Q & A

QUESTIONS FOR GLIDER PILOTS
WITH ANSWERS

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DESKTOP STUDIO

Q & A

Questions and Answers for Glider Pilots

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"Rule Forty-two. All persons more than a mile high to leave the court."
Everybody looked at Alice.
"I'm not a mile high," said Alice.
"You are," said the King.
"Nearly two miles high, " added the Queen.
"Well, I shan't go, at any rate," said Alice: "besides, that's not a regular rule: you invented it just now."
"It's the oldest rule in the book," said the King.
"Then it ought to be Number One," said Alice.'

L.Carroll (1865)
Alices Adventures in Wonderland,

after getting her Silver Height claim disallowed by the **BGA** ?

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Q & A

Chris Robinson has a Physics Degree, as a teacher of Physics and Mathematics he worked in New Zealand and at Colleges of Further Education and English Public schools. He was actively involved in the early introduction of Microcomputers into the education system, finally leaving teaching to set up one of the early Microcomputer dealerships in 1979.

A keen Ocean Racer on the East Coast he developed the **TIDERACE** system used for navigation and tactical purposes on board the leading **ADMIRALS CUP** yachts in the 80's. On "**FEVER**" the famous ONE TON racing yacht owned by his company he skippered and navigated to many successes over several seasons.

Following the sale of his company he took up gliding, producing the **GLIDE ON** final glide calculator that is now marketed worldwide. He flies an **LS4a** from WORMINGFORD, the base of the **ESSEX and SUFFOLK GLIDING CLUB.**

Q & A

Introduction

Q & A is a book of Questions for Glider Pilots and students, the aim is to clarify various topics by sets of related and often structured questions on the topic. A variety of styles are used from simple sets of identification problems, chart symbols, abbreviations and the like, to sets of questions each of which make the following more difficult question easier to understand.

The questions are not aimed at any particular level of Pilot, they probably cover most areas required by **BGA** tests at all levels, many are beyond the levels of understanding required by the Bronze "multiguess" papers but should be easily understood by these students in any case.

The main objective is to provide useful entertainment when actually flying a glider is not practically possible and to act as a reminder of some of the facts we all should, as glider pilots, be constantly aware of.

Introduction to the Second Edition

More of the same, sections have been enlarged with more questions, often variations on the same subject, a short section of multiple answer questions added to give an idea of the format of the Bronze C papers.

I have included **NOTES FOR GLIDER PILOTS** by **ERIC RICHARDS**, President and ex CFI of Essex and Suffolk Gliding Club. These concise notes have been given to all new members of the club for some years now. Eric who also has a BSc in Physics, some 5,500 hours and three diamonds, was a founder member of the club. His quiet manner has inspired hundreds of pilots, his enthusiasm even now in his mid seventies is unmatched. Always ready to advise, fly the tug, or prove the day is soarable when all others have failed. His wisdom is reflected in his notes, I trust you find them useful.

NOTE

As a note to the purists, the following terms have been used incorrectly throughout this book.

Kilogram, a unit of mass, is commonly used as **Kilogram weight,** a force. The **Newton** is used but sparsely, similarly the **pound weight** is used along with the **foot.** Bastard units of no relevance are used such as the **Kilogram Metre** and **Pound Foot.** they are obvious to the reader without a great deal of understanding of Physics.

Many simplifications are used in an attempt to clarify, I hope that they do not lead to misconceptions, the reader who instantly spots them should carefully consider if they are reasonable for pilots of less then their level of understanding.

Overall I trust that you understand the reasons for these actions, the book is meant as a helpful document for Glider pilots not as a Physics text.

TECHNICAL NOTE

The second edition of the book was produced using an **IBM PS/2 Model 80/A16** with 19" mono screen, LaserJet for proofs before output to our Linotronic 200 Imagesetter producing final film for the printers. **Pagemaker V4.0** was used for typesetting and **Coreldraw V2** for the preparation of the graphics. **Publishers Paintbrush** on an **Epson Colour** scanner was used to input diagrams. The original text was prepared using **Wordperfect V5.1.**

QUESTION SECTION

Very Basic Principles

1 What is a **FORCE**? What does it do?

2 If you push on a wall, it does not move , why?

3 If a heavy man walks across a floor he does not normally leave a mark whilst a small woman wearing stiletto heels can easily damage the floor. Why?

4 Which of the following generates the highest **pressure**?
a) 10Kgs weight spread over 10cm.
b) 100 Kgs weight spread over 50cm
c) 3Kg weight spread over 1cm

5 To hold a weight of 300 kg in the air what force must be applied?

6 What part of a glider creates this lifting force?

7 If you roll a ball on grass, it eventually stops, why?

8 How could you make the ball roll further for the same amount of effort?

9 In a vertical pile of 5 bricks, each weighing 5kg and having a horizontal cross sectional area 100 sq cm calculate the pressure on the lower surface of each brick as you rise up the pile.

10 On a simple kitchen scale, weights of iron are used to weigh foods, if the scales have arms of the same length to which the iron weights and the foods are attached, what would be the weight of iron used to balance a 1Kg bag of flour? Why?

Basic Principles

1 **Force = Mass x Acceleration** is a simple statement of Newtons 2nd Law of motion. What is meant by the term "acceleration"?

2 Newtons 3rd Law of Motion states that **To Every Action there is an equal and opposite Reaction.** Give an example, concerning sitting in a STATIONARY glider.

3 What is the approximate weight of air pressing down on each square inch of the earths surface at sea level? What is this force per square inch called?

4 When a glider is flying at a constant speed in a straight line, what can you state about the sum of all the forces acting on it?

5 A brick falling from a great height will initially accelerate and then reach a **Steady Velocity** until it hits the ground. Why?

6 A rock tied to a piece of string is rotated at a steady rate, head high, in a horizontal circle. From the rocks point of view what forces are acting? If the string breaks, in what direction will the rock move?

7 On a fairground roundabout you are rotated inside a drum, being pressed onto the wall of the drum. When the floor is lowered away from under your feet you remain pressed to the rotating wall. What forces are acting on you? Why don't you slide down the wall?

8 When a glider turns, it accelerates towards the centre of the circle it is traversing, what part of the glider provides the force causing this?

9 Why, when you lower the nose of a glider does it accelerate quickly to a higher steady speed rather than accelerate constantly?

10 A 10lb weight is attached to the end of a very light rod 11' long, 1lb is attached to the other end. Where along the rod is the point where it will **Balance**? If you used a 2lb weight instead of the 1lb where would it then balance?

Wings and Things

1 The amount of **Drag** on any moving object depends on several factors. Name as many as you can.

2 A flat plate is placed in a parallel airstream in such a way as the airstream flows symmetrically over the two sides of the plate. When the angle of the plate relative to the airstream is changed, forces are generated on the plate. What is the name given to the angle between the plate and the airflow?

3 The forces acting on the plate will try to accelerate the plate out of the airstream. These forces are commonly split up into two components, one at right angles to the airflow and one along the direction of the airflow. What are each of these components called?

4 If we replace the plate with a wing section, an aerofoil, we measure the angle between the airflow and a line through the leading edge to the trailing edge of the wing. What do we call this line?

5 An aerofoil is shaped to produce an increase of pressure below it and a decrease above it, for most glider aerofoils which is the larger effect, roughly in what ratio do the surfaces of the wing produce lift?

6 A glider of 360Kg weight, has wings of area 10 square metres. In level flight what is the total vertical force supplied by the wings?

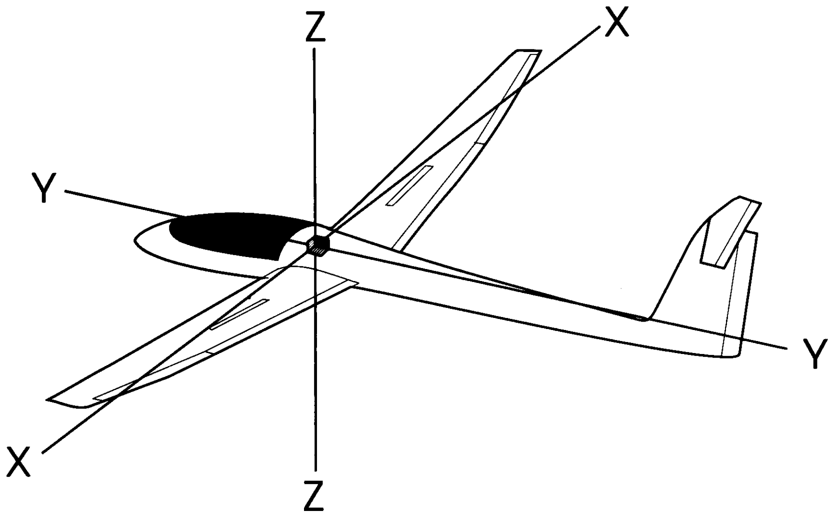
7 What is the wing loading of the glider in Q6? What would it be when 140 Kg of Water Ballast is carried?

8 If we replaced the air with a liquid moving at the same speed relative to the aerofoil, would the forces generated be greater or less than with air?

9 If the aerofoil is moving through the air at a higher speed would the forces be greater or less?

10 The forces generated by a wing moving through the air at a fixed angle are dependent on four main factors, name them?

Effect of Controls



Complete the following table, stating about which of the three perpendicular axes each control effects.

	AXIS EFFECTED	
	Primary effect	Secondary effect if any
Ailerons		
Rudder		
Elevator		
Air brakes		
Flaps		

Stalls

1 List the **Two** main types of **Drag** important to gliders. What causes them?

2 Draw a simple sketch graph showing how these types of Drag vary with air speed. Diagrammatically add them together and show how the total drag on the glider varies with speed.

3 Both **Lift** and **Drag** increase with the angle of attack, at a certain angle the airflow breaks away from the upper surface of the wing. This is called the **Stalling Angle**, for most aerofoils it has the same approximate value. What is this value?

4 In flying a simple glider, which factors can you control that vary the amount of Lift generated? In steady flight how much Lift and Drag are generated in total?

5 The **Centre of Pressure, C of P**, which is the point through which the **Total Aerodynamic Reaction, TR** acts, moves backward and forward in the wing with varying angles of attack. The weight of the glider however always acts in the same place, at the **Centre of Gravity, C of G.** If a horizontal distance exists between the Centre of Pressure and the Centre of Gravity a turning moment will exist on the wing. What common design feature is used to balance this turning moment?

6 The reaction, TR = 2800**N** on a glider of 300kg mass.
The balancing force of 200**N** is 5.6m behind the C of G. How far forward of the C of G is the C of P in this case?
(Note: The **Newton, N**, a unit of FORCE is defined as the force that gives a 1 kg mass an acceleration of 1 m/s^2. 1 kg Mass has a weight of 10**N**)

7 At the stall the C of P moves aft and TR is drastically reduced. What is the effect on the glider when this happens?

8 What is **Wash Out**? What does it do?

9 Often a glider will drop a wing in a stall, trying to lift the wing using ailerons in the normal way seems to make the situation worse. Why?

10 For a stalled wing to become unstalled, what condition is essential?

Staiis and Spins

1 When the stick is moved to the right, explain the effect of the Aileron on the amounts of **Lift and Drag** produced by the Right Wing.

2 What happens to the left wing in the above case?

3 For each wing in this case, what happens to its **angle of attack?**

4 At the point of stall what is approx value of the angle of attack?

5 When entering a stall the glider sometimes drops a wing. Consider the reactions caused by trying to correct this by using the ailerons. What will happen to the angle of attack of the lower wing when the aileron is applied? What will happen to the amount of Lift and Drag produced by each wing?

6 A possible end result of the actions in 5 is **Autorotation or Spinning.** To stop the spin, the wing (or wings) must be made to generate lift again.
Explain the actions you should take to exit the spin?

