ECSM Wing

Air Training Corps

Leading Cadet Training

Principles of Flight
Airmanship
Basic Navigation

Revision Notes and Questions

Cadet ………………………………………

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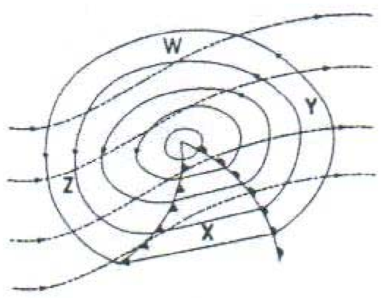
Upper Winds

The upper wind is responsible for the general movement of a depression.
This diagram shows isobars for both the upper



winds (dotted) and lower winds (solid lines). If you are standing at position 'Y' with your back to the lower wind, the upper wind is moving from west to east , the depression has not reached you yet and the weather is likely to deteriorate.

Anticyclones

Anticyclones are regions of high pressure with widely spaced isobars and light winds. In general they are stable, slow-moving systems, consisting of warm, dry air, bringing long periods of fine clear weather.

Clouds

Clouds are named according to both their shape and their height. There are three main *types* of cloud:

Cirrus - found only at high levels and composed of ice crystals. (Cirrus means thread or hair.)

Cumulus - a lumpy or heaped cloud.

Stratus - a featureless layer cloud.

Dependant upon their height, clouds may be prefixed with :

Cirro - high clouds (5,500m to 11,000m)
e.g. cirrocumulus, cirrostratus.

Alto - medium level (2000m to 5,500m)
e.g. altocumulus, altostratus.

Clouds with no prefix have a base below 2000m, e.g. cumulus, cumulonimbus, stratus and stratocumulus.

Depressions move under the influence of:

a) Lower winds. b) Warm fronts.
c) Cold fronts. d) Upper winds.

Upper winds are generally responsible for:

a) The strength of the surface wind.
b) Poor weather.
c) Fine weather.
d) Movement of a epression.

In the diagram above left, the dotted lines represent the upper wind and the solid lines the lower wind. If you stood at Y with your back to the lower wind and the upper wind is moving from left to right:

a) You'll feel a warm wind in your face.
b) The weather is likely to improve.
c) The weather is likely to deteriorate.
d) There will be no change in the weather for a while.

An anticyclone is:

a) An area of low pressure.
b) An area of high pressure.
c) A depression.
d) An area between two areas of high pressure.

Generally an area of high pressure will tend to bring:

a) Fast moving wet weather systems.
b) Fast moving fine weather systems.
c) Long periods of fine weather.
d) Long periods of poor weather.

Stratus is what type of cloud?

a) Lumpy or heaped. b) Hair-like.
c) Featureless layer. d) Thread-like.

Cumulus is what type of cloud?

a) Lumpy or heaped. b) Hair-like.
c) Featureless layer. d) Thread-like.

Cirrus is what type of cloud?

a) Lumpy. b) Heaped.
c) Hair or thread-like. d) Featureless layer.

Cloud names may have a prefix which indicates the height of the cloud base. Which of these indicates a cloud with a base at medium level?

a) Nimbo. b) Cirro. c) Alto. d) Strato.

When alto is used as a prefix in a name of a cloud, that cloud may be found at:

a) Any level. b) Low level.
c) Medium level. d) High level.

Which of these would only be found at high level?

a) Stratocumulus. b) Altocumulus.
c) Altostratus. d) Cirrostratus.

High level cloud names begin with the prefix:

a) Strato b) Alto
c) Nimbo d) Cirro

HOW TO USE THIS BOOK

This manual contains essential knowledge and key revision points for the three Leading Cadet subjects, Principles of Flight, Airmanship and Basic Navigation.

You may be sitting all three subjects together, or you may be sitting them separately. Ensure you know which subjects you will be sitting before each examination and retain this book until you have successfully passed all three subjects.

Read each page, then read the associated questions. Underline or highlight the correct answer. Before the examination date, check with your instructor to ensure that *your* chosen answers are the *correct* ones. Revise these questions and answers as they will constitute a very high proportion of the actual examination questions.

Sqn Ldr P Twose
Training Officer
ECSM Wing

Leading Cadet Training

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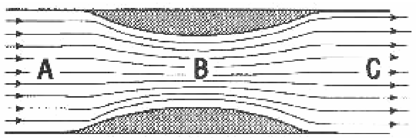
CHAPTER 1 <u>LIFT AND WEIGHT</u>

Many years ago Sir Isaac Newton formulated laws which explain the way things move. One of his laws states that 'to every action there is an equal and opposite reaction'. A vehicle weighing 1 tonne will press down on the road with a force of 1 tonne. The road must press *up* with a force of 1 tonne to support the vehicle. Similarly a 10 tonne boat is supported by an upward 10 tonne force from the water, otherwise it would sink. How can an aircraft, which may weigh hundreds of tonnes, be supported by just air? In a simple wind-tunnel experiment air is blown

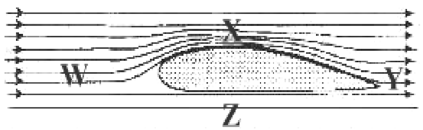


from A, through a constriction at B, and comes out at C. If airspeed and pressure are measured at each of these three points we find that the air speeds up to get through the restriction at B then slows again at C. When airspeed increases, the pressure actually *decreases.* This is known as Bernoulli's Principle. The pressure recorded at B will be lower than at A or C.

If you find this hard to believe, then hold a sheet of paper as shown in the diagram below and blow along the curved top edge of the paper.

The paper will rise into line with the airflow. By speeding up the airflow over the top you have reduced the pressure above the paper, so the normal air pressure under the paper pushes it up.

The top surface of an aircraft's wing is shaped like half of the constriction in the wind tunnel.



The air increases in speed as it flows over the wing and the pressure at point X is therefore reduced. The resulting pressure difference between the air above and below the wing pushes the wing upwards. At flying speeds, this force is sufficient to support the weight of the aircraft.

Which scientist formulated laws which explain the way things move?

a) Morgan. b) Newton. c) Riddeley. d) Einstein.

That scientist's 3rd law states that:

a) Every object has weight.
b) Weight equals lift during flight.
c) Every force causes an object to move.
d) Every action has an equal and opposite reaction.

In the wind-tunnel diagram, air is flowing past a constriction. What has happened to the air pressure at point B?

a) It is lower than at point A.
b) It is the same as at point C.
c) It is greater than at point C.
d) It is greater than at point A.

For air moving in a smooth streamline flow, if the air is made to speed up, what happens to the pressure of the air where it is flowing faster?

a) It increases. b) It fluctuates wildly.
c) It decreases. d) It remains constant.

Bernoulli's Principle says that:

a) Where air is speeded up the pressure decreases.
b) Where air speed decreases the temperature increases.
c) Where air is speeded up the pressure increases.
d) Where air speed increases the temperature increases.

When you blow along the curved top of a sheet of paper, the paper rises. This is because of:

a) The skin friction that develops along the top of the paper.
b) A reduction in the air pressure along the top of the paper.
c) The vortices that form along the top of the paper.
d) A rise in the air pressure along the top of the paper.

Where is the airflow fastest in the diagram of an aerofoil in an airflow?

a) W b) X c) Y d) Z

Where is the air pressure lowest in the diagram of an aerofoil in an airflow?

a) W b) X c) Y d) Z

As air passes over the top surface of a wing in normal flight, its speed will:

a) Increase. b) Reduce considerably.
c) Reduce slightly. d) Remain constant.

Why is lift produced when air flows over the top surface of a wing?

a) The air pressure rises because the air is speeded up.
b) The air pressure rises because the air is slowed down.
c) The air pressure falls because the air is speeded up.
d) The air pressure falls because the air is slowed down.

<u>Arctic Maritime</u>

Originates in cold Arctic seas and picks up little moisture as it travels south.
Summer: very cold, frequent heavy showers.
Winter: very cold, strong N-NE wind, heavy snow.

<u>Polar Continental</u>

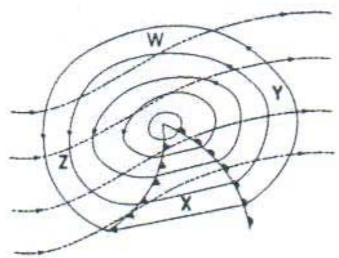
Originates in Siberia, it is very cold in winter, but warm in summer. The short sea track to the south of England means that it remains quite dry with little or no cloud, whereas in Scotland, weather conditions can be quite different.
Summer: warm and dry, cloud free.
Winter: sleet and snow in north, cold and dry in south.

<u>Fronts and Frontal Depressions</u>

Fronts and depressions are the cause of most of the poor weather we experience. Weather changes occur as the result of water vapour and variations in air pressure. To understand what is happening, meteorologists draw charts linking all points of equal pressure (isobars) to gain an understanding of weather features in much the same way as contours (lines joining points of equal height) help you to picture a geographical feature from a map.

Just as the distance between contours indicates the steepness of a hill, the distance between isobars indicates a change in pressure or a pressure gradient. A steep gradient with the isobars close together results in high winds, whereas widely spaced isobars result in light breezes.

Areas of low pressure are called lows or depressions, areas of high pressure, highs or anticyclones.



Most depressions are accompanied by 'fronts' where a cold air mass meets a warm one. In this diagram of a depression moving east, 'X' is the warm sector with a warm front to the east and a cold front moving in behind from the west. As cold fronts move faster than warm fronts, the cold front eventually catches up with the warm front and 'lifts' the warm sector air away from the ground completely. This 'occluded' front is represented by a line of alternate semi-circles and triangles.

Which of these types of air mass brings cold dry weather with little or no cloud to the British Isles in winter?

a) Polar continental via the short sea track.
b) Polar maritime.
c) Polar continental via the long sea track.
d) Returning polar maritime.

Lines on a weather chart joining all points of equal pressure are called:

a) Cold Fronts b) Occluded Fronts.
c) Warm Fronts d) Isobars.

Isobars are drawn on a weaher map joining points of equal:

a) Temperature. b) Windspeed.
c) Humidity. d) Pressure.

An area of low pressure is also known as:

a) A depression. b) A warm front.
c) An occluded front. d) An anticyclone.

Fronts occur where:

a) The atmospheric pressure is very high.
b) Two warm air masses meet.
c) A cold air mass meets a warm air mass.
d) Two cold air masses meet.

This diagram shows:

a) An anti-cyclone.
b) A warm front.
c) An occluded front.
d) A cold front.

This diagram shows:

a) An anti-cyclone.
b) A warm front.
c) An occluded front.
d) A cold front.

When a cold air mass catches up with another cold air mass, thereby undercutting a comparatively warm air mass and pushing it upwards off the Earth's surface, the weather system is called:

a) A cold stream. b) An occluded front.
c) A ridge of high pressure. d) A non-frontal depression.

This diagram shows:

a) An anti-cyclone.
b) A warm front.
c) An occluded front.
d) A cold front.

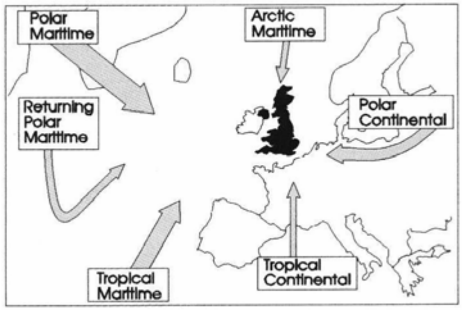
An occluded front is represented by:

a) A line carrying alternate semicircles and triangles.
b) A line carrying alternate semicircles and squares.
c) A line carrying semicircles.
d) A line carrying squares.

CHAPTER 4 **WEATHER**

There are six main air masses that affect the weather in the British Isles, each having its own distinctive characteristics. To complicate matters, these characteristics also change by season.

Air Masses



Polar Maritime

Originates in North Canada and Greenland, picks up water vapour from the Atlantic before reaching the British Isles.
Summer: cool winds, heavy showers.
Winter: heavy showers in west, clear in east.

Returning Polar Maritime

Originates in Canada as cold, dry air, but moves south and picks up a lot of water vapour. It is much warmer and wetter than Polar Maritime air.
Summer: warm with squally showers and storms.
Winter: low stratus cloud, showers in mountains.

