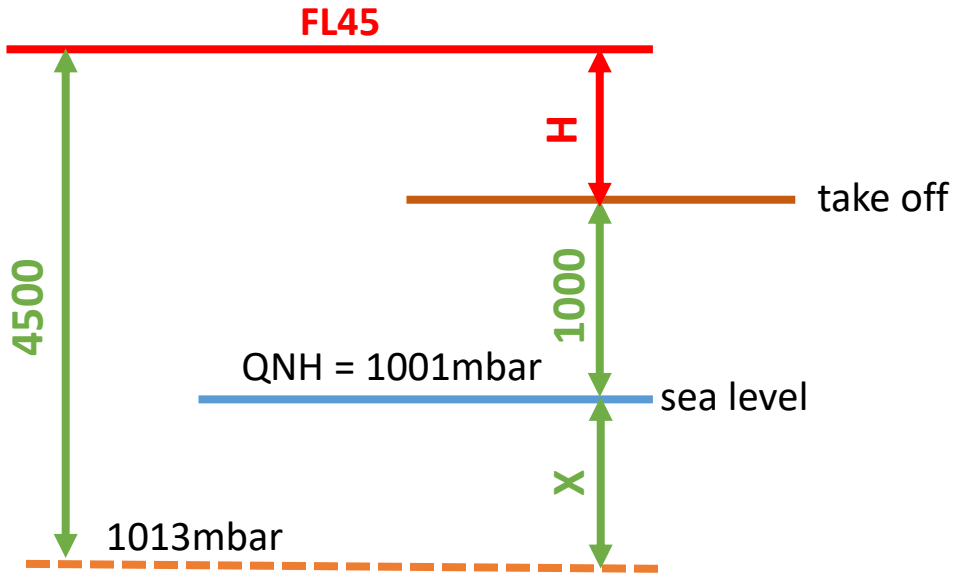
It often helps to draw the problem as a series of levels.

From the diagram it is easy to see that the solution H = 4500 – (1000 + X)

and

X = (1013mbar – 1001mbar) x 30 feet
= 12 x 30 = 360 feet

Therefore H = 4500 – (1000 + 360) = **3140 feet**



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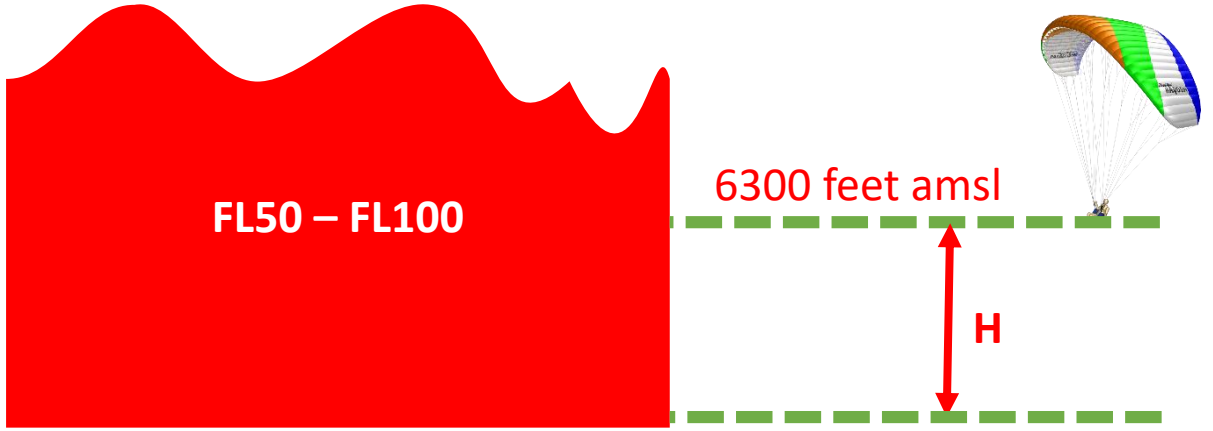
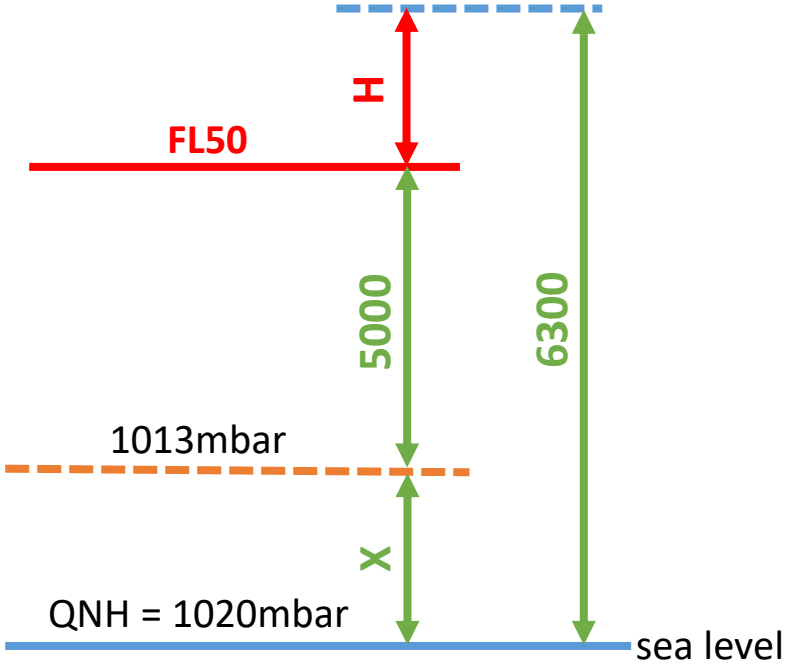
You are flying at 6300 feet amsl and rapidly approaching airspace with a floor of FL50.
If QNH = 1020mbar how much height do you need to lose to avoid entering the airspace?





Solution

H = 6300 – (5000 + X)

X = (1020 – 1013) x 30
= 7 x 30 = 210 feet

Therefore H = 6300 – (5000 + 210) = **1090 feet** (descend to <5210 feet amsl)

Some useful points to remember when answering Flight Level questions:-

- Standard pressure = 1013 mbar
- A change in height of 30 feet = 1mb change in air pressure
- Air pressure decreases as height increases
- QNH = atmospheric pressure at mean seal level
- Add two zeros to the Flight Level to convert it to feet (above standard pressure)

Pilots usually find it difficult to decide if the airspace is going to move up or down based on the days QNH:-

- If QNH is ***lower*** than standard pressure then the Flight Level will be ***lower*** compared to msl
- If QNH is ***higher*** than standard pressure then the Flight Level will be ***higher*** compared to msl

- If in doubt draw a diagram

Note – 1mb does not exactly equal 30 feet of height but is close enough for the calculations in the pilot exam. Likewise Standard Pressure can be rounded to 1013mbar is sufficient for our purposes

You may also see pressure defined in hectopascals (hPa). As 1mbar = 1hPa you may use the same calculation as in the examples