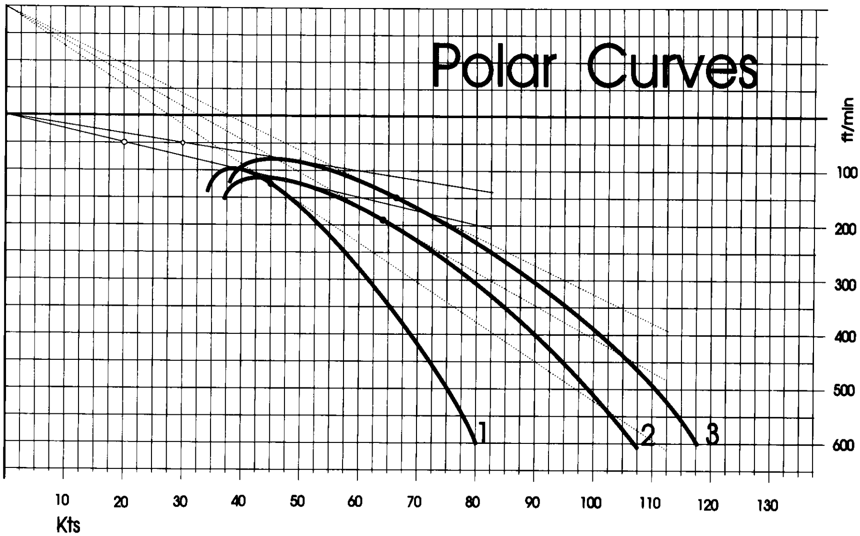
7 Older textbooks often refer to an **incipient spin**? More modern terminology is a stall with wing drop. How do you recover from one?

8 Most gliders when left "hands off", enter a **spirai dive**.
What is this and how is it different from a spin?

9 A heavy pilot often has problems in attempting to make a glider intentionally spin, why is this?

10 Light pilots often have to carry ballast weights, why?

Performance



In the above Polar Curves diagram, Glider 1 is a High Performance wooden glider, Glider 2 is a Modern 15m Glass glider and Glider 3 is a 25m Super glider.

1 Calculate L/D_{max} and best glide speed for each glider in turn

2 Calculate achieved **L/D** at 60knts for each Glider

3 Calculate achieved **L/D** at 80knts for each Glider

4 With the minimum loss of height , how long will each Glider take to cross an area of sink at 200ft/min, 2 Nm wide?

5 In Q4 how much height will each glider loose crossing the 2Nm?

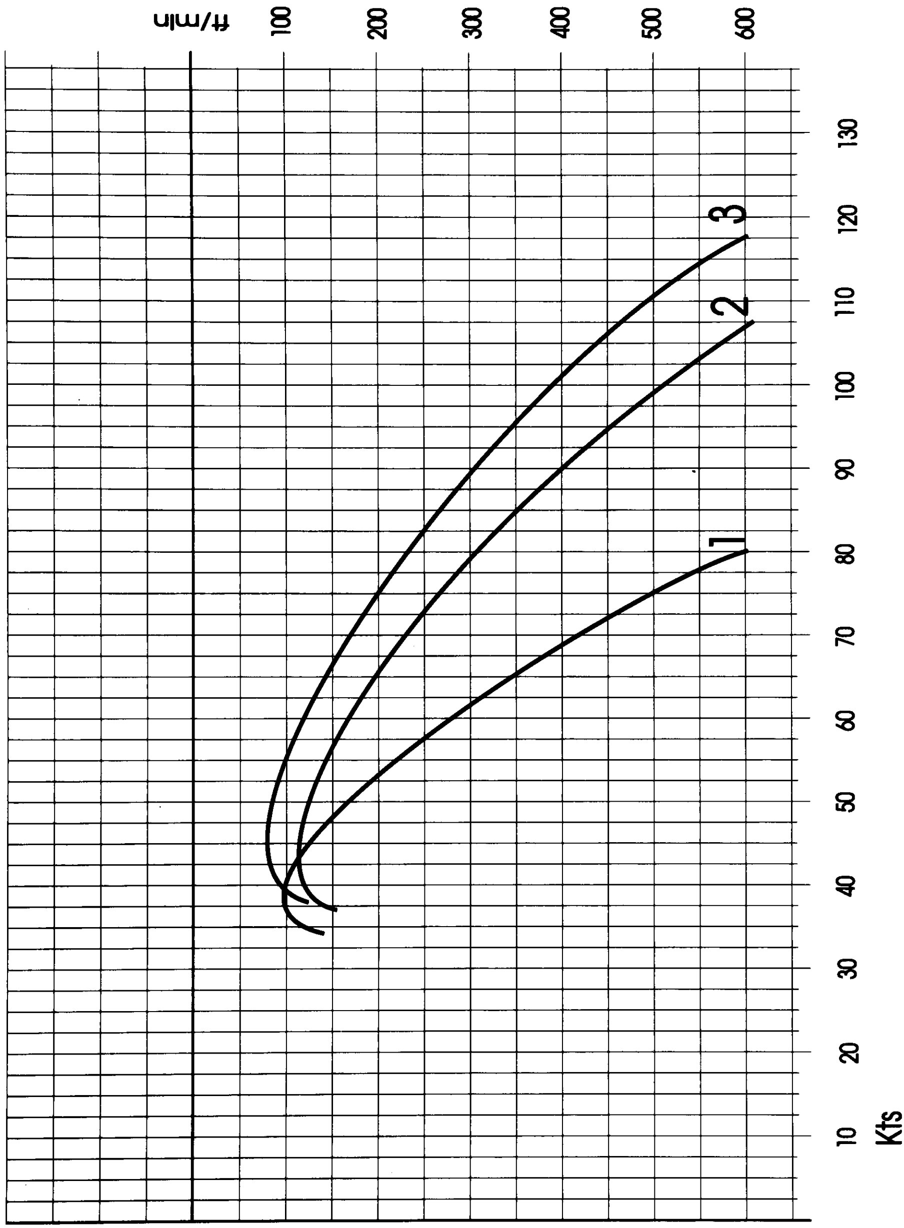
6 Against a 20Kt headwind, calculate the best attainable L/D in each case

7 Repeat Q4 against a 20Kt headwind

8 Repeat Q5 against a 20Kt headwind

9 How far can each glider Final Glide for each 1000ft of loss of height in still air?

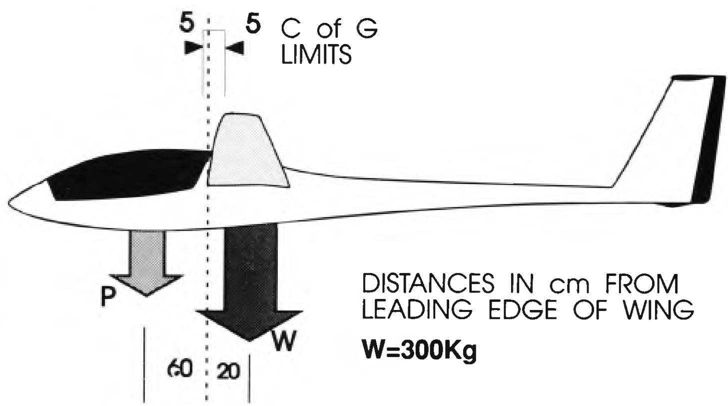
10 Calculate the minimum height required for each glider to Final Glide 30Km, leaving a safe height of 800ft for a circuit, in still air



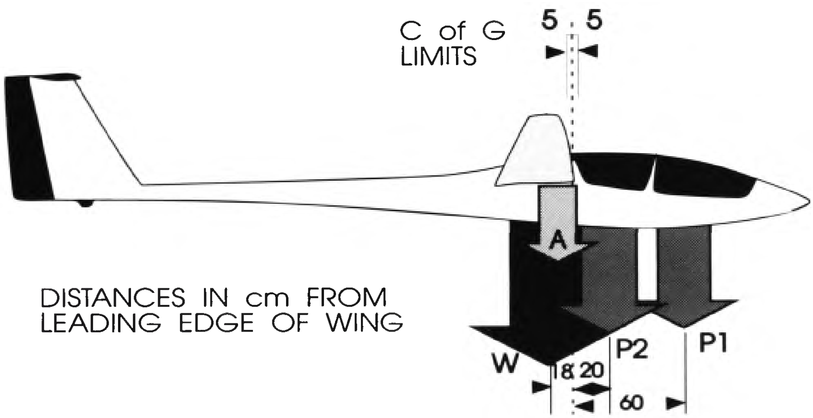
LARGE COPY OF POLARS FOR YOU TO WORK ON

Balance

For a glider to be stable the loads it carries must balance within the C of G limits of the design. Complete the following tables.



	Distance from		Turning moment	
	Forward limit	Aft limit	Forward limit	Aft limit
Glider (Empty)				
Pilot				
Now, about balance point, **clockwise moment= anticlockwise moment**, therefore Max pilot weight= Kg (C of G forward) and Min pilot weight= Kg (C of G Aft).				



	Distance from		Turning moment	
	Forward limit	Aft limit	Forward limit	Aft limit
Glider (500Kg)				
Pilot 1				
Pilot 2 (100 Kg)				

Sum of clockwise moments = Sum of anticlockwise moments, therefore Max pilot weight= Kg (C of G forward) and Min pilot weight= Kg (C of G Aft).

Repeat the above exercise allowing for 200Kg of Water Ballast acting 10cm behind the leading edge.

Carefully describe the following design terms and features found on some gliders. Why is each used ?

1 Dihedral.

2 Sweepback.

3 Sweepforward.

4 High aspect ratio wings.

5 Differential ailerons.

6 Frise ailerons.

7 Flaps.

8 Spoilers.

9 Airbrakes.

10 Water Ballast.

B.G.A 4996 Flight Limitations

MAXIMUM SPEEDS	KTS
Pitot - static installation	
Nose Pot, flush vents	
Never Exceed	150
Air Brakes Open	150
Rough Air	100
Aerotow	100
Winch / Autotow	90

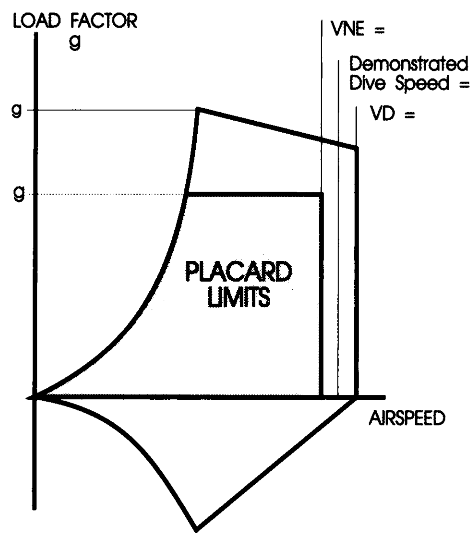
WEAK LINK to break at **1000** lbs

Cloud Flying (T/S fitted) yes

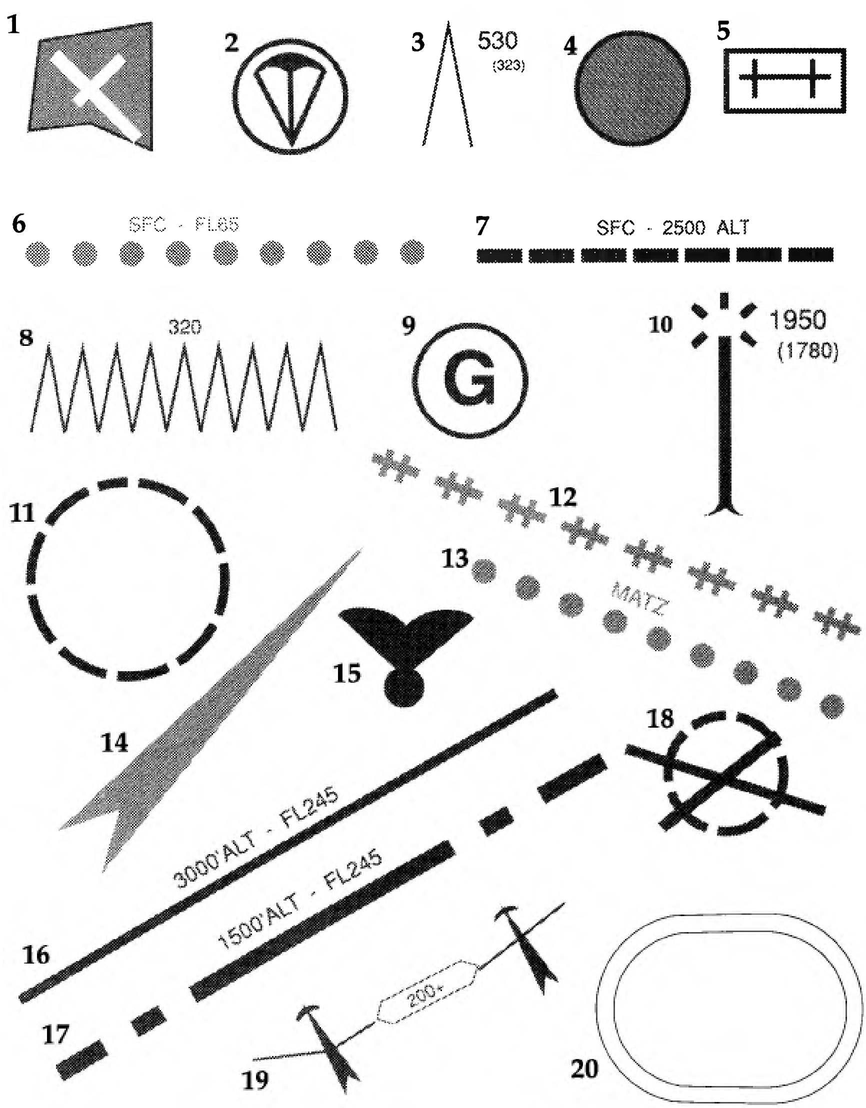
AEROBATIC MANOEUVRES: LOOP, SPIN, STALL TURN, TIGHT TURN 4g