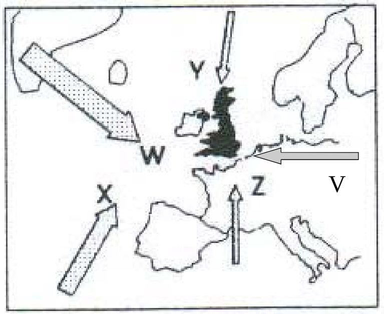
Tropical Maritime

Originates in warm tropical oceans around the equator and brings cloudy, warm and wet air all year round.
Summer: warm SW winds, low stratus clouds.
Winter: mild, low stratus, drizzle, mountain rain.

Tropical Continental

Originates in North Africa.
Summer only: very hot, dry, hazy, occasional thunderstorms.

Look at the figure below for the next five questions.



Which air mass is called Arctic Maritime?
a) V b) W c) X d) Y e) Z

Which air mass is called Tropical Maritime?
a) V b) W c) X d) Y e) Z

Which air mass is called Tropical Continental?
a) V b) W c) X d) Y e) Z

Which air mass is called Polar Maritime?
a) V b) W c) X d) Y e) Z

Which air mass is called Polar Continental?
a) V b) W c) X d) Y e) Z

Which air mass starts off very cold with dry air but arrives in the U.K. warm and wet?

a) Arctic Maritime. b) Polar Maritime.
c) Returning Polar Maritime. d) Tropical Continental.

Which air mass originates around the equator and brings warm, cloudy weather to the U.K. in both summer and winter?

a) Arctic Maritime. b) Polar Maritime.
c) Tropical Continental. d) Tropical Maritime.

Which air mass originates in North Africa and brings hot, dry weather with occasional thunderstorms to the U.K. in summer?

a) Arctic Maritime. b) Polar Continental.
c) Tropical Continental. d) Tropical Maritime.

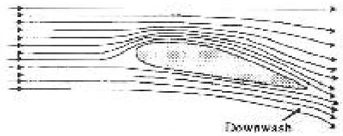
Which air mass originating in Siberia brings to the U.K. warm weather in summer and cold weather in winter?

a) Arctic Maritime. b) Polar Continental.
c) Tropical Continental. d) Tropical Maritime.

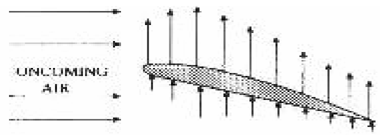
Which air mass originates in the north of Canada and Greenland, brings cool winds and heavy showers to the UK both summer and winter?

a) Polar Continental. b) Polar Maritime.
c) Tropical Continental. d) Arctic Maritime.

In normal flight conditions the wing is inclined to the oncoming airflow at a slight positive angle. This deflects some of the airflow downwards creating a 'downwash' which adds to the lift generated by the top surface of the wing.

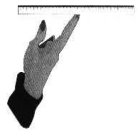


Under these flight conditions *all* parts of a wing generate lift, though to varying degrees.
This diagram illustrates several important points:



a) the top surface normally generates more lift than the bottom surface (sometimes 80% of it).
b) the greatest amount of lift on the top surface occurs where the surface is curved the most.
c) all lift forces act at 90° to the oncoming air-flow.

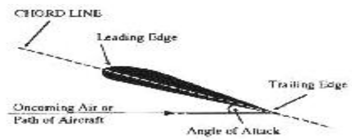
All of these lift forces can be combined and represented by a single arrow from the **'centre of pressure'** where all lift forces can be said to act.



This is similar to finding the centre of gravity of a ruler. All the small forces of gravity acting on the ruler balance about the centre of gravity.

Factors Affecting Lift

Several factors affect the amount of lift a wing produces. At subsonic speeds, doubling the airspeed gives **four** times the lift, trebling the airspeed gives **nine** times the lift.



Increasing the 'angle of attack will increase lift until the angle reaches about 15°.

Angle of attack is the angle between the chord line of a wing and the oncoming air.

Where is the greatest amount of lift normally generated on an aerofoil?

a) Top surface. b) Bottom surface.
c) Trailing edge. d) Leading edge.

Lift is obtained from almost all parts of the wing but not equally from every part. About how much is obtained from the top surface of an aircraft wing?

a) Up to 80%. b) Up to 50%.
c) Up to 33%. d) Up to 25%.

On a general purpose aerofoil, the greatest amount of lift occurs:

a) Just forward of the trailing edge.
b) At the centre of the bottom surface.
c) Where the top surface is not curved.
d) Where the top surface is curved the most.

In what direction relative to the direction of the oncoming air, or path of the aircraft, do the lift forces act?

a) At about 4 degrees. b) The opposite direction.
c) At 90 degrees. d) The same direction.

The point on a wing at which all the lift forces are said to act is:

a) Centre of pressure. b) Dynamic centre.
c) Pressure point. d) Static point.

In the figure on the left, all the small forces of gravity acting on the ruler balance at a point called:

a) The static centre. b) The centre of gravity.
c) The centre of pressure. d) The dynamic centre.

If an aircraft's speed through the air is increased from 250 kts to 500 kts, what happens to the amount of lift produced?

a) It is increased by four times. b) It is doubled.
c) It is reduced to a quarter. d) It remains the same.

For low subsonic speeds, if the airspeed is doubled and all other factors affecting lift are unchanged, the lift is:

a) Unchanged. b) Multiplied by 2.
c) Multiplied by 4. d) Multiplied by 8.

On an aircraft, if the airspeed over a wing is trebled and all other factors affecting lift are unchanged, the lift is:

a) Multiplied by about 3. b) Divided by about 3.
c) Unchanged. d) Multiplied by about 9.

Angle of attack means:

a) The angle between the chord line of the wing and the oncoming air.
b) The angle of sweepback of a wing.
c) The amount by which the aircraft's nose is above the horizon in level flight.
d) The angle at which a wing is fixed to the fuselage.

The chord line of a wing is a straight line joining the leading edge to the trailing edge.

Air density also affects lift. If the air becomes 'thinner' (as it does with increasing altitude or temperature) the amount of lift is reduced.

Wing shape and area significantly affect the amount of lift produced. An aircraft designer will design a wing for the aircraft's specific role: a big high lift wing for a heavy slow transport, a thin high speed wing for a fighter.

In this diagram Z and W are thin, high-speed wing sections. X is a general purpose wing section and Y illustrates a high-lift section. The dotted line is the mean camber line for each wing.

In most aircraft the pilot will have some control over the wing section and area. He can increase the effective camber of the wing (and hence lift) by lowering flaps. Flaps are covered in more detail in Chapter 3.

Straight and Level Flight

The force of gravity acting on an aircraft is called 'weight'.

When an aircraft is in straight and level flight, neither climbing or descending, then lift exactly equals weight.

If lift is greater than weight, the aircraft will climb, if weight is more than lift it will descend.

If an aircraft in steady straight and level flight suddenly reduced its weight by dropping supplies or jettisoning fuel, then the aircraft would start to climb rapidly unless the pilot took corrective action on the flying controls.

What is the chord line of a wing section?

a) A curved line following the mean camber of the wing from the leading edge to the trailing edge.
b) A straight line joining the leading edge to the trailing edge.
c) The line at which the wing is set to the fuselage.
d) A line through the leading edge parallel to the thrust line.

If the air density in an airflow is reduced and all other factors are unchanged, what happens to the lift generated by a wing in the airflow?

a) It is reduced.
b) It is increased.
c) It is unchanged.
d) It becomes unpredictable.

Which of the wing sections are for high speed?

a) W and Z b) X and Y
c) W and Y d) Y and Z

Which of the wing sections is for general purpose?

a) W b) X
c) Y d) Z

Which of the wing sections is for high lift?

a) W b) X
c) Y d) Z

To fly, an aircraft must generate lift to oppose its:

a) Drag. b) Weight.
c) Inertia. d) Thrust.

The effect of gravity on an aircraft is called:

a) Thrust. b) Lift.
c) Drag. d) Weight.

Only one of these statements is true for an aircraft in straight and level flight. Which one?

a) Lift is slightly more than weight.
b) Lift exactly equals weight.
c) Lift is slightly less than weight.
d) Lift is considerably greater than weight.

If an aircraft in steady straight and level flight suffered a sudden reduction in weight (for example, by jettisoning fuel) and the pilot made no changes to the controls, the aircraft would begin to:

a) Speed up.
b) Climb
c) Descend.
d) Slow down.

Errors

No method of estimating distance is entirely accurate, and when you add errors in measuring direction as well, you can see how quickly your 'area of uncertainty' can grow as you are travelling.

For instance, if you assume a possible error of +/- 10% in measuring distance and one of +/- 4% in measuring direction, your area of uncertainty is about the size of 4 football pitches after only 1 km, and a staggering 36 football pitches after 3 km!

In order to keep this 'area of uncertainty' to a minimum, it is important that you measure bearings as accurately as possible and practice pacing and timing distances to reduce the error as much as possible.

Handrailing

If a track or path leads directly to where you want to go, it would be sensible to follow it. You could just as easily follow a wall, river, ridge, electricity pylons or any other linear feature that leads the right way. You are using the linear feature as a 'handrail' to guide you to your destination.

Note: After a serious accident caused by 'handrailing' down a steep stream valley, HQAC have directed that this method is to be used with extreme caution.

Contouring

Is it better to go round a hill or over the top? The two routes may take the same time, but 'contouring' round, following a contour of the hill, usually takes less effort. This is particularly the case if you are carrying heavy packs.

Attack Points

An attack point is an easily identifiable feature which is close enough to your objective to enable you to home in on it with some degree of accuracy. It sometimes pays to go slightly out of your way to hit a definite target to assist in reaching your final objective.

Measuring distances accurately whilst out walking helps you particularly to:

a) Choose the shortest route.
b) Reduce the area of uncertainty in your position.
c) Calculate magnetic variation.
d) Calculate the gradient.

When navigating, in order to reduce the area of uncertainty to a minimum, you should:

a) Always follow paths.
b) Never follow contours.
c) Measure distances and bearings as accurately as possible.
d) Walk as quickly as possible to your destination.

A cadet decides to follow a stream down from the hillside because she knows that the stream runs close to her campsite. The cadet is using a navigational technique known as:

a) Aiming off.
b) Resection.
c) Handrailing.
d) Contouring.

Handrailing is the term for:

a) Aiming for a prominent feature close to your destination.
b) Following linear features to get to your destination.
c) Walking on a compass bearing.
d) Avoiding climbing by maintaining height.

Following linear features to guide you to your destination is known as:

a) Aiming off.
b) Using attack points.
c) Handrailing.
d) Contouring.

Walking round a hill without gaining or losing height is called:

a) Handrailing.
b) Contouring.
c) Aiming off.
d) Pacing.

What is an 'attack point'?:

a) Any trig point.
b) Any prominent feature close to your objective.
c) Any prominent feature that can be easily identified.
d) The summit of any hill.

CHAPTER 3 PRACTICAL NAVIGATION

If you know how fast you walk, you can work out how long it will take you to cover a known distance. For instance, a typical group will walk 1km over reasonably flat ground in 15 minutes, it would therefore take one hour to cover 4 km in similar terrain.

Measuring distances accurately when hillwalking is important because it helps you calculate your speed of travel accurately.

Naismith's Rule

A Scottish climber called Naismith devised a rule (in 1892!) to calculate walking speeds over mountainous terrain.

His basic rule assumed a walking speed of 4 km per hour over normal (flat) terrain.

Climbing took more time, so he added 30 minutes for every 200m of climbing.

Steep descents also need extra care and time, so he added 10 minutes for every 200m of steep descent.

On expeditions you must take the group's fitness into account, and also the fact that you will be carrying heavy packs.

Pacing

Distance can be measured by counting paces (or every *other* pace) and with practice this can be very accurate, but only over short distances.

Measuring distances accurately whilst hillwalking is important because it:

a) Calculates your speed of travel.
b) Keeps you on schedule.
c) Chooses the shortest route.
d) Pinpoints your position accurately.

What do you estimate as the average walking speed of a group on level ground?

a) 2 kph. b) 4 kph. c) 6 kph. d) 8 kph.

A cadet is able to walk 1 km over reasonably flat ground in 20 minutes. How long would it take him to cover 4.5 km in similar terrain?

a) 40 mins. b) 60 mins. c) 90 mins. d) 120 mins.

Whilst walking over reasonably flat ground, a cadet takes 1 hour to cover 3 km. How long will it take him to walk 500 m at the same speed?

a) 10 mins. b) 15 mins. c) 20 mins. d) 60 mins.