From the Placard shown complete the values on the diagram of the Manoeuvring envelope

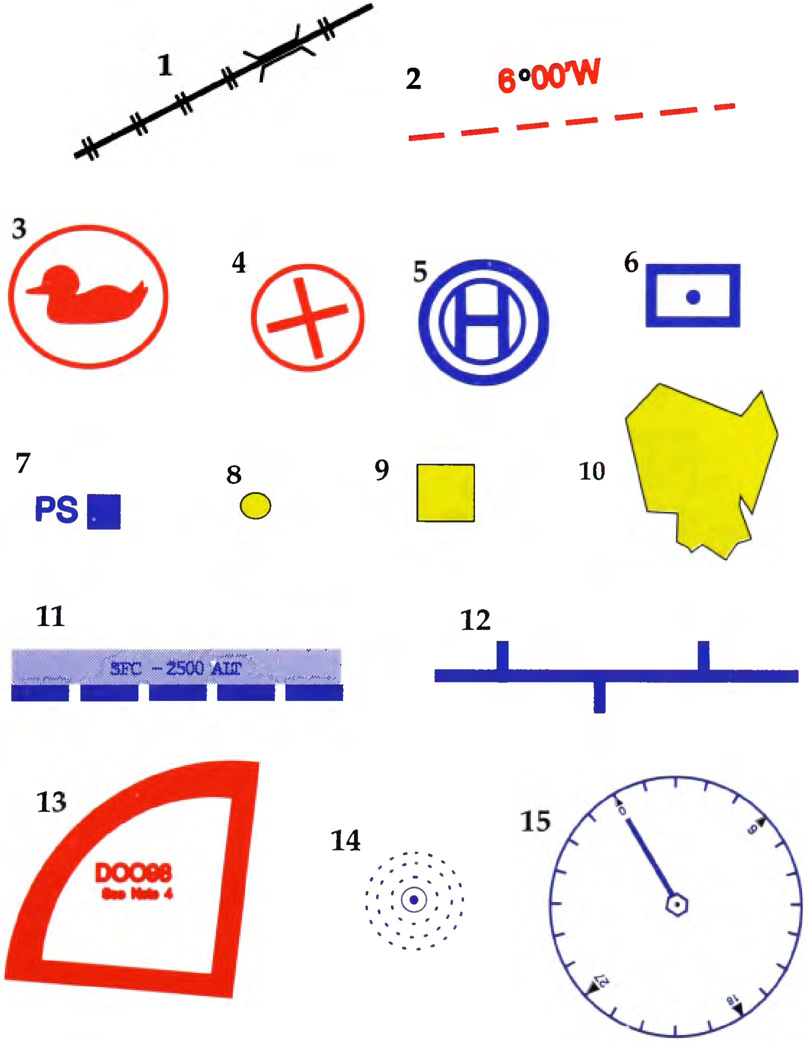
Explain the significance of the stall line.



You may see these symbols on a chart, explain the meaning of each



You may see these symbols on a SCALE 1:500 000 chart, explain the meaning of each



Compass Basics

1 Fill in the table of compass headings and reciprocal courses.
(A reciprocal is the course to fly back from the heading along the same track)

Course	Compass Heading	Reciprocal
North		
South		
East		
West		
North East		
South East		

2 You intend to fly on compass course 150°, what will your compass read if you are actually flying

a) 30° left of course
b) 20° right of course

3 Starting facing north, in which direction will you face if you make the following turns in succession

a) 20° Right
b) 100° Right
c) 140° Left
d) 180° Left

4 Wind directions are stated as the direction FROM which the wind comes, with a westerly wind blowing, you steer a course of 180°, will your track, the actual course over the ground be greater or less than 180°? What will be the situation on the reciprocal course?

5 What factors could lead to your compass being inaccurate?

Compass problems

1 What is **Deviation**?

2 What is **Variation**?

3 Why does Variation change year by year and place by place?

4 What are Isogonals?

5 What are the meanings of
i) **TRUE, T**
ii) **MAGNETIC, M**
iii) **COMPASS, C**

In the following questions,

Variation is	5 W	
Deviation is	5 W	between 0° - 90°
	0	between 91° -180°
	5 E	between 181° - 270°
	0	between 271° - 359°

6 Having drawn a line on your chart to your **Turning Point, TP** on an out and return task you find it bears 49°T, on a windless day what is your correct compass course to steer?

7 Having got to the TP, what course do you steer for the return leg?

8 You are flying along the line of a motorway, your compass reads **260° C**, what is the TRUE bearing along the motorway?

9 What is the Magnetic bearing of the motorway in Q8?

10 A clockwise symmetric diamond task is set on a windless day All four legs are the same length, TP2 being True north of the Start / Finish. What are the four compass courses to steer for the legs?

More Compass Questions

In questions 1 - 5, a northwesterly 20knt wind is blowing, you are flying at 50knts on the following **compass headings**, by simple sketches calculate your approx ground speed and track (actual direction of travel across the ground) in each case (Ignore Deviation and variation).

1 **135°**

2 **315°**

3 **45°**

4 **270°**

5 **180°**

6 You are flying towards CAMBRIDGE UK, with a strong crosswind from your left, as you progress along the track would you expect your altimeter to begin to read high or low? Why?

7 You have a compass on your panel which is fluid damped, on an east to west leg, as you pull out of turns you notice the compass always seems to flick in the same direction, which way and why?

8 If Q6 was on a flight towards Benalla in Australia would answer be the same, explain why?

9 Also on the Benalla flight your compass behaves strangely compared to your previous experiences in Q7. Why?

10 What is meant by the **Angle of Dip**?

Chartwork

The following are often seen on Navigational Charts, explain carefully their meanings:

1 **M A T Z**

2 **FL 65**

3 **A T Z**

4 **M A T Z (BY NOTAM)**

5 **Cromer 165 (C)**

6 **180**

7 **ASR**

All the following refer to a day when barometric pressure is **1000Mb at sea level.**

8 Before take off, as you set your altimeter to Zero height you note it reads **960Mb.** What does this tell you about your the location of your launch point?

9 The site is under a blue coloured strip on the chart with the letters **FL55 - FL245** marked on it. What does this mean? How high can you fly today over the site according to your altimeter?

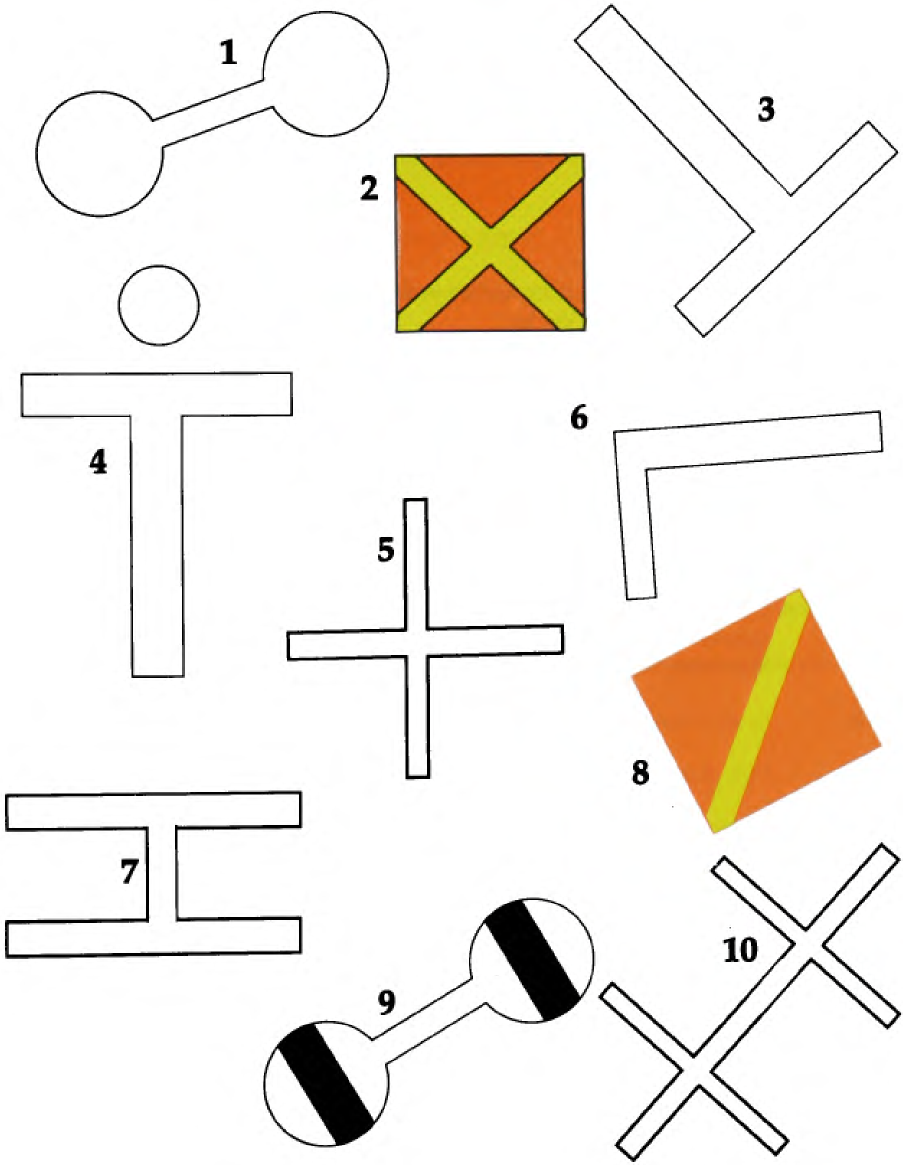
10 4 miles upwind of the site, at the same ground level, a military airfield with a **MATZ** is under the flight corridor. What is the separation between the top of this and the **FL 55** corridor?

Abbreviations

Flying seems to generate more abbreviations than most activities. What do these mean.?

1	AGL	**16**	UK AIP
2	AMSL	**17**	NOTAM
3	FL	**18**	AFTN
4	SFC	**19**	UHMRA
5	ASR	**20**	FIR
6	VOR	**21**	DoT
7	DME	**22**	ATC
8	NDB	**23**	Mb
9	LARS	**24**	AIS
10	HIRTA	**25**	NATS
11	D	**26**	CAP
12	DACS	**27**	C of A
13	DAAIS	**28**	ANO
14	AIAA	**29**	CIVV
15	ATA	**30**	FAI

You may see these signals from the air at an aerodrome, explain the meaning of each



Air Traffic Rules

What do the following abbreviations stand for

1 VFR
2 VMC
3 IFR
4 IMC

5 For a fixed wing aircraft to remain under VFR it must remain certain distances away from cloud. How far?

6 Outside Controlled airspace an aircraft below 3000' at less than 140 knots must satisfy certain conditions to remain under VFR.
What are these conditions?

Explain the following terms

7 Control Zone
8 Control Areas
9 Airways
10 Purple Airways
11 Special Rules Zones and Airways
12 Mandatory Radio airspace

13 At what minimum height may a glider fly over a town?

14 How close may a glider fly to a structure without permission?

15 What is the radius and effective height of an ATZ of an aerodrome?

16 What are the usual dimensions of a MATZ? What is a CMATZ?

17 With no ATZ and no other signals or existing traffic, which direction of circuit should be flown when landing at an aerodrome?

18 When landing in a large field containing gliders which have just landed on which side of the gliders should you land?

19 Where would a pilot find the latest information on the route and aerodromes he plans to use?

20 How fast may you tow your glider trailer on public roads in the UK?

Radio and Recommended Practices

1 What Radio frequencies are assigned exclusively to gliders flying in the U.K.

2 Another frequency is available for ground to ground transmissions.
What is it?

3 What should be the radio callsign of a glider?

4 When moving a glider on the site, which wing tip should be manned?

5 On a multiple pull out winch system which cable should be used first?

6 On a winch launch when the glider is being launched too fast what signal should the pilot make?

7 **CB-SIFT-CB** is the BGA recommended cockpit checklist, what do the letters stand for?

8 Above what height does the BGA recommend oxygen to be used?

9 How often should your parachute be checked by a competent authority?

10 Following an aerotow launch, after releasing the cable the glider should turn in which direction in the U.K.? Is this a universal rule?

Signals

On a cross country flight, cloud cover has apparently stopped the thermal activity, looking for a landing area you see an airfield onto which you decide to make a landing. You observe the following signals, explain what you should do in each case.

1 Continuous Green Light.

2 Continuous Red Light.

3 Green Flashes.

4 Red Flashes.

5 White Flashes.

6 Red Flare.

7 A series of Rockets with Red and Green stars at about 10 sec intervals.

8 No signals at all, the airfield however looks active.

9 On getting lower you see a red panel with a yellow cross in the signal square.

10 Your Aerotow retrieve arrives 15 mins before sunset, what lights should the glider show during the half hour tow back to base?

Clouds

For each of the following cloud types, state whether they are High, Medium or Low clouds and give a basic description,

1 Cumulus.

2 Stratocumulus.

3 Altocumulus.

4 Cirrocumulus.

5 Cumulonimbus.

6 Stratus.

7 Altostratus.

8 Nimbostratus.

9 Cirrostratus.

10 Cirrus.

Terms

Explain each of the following Meteorologic Terms,

1 Lapse Rate.

2 Adiabatic Cooling.

3 Dew Point Temperature.

4 Dry Adiabatic Lapse Rate.

5 Wet Adiabatic Lapse Rate.

6 Stable Atmosphere.

7 Unstable Atmosphere.

8 Latent Heat.

9 Inversion.

10 Depression.

11 Anticyclone.

12 Diurnal Variations.

13 Anabatic Wind.

14 Land Breeze.

15 Sea Breeze.

16 Orographic Cloud.

17 Isobars.

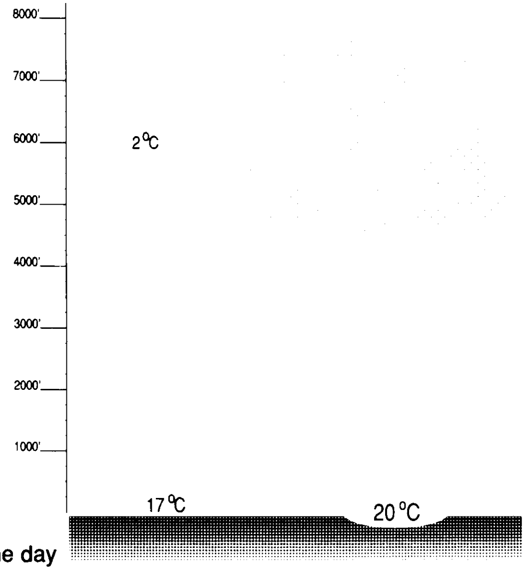
18 Troposphere.

19 Tropopause.

20 Geostrophic Force.

Cumulus Clouds

In all these questions you may assume the Dry Adiabatic Lapse rate is 3° C per 1000ft.



From the diagram calculate,

1 The Lapse Rate for the day

2 The Dew Point

By drawing a similar diagram, explain the results, for the following conditions, Ground Temperature 15° C, dry heated air to 20° C at ground level,

3 Lapse rate 2°C per 1000ft, Dew Point 8° C.

4 Lapse rate 2° C per 1000ft, Dew Point 4° C.

5 Lapse rate 2.5° C per 1000ft, Dew Point 5° C.

6 Lapse rate 3.1° C per 1000ft, Dew Point 5° C.

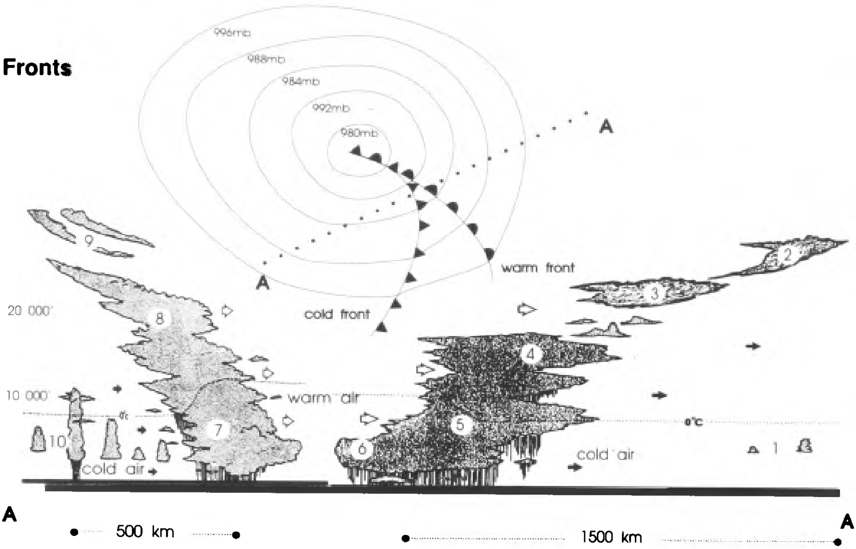
At 4000ft an inversion exists where the air gets warmer with increasing height, this has been caused by subsidence of the upper atmosphere.

7 Explain the effect of the inversion to the conditions in Q3

8 Explain the effect of the inversion to the conditions in Q4

9 Explain the effect of the inversion to the conditions in Q5

Fronts



The above diagrams show the chart of a typical Depression and a cross section along the line marked A A on the chart.

It is important that we can read the sky for signs of a change in the weather. The cloud types associated with fronts normally follow a sequence across the sky.

1 On the diagram above the cloud types are numbered from 1 to 10, fill in the table below with the name of each type referred to in the diagram.

1		6	
2		7	
3		8	
4		9	
5		10	

2 What would you expect to happen to the wind direction and air pressure as the warm front approaches and passes?

3 Similarly, what happens to the wind direction and air pressure as the cold front approaches and then passes?

4 **Red sky at night, shepherds delight,**
Red sky at dawning, shepherds warning, is a well known maxim for forecasting the weather, it directly relates to the above questions. Explain the logic behind the maxim.

Hill Lift

The diagram shows the Streamlines for a 20knt airstream flowing over a 300ft ridge. Where the streamlines are going upwards is an area of lift whilst down streamlines are in an area of sink. The angle of the streamline to the horizontal is proportional to the rate of lift (or sink). The more vertical the greater the lift or sink.

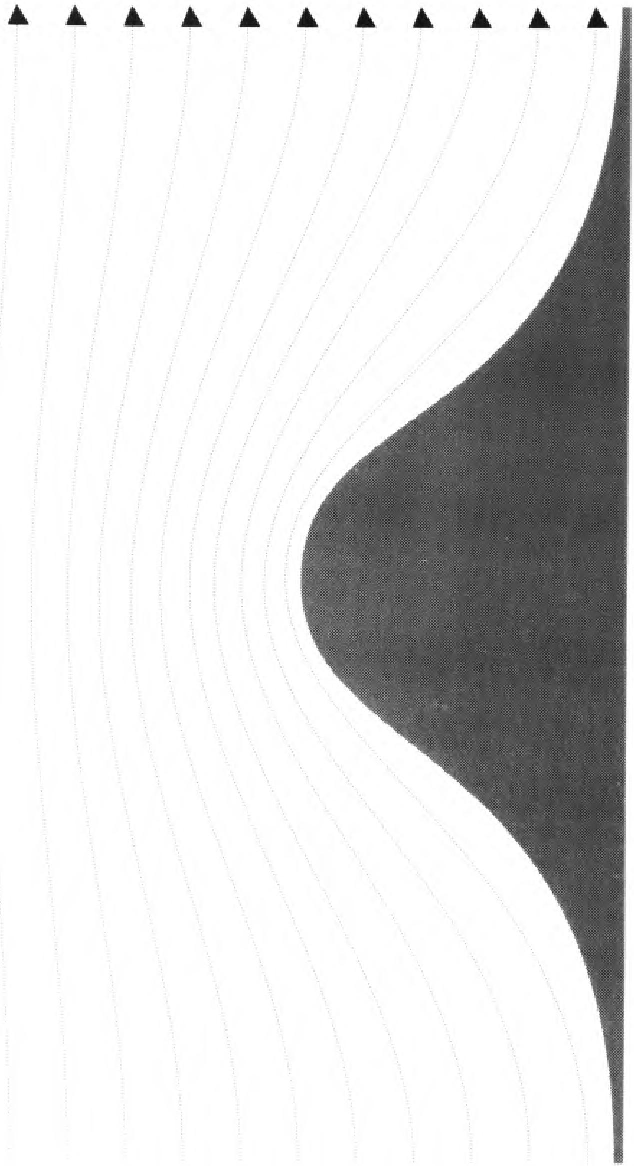
1 On the diagram find points that all have the same angle of slope, there may be more than one point on each line. The lines joining these points represent lines of equal lift, so if you join up the points you can draw the lift contours for this idealised ridge.

2 Do this for three different angles in the lift area and then repeat for one angle in the sink area. Is it symmetric on both sides of the ridge?

3 Draw a line joining the mid point of each lift contour, continue it down to the slope. Note the approx angle this line makes with the slope.

4 Within the lift area the horizontal component of the wind, the headwind or tailwind, changes according to the amount of lift, why?

5 If you get too far over the ridge getting back to the lift can be extremely difficult if not impossible, why?



A LARGE COPY OF THE DIAGRAM FOR YOU TO WORK ON

THEORY OF FLIGHT

1 The lift generated by a wing is proportional to
a) The area of the wing
b) The speed of the glider
c) The angle of attack
d) All of the above

2 What affect does the use of airbrakes have on stalling speed?
a) Increase stalling speed
b) Decrease stalling speed
c) No effect on stalling speed

3 What effect does dirt and rain have on stalling speed?
a) Increase stalling speed
b) Decrease stalling speed
c) No effect on stalling speed

4 In a steep turn, the stalling speed is
a) The same as usual
b) Higher than normal
c) Lower than normal
d) Twice normal

5 During a WINCH launch, the stalling speed Is
a) The same as usual
b) Higher than normal
c) Lower than normal
d) Twice normal

6 Which of the following is essential to enter a spin
a) Poorly coordinated or crossed controls
b) A wing being stalled
c) A light pilot
d) Slow speed

7 During a stall a wing drops, trying to raise the wing with the aileron makes the situation worse because
a) Aileron down on down wing increases angle of attack further and increases stall.
b) Aileron up on up wing will increase angle of attack and will stall it too
c) Aileron down on down wing decreases angle of attack further and increases stall.
d) Aileron up on up wing will decrease angle of attack and will stall it too

In Question **8 - 10**, there are 4 statements, only one of each set being **incorrect**, select it.