What is Naismith's rule?

a) 3 kph overall.
b) 5 kph overall.
c) 5 kph plus an hour for any climbing.
d) 4 kph as measured on the map plus half an hour for every 200m climbed.

Naismith's Rule applies to the calculation of:

a) Gradients.
b) Shapes depicted by contour lines.
c) Headings and bearings.
d) The speed of advance on foot in mountainous country.

How can you estimate distance covered from your last check point?

a) Use your mobile phone.
b) Use a pedometer.
c) Consult your GPS.
d) Measure the time taken and calculate at 4Km per hour.

How much time should be added to a journey on foot for every 200 meters climbed using Naismith's Rules?

a) 15 minutes. b) 20 minutes.
c) 25 minutes. d) 30 minutes.

How much time should be added to a journey on foot for every 200 meters of steep descent, using Naismith's Rules?

a) 5 minutes. b) 10 minutes.
c) 15 minutes. d) 20 minutes.

Pacing can be an accurate way of measuring distances if carried out over:

a) Long distances. b) Medium distances.
c) Short distances. d) 5000 paces.

CHAPTER 2 THRUST AND DRAG

Besides lift and weight, two other forces act on an aircraft, thrust and drag.

Thrust

An aircraft's engine, or engines, produce thrust to propel the aircraft forwards through the air. A propeller 'screws' air backwards, a jet engine expels air backwards at high speed. In both cases, pushing air backwards thrusts the aircraft forwards. (Newton's Law again—every action has an equal and opposite reaction!) The thrust force acts along a line from the tail through the nose of the aircraft.

Drag

Drag is the force which hinders the aircraft's progress through the air. Every part of the aircraft over which air flows produces drag which resists forward motion. 'Fairing off' or streamlining can significantly reduce this. To simplify matters, we add all of these drag forces together and represent them with a single line (as we did with the lift forces). This line runs from the nose through the tail of the aircraft and directly opposes the thrust line.

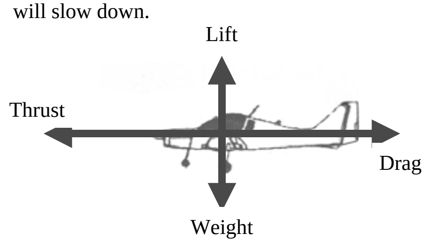
Variation of Drag with Airspeed

Drag varies (like lift) with the square of the airspeed. Doubling the airspeed gives **four** times the drag, trebling the airspeed, **nine** times the drag.

Straight and Level Flight

In ***steady*** (i.e. not speeding up, not slowing down) straight and level flight, just as lift must equal weight, so the thrust must equal the total drag.

If thrust is greater than drag the aircraft will accelerate, if the drag exceeds the thrust the aircraft will slow down.



In steady straight and level flight, thrust opposes the drag and is equal to it, and lift opposes weight and is equal to it.

What is the force called that drives an aircraft forwards?

a) Weight. b) Drag.
c) Lift. d) Thrust

The reaction to the rearward movement of air produced by the propeller or jet is called:

a) Thrust. b) Drag.
c) Resistance. d) Friction.

The resistance to the forward movement of an aircraft is called:

a) Drag. b) Resistance.
c) Turbulence. d) Thrust.

To accelerate an aircraft from straight and level flight, which of the following statements is true?

a) Thrust must equal drag.
b) Drag must exceed thrust
c) Thrust must exceed drag.
d) Drag must be half thrust.

To slow an aircraft from straight and level flight, which of the following statements is true?

a) Thrust must be less than drag.
b) Thrust must equal total drag.
c) Thrust must exceed total drag.
d) Drag must be greater than thrust.

Which part of an aircraft produces drag which resists forward motion?

a) Every part of an aircraft over which air flows.
b) The fuselage but not the wings.
c) Only those parts which are producing lift.
d) Only those parts of the aircraft that are not producing lift.

If you doubled the airspeed the drag would increase by a factor of:

a) 2 b) 4 c) 6 d) 8

If you trebled the airspeed the drag would increase by a factor of:

a) 3 b) 6 c) 9 d) 12

A stream line shape with an airspeed of 100 kts has a drag force of 200 N (Newtons). If the airspeed were increased to 300 kts what would the drag be?

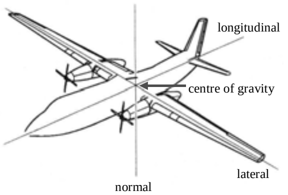
a) 400 N b) 800 N c) 1800 N d) 3600 N

Which of these statements about an aircraft in straight and level flight is true?

a) Thrust is equal to the drag.
b) Thrust is equal to twice the drag.
c) Thrust is equal to half the drag.
d) Thrust is equal to four times the drag.

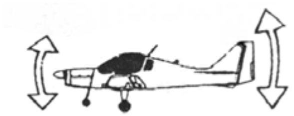
CHAPTER 3 <u>STABILITY & CONTROL</u>

There are three axes about which an aircraft rotates, and all go through the centre of gravity.



The **lateral** axis runs from wingtip to wingtip. Movement about this axis is called **pitching.**

Fig 1

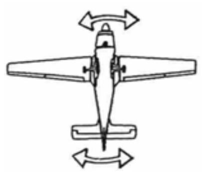


The **longitudinal** axis runs from nose to tail. The aircraft **rolls** about this axis.

Fig 2

Aircraft **yaw** about the **normal** axis which runs vertically downwards through the aircraft.

Fig 3



<u>Stability</u>

Turbulence will frequently displace an aircraft from straight and level flight. A well designed aircraft will tend to go back to level flight of its own accord without the pilot having to make continual adjustments. This property is **stability**.

Stability in the **pitching** plane is provided by the tailplane. In normal flight the tailplane meets the airflow at 0° angle of attack. If the aircraft is disturbed in pitch the tailplane meets the airflow at either a positive or negative angle of attack. This creates lift, either upwards or downwards, which pushes it back to zero angle of attack and therefore straight and level flight.

Each of the three axes of an aircraft pass through the aircraft's:

a) Wings.
b) Centre of gravity.
c) Cockpit.
d) Engine bearings.
e) Centre of pressure.
f) A point halfway along a line between the wing tips.
g) A point halfway between the tail and the nose.

Which axis runs from nose to tail in an aircraft?

a) Bilateral. b) Normal.
c) Lateral. d) Longitudinal.

Which axis generally runs from wing tip to wing tip?

a) Normal. b) Lateral.
c) Diagonal. d) longitudinal.

The 3 axes about which an aircraft moves are:

a) Longitudinal, lateral and diagonal.
b) Longitudinal, lateral and normal.
c) Lateral, normal and diagonal.
d) Lateral, bilateral and normal.

The movement of an aircraft about its lateral axis is called:

a) Pitching. b) Slewing. c) Yawing. d) Rolling.

The movement of an aircraft about its longitudinal axis is called:

a) Damping. b) Rolling. c) Yawing. d) Pitching.

The movement of an aircraft about its normal axis is called:

a) Rolling. b) Damping. c) Pitching. d) Yawing.

See figure 1. What sort of movement is shown?

a) Pitching. b) Yawing. c) Rolling. d) Swinging.

See figure 2. What sort of movement is shown?

a) Pitching. b) Yawing. c) Rolling. d) Swinging.

See figure 3. What sort of movement is shown?

a) Pitching. b) Yawing. c) Rolling. d) Diving.

A well designed aircraft that is disturbed from level flight (say by bumpy air) will tend to go back to level flight of its own accord, without the pilot having to make adjustments. This property is called:

a) Damping. b) Stability.
c) Instability. d) Inertia.

2. Hold the compass in this position and turn the capsule until the orienting arrow lies directly beneath the north end of the compass needle. This gives the magnetic bearing.

3. Now turn the capsule to deduct the GMA. This now gives the grid bearing.

4. Place the compass on the map (you do not have to have the map oriented, you are only going to use the compass as a protractor again at this stage) with its long edge passing through your present position. Do ***not*** turn the capsule.

5. Turn the whole compass until the orienting lines are parallel to the N-S grid lines and the orienting arrow points to north on the map. (Ensure the long edge of the compass is still through your present position).

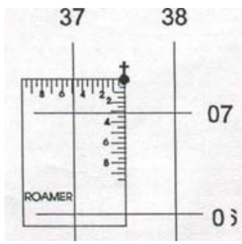
6. The edge of the compass that runs through your position should now run through symbol of the object you initially took the bearing upon.

To help you remember to ***deduct*** the GMA when taking bearings of features and finding them on the map, remember the phrase:

MAG to GRID - get RID

<u>Resection</u>

If you wish to determine your position on a map by reference to features around you, try and identify three features and take their bearings. Drawing these lines on your map should fix your position, but it is unlikely that all three lines meet at a point. If you have measured and plotted accurately you should have only a small triangle formed where the three bearings cross. Take your position as being near the centre of this triangle.



<u>Roamers</u>
On the corners of most compass bases you will find one or more 'roamers'. These can be used to find a six figure grid reference very accurately. Place the corner of the roamer on the feature and read from where the scales intersect the grid lines, eastings first. The four figure grid reference from the SW corner of the square defines the 1km square (37,07). In this example the six figure grid reference is 375,073.

You are at a point where variation is 2 degrees W and grid magnetic angle is 5 degrees W. If the compass bearing of a church is 350 degrees, what is its grid bearing?

a) 343 degrees. b) 345 degrees.
c) 347 degrees. d) 348 degrees.

You are at a point where variation is 1 degree W and grid magnetic angle is 6 degrees W. If the compass bearing of a trig point 150 degrees, what is its grid bearing?

a) 143 degrees. b) 144 degrees.
c) 156 degrees. d) 157 degrees.

How can we remember when changing magnetic bearings to grid bearings?

a) Always minus. b) Always plus.
c) MAG to GRID—get RID. d) MAG to GRID—ADD.

What is resection?

a) Take tree bearings to separate features and the middle of the triangle is your position.
b) Back Track.
c) Draw a cross section of the surrounding contours.
d) Use reciprocal bearings.

If you wanted to fix your position on a map by reference to prominent landmarks within your field of vision, what would give the best result?

a) One bearing giving a position line.
b) Two bearings crossing.
c) Three bearings crossing to give a small position triangle.
d) Three bearings crossing to give a large position triangle.

When using an M726 1:50,000 map, a four figure grid reference will define a 1 kilometre square on the map. The four figure reference refers to a particular corner of the square: which corner?

a) NW b) SW c) SE d) NE

What is a roamer?

a) Ensures better accuracy. It fins a position to the third grid reference point on a Silva compass.
b) Acts as a magnifier.
c) Reads off the grid reference.
d) Helps you navigate.

A roamer would be used in finding:

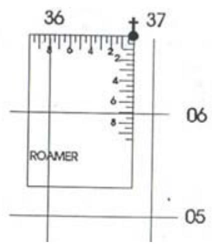
a) A relative bearing. b) The average gradient.
c) A grid reference point. d) The direction of a track.

In the diagram on the left, the six figure GR shown would be:

a) 073 375 b) 075 373 c) 375 073 d) 373 075

In this diagram, the six figure GR shown would be:

a) 367 068
b) 368 067
c) 067 368
d) 068 367



Setting a Compass Heading

To enable you to walk from one point to another on a compass heading you must locate both points on your map and take a bearing.

1. Place the compass on the map with its long edge running through both points and the direction of travel arrow pointing in the direction you wish to travel (You do not need to orientate the map for this operation).

2. Hold the compass plate firmly and turn the compass capsule until the orienting lines on its base are parallel to the north-south grid lines and the orienting arrow points to the top of the map.

3. The compass now registers the number of degrees between grid north and your intended direction of travel.

Note that you have effectively used the compass as a protractor. In order to now use your compass to walk on that bearing you must take the difference between grid north and magnetic north into account.

4. In order to add the Grid Magnetic Angle (GMA) turn the compass capsule to add those extra degrees.

5. Remove the compass from the map. Hold it in front of you so that it is level and the direction of travel arrow points away from you. Turn your body until magnetic needle falls inside the orienting arrow on the base of the capsule - red end pointing north. The direction of travel arrow will now be pointing the direction you need to travel.

To help you to remember to ***add*** on the GMA when taking a bearing from a map with ***westerly*** variation, remember the phrase:

GRID to MAG - ADD

Try to avoid walking while staring at your compass. A better technique is to pick out some feature in the far distance and walk to that.