8 In a Full Spin,
a) The ASI, may read 0
b) The T & S ball stays central.
c) The 'g' force remains steady
d) The ailerons are ineffective

9 In a Spiral Dive
a) The Speed rapidly increases
b) The T & S ball stays central
c) The 'g' force remains steady
d) Rotation faster than a spin

10 The following design features INCREASE stability
a) Sweepback
b) Dihedral
c) Wash out
d) Sweepforward

AIRMANSHIP

1 On a winch launch the signal for TOO FAST is
a) Wag tail side to side
b) Waggle the wings
c) NONE
d) Something else

2 On a winch launch the signal for TOO SLOW is
a) Waggle tail
b) Waggle the wings
c) NONE
d) Something else

3 On an Aerotow you get out of position climbing above the tug, the best option is
a) Put nose down to regain position
b) Open airbrakes
c) Release Immediately
d) Keep going, it will sort itself out

4 In high winds approach speeds are increased because of
a) Wind Gradients
b) Turbulence
c) Wind shadows
d) All of the above

5 On landing you bounce 15ft into the air, your best option is
a) Close airbrakes and start again
b) Open airbrakes to loose height
c) Do nothing and it will sort itself out
d) Lower nose to gain speed

6 On a windy day, after landing you should
a) Stay in the glider and await help
b) Put parachute on wingtip and go for help
c) Park into wind and leave glider to get help
d) Something else

7 When joining a thermal, which already contains other gliders you
a) Always circle to the right
b) Always circle to the left
c) Circle the way you fly best
d) Circle the same way as the other gliders

In questions **8-10** one of the statements is **incorrect**, select it

8 The following should be considered in selecting a field for a field landing
a) Wind direction
b) Access for trailer
c) Crop type
d) Slope

9 During a winch launch, you must consider
a) Stalls can happen at higher speeds than normal
b) The loading on the glider can be far higher than felt by the pilot
c) Releasing if anything seems to be going wrong
d) Rapid rotation to get best height

10 Spin Recovery
a) Stick forward always works
b) Opposite rudder first
c) After rudder, Pause, then stick forward
d) Recover from dive normally

NAVIGATION

1 The reciprocal course to 45° is
a) 90°
b) 135°
c) 180°
d) 225°

2 Your base site is at 300' above sea level. On a day when atmospheric pressure is 980Mb at sea level your altimeter subscale will read to zero altimeter
a) 1000Mb
b) 990Mb
c) 970Mb
d) 960Mb

3 On the above day, what reading on your altimeter will indicate FL50
a) 4300'
b) 4700'
c) 5000'
d) 5300'

4 As you fly from an area of high pressure into an area of lower pressure would you expect your altimeter to
a) Read correctly at all times
b) Read High
c) Remain the same
d) Read Low

5 An Isogonal is
a) Line of equal Barometric Pressure
b) Line of equal Ground Height
c) Line of equal Magnetic Variation
d) Line of equal Magnetic Deviation

6 Your required track on a final glide is due North, you glide calculator suggests 60kts what approx course would you steer to allow for the 10kt easterly that is blowing?
a) 80°
b) 10°
c) 350°
d) 280°

7 In a windless area of Variation 8W you wish to steer along 45T, your compass has negligible deviation. The compass course to steer is
a) 37°
b) 45°
c) 53°
d) Something else

In questions **8 -10** one of the statements is **incorrect**, select it

8 The following areas must NEVER be entered by gliders
a) Danger areas
b) UHMRA
c) TMA
d) Purple Airspace

9 The following are publications carrying navigational information
a) FIR
b) NOTAM
c) UKAP
d) AIS

10 The following relate to chart heights
a) AGL
b) FL
c) AMSL
d) ASR

AIR LAW

1 A **white dumbbell** painted on the ground on the airfield at which you are about to land means
a) Do not Land
b) You may land on the grass
c) Land on the hard surface
d) Glider flying taking place

2 A white **T** in the signal square means
a) Land in the direction of shaft towards cross arm
b) Land in the direction of shaft away from cross arm
c) Land in opposite direction to takeoffs
d) Land on hard Tarmac areas

3 With 8/8 cloud cover at 5000' in good visibility how high can a glider fly remaining in **V.F.R.**
a) 5000'
b) 4500'
c) 4000'
d) 3000'

4 In **question 3** if cloudbase was 2500' the answer would be
a) 3000'
b) 2500'
c) 2000
d) 1500'

5 **Flight Level 55** means an altitude of
a) 5500'
b) 5500 AMSL
c) 5500 AGL
d) Something else

6 How wide is an **Airway**?
a) 1Nm
b) 2Nm
c) 5Nm
d) 10Nm

7 Which of the following frequencies should not be used by gliders
a) 130.4Mhz
b) 130.125Mz
c) 129.95Mhz
d) 129.90Mhz

In question **8 - 10** one of the statements is **not true** select it

8 Following a serious Gliding accident you must inform the following
a) Police
b) DoT, AIB
c) BGA
d) CAA

9 The following **light signals** have the given meanings to an aircraft in flight
a) Red Light - Do not land: wait for permission
b) Red Flashes - Do not land: airfield unavailable
c) Green Light- You may land
d) Green Flashes - You may land on grass

10 The following rules relate to **Rights of Way**
a) Head-on, each glider alters course to its right
b) Converging, the aircraft on the right gives way.
c) Overtaking, the overtaking aircraft keeps out of the way.
d) Landing, the lower aircraft has right of way

METEOROLOGY

1 Which of the following are **NOT** Low clouds

a) Stratus
b) Cumulus
c) Cumulonimbus
d) Altocumulus

2 Which of the following conditions causes a **SEA Breeze**

a) A light wind from the direction of the sea
b) Hot air over the land rising , being replaced by cooler sea air.
c) Hot air over the sea rising , being replaced by cooler dry air.
d) An offshore breeze

3 The **Dew Point** is

a) 4°C
b) the altitude where clouds form
c) the point where condensation starts to occur
d) the temperature where th air becomes saturated

4 An **anticyclone**, in the Northern Hemisphere, is

a) An area of HIGH pressure with winds that rotate about it in a anticlockwise direction
b) An area of HIGH pressure with winds that rotate about it in a clockwise direction
c) An area of LOW pressure with winds that rotate about it in a anticlockwise direction
d) An area of LOW pressure with winds that rotate about it in a clockwise direction

5 **Diurnal Variations** are caused by

a) The time of day or night
b) The time of the year
c) The wind direction
d) The soil type and moisture content

6 A **stable atmosphere** means

a) the temperature difference between rising air and its surroundings increases with altitude
b) the lapse rate for the day is less than the dry adiabatic lapse rate
c) the lapse rate for the day is greater than the dry adiabatic lapse rate
d) the lapse rate for the day is less than the wet adiabatic lapse rate

7 The Dry adiabatic lapse rate is approx

a) 2° per 100' increase in altitude
b) 3° per 1000' increase in altitude
c) 2° per 100' increase in altitude
d) 3° per 1000' increase in altitude

Questions **8-10** all relate to the passage of a depression

a) Altostratus
b) Cirrus
c) Nimbostratus
d) Cirrostratus

8 Which of the above is the first cloud seen as a forewarning of bad weather?

9 Which of the above shoes haloes?

10 Which of the above is associated with heavy rain?

A Answers Section

1 Gravity produces a Force, weight on body, your muscles cause a force to act on a football when you kick it ! A force makes a mass accelerate in the direction the force is applied. Gravity acts downwards.

2 If you push, apply a force, to a fixed object like a wall it does not accelerate, in effect a **REACTION** occurs which causes a FORCE equal in size but opposite in direction to push back at you, the overall effect is that the two forces cancel each other out with no masses being accelerated.

3 When we exert a force over an area we call it a **PRESSURE**. In this case the force is **WEIGHT**, obviously the weight of a heavy man spread over the area of his whole foot is far smaller than the pressure exerted by even a small woman over the tiny area of a stiletto heel.

4 **a)** Pressure $= \frac{\text{Force}}{\text{Area}} = \frac{10}{10} =$ **10Kg/Cm²**

b) Pressure $= \frac{\text{Force}}{\text{Area}} = \frac{100}{10} =$ **2Kg/Cm²**

c) Pressure $= \frac{\text{Force}}{\text{Area}} = \frac{3}{1} =$ **3Kg/Cm²**

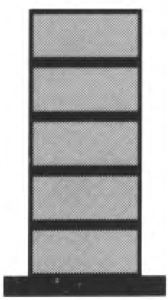
The lowest weight spread over the smallest area in fact exerts the greatest pressure.

6 In a glider, the wings when they move forward through the sir produce **LIFT**, thus upward force must equal the weight of the glider to prevent it **ACCELERATING** into the ground.

7 The blades of grass resist the motion of the ball as does the air through which it passes. This is a simple form of friction, a force that acts to oppose motion, causing bodies to decelerate.

8 Reduce the **FRICTION**, cut the grass or roll on a smooth surface air friction is more difficult to reduce although a very smooth surface will help.

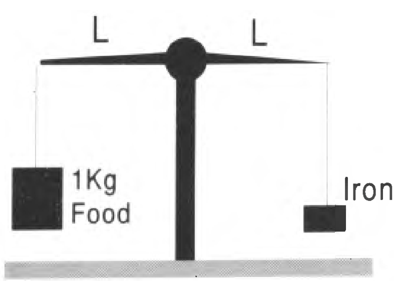
9



Notice how pressure increases as you move down the pile.

1 Brick	Wt is 5Kg / Area100	=	**0.05Kg/Cm²**
2 Bricks	Wt is 10Kg / Area 100	=	**0.10Kg/Cm²**
3 Bricks	Wt is 15Kg / Area 100	=	**0.15Kg/Cm²**
4 Bricks	Wt is 20Kg / Area 100	=	**0.20Kg/Cm²**
5 Bricks	Wt is 25Kg / Area 100	=	**0.25Kg/Cm²**

10



W must equal 1Kg to balance since arms of scale have equal lengths

1 Acceleration is a **VECTOR** quantity. A vector quantity has both magnitude and direction. Acceleration is therefore a change of **speed OR direction**. Conversely if a body changes direction without change of speed a **FORCE** must have acted in the direction of the change.

2

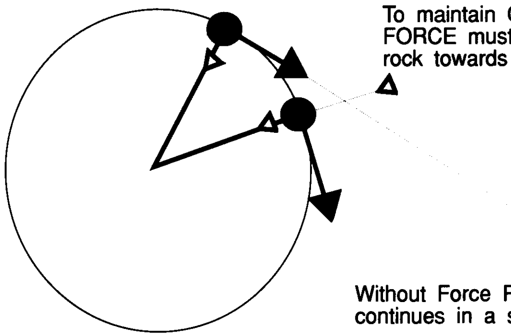
Since the system, i.e. you in the glider, is stationary then the total acceleration is **ZERO,** therefore the total FORCE in any direction is ZERO. Your WEIGHT, a force, is sitting in the seat, weight, the force generated by gravity on a mass acts vertically towards the centre of the earth. Since you are not accelerating towards the centre of the earth, an equal force, the Reaction pushes up on you from the seat.

3 The weight of air, a force acting on every square inch of the earths surface is approx. 14lbs. Therefore the **Air pressure** is 14lbs per sq. inch. Weather effects changes the pressure SLIGHTLY about 94% to 106%

4 At constant velocity, means **NOT ACCELERATING**, therefore the total force must be **ZERO.**

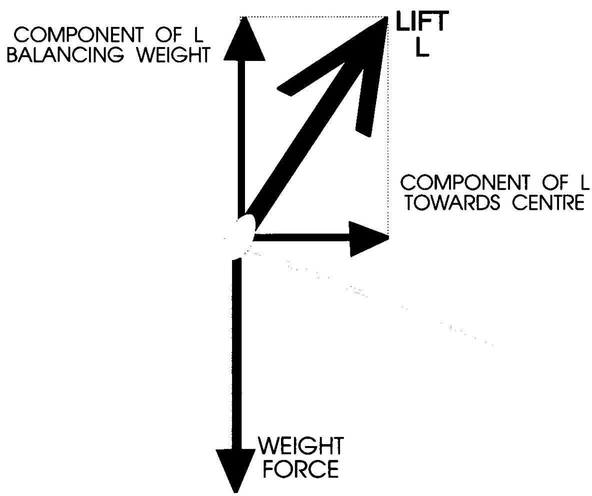
5 In a vacuum the brick would accelerate constantly until it hit the ground, however in air. Air friction causes **DRAG**, a force resisting the motion. At slow speeds the drag is small, increasing with speed until the **DRAG FORCE** equals the **WEIGHT** at which time it stops accelerating, it reaches a TERMINAL velocity.

6



As the rock goes around the circle it changes direction, therefore it is accelerating. The direction of the change of velocity is towards the centre of the circle. The only forces acting on the rock are its weight, drag and the tension in the string. The weight and drag cause the rock to lag behind and below the horizontal, components of the tension balancing these forces. The tension force is towards the centre, causing the rock to accelerate towards the centre. If you suddenly cut the string the tension force is suddenly removed, the rock will stop accelerating towards the centre of the circle and continue to move in a straight line along the TANGENT to the circle. NOT outwards as many think, there is NO FORCE acting outwards and NO reason to move outward.

7 Like the rock in Q6 the force is towards the centre, in this case the reaction against the surface of the drum. Your body wishes to continue along the tangent but is forced towards the centre by rotating the wall. Your reaction against the wall gets larger as the speed of rotation increase, eventually a speed is reached when you in effect are glued to the wall by a FRICTION FORCE such that the floor is not required to support your weight.

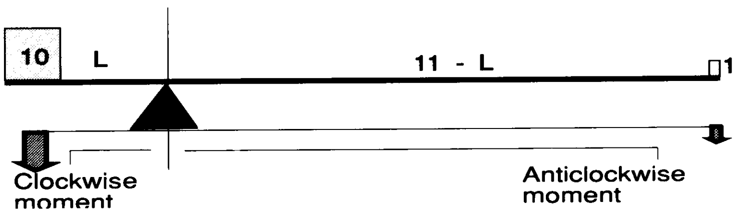


8 To turn a glider must bank, the wings provide lift perpendicularly to their surface, the lift L is as shown above. Taking components vertically and Horizontally you can see that the vertical component must equal the weight force to stop the glider accelerating down wards whilst the horizontal component must provide the required force toward the centre for the glider to travel in a circle. Note that when banked, the total lift L must be greater then when not banked since it also has to produce the force towards the centre.

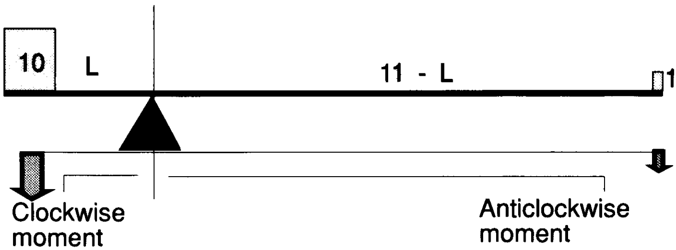
9 Lowering the nose of a glider will instantly cause the glider to accelerate to a point where once again the DRAG increase to match the component of weight causing the acceleration.

10 Each weight effects a moment about the balance point which is equal to the amount of weight multiplied by the horizontal distance between the balance point and the weight.

For a balance to occur the sum of the clockwise moments must equal the sum of the anticlockwise moments about the balance point.



Clockwise moment	=(11 - L) x1
Anticlockwise moment	= L x 10
It is clear that **L**	**=1**
	Balance point is 1' from the end



Now when a **2lb** weight is used

Clockwise moment = (11 - L) x 2 = 22 - 2L

Anticlockwise moment = L x 10 = 10L

10L = 22 - 2L

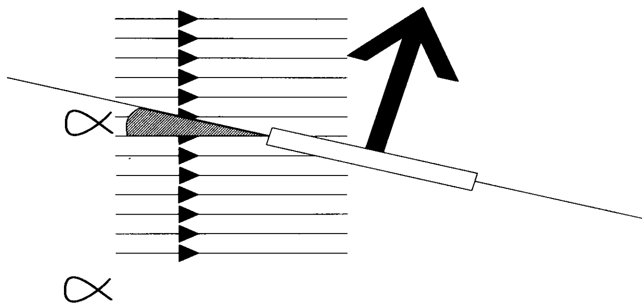
12L = 22

L = 22/12ft = 22"

Balance point is now 22" from the end

1 DRAG is dependant on several factors, **SIZE** and **X-sectional area, surface texture, speed of movement, viscosity of fluid** (air is a fluid) through which movement is being made.

2



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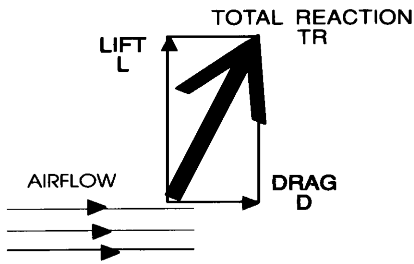

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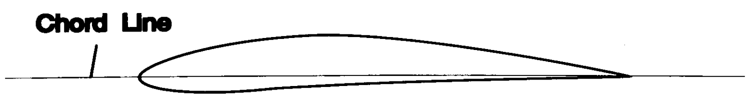
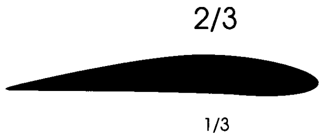


5 For most glider aerofoils, lift ratio is **2:1** for upper to lower surface respectively.



6 In steady flight, the glider is not accelerating therefore the total force is ZERO. 360kg weight must be balanced exactly by lift from the wings.

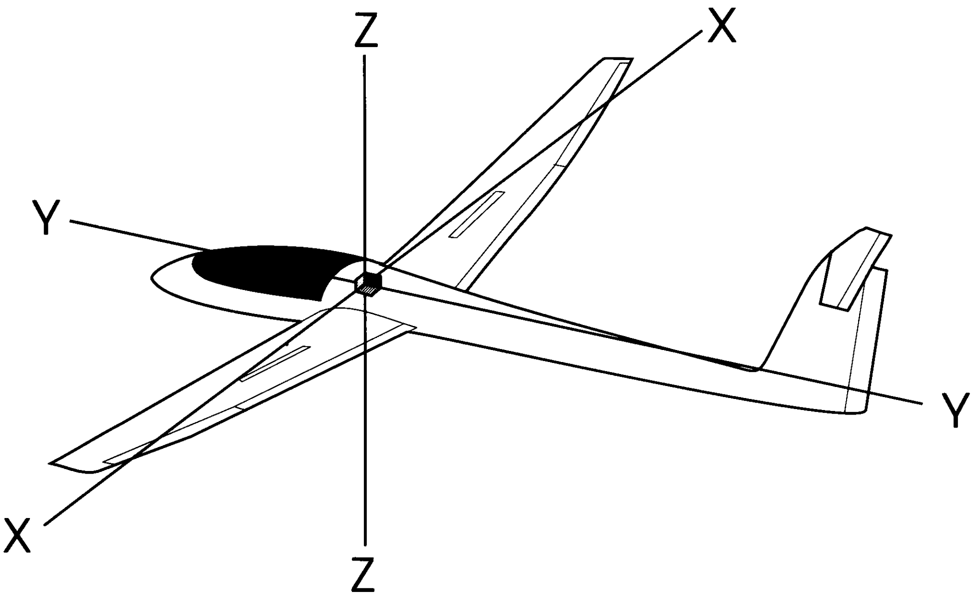
7 Wing loading is Weight / square metre

in Q6			
Wing loading is	**360Kg/10m²**	**=**	**36Kg/m²**
with	140Kg of water ballast,		
total load,	360Kg + 140Kg =		500Kg
Wing loading is	**500Kg/10m²**	**=**	**50Kg/m²**

8 Since the forces generated, lift and drag are proportioned to the density of the fluid they would be greater in a liquid than air. Try pushing your hand through water and then air.

9 The faster you move the aerofoil the greater the lift and the drag!

10 Area of wing, Shape of Aerofoil, Density of air and the speed aerofoil moves through the air.

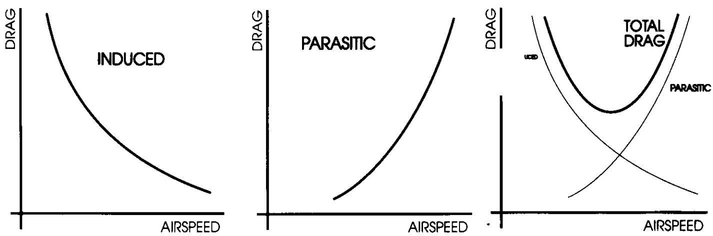


Complete table should look like this.

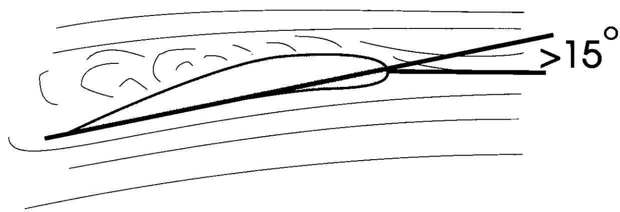
	AXIS EFFECTED	
	Primary effect	Secondary effect if any
Ailerons	**Y - Y**	**Z - Z**
Rudder	**Z - Z**	**Y - Y**
Elevator	**X - X**	**NONE**
Air Brakes	**X - X**	**NONE**
Flaps	**X - X**	**NONE**

1 **Wing Drag** which has three parts, Skin friction, Induced drag and Form drag. **Parasite Drag** which has two parts, Skin friction and Form drag.

2

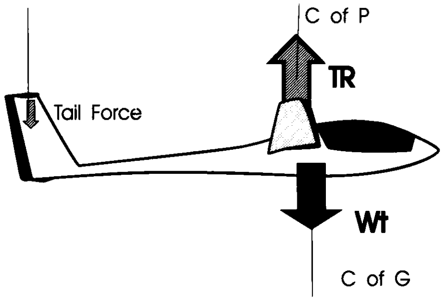


3 The stalling angle, the angle at which the airflow across the aerofoil breaks down is approx. **15°** for glider aerofoils.



4 The amount of lift generated by a simple wing is proportional to the speed the wing moves through the air and the angle of attack chosen. The pilot can control these factors although they are directly related in steady flight.
In steady fight the total amount of lift and drag generated always is such that the Total Reaction is equal to the weight of the glider. Since the glider is not accelerating towards the ground the total force vertically acting on it must be **ZERO**.

5 The tailplane acts to produce a turning force to balance the rotation caused by the difference in positions of the C of G and C of P.



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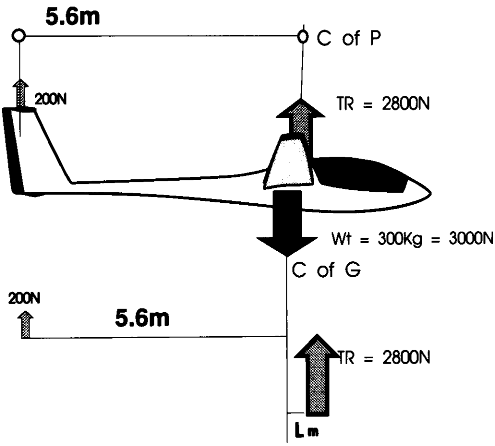
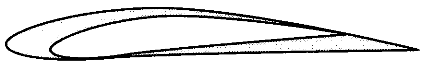


Clockwise moment	=	Anticlockwise moment		
Clockwise moment	=	200 x 5.6	=	1120Nm
Anticlockwise moment	=	1120Nm	=	2800 x L
L	=	$\frac{\mathbf{1120}}{\mathbf{2800}}$	**=**	**0.4m**
L	**=**		**=**	**40cm**

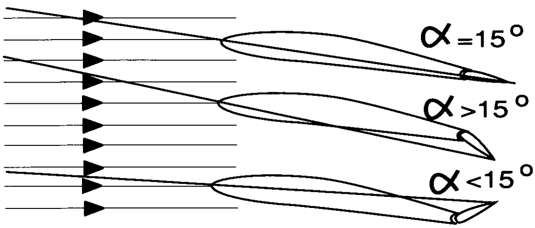
7 If TR is reduced the gliders weight will be greater than TR therefore the glider will accelerate downwards, with the centre of pressure moving aft the nose of the glider will drop first. Classic stall symptoms!

8 **Washout** is the designed amount of **TWIST** in the tip of the wing, such that when the main area of the wing is at the stall angle the tip areas due to twist are at less then the stall angle, this stops the whole wing stalling at one time making the stall more gentle.



Wash Out
Aerofoil at wingtip always has less
Angle of Attack then main wing body

9 If a glider drops a wing at the stall and ailerons are conventionally used then the aileron on the downgoing wing will move down, increasing the angle of attack further on a stalled wing, conversely on the upgoing wing the aileron will, move up decreasing the angle of attack and increasing the amount of lift generated by the wing.