Taking a Bearing on a Distant Object

In order to help pinpoint your position you may need to take a compass bearing of a distant object and convert it into a map bearing. To do this:

1. Point the direction of travel arrow at the distant object.

To take a bearing between 2 features on a map, you would first place the compass on the map so that its longest edge runs through both features and its direction of travel arrow points in your intended direction of travel. You would then:

a) Turn the capsule on the compass to deduct the grid magnetic angle.
b) Turn the map and compass together until the needle falls into the orienting arrow.
c) Turn the capsule on the compass until the needle falls into the orienting arrow.
d) Turn the capsule on the compass so that its orienting lines are parallel to the north-south grid lines.

The direction of a track drawn between two places on a map is measured against the grid-lines and found to be 102 degrees (grid). If magnetic north is five degrees west of grid north, what is the magnetic bearing of the track?

a) 097 degrees (M) b) 107 degrees (M)
c) 095 degrees (M) d) 102 degrees (M)

The grid bearing between two features on a map was measured to be 040 degrees (Grid). If the grid magnetic angle is 6 degrees west of grid north, what is the magnetic bearing?

a) 034 degrees. b) 040 degrees.
c) 043 degrees. d) 046 degrees.

A grid bearing from a M726 series OS map on which the magnetic variation is westerly, can be converted to a magnetic bearing by:

a) Subtracting the angular difference between magnetic north and grid north.
b) Adding the angular difference between magnetic north and grid north.
c) Adding the angular difference between grid north and true north.
d) Subtracting the angular difference between grid north and true north.

When walking on a bearing in good visibility, the best technique is to:

a) Follow your compass and ignore the countryside.
b) Send a team member out 50 metres and walk to there.
c) Select an object 5 metres in front and walk to it.
d) Select a distant feature that is along your intended direction of travel.

When using a compass to take a bearing on a distant object, you would first of all:

a) Turn the capsule to subtract the grid magnetic angle.
b) Align the red compass needle to point at the object.
c) Point the direction of travel arrow at the object.
d) Turn the capsule so that the orienting arrow points at the object.

Stability in the **rolling** plane is usually established by setting the wings into the fuselage at a slight upward angle to the horizontal called **dihedral**.

If a wing drops in turbulence the aircraft will 'slip' sideways towards the dropped wing. The lower wing now has a greater angle of attack to the oncoming airflow than the upper wing. Additionally the upper wing's airflow is being affected by the shielding of the fuselage. This differential between each wing's lift rolls the aircraft back to straight and level flight.

High wing aircraft have natural stability in the rolling plane because the centre of gravity is well below the wing creating a 'pendulum' effect. Where too much stability would hinder manoeuvrability designers incorporate **anhedral** to reduce excessive stability.


anhedral

Stability in the **yawing** plane (sometimes called *directional stability*) is provided by the aircraft's fin. A air disturbance causing the aircraft to yaw will put the fin into the airflow at an angle of attack creating 'sideways lift' to push it back into line. Most aircraft have a large fin placed as far back as possible to increase the weathercock effect and ensure directional stability.

Note that we always describe pitching, rolling and yawing relative to the pilot, not the horizon.

The Pilot's Controls

Pitching: The pilot uses elevators, two moveable parts of the tailplane, to make the aircraft's nose pitch up or down.

Yawing: The rudder, a single control surface hinged to the trailing edge of the fin, is connected to the rudder pedals in the cockpit.

Rolling: On the trailing edge of each wing towards the tip are moveable parts called ailerons. These move in opposite directions, one up, one down, in response to the pilot's control column inputs. This increases lift on one wing and decreases lift on the other so that the aircraft rolls.

What part of an aircraft provides stability in the pitching plane?

a) The fin. b) The undercarriage.
c) The nose. d) The tailplane.

In the two silhouettes on the left, these aircraft are flying towards you. What angles are the arrows pointing to?

a) Dihedral angle. b) Anhedral angle.
c) Lift angle. d) Cohedral angle.

In the Harrier diagram, the aircraft is flying towards you. What angle is the arrow pointing to?

a) Cohedral angle. b) Lift angle.
c) Dihedral angle. d) Anhedral angle.

What gives an aircraft stability in the rolling plane?

a) Anhedral angle. b) Dihedral angle.
c) The tailplane. d) The fin.

Which of these gives an aircraft stability in the yawing plane?

a) High centre of gravity.
b) Anhedral.
c) Dihedral.
d) Sufficient fin area.

Which of these gives an aircraft high directional stability?

a) Small fin area.
b) Rearward centre of gravity.
c) Low centre of gravity.
d) Large fin area.

Aircraft movements such as pitching, rolling and yawing are always described in relation to the:

a) Ground. b) Pilot.
c) Airflow. d) Horizon.

In order to control an aircraft in the pitching plane, the pilot of an aircraft fitted with conventional controls uses:

a) The ailerons. b) The fin.
c) The rudder. d) The elevators.

In order to control an aircraft in the yawing plane, the pilot of an aircraft fitted with conventional controls uses:

a) The ailerons. b) The flaps.
c) The rudder. d) The elevators.

In order to control an aircraft in the rolling plane, the pilot of an aircraft fitted with conventional controls uses:

a) The ailerons. b) The fin.
c) The rudder. d) The elevators.

aileron

The flying controls have the same effect on the aircraft, relative to the pilot, regardless of the attitude the aircraft is in. For instance in the diagram below the aircraft is climbing vertically. If the pilot pushes forward on the control column the nose will pitch nose forward.

Trimming Tabs

Changes in an aircraft's centre of gravity (due to fuel usage, munitions dropped or payloads released) or its centre of pressure (due to changes of power, speed, configuration or engine failure) will affect the balance of forces on the aircraft. The pilot would have to apply constant pressure on the flying controls to maintain straight and level flight and would be unable to do this safely for long.

Trimming tabs are small control surfaces attached to the trailing edges of the elevators, ailerons and rudder. They can be adjusted from the cockpit to 'trim out' or cancel out any unwanted forces on the flying controls. They can be adjusted to remove entirely the need to hold any pressure on the control column or rudder pedals.

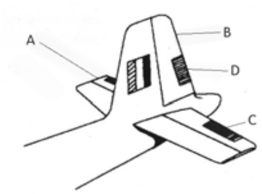


Fig 4

A - elevator
B - rudder
C - elevator trimming tab
D - rudder trimming tab

Flaps

A wing shape which enables an aircraft to make a slow controlled approach for landing with good forward vision over the nose will not be an efficient wing at high speeds. The solution is to design a wing for its main task and add flaps for use on approach and landing.

In the diagram on the left, what does the arrow point to?

a) Fin. b) Fuselage.
c) Aileron. d) Rudder.

At position 1, the aircraft is climbing vertically. To make the aircraft move to position 2 and then to position 3, the pilot must move the control column:

a) To the left. b) To the right.
c) Back. d) Forward.

In figure 3, what does arrow A point to?

a) Elevator. b) Rudder.
c) Fuselage. d) Fin.

See figure 4. In this diagram, what does arrow B point to?

a) Fuselage. b) Aileron.
c) Rudder. d) Fin.

What is the purpose of the trimming tabs on flying controls?

a) To increase the approach angle during landing.
b) To improve the manoeuvrability of the aircraft.
c) To cancel out the unwanted forces on the pilot's controls.
d) To reduce the take off run of an overloaded aircraft.

See figure 4. In this diagram, what is arrow C pointing to?

a) A rudder trimming tab.
b) An elevator trimming tab.
c) A fin.
d) A fuselage.

See figure 4. In this diagram, what is arrow D pointing to?

a) A rudder trimming tab.
b) An elevator trimming tab.
c) A fin.
d) A fuselage.

A designer needs one shape of wing for the highest possible flying speed but another for the slowest possible landing speed. What does he provide to enable one wing to achieve both?

a) Flaps. b) Elevators.
c) Trimming tabs. d) Balance tabs.

See figure 4. Which of these is a simple flap?

a) W b) X
c) Y d) Z

See figure 4. Which of these is a fowler flap?

a) W b) X
c) Y d) Z

CHAPTER 2 <u>THE COMPASS</u>

In a typical compass, such as the Silva type, the magnetic needle is half red (points north) and half white (points south). It is housed in a transparent liquid filled capsule which 'damps' the compass needle so that it settles down quickly.

Holding the compass horizontally when taking a reading ensures that the needle floats freely.

Magnetic Deviation

As the compass needle is a small magnet, it will be affected by ferrous metals close by. This causes the compass needle to deviate from its true position.

Setting the Map with a Compass

If you cannot easily set the map using observable features you can set it using a compass.

1. Turn the compass capsule until the grid magnetic angle (GMA) is set against the direction arrow.

2. Place the compass onto the map so that the long edge of the compass matches the N-S grid lines and the direction of travel arrow points to the top of the map.

3. Turn the map and compass ***together*** until the compass needle falls inside the orienting arrow, red end pointing north.

Your map should now be correctly set and you can use it to identify features on the map with the real features on the ground.

What is the compass we use for navigation when walking?

a) Standard RAF compass. b) Silva compass.
c) Primatic compass. d) DIC

On a Silva walking compass what colour is the magnetic needle?

a) Red and White. b) Red and Black.
c) Blue and Red. d) White and Blue.

What is the purpose of liquid in the capsule of a compass?

a) Increases the needle's sensitivity.
b) Prevents the needle from moving.
c) Allows the needle to be seen more clearly.
d) Allows the needle to settle down quickly.

When using a magnetic compass, why is it particularly important to hold it horizontal when taking a reading?

a) To improve damping.
b) To eliminate compass errors.
c) To ensure that the needle floats freely.
d) To minimise the effects of local magnetic attraction (e.g. from wire fences, electric cables etc.)

Which of the following would cause magnetic deviation if close to a compass (more than one answer)?

a) An aluminium tent pole. b) A tree.
c) A plastic water bottle. d) A cattle grid.
e) A pencil. f) A bic biro.
g) Paper. h) A plastic spoon.
i) Iron. j) A highlighter.

A compass needle may be affected by iron objects close by. This is called:

a) Magnetic orientation. b) Magnetic variation.
c) Magnetic fluctuation. d) Magnetic deviation.

What is compass deviation?

a) The difference between magnetic north and grid north.
b) The difference between magnetic north and true north.
c) The effects of non-magnetic and non-ferrous metals on a compass needle.
d) The effects of nearby ferrous metals or magnetic materials on a compass needle.

When setting a map with a compass, what is the first action?

a) Turn the map and compass together until the compass needle falls inside the orienting arrow.
b) Set the map down on a firm, non-magnetic surface.
c) Determine the grid magnetic angle and set this value against the direction arrow of the compass.
d) Place the compass onto the map with the long edge on a north/south grid line.

The final step in setting a map with a compass is to:

a) Turn the map and compass together until the needle is pointing south.
b) Turn the map only until it is pointing north.
c) Turn the compass only until it is pointing north.
d) Turn the map and compass together until the needle is inside the orienting arrow.

What is the angular difference between true north and magnetic north called?

a) Magnetic deviation.
b) Magnetic variation.
c) Magnetic differential.
d) Compass error.

The angular difference between grid north and magnetic north is:

a) Magnetic difference angle.
b) Magnetic variation.
c) Grid variation.
d) Grid magnetic angle.
e) Grid deviation angle.
f) Compass deviation angle.
g) Magnetic deviation angle.

Where, on an M726 OS map is the information on magnetic variation located?

a) At the top of the map.
b) At the bottom of the map.
c) At the extreme left of the map.
d) On the back of the map.

What information is provided at the bottom of an M726 OS map?

a) Sheet number.
b) Magnetic variation.
c) Grid magnetic angle.
d) Abbreviations.

Where is information on the grid magnetic angle located on an M726 OS map?

a) At the centre of the bottom margin.
b) At the centre of the top margin.
c) In the extreme left hand side of the map.
d) On the back of the map.

How many Norths do we have to consider when using an Ordnance Survey map?

a) 1 b) 2
c) 3 d) 4

There are many types of flaps, but when selected down they all increase the effective camber of the wing and hence its lift.

W Clean Wing

X Simple Flap

Y Split Flap

Z Fowler Flap

Fig 5

If full (90°) flap is selected for an approach to land, drag is significantly increased and the steeper approach angle gives the pilot a better forward view. The lower approach speed also gives a reduced touch-down speed and a shorter landing run.

For take-off, a small amount of flap (about 15°) will improve lift at take-off speeds and shorten the take-off run with only a very small drag penalty.

Slats

Slats are another device which designers may fit to improve handling at low speeds.

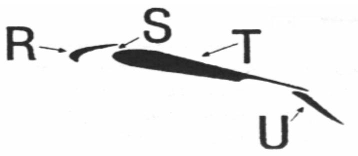


Fig 6

R - Slat S - Slot T - Wing Section U - Flap

Positioned along the leading edge of the wing, slats are opened at slow speeds enabling air to flow through the slot between the slat and the wing. This smoothes the airflow over the wing. Instead of stalling at the usual 15° angle of attack the wing can reach as much as 25° before stalling and the stalling speed is very much reduced.

Slats do cause some extra drag, so most are designed to close automatically at lower angles of attack.

See figure 5. Which of these is a split flap?

a) W b) X
c) Y d) Z

A pilot selects full flap when coming in to land. This will:

a) Reduce the angle of approach and improve the forward vision.
b) Increase the angle of approach and improve the forward vision.
c) Decrease the angle of approach and reduce the landing run.
d) Increase the angle of approach and increase the landing run.

Which of the following will occur when flap is lowered during the approach to land?

a) Stalling speed will be increased.
b) Lift will increase.
c) A higher touch-down speed will be needed.
d) Drag will be reduced.

Which of these flap settings would a pilot most probably select for a shorter take off?

a) 120 degrees. b) 90 degrees.
c) 60 degrees. d) 15 degrees.

To obtain maximum drag from an aircraft's flaps, they should be set to:

a) 10 degrees. b) 30 degrees.
c) 40 degrees. d) 90 degrees.

What is the purpose of a slat on an aerofoil?

a) To improve handling at high speed.
b) To reduce drag at high speeds.
c) To make the air turbulent at low speeds.
d) To improve handling at low speeds.

Which of these describes the effect of slats at low speeds?

a) Generate extra turbulence in the airflow over the wing.
b) Help the pilot to move the control surfaces into the airflow.
c) Make it more difficult for the pilot to move the control surfaces into the airflow.
d) Smooth out the turbulence in the airflow over the wing.

When slats are open on a wing, what effect will this have on i) the stalling angle, and ii) the stalling speed?

a) Increase Increase
b) Reduce Increase
c) Increase Reduce
d) Reduce Reduce

When slats are open on a wing, what effect will this have on the drag?

a) No effect.
b) Decrease it.
c) Increase it.
d) Reduce it to zero.

See figure 6. On this cross section of a wing, which arrow points to a slat?

a) R b) S
c) T d) U

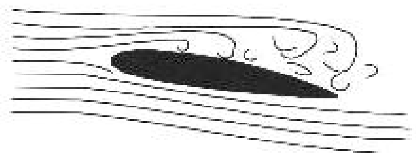
See figure 6. On this cross section of a wing, which arrow points to a flap?

a) R b) S
c) T d) U

CHAPTER 4 STALLING

In normal flight the wing meets the air at a small angle of attack. If the pilot increases the angle of attack the wings will produce more lift.

Lift continues to increase with increasing angle of attack until about 15° when the airflow breaks away from the top surface of the wing and becomes turbulent. Virtually all lift is lost. This is the **stall**. The stalling angle (or critical angle as it is some-



times known) varies from one type of wing to another, but each particular wing has its own stalling angle and it will **always** stall when the angle of attack reaches that angle. For most conventional aircraft the stalling angle is about 15°.

Stalling Speed

Although the angle at which a wing stalls is constant, the stalling **speed** does vary.

The heavier an aircraft is, the higher will be the stalling speed and a lower weight reduces it.

Manoeuvres like steep turns increase the g-forces and the apparent weight of the aircraft. This increases the stalling speed. The steeper the turn, the higher he stalling speed.

Ice accumulation or damage to the wings will increase stalling speeds.

Lowering flaps lowers the stalling speed as it improves the wing shape for low speed flight.

On a general purpose wing, at which angle of attack is the greatest lift produced?

a) About 5 degrees. b) About 10 degrees.
c) About 15 degrees. d) About 20 degrees.

When the angle of attack of a general purpose wing increases beyond about 15 degrees the airflow becomes turbulent and lift decreases rapidly. The sudden loss of lift is known as:

a) The spin. b) The stall.
c) The vortex. d) Boundary layer separation.

Which of these statements, about the airflow over the wing of an aircraft just beyond the point of stall, is true?

a) It becomes very smooth.
b) It stops completely.
c) It speeds up tremendously.
d) It becomes turbulent.

The angle of attack at which a wing stalls is known as:

a) Crucial angle. b) Stilled angle.
c) Critical angle. d) Stopped angle.

At the stall of a particular wing, which one of these factors is NOT variable?

a) The angle of attack at which it stalls.
b) The amount of lift being produced by the wing at the stall.
c) The amount of weight supported by the wing.
d) The air speed at which it stalls.

Which of these is always the same at the point of stall for a particular wing?

a) Its angle above the horizon.
b) Its speed through the air.
c) Its angle of attack.
d) Its wing loading.

Which of the following statements is true?

a) A wing can stall at any angle of attack.
b) The airspeed at which an aircraft stalls does not vary.
c) The airspeed at which an aircraft stalls does vary.
d) The stall is the same for all aircraft.

For a particular aircraft, which of these will reduce the stalling speed?

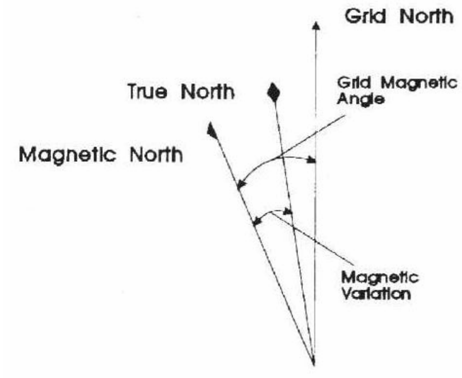
a) A reduction in weight.
b) A reduction in power.
c) Putting the aircraft into a turn.
d) Raising the flaps.

Which of the following will increase the stalling speed of an aircraft?

a) Putting it into a turn. b) Increasing the power setting.
c) Lowering the flaps. d) Reducing the weight.

Magnetic North

The earth behaves like a giant magnet with its own magnetic field. A free moving magnetic needle will align itself with this magnetic field and point in a north/south direction. Unfortunately the magnetic north pole does not exactly coincide with the geographic (true) north pole. The magnetic north pole is in Canada, slightly north of Hudson Bay. In the British Isles magnetic north is presently about 5° west of true north.



Magnetic Variation

Magnetic variation (the difference between true north and magnetic north) is different in different parts of the world. In some parts of the world magnetic north it is east of true north. Magnetic variation is displayed on the bottom of OS maps.

A further complication is that magnetic north is not fixed. It moves very slowly, but changes its position a little every year. This information can also be found at the bottom of your map.

Grid Magnetic Angle

For map reading purposes, true north has no real importance. All compass references are made to either grid north or magnetic north, so the difference between these two norths must be known. This information is given in the centre of the top margin of the map and is called Grid Magnetic Angle (GMA).

Three Norths

For a full appreciation of Ordnance Survey maps and navigation we must consider and understand the significance of <u>all three</u> north points.

Which physical property of the earth do we use when navigating using a compass?

a) The surface is covered with lines of latitude and longitude.
b) It has a magnetic field.
c) It has a gravitational field.
d) It rotates clockwise.

A freely suspended magnetic needle will point:

a) To grid north.
b) To the geographical North Pole.
c) To the magnetic North Pole.
d) Straight down to the ground.

The Earth's magnetic pole is located:

a) In the same place as the true North Pole.
b) In the same place as the grid North Pole.
c) In northern Siberia.
d) Slightly north of Hudson Bay in Canada.

Which north changes its position slightly over the years?

a) True north.
b) Grid north.
c) Geographic north.
d) Magnetic north.

Which of the following statements about the direction of magnetic north from locations in the U.K. is true?

a) It is the same as true north.
b) It is the same as grid north.
c) It is the same as both true and grid north.
d) It differs from both true and grid north.

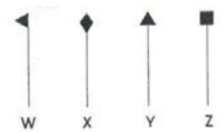
The position of the magnetic north pole:

a) Is fixed and remains in the same place constantly.
b) Is not fixed but changes its position a little every year.
c) Only changes when new maps are issued.
d) Is the same as the true north pole

Look at the symbols below for the next three questions.

Which of these symbols represents magnetic north?

a) W b) X
c) Y d) Z



Which of these symbols represents grid north?

a) W b) X c) Y d) Z

Which of these symbols represents true north?

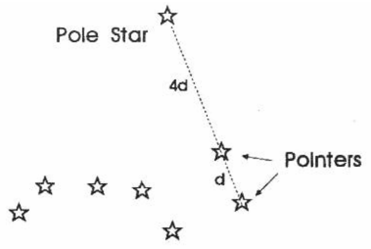
a) W b) X c) Y d) Z

Magnetic Variation is the angular difference between:

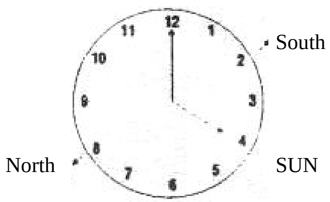
a) true north and grid north.
b) true north and magnetic north.
c) grid north and magnetic north.
d) grid lines and lines of longitude.

Finding North without a Compass

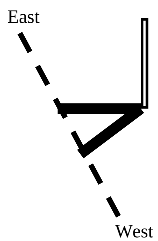
In the northern hemisphere the direction of the north pole is indicated by the position of the Pole Star. This can be found by following the pointers in the group of stars known as the Great Bear or Plough.



Using an analogue watch, point the hour hand at the sun and bisect the angle between the hour hand and the twelve o'clock position. This line points due south. (Use the one o'clock position during British Summer Time.)



To use the shadow method, place a stick in the ground and mark the end of its shadow with a small stone. After 10 to15 minutes use a second stone to mark the end of the stick's shadow again. A line between the two stones runs roughly west to east, and a line at right angles to that will run north to south, north being the point away from the stick.



Why is it important to set a map before using it in the field?

a) So that a compass can be used to follow the required direction over the ground.
b) So that distances can be measured more easily.
c) So that features on the ground seen by the observer can be easily related to features on the map.
d) So that names printed on the map may be read more easily.

Which star group can be used to find the Pole Star?

a) Orion's Belt.   b) The Crab Nebula.
c) The Great Bear.   d) The Milky Way.

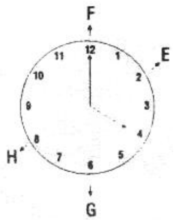
From the diagram of the star constellation The Plough, which letter indicates the correct position of the Pole Star?

a) W   b) X
c) Y   d) Z

When using a watch to find north/south, what should be pointed towards the sun?

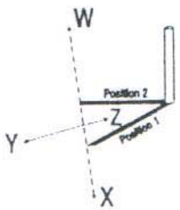
a) The 12 of the watch face.   b) The second hand.
c) The minute hand.   d) The hour hand.

You are on the Isle of Wight on 21 November at 4 pm (GMT) and you hold your watch flat and correctly aligned as in the previous question, which arrow will be pointing north?



a) E   b) F
c) G   d) H

While on expedition in South Wales a cadet places a stick in the ground and watches the shadow move from position 1 to position 2. Which arrow points north?



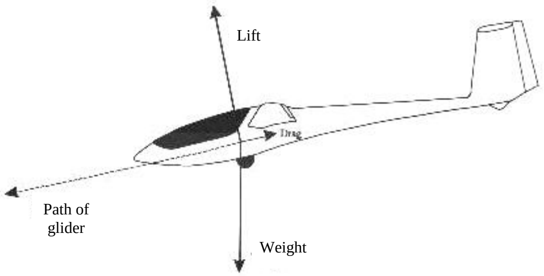
a) W.
b) X.
c) Y.
d) Z.

Which of the following is not a method for determining north without a compass?

a) Using the shadow from a stick.
b) Using a watch with the sun.
c) Finding the pole star from The Plough.
d) Finding wind direction.

CHAPTER 5 GLIDING

You will recall that when an aircraft is in steady straight and level flight the four forces balance, lift = weight and thrust = drag. If the engine(s) were to be switched off or fail , the pilot would have to put the aircraft into a descent to maintain airspeed and prevent the aircraft stalling. He is using an element of the weight vector to replace thrust. This is how gliders fly.



The Viking glider has a gliding angle of approximately 1 in 35. This means that from a height of 1 kilometre (3,280 feet) it will travel 35 kilometres in still air conditions before touching down. A high performance glider with a glide angle of 1 in 40 will travel 40 km from the same height or just 20 km from a height of 0.5 kilometre (1640 ft).