Effect of use of Ailerons
on angle of attack close to
the Stall

10 The airflow must be made to reattach to the wing, to do this the **ANGLE OF ATTACK** must be decreased.

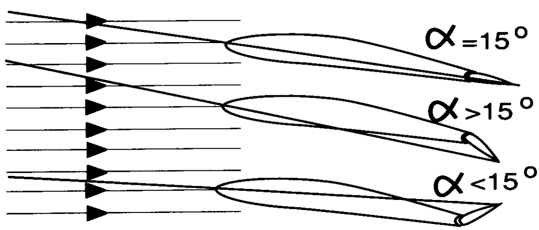
1 If the stick is moved to the right the **AILERON** on the right wing moves **UP** decreasing the **ANGLE OF ATTACK** and therefore reducing the Lift and Drag generated by the RIGHT wing.

2 If the stick is moved to he right the **AILERON** on the left wing moves **DOWN** increasing the **ANGLE OF ATTACK** and therefore increas ing the Lift and Drag generated by the LEFT wing.

3 The angle of attack will decrease for the downgoing wing and increase for the upgoing wing.

4 At the point of stall the angle of attack is approximately 15°

5 As the angle of attack is approx. 15° at the stall and the glider then drops a wing, using the ailerons to try to lift the wing will cause the angle of attack on the downgoing wing which will have DOWN aileron, will be INCREASED above 15° whilst the upgoing wing will have UP aileron which will be DECREASED below 15°. The Lift and Drag produced by the upgoing wing will be INCREASED as the wing unstalls whilst the lift and drag on the downgoing wing which is more stalled will decrease.



Effect of use of Ailerons on angle of attack close to the Stall

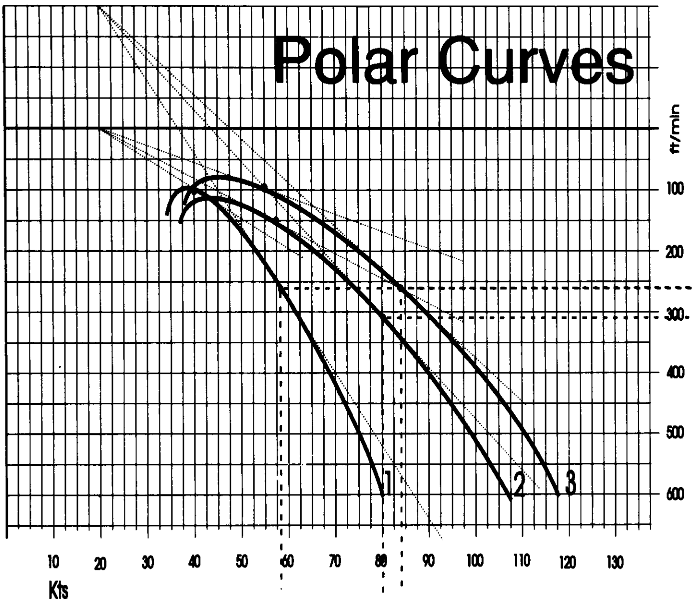
6 If nothing is done in the situation in Q5 then **AUTOROTATION** occurs, a spin, to stop the spin the wings must be unstalled, the angle of attack must be decreased. The lower, more stalled, wing however generates MORE Drag which **YAWS** the glider, to counter this FULL OPPOSITE RUDDER should be applied followed by a short pause, then, easing the stick steadily forward until the spin stops, centralise the rudder and ease out of the dive.

7 The situation where a glider at the stall drops a wing due to various reasons, is known as an incipient spin. The recovery is to stop the stall first and then to level the wings.

8 In a full spin the airspeed stays almost constant, if the ASI reads, normally with large angles of Yaw. In a spiral dive, speed and **"g"** increase rapidly, rotation is slower than a spin and the controls work normally.

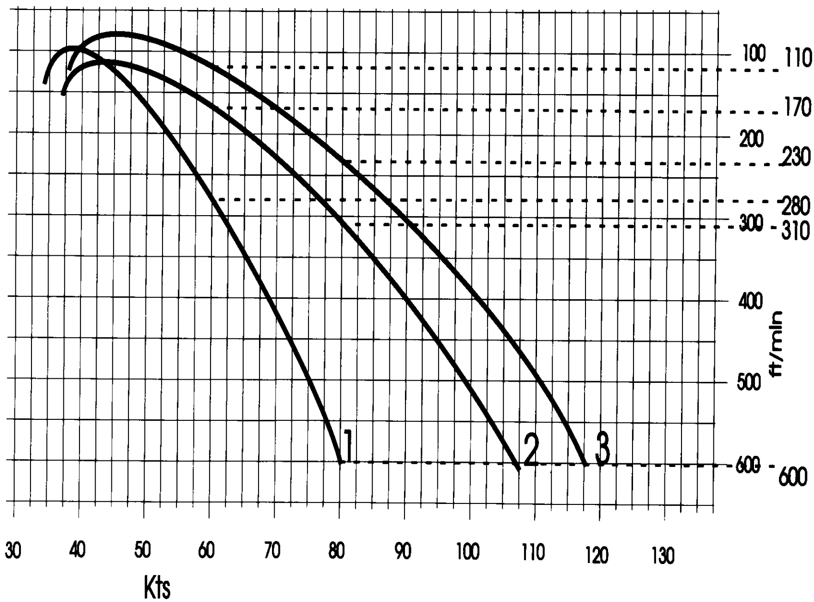
9 With a heavy pilot the C of G of the glider will probably be near or on the forward limit, the C of P is normally aft of the C of G, the glider in the stall drops its nose and rapidly gains speed unstalling the wings without any pilot input. Since it is difficult for the glider with a heavy pilot to remain stalled and the glider cannot spin unless stalled, spins are difficult to initiate.

10 Light pilots often have to carry ballast weights to out the C of G forward of the Aft limit, this limit is usually caused by the amount of correcting force that the tailplane can generate to balance the moment caused by the variation of position of the C of P relative to the C of G. Generally the glider is less stable and hence more responsive when flown with the C of G close to the aft limit.



1 1 Nm = 6076' Therefore 1 Knt=6076'/hour =6076'/60 min
=100ft/min
approx

From Graph looking at tangent to curves from origin,
Slope of Tangent = Best Glide Angle = L/D max
Glider 1 has a L/D max = Best Glide Angle = 40 knts at 100 ft/min
= 4000 ft/min at 100 ft/min
= **40:1**
Similarly Glider 2 = 40knts at 100ft/min = **40:1**
Similarly Glider 3 = 30knts at 50ft/min = **60:1**



2

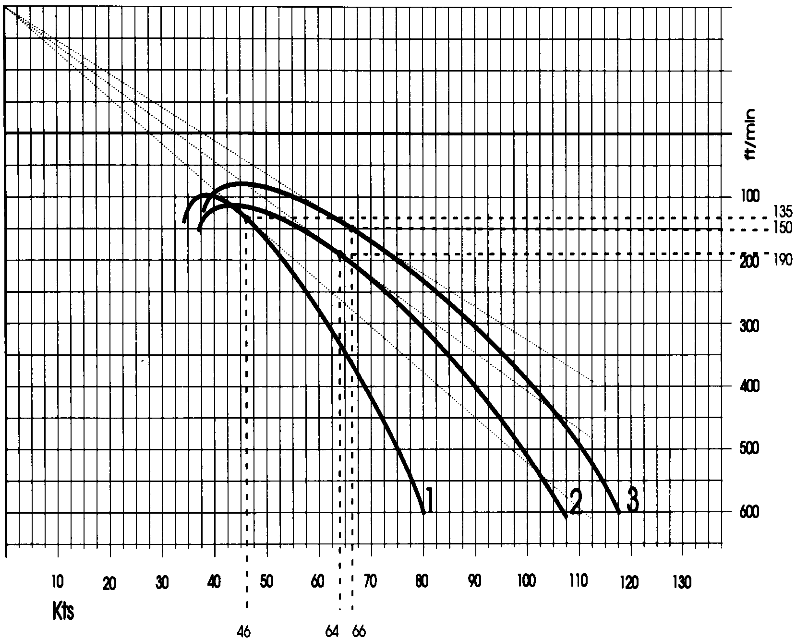
At 60 Knts

Glider 1, has sink rate	= 280ft/min	=60 / 2.8 = **21**
Glider 2, has sink rate	=170ft/min	=60 / 1.7 = **35**
Glider 3, has sink rate	=110ft/min	=60 / 1.1 = **55**

3

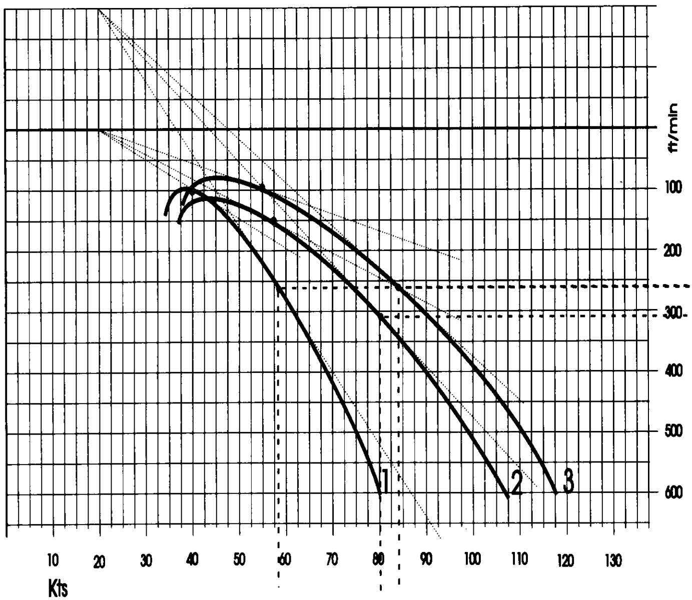
At 80 Knts

Glider 1, has sink rate	= 600ft/min	=80 / 6.0 = **13**
Glider 2, has sink rate	= 310ft/min	=80 / 3.1 = **26**
Glider 3, has sink rate	=230ft/min	=80 / 2.3 = **35**



4 Speed to fly with minimum height loss in sink is found from the tangent from a point equivalent to the negative rate of sink, i.e. + 200ft/min to compensate for a sink of 200 ft/min (-200ft/min). From the graph, these tangents touch the polars to give
Glider 1,46knts, therefore 2Nm takes 2 x 60/46 mins=**2.60mins.**
Glider 2,64knts, therefore 2Nm takes 2 x 60/64 mins=**1.88mins.**
Glider 3,66knts, therefore 2Nm takes 2 x 60/66 mins=**1.82mins.**

5 Glider 1, 2.60 mins at 46 knts. Height loss is 200 + 135ft/min = **870ft**
Glider 2, 1.88 mins at 64 knts. Height loss is 200 + 190ft/min = **733ft**
Glider 3, 1.82 mins at 66 knts. Height loss is 200 + 150ft/min = **637ft**



6 As in question 1 except origin is moved to allow for headwind,

Glider 1, 22knts at 100ft/min= **22:1**
Glider 2, 35knts at 140ft/min= **25:1**
Glider 3, 35knts at 10ft/min= **35:1**

7 As in Q4 but also moving origin to compensate for headwind. Speed to fly with minimum height loss in sink is found from the tangent from a point equivalent to the negative rate of sink, i.e. + 200ft/min to compensate for sink of 200 ft/min (-200 ft/min)

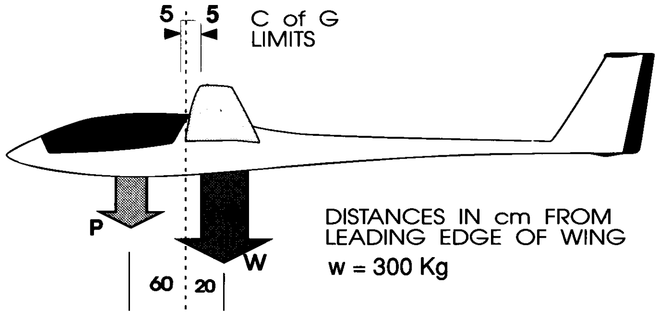
From the graph, these tangents touch the polars to give
Glider 1,58knts,therefore 2Nm takes 2 x 60/(58-20) mins = **3.16mins**.
Glider 2,80knts,therefore 2Nm takes 2 x 60/(80-20) mins = **2.00mins**.
Glider 3,83knts,therefore 2Nm takes 2 x 60/(83-20) mins = **1.90mins.**

8 Glider 1,3.16 mins at 58 knts. Height loss is 200 + 260ft/min= **1454ft**
Glider 2,2.00 mins at 80 knts. Height loss is 200 + 310ft/min= **1020ft**
Glider 3,1.90 mins at 83 knts. Height loss is 200 + 260ft/min= **874ft**

9 Glider 1,L/D max=**40:1** therefore for 1000' height loss, glide is 40 x
=40,000'
=**6.6 Nm approx**
Glider 2, as 1 =**6.6 Nm approx** 1000
Glider 3, L/D_{max} =**60:1** therefore for 1000' height loss, glide is 60 x
=60,000'
=**10Nm approx**
1000

10 Gliders 1 and 2,
20 Nm requires 3000' plus safe height of 800'=**3800'**

Glider 3,
20 Nm requires 2000' plus safe height of 800'=**2800'**



The distances relative to the C of G limits are easy to see,

	Distance from		Turning moment	
	Forward limit	Aft limit	Forward limit	Aft limit
Glider (Empty)	25cm	15cm	75	45
Pilot	55cm	75 cm		

Sum of clockwise moments=Sum of anticlockwise moments, therefore Max pilot weight= Kg (C of G forward) and Min pilot weight= Kg (C of G Aft).