As gliders fly so slowly, any wind has a significant effect on their performance. A glider flying at 35 kts with a 35 kt tailwind will have a speed over the ground of 70 kts. If the glider then turns into the wind it would have a groundspeed of zero kts and to an observer on the ground would appear to lose height over the same spot.

Airbrakes

Instead of flaps, most gliders are fitted with airbrakes. These are panels which are normally flush with the upper and lower surfaces of the wings but when selected by the pilot pop out of the wings at 90° to the surface where they interfere with the airflow considerably increasing drag. To maintain airspeed the pilot lowers the nose, increasing the gliding angle and allowing him to land in a much smaller space than would otherwise be possible.

Name the three forces acting on a glider in steady balanced flight.

a) Drag, thrust and lift.
b) Drag, weight and lift.
c) Drag, weight and thrust.
d) Thrust, weight and lift.

A glider with a gliding angle of 1 in 40 is in still air and flying over level ground. What distance will the aircraft travel from a height of 1640 feet (0.5 km) before reaching the ground?

a) 10 kms   b) 20 kms
c) 40 kms   d) 80 kms

A glider with a gliding angle of 1 in 20 is in still air and flying over level ground. What distance will the aircraft travel from a height of 1640 feet (0.5 km) before reaching the ground?

a) 5 kms   b) 10 kms
c) 20 kms   d) 8.75 kms

A glider with a gliding angle of 1 in 30 is in still air and flying over level ground. What distance will the aircraft travel from a height of 1640 feet (0.5 km) before reaching the ground?

a) 15 kms   b) 25 kms
c) 30 kms   d) 60 kms

A glider with a gliding angle of 1 in 35 is in still air and flying over level ground. What distance will the aircraft travel from a height of 1640 feet (0.5 km) before reaching the ground?

a) 8.75 kms   b) 17.5 kms
c) 35 kms   d) 70 kms

A glider with a flying speed of 35 kts flies into a head wind of 35 kts. To an observer on the ground the glider will appear to:

a) Cover the ground at 35 kts.
b) Lose height slowly over one spot.
c) Cover the ground at 70 kts.
d) Climb steadily.

When would a glider pilot use airbrakes?

a) When wanting to climb.
b) When approaching to land.
c) When wanting to turn.
d) When being winch-launched.

The action of airbrakes on the wings of a glider is to:

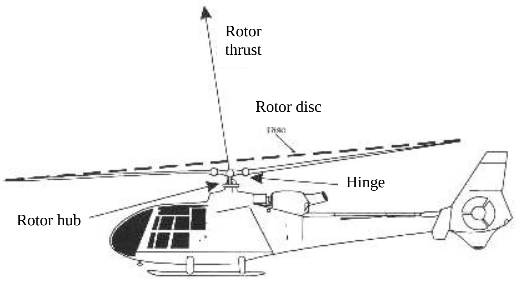
a) Increase lift and increase drag.
b) Increase lift and reduce drag.
c) Reduce lift and increase drag.
d) Reduce lift and reduce drag.

CHAPTER 6 THE HELICOPTER

Each main rotor blade of a helicopter has an aerofoil cross section and a helicopter generates lift by spinning these aerofoil shaped blades. The area swept by these blades is called the rotor disc.

The pilot is able to adjust the angle of attack of the blades, increasing the pitch angle to increase lift and decreasing the angle to decrease lift. He is also able to increase the angle (and hence lift) as each rotor goes through only a part of the plane of rotation, reducing it over another part.

For instance, if each blade is made to increase lift as it passes the rear of the disc and descend as it passes the front, the whole rotor disc will tilt forwards and the helicopter will move forwards.



Similarly the helicopter can be made to move backwards and sideways.
As the pitch of each blade varies through the 360° cycle, the control for this is called the **cyclic** pitch control.

Torque Reaction

Every action has an equal and opposite reaction. Spinning the rotor blades one way will spin the fuselage the opposite way with disastrous results. This is called 'torque reaction'. A small rotor, far back on the tail for leverage, with its rotational disc vertical, creates a horizontal thrust force which counters this fuselage torque reaction. The pilot can vary the force provided by using his rudder pedals to yaw the helicopter or keep it in balanced flight.

What shape is the x-section of a helicopter rotor blade?

a) Triangular. b) Square.
c) Aerofoil. d) Round.

A helicopter generates lift by:

a) Spinning aerofoil shaped blades.
b) Spinning an aerofoil shaped tail rotor.
c) Using the engine exhaust.
d) Using the torque reaction.

A helicopter's rotor disc is:

a) Controlled by the yaw pedals.
b) The area swept by the rotor blades.
c) Used to programme the path of the helicopter.
d) Only used when hovering.

The lift of a helicopter blade can be increased by:

a) Pointing the nose into wind.
b) Slowing the rotor head down.
c) Increasing the pitch angle.
d) Decreasing the pitch angle.

How is horizontal flight achieved in a helicopter?

a) Tilting the rotor disc.
b) Increasing the speed of the tail rotor.
c) Decreasing the rotor speed.
d) Increasing the rotor speed.

The pitch angle of a helicopter's rotor blades can be altered individually as each one traverses the plane of rotation. This is called:

a) Pitching. b) Torque reaction.
c) Cyclic pitch. d) Collective control.

When a helicopter rotor is driven in a circular motion tere is an opposing force. What is this force called?

a) Lift. b) Drag.
c) Torque reaction. d) Lift reaction.

What is the purpose of the helicopter's tail rotor?

a) Counter torque reaction.
b) Provide thrust.
c) Control the aircraft in the rolling plane.
d) Reduce drag.

The pitch angle of all the main rotor blades of a helicopter can be altered by the same amount at the same time. This is called:

a) Cyclic pitch. b) Collective pitch.
c) Torque reaction. d) Pitching.

A helicopter pilot uses the collective pitch control mainly to control:

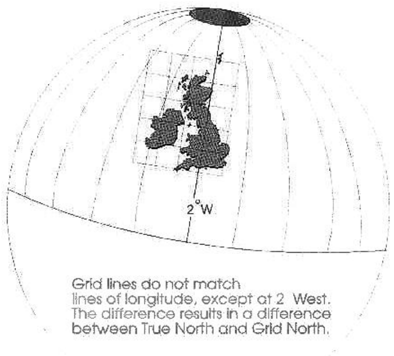
a) Horizontal flight.
b) Movement of the nose in the rolling plane.
c) Movement of the nose in the yawing plane.
d) Vertical flight.

CHAPTER 1 BASIC NAVIGATION

Good navigation is all about knowing where you are on a map.

The National Grid

Ordnance Survey maps are all based on a rectangular National Grid system. This flat 'grid' has been placed over the earth's curved surface. As a result the grid lines do not exactly match the lines of latitude and longitude.

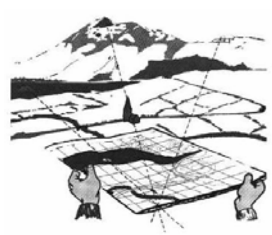


Lines of longitude get closer together as they approach the true north and south poles. Grid lines are all parallel and point to an imaginary point called Grid North. The actual difference between the two points varies depending upon where you are in the UK but is normally not more than 2°.

In navigating with an Ordnance Survey map you must always use grid north as your reference.

Setting or Orientating Your Map

One of the first things you should do when using a map is to relate the features on the map to the features on the ground. In order to do this you must turn the map in such a way that identifiable features on the ground are in their correct position relative to the map.



By keeping your map correctly orientated as you travel you can more easily use features on the ground to confirm your position.

What is navigation all about?

a) Establishing your height above sea level.
b) Checking your position against GPS.
c) Knowing where you are on the map.
d) Finding your latitude and longitude.

The difference between true north and grid north arises because:

a) Lines of latitude are not parallel.
b) Lines of latitude and longitude do not match grid lines exactly.
c) Lines of latitude and longitude match grid lines exactly.
d) Grid lines get closer together near the poles of the earth.

What happens to the lines of longitude as they approach the north pole?

a) They stay parallel.
b) They get closer together.
c) They follow the grid lines exactly.
d) They move apart.

Grid lines on a map:

a) Point to grid north.
b) Get closer together approaching the poles.
c) Point to true north.
d) Follow lines of latitude and longitude exactly.

The difference between grid north and true north in the UK:

a) Is not more than 2 degrees in most places.
b) Is at least 2 degrees in most places.
c) Changes a little each year.
d) Always equals zero degrees.

When navigating with a map, which north must you always use for reference?

a) True north. b) Grid north.
c) Actual north. d) Magnetic north.

Setting a map is also known as:

a) Turning. b) Mapping.
c) Orientating. d) Clocking.

Orientating a map (turning a map so that identifiable features are in their relative position) can also be called:

a) Ranging a map. b) Organising a map.
c) Sighting a map. d) Setting a map.

Setting or orientating a map is:

a) Positioning your map relative to the features on the ground.
b) Holding it flat and horizontal.
c) Holding it so that the contour numbers are the right way for reading.
d) Folding it correctly for use outdoors.

Correctly orientating your map will help you to:

a) Read place names more easily.
b) Read the numbers on contour lines more easily.
c) Measure distances more accurately.
d) Determine your approximate location more easily.

Basic Navigation

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Chapter 1 Basic Navigation

The National Grid
Setting or Orientating Your Map
Finding North without a Compass
Magnetic North
Magnetic Variation
Grid Magnetic Angle (GMA)

Chapter 2 The Compass

Magnetic Deviation
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Naismith's Rule
Pacing
Errors
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Chapter 4 Weather

Air Masses
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Upper Winds
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Clouds

Flying Controls

The helicopter has four main flying controls:

Collective Pitch Control

The collective pitch control changes the pitch angle of all the blades of the rotor by the same amount at the same time and controls the vertical movement of the helicopter. A cam arrangement attached to the lever opens the throttle to maintain RPM for **small** lever movements.

The Hand Throttle

For **large** movements of the collective lever the cam arrangement which maintains engine power under load is not adequate. In these situations the pilot will twist the hand throttle located on the end of the collective lever.

Cyclic Pitch Control

By tilting the rotational disc of the main rotor the cyclic pitch control is used to make the aircraft move horizontally. It is normally operated by the pilot's right hand like the control column of a conventional aircraft.

If the stick is moved forward the disc is inclined forward and the helicopter moves into forward flight. The stick can be moved in any direction, tilting the disc in the same direction to move the helicopter forwards, sideways or backwards.

Tail Rotor Control

The tail rotor, which controls the helicopter in yaw, is operated by rudder pedals similar to fixed-wing aircraft. Pushing the right pedal forward will yaw the helicopter to the right and vice-versa.

When the pilot of a helicopter makes a **large** upwards movement of the collective lever, more power is required. How is this extra power obtained?

a) An automatic cam arrangement opens the engine throttle and no further action is required.
b) The pilot turns the hand throttle to open it.
c) The yaw pedals are operated to increase the load on the engine.
d) The cyclic pitch is altered taking the load off the tail rotor.

Where is the hand throttle of a helicopter located?

a) At the top of the joystick.
b) On the cyclic control.
c) On the cockpit wall.
d) On the end of the collective lever.

Tilting the rotor disc of a helicopter forward will make the helicopter:

a) Travel forwards.
b) Hover.
c) Travel backwards.
d) Climb.

What is the main function of a helicopter's cyclic control?

a) Acts as a rudder.
b) Controls the helicopter's vertical movement.
c) Controls horizontal flight in any direction.
d) Controls the engine speed.

A helicopter pilot uses the yaw pedals to control:

a) The pitch angle of the main rotor blades.
b) Forward speed.
c) Vertical flight.
d) The tail rotor.

Airmanship

Introduction

The Airmanship section consists of two chapters, plus thirty aircraft about which you must know some basic facts and be able to recognise from their silhouettes.

You must be able to identify an aircraft from any **one** of its three silhouettes. Some questions show only one silhouette for an aircraft, some all three.

You should also know the **role** of each aircraft, and the **number** and **type** of engine(s).

(In almost all examination questions you will be able to determine the correct answer by just knowing the *number* of engines in each case.)

On pages 20 to 23, neatly write each aircraft's name against its silhouette, its role, and the number and type of engines. Use these as your revision guide.

Alternatively, check out:
www.theaircadets.org => Downloads => Aircraft Recognition Cards
for a full set of revision silhouettes and essential information on each aircraft.

Note that aircraft may have piston engines, turbojet engines or turboprop engines (jet engines driving a propeller). All helicopter engines are turboshafts (jet engines driving a shaft, which in turn drives the rotors).

Between 3 and 7 of the 25 examination questions will be from chapters one and two, the remaining questions will be on aircraft knowledge. Of the aircraft knowledge questions, between 4 and 11 will involve identifying silhouettes, the rest will be questions on aircraft roles or engines.

Airmanship

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Telephone Communication
Helicopter Operating Areas
Hazard and Obstruction Markers
Aviation Radio Aids
- RADAR
- DRDF
- ILS
- PAR
- GCA

Airways

Aircraft Knowledge Silhouettes

Chapter 2 Rules of the Air

Rights of Way
- Different Aircraft Types
- Similar Aircraft Types

Navigation Lights
Avoiding Other Aircraft
- The Clock Code

Avoiding Other Aircraft

Flight crew communicate with each other to point out aircraft which may pose a threat. To pinpoint the location of other aircraft a 'clock code' system is used whereby a position directly ahead of the aircraft is "12 'o clock" and a position directly astern is "6 'o clock".

For extra clarity you can add 'HIGH', 'LEVEL' or 'LOW' depending upon whether the aircraft is above, at, or below your level.

If an aircrew member reports to the Captain that they see another aircraft "at six o' clock, level", which way should the Captain look to see the other aircraft?

a) Directly behind.
b) At 90 degrees to the left.
c) At 90 degrees to the right.
d) Directly ahead.

CHAPTER 2 RULES OF THE AIR

Just as drivers must obey the Highway Code to avoid accidents, pilots must obey 'Right of Way' rules.

Rights of Way for Different Aircraft Types

There are four main types of aircraft - balloons, gliders, airships and conventional powered aircraft.

Balloons cannot be steered, therefore all other types of aircraft must give way to them.

Gliders are manoeuvrable, but have no engines and fly at low speeds. They have right of way over powered aircraft and airships.

Airships do have engines and can avoid collision more easily than gliders or balloons. For this reason they must give way to gliders and balloons.

Conventional powered aircraft must give way to balloons, gliders and airships.

Rights of Way for Similar Types

When two aircraft are approaching head-on, each must alter course to the right.

If two aircraft are on converging courses, the aircraft which has the other on its right must give way.

An aircraft being overtaken has right of way. The overtaking one must avoid the other by turning right.

Navigation Lights

In addition to flashing 'anti-collision' lights, aircraft carry navigation lights to help pilots judge which way other aircraft are travelling at night.

Balloons carry a single red light suspended below the basket.

Conventional powered aircraft have a red light on the port wingtip, a green light on the starboard wingtip and a white light on the tail.

Who must give way to a balloon?

a) Only airships. b) Only conventional powered aircraft.
c) Only gliders. d) All types of aircraft.

Who must give way to a glider?

a) Only conventional powered aircraft. b) Only airships.
c) All types of aircraft except balloons. d) Only balloons.

Who must give way to airships?

a) Conventional powered aircraft. b) Balloons.
c) Gliders. d) All types of aircraft.

Who must give way to a conventional powered aircraft?

a) None. b) Airships.
c) Only gliders. d) Only balloons.

Which of these types of aircraft has to give way to all of the others?

a) Balloons. b) Airships.
c) Gliders. d) Powered aircraft.

If two aircraft are converging at the same height, which must take avoiding action?

a) The aircraft that has the other on its right.
b) The aircraft that has the other on its left.
c) The slower of the two.
d) The faster of the two.

According to the rules of the air, if a faster aircraft is catching up with a slower one which is ahead and at the same height, how should the faster aircraft overtake?

a) By maintaining height and overtaking on the starboard side of the slower aircraft.
b) By maintaining height and overtaking on the port side of the slower aircraft.
c) By climbing at least 1000 feet higher and then overtaking.
d) By descending at least 1000 feet lower and then overtaking.

All aircraft carry navigation lights at night. Suspended below the basket, a balloon carries:

a) Two red lights.
b) One red and one green, red above green.
c) One red and one green, green above red.
d) One green light.
e) One red light.

What are the standard navigation lights carried by a powered aircraft?

	PORT	STARBOARD	TAIL
a)	Red	White	Green
b)	Green	White	Red
c)	Red	Green	White
d)	White	Red	Green

CHAPTER 1 AIR TRAFFIC CONTROL

At RAF airfields all movements of aircraft, both on the ground and in the air are monitored by Air Traffic Control (ATC). The ATC controllers operate from the 'control tower'.

The Aerodrome Controller

Aircraft on the ground (and vehicles) in the manoeuvring area and in the local circuit are handled by aerodrome controllers (sometimes called airfield controllers), who work in a glass walled control room on the top of the control tower.

Communication from the control tower to aircraft and vehicles on the airfield is by VHF and UHF RT. (Very High Frequency and Ultra High Frequency Radio Telecommunications)

The Approach Controller

Aircraft outside the circuit, but within the airfield's area of responsibility are handled by the approach controllers. This includes aircraft departing and joining the circuit and aircraft making instrument approaches.

Other controllers responsible for the safety of aircraft flying between airfields are located at Air Traffic Control Centres (ATCC's) or Air Traffic Control Radar Units (ATCRU's) neither of which are necessarily located on airfields.

The Runway Controller

Busy training airfields often have a runway controller located in a red and white chequered caravan located near the touch-down point.

Telephone Communication

Good communications between airfield control towers, ATCC's and ATCRU's are vital. All are linked by direct cables (landlines). The network was known as the Defence Fixed Telecommunication System (DFTS), now the RAF Telecommunications Network (RAFTN).

Helicopter Operating Areas

Helicopter landing areas are identified by a large (4m by 2m across) letter 'H'.

Which building at an airfield houses the people who monitor aircraft on the ground and in the air?

a) Air traffic coordination room.
b) Air traffic coordination tower.
c) Air traffic control tower.
d) Airborne traffic control room.

Which of the following controls the movement of both vehicles and aircraft in an airfield's ground manoeuvring area?

a) Ground controller. b) Air controller
c) Approach controller. d) Airfield controller.

Which of the following would normally work in a glass walled room in the control tower?

a) Approach controller. b) Airfield controller.
c) Ground controller d) Air controller.

The main method of communicating from the control tower to aircraft and vehicles on an airfield is by:

a) HF and MW RT. b) VHF and UHF RT.
c) RAFTN. d) Tele-talk.

Which of the following controls aircraft departing from and arriving at an airfield?

a) Approach controller b) Ground controller.
c) Air controller. d) Airfield controller.

What does the abbreviation ATCC represent?

a) Air Traffic Control Coordination
b) Air Traffic Control Centre.
c) Air Traffic Coordination Centre.
d) Air Traffic Control Conference.

What does the abbreviation ATCRU represent?

a) Air Traffic Control Relay Unit.
b) Air Traffic Control Radio Unit.
c) Air Traffic Control Radar Unit.
d) Air Traffic Control Response Unit.

Which of the following would normally work in a red and white caravan?

a) Airfield controller. b) Ground controller.
c) Approach controller. d) Runway controller.

What does the abbreviation DFTS represent?

a) Defence Flexible Telephone System.
b) Defence Fixed Telecoms System.
c) Defence Force Trunking System.
d) Defence Fixed Teletype System.

What does the RAF call its system of telephones?

a) RAFPN b) RAFCN c) RAFTS d) RAFTN

A marker 4m high by 2m across in the shape of a letter 'H' identifies what?

a) A helicopter servicing area.
b) A helicopter loading area.
c) A helicopter target area.
d) A helicopter landing area.

Airfield Hazard and Obstruction Markers

Stationary hazards are marked with a yellow three-sided solid mounted on a pole set in a round base.

At airfields where taxiing on the grass is permitted, bad ground will be indicated by one of the following methods:

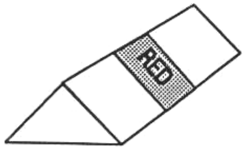
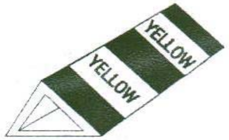


Fig 1

A white canvas marker with a red band.

Fig 2

A yellow and black striped solid.



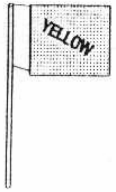


Fig 3

Yellow flags on light stakes.

Aviation Radio Aids

RADAR, which stands for Radio Detection And Ranging is a system of locating aircraft by transmitting a pulse of electromagnetic energy and picking up the small 'echo' reflected back from the aircraft. It is the 'eyes' of air traffic control.

DRDF (Digital Resolution Direction Finding) indicates the direction of an aircraft from the airfield by sensing the source of the aircraft's radio transmissions. Although the approach controller can tell the pilot what course to fly to reach the airfield, DRDF does not indicate the range.

ILS stands for Instrument Landing System. Ground transmitters define a radio beam and instruments in the cockpit display a runway centre line and glide-slope for the pilot to fly without controller assistance..

A helicopter landing area is identified by:

a) A letter 'L' b) A large circle.
c) A letter 'C' d) A letter 'H'

A three sided solid mounted on a pole with a round base identifies what?

a) Stationary hazards. b) Mobile hazards.
c) Bad ground. d) Good ground.

Which of these would signify a stationary object that constitutes a hazard?

a) A three-sided solid on a pole with a round base.
b) Yellow flags.
c) A white canvas V
d) A white triangle on a pole.

What does the marker in figure 1 indicate?

a) Ground is unserviceable for takeoffs.
b) Ground is unobstructed.
c) Area of bad ground, not to be taxied upon.
d) Ground is serviceable for taxying.

What does the marker in figure 2 indicate?

a) Ground is marshy.
b) Ground is suitable for taxying.
c) Ground is unobstructed.
d) An area of ground unsuitable for taxying.

What does the marker in figure 3 indicate?

a) Ground is swampy.
b) Ground is obstructed.
c) An area of ground unsuitable for taxying.
d) Ground is suitable for takeoffs.

What does the abbreviation RADAR represent?

a) Radio Detection And Reporting.
b) Rapid Detection And Ranging.
c) Raiders Detection And Reporting.
d) Radio Detection And Ranging.

What is DRDF used for?

a) Locates the range and bearing of an aircraft.
b) Guides the pilot onto the runway with no assistance from the ground.
c) Gives approach control the range and height of an aircraft.
d) Allows approach control to give the pilot a direction to fly to reach the airfield.

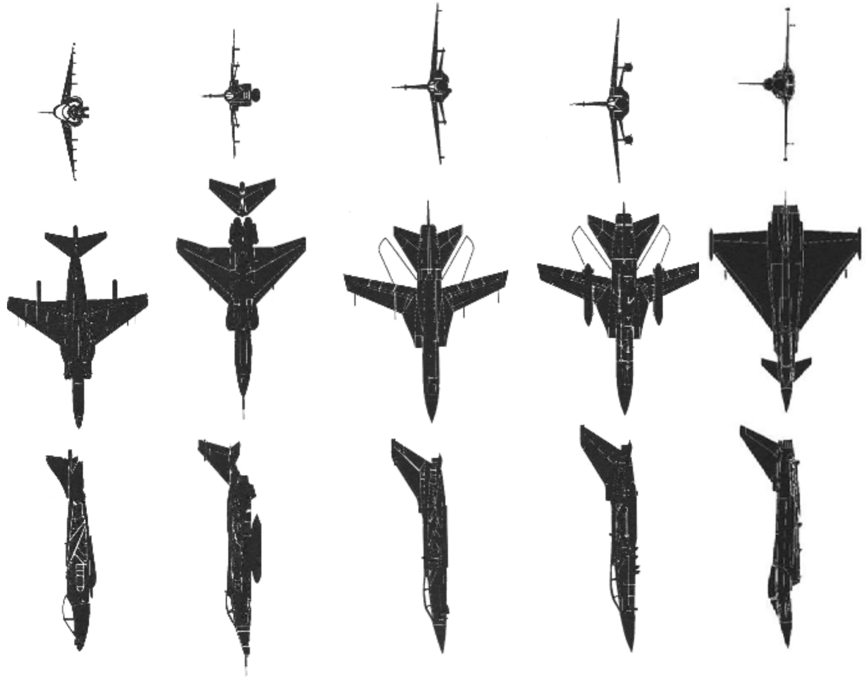
What does the abbreviation ILS represent?

a) Instrument Lighting System. b) Initial Landing Sight.
c) Instrument Landing System. d) Inertial Landing System.

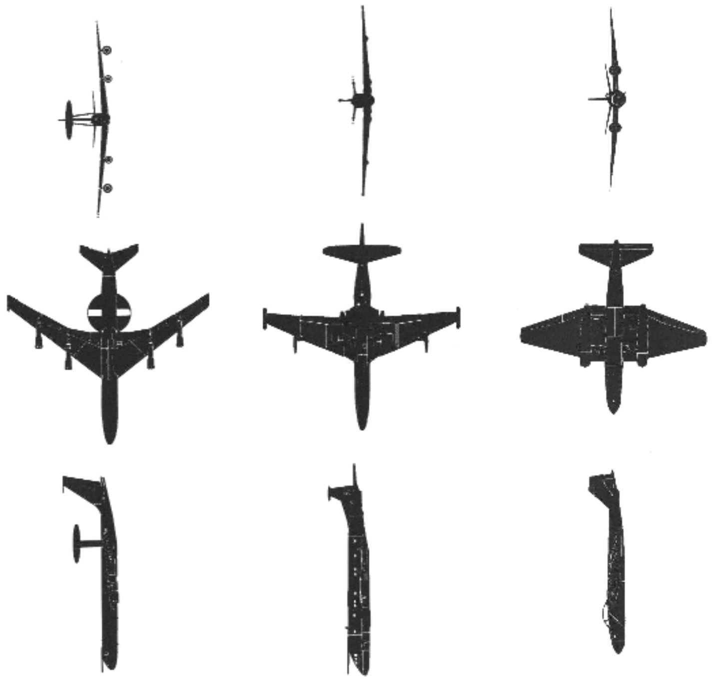
What is ILS used for?

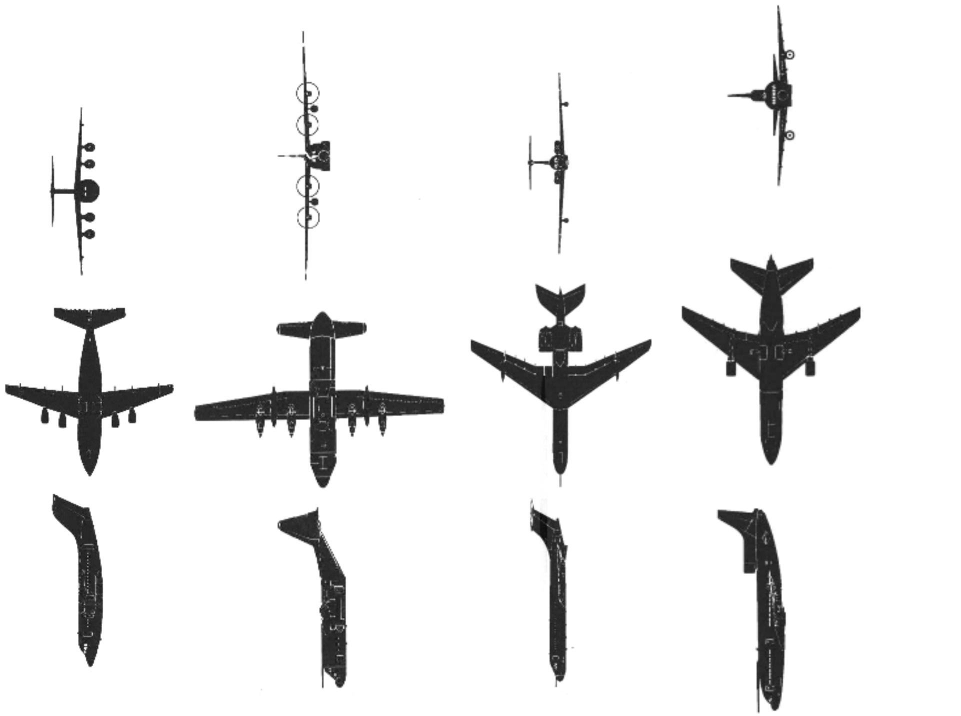
a) Lets the pilot see the runway lights.
b) Guiding the pilot onto the runway with no assistance.
c) Allows approach control to guide the pilot in bad weather.
d) Locates the range and bearing of an aircraft.

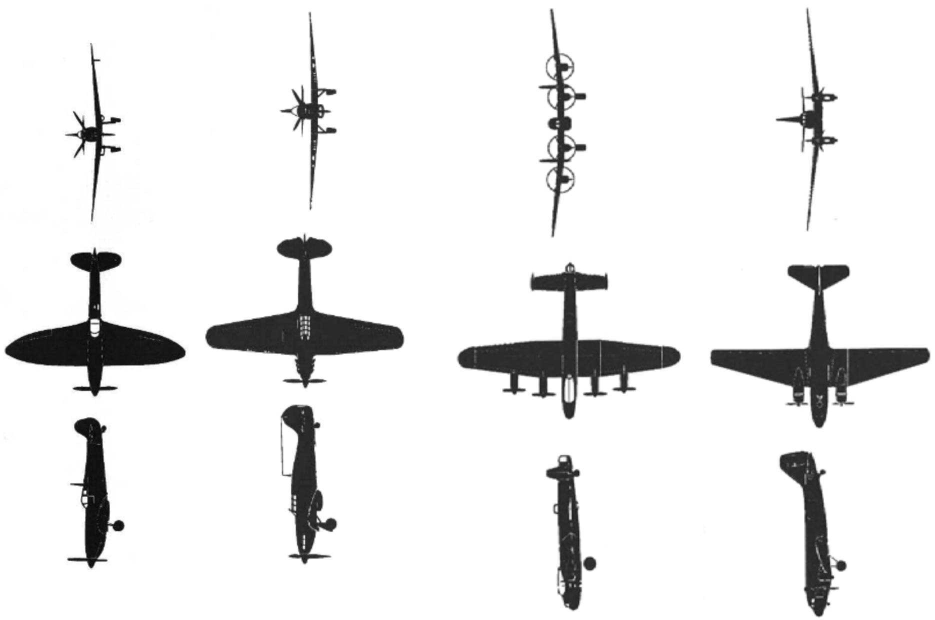
Aircraft under 15m wingspan



Aircraft over 15m wingspan







PAR stands for Precision Approach Radar. Using radar the ground controller is able to see the aircraft's position relative to the runway centre line and correct glideslope and pass this information to the pilot until he is able to land visually. This procedure is called a ground controlled approach (GCA).

<u>Airways</u>

Airways are a network of imaginary 'tunnels' in the air. They provide a safe means of moving large numbers of aircraft under air traffic's control. Any aircraft, whether military or civilian may use them providing they comply with the requirements:

1. The pilot must have a valid instrument rating.
2. The aircraft is fitted with appropriate radio and navigational equipment.
3. The flight is made in accordance with the rules.

Airways are between 10 and 20 nautical miles wide, the centres of the airways being marked by a series of radio navigation beacons.

Contact with ATCC must be established before an aircraft can enter or join an airway.

Aircraft flying outside controlled airspace may only cross an airway, either by flying underneath it, providing the base of the airway is above ground, or with clearance and radar control from the appropriate ATCRU.

What does the abbreviation PAR represent?

a) Pilot Applied Radar.
b) Preplanned Approach to Runway.
c) Pilot Aided Radar.
d) Precision Approach Radar.

What is PAR used for?

a) Guiding the aircraft down the correct glide slope towards touchdown.
b) Guiding the pilot onto the runway with no assistance from the controller.
c) Giving the pilot directions when flying between airfields.
d) Allowing the pilot to get a fix on the aircraft's position.

Which of the following are requirements for using an airway? (More than one answer.)

a) The flight is made during daylight hours.
b) The flight is made in accordance with the rules.
c) The aircraft is fitted with appropriate radio and navigational equipment.
d) The aircraft must not enter cloud.
e) The correct speed at time of joining.
f) The pilot has a valid instrument rating.

In nautical miles, what is the range of widths of airways?

a) 1 to 5. b) 5 to 10. c) 10 to 20. d) 20 to 30.

Airways are marked by:

a) National grid power lines.
b) Lights at certain points along the ground.
c) A series of radio navigation beacons.
d) Radio signals from air traffic control centres.

The markers in the previous question are positioned along:

a) The outer edge of the airway.
b) The centre of the airway.
c) Each side of the airway.
d) The inner edge of the airway.

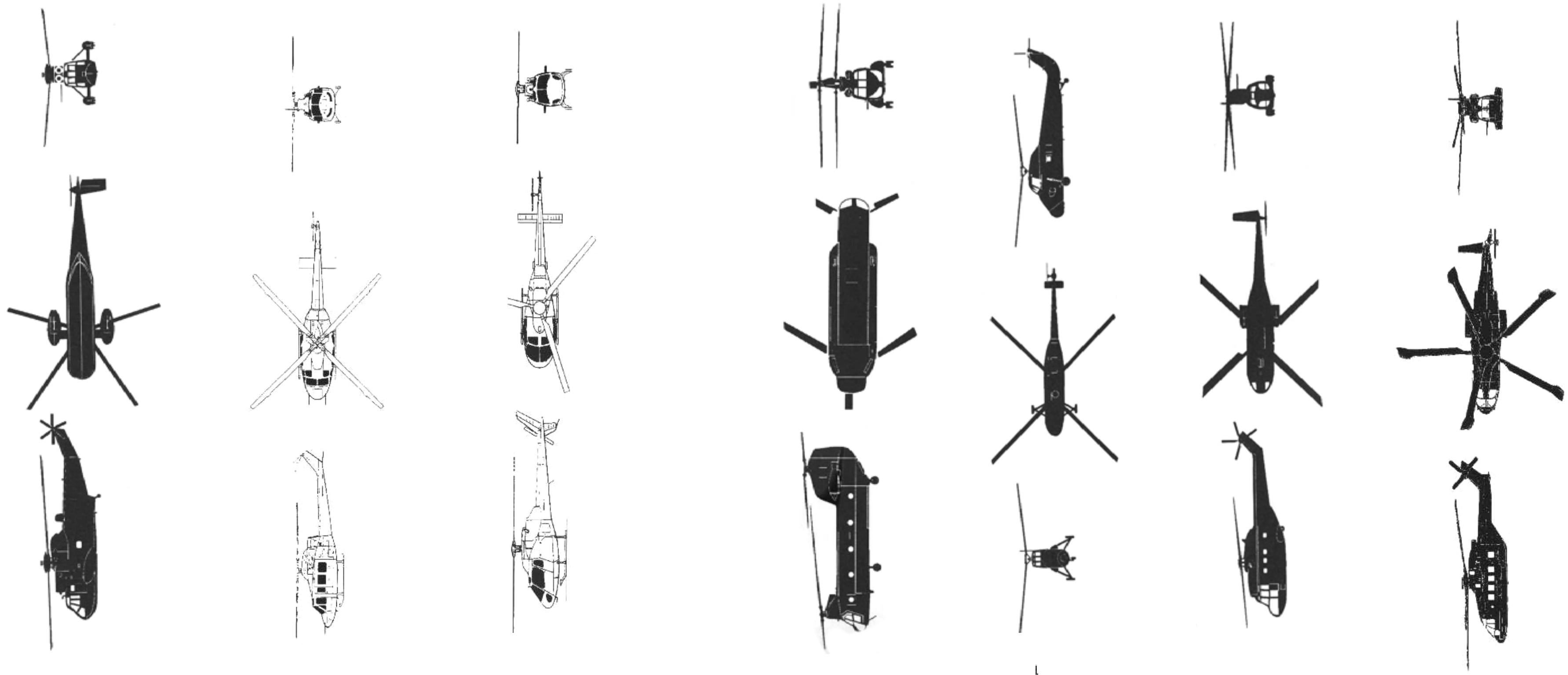
ATCC provides which service in connection with airways?

a) Clearance to fly over the top.
b) Planning of route.
c) Permission to takeoff.
d) Clearance to use airway.

If an aircraft wishes to cross an airway, which of the following is permitted? (More than one answer!)

a) Aircraft can be flown through under radar control from the ATCRU.
b) Aircraft must join airway, fly along it and turn off when instructed by ATC.
c) Aircraft may fly through without clearance provided it is clear of cloud.
d) Provided there is no traffic in that part of the airway it can fly through without clearance.
e) Providing the base of the airway is above ground, the aircraft can be flown underneath without clearance.
f) Providing there is no cloud, the aircraft can fly through at any point without clearance.
g) Providing the pilot has an instrument rating, he can fly through without clearance.

Helicopters



Trainers