Now the turning moment of the weight of the glider about the point of the forward limit is calculated by multiplying the force, in this case weight in Kg Wt. by the horizontal distance from the balance point, in this case the forward limit of the C of G.

i.e 300KG wt x 0.25M = 75KgM

This is a clockwise moment, so the pilot weight must provide the anti-clockwise moment to balance this, therefore

$$75 = P\text{ wt} \times 0.55$$

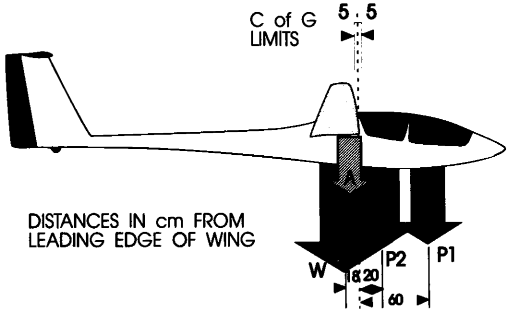
$$Pwt = \frac{75}{0.55} = 136Kg$$

Repeating for Aft limit gives

$$Pwt = \frac{45}{0.65} = 69Kg$$

	Distance from		Turning moment	
	Forward limit	Aft limit	Forward limit	Aft limit
Glider (Empty)	25cm	15cm	75KgM	45KgM
Pilot	55cm	70 cm	75KgM	45KgM

Sum of clockwise moments=Sum of anticlockwise moments, therefore Max pilot weight=136Kg (C of G forward) and Min pilot weight=69Kg (C of G Aft).



	Distance from Forward limit	Aft limit	Turning moment Forward limit	Aft limit
Glider (500Kg)	23cm	13cm	115	65
Pilot 1	55cm	65cm		
Pilot 2 (100Kg)	15cm	25cm	15	25
Sum of clockwise moments=Sum of anticlockwise moments, therefore Max pilot weight= Kg (C of G forward) and Min pilot weight= Kg (C of G Aft).				

Now total clockwise moments + total Anticlockwise moments

In Forward position of C of G

$$(P\ wt \times 0.55) + 15 = 115$$

$$P\ wt = \frac{115-15}{0.55} = 182Kg$$

In Aft position of C of G

$$(P\ wt \times 0.65) + 25 = 65$$

$$P\ wt = \frac{65-25}{0.65} = 62Kg$$

	Distance from Forward limit	Aft limit	Turning moment Forward limit	Aft limit
Glider (500Kg)	23cm	13cm	115	65
Pilot 1	55cm	65cm	100	40
Pilot 2 (100Kg)	15cm	25cm	15	25
Sum of clockwise moments=Sum of anticlockwise moments, therefore Max pilot weight=**182**Kg (C of G forward) and Min pilot weight=**62**Kg (C of G Aft).				

The values with 200g of water ballast on board are:-

Max Pilot wt (P1) = **236Kg;** Min Pilot wt (P1) = **77Kg**

However the total load may exceed the stress limit of the airframe in max configuration. Maximum pilot weight may be less than balance allows.

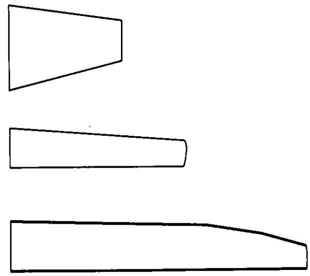
1 **Dihedral**, the wings are angled upwards relative to a horizontal plane running through the fuselage. It is used to increase stability in Roll. When a glider is slightly rolled, and does not turn, it slips towards the lowered wing. As soon as it slips then the lower wing is flying with an increased angle of attack whilst the upper wing has a decreased angle of attack, the lower wing produces more lift, the upper wing less, this causes the glider to resist the roll.

2 **Sweepback**, the tips of the wings are behind the roots in the horizontal plane, again a device to increase roll stability, with sweepback as the glider slips the lower wing is presented properly to the air whilst the upper wing is at a sharp angletotheairflow. Italsoincreases YAW stability since more of the lower wing is presented to the air causing more lift and

▲▲▲▲▲▲▲▲▲▲▲▲▲▲▲▲▲▲▲▲

3 **Sweepforward,** the tips of the wings being ahead of the roots in the horizontal plane, most common in tandem two seaters. In this case for the rear passenger to be close to the C of G without Sweepforward he must be positioned between the wings with very poor visibility. Sweepforward ena bles the wing root to be moved aft whilst maintaining the position of the C of P, the rear passenger sits level or forward of the leading edge at the root has a good view out. However, sweepforward has a negative stability results in ROLL and YAW, usually gliders with Sweepforward have large amounts of Dihedral to help compensate for the loss of stability.

4 **Gliders**, tend to have long slim wings, limited only in length to width ratio, **ASPECT RATIO,** by the materials available at the time of the design. The idea being to minimise drag, specifically the tip vortices by reducing the amount of tip around which the vortices can take place. One problem with long slim wings however is that the ailerons are a long way from the fuselage, the drag caused by them exerts large moments and causes more pronounced Yaw than in power aircraft.



5 **Differential Ailerons,** by carefully designing the linkages the up aileron is made to move further than the down aileron, this the up aileron produces ore drag which reduces the Yaw caused as the secondary effect of the ailerons.

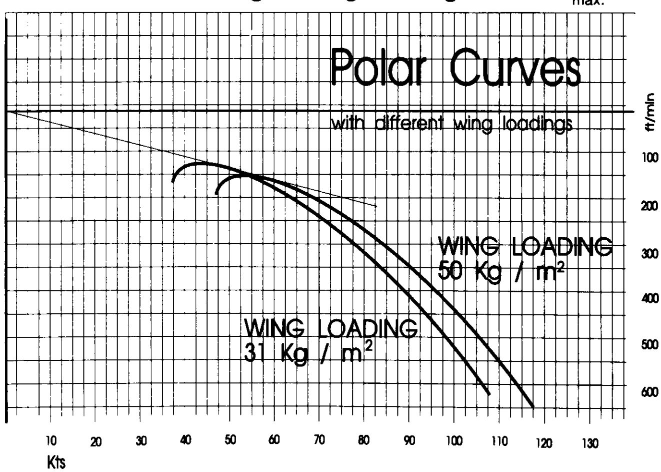
6 **Frise Ailerons,** the aileron is designed such that when in the up position a part sticks out below the wing causing turbulence. As with differential ailerons the aim is to minimise YAW. Most common on power aircraft since they do cause additional drag in use.

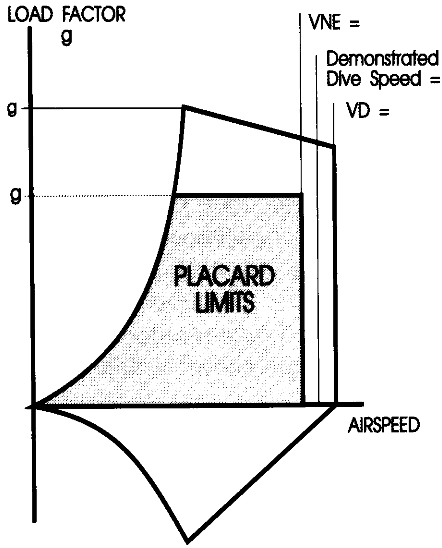
7 **Flaps,** the rear part of the aerofoil is hinged allowing movement up and down in the same sense on both wing. It is impossible to design an aerofoil that is efficient at all speeds, by the use of flaps the designer attempts to reprofile the aerofoil in flight to enable it to work more efficiently in various situations.

8 **Spoilers**, thin plates usually about 3 feet long set on the top surface of the wing, spanwise close to the thickest part of the section. The spoiler when closed lies flush with the wing, when opened they rise to almost perpendicular to the wing. They increase the DRAG with the effect of steepening the glide angle for control in landing.

9 **Airbrakes,** a development of Spoilers that produce considerable amounts of Drag and reduce the amount of lift produced by the wing. Commonly both above and below the wing they consist of flat plates that can be extended perpendicularly from the wings sur face.

10 **Water Ballast**, tanks usually in the wing root area are available to carry water as ballast, arrangements normally exist for the dumping of the ballast during flight. The extra weight has the effect of increasing the amount of stored potential energy in the glider at any given height, the minimum rate of sink is increased but so is the speed at which this occurs, the L/D_{max} ratio remains the same. The effect is to increase the wing loading and move the polar perform ance curve down along the original tangent to $L/D_{max.}$





V_{NE} directly from the Placard = **150Knts**

V_D the design dive speed is where Vne was calculated from

V_{NE} $=0.9\ V_D$ so $V_D = V_{NE}/0.9$

= **167knts**

Demonstrated Dive Speed is midway between V_{NE} and V_D thus is

(150 = 167) /2 = **158Knts**

Max Placard g = **4g**

The design g limit is 1.5 x 4 = **6g**

Above the stall line it is not possible to fly the glider, any attempt to apply more than this value of g (load) at this speed will stall the glider.

1 **Civil Aerodrome,** runways in pattern indicated.

2 **Free-fall parachuting site,** parachutists may be expected in the airspace contained in a circle radius 1.5Nm or 2Nm upto FL150.

3 **Air navigation obstacle,** unit, Numerical in Italics is elevation of top of obstacle a.m.s.l. whilst numeral in (bracket) is height of top of obstacle above local Ground level.

4 **High Intensity Radio Transmission Area**, radius greater than 0.5Nm effective to height shown in thousands of feet AMSL.

5 Glider launching takes place at this site as an additional activity.

6 Boundary of a Special Rules Zone (SRZ) or Special Rules Area (SRA) vertical limits as noted.

7 Boundary of Low Level Corridor or Special Route, vertical limits as noted.

8 **Continuous High Obstruction** at 320ft above ground level.

9 **Glider launching site.**

10 **Exceptionally high obstacle**, 1000' or more AGL, lit, Numeral in *Italics* is elevation of top of obstacles a.m.s.l. whilst numeral in **(bracket)** is height of top of obstacle above local Ground Level.

11 **Air Traffic Zone,** around aerodrome.

12 Altimeter setting region boundary.

13 Boundary of Military Aerodrome Traffic Zone.

14 **Instrument Approach Cone,** aligned with runway of aerodrome. Aircraft can be expected in the cone area following instrument guided approaches.

15 **Hang Glider** launching site

16 **Control Area boundary,** 3000ft AGL to FL245.

17 **Control Area inner boundary**, limits as noted.

18 **Disused aerodrome** with runways as shown.

19 **Power cables**

20 **A racecourse.**

1 **Railway,** multiple track with Bridge or Viaduct.

2 **Isogonal,** line of equal magnetic variation, at date stated on chart.

3 **Bird Sanctuary,** airspace restricted to effective altitude Above Mean Sea Level.

4 **Aerodrome**, disused or abandoned.

5 **Heliport** - government

6 **Distance Measuring Equipment,** DME

7 **Power Station**

8 **Small town**, village or hamlet. (Yellow).

9 **Town**, 1 to 2 sq miles. (Yellow).

10 **City or large town,** over 2 sq miles. (Yellow).

11 **Control Zone (CTR),** from surface to 2500' above ground level.

12 **Flight information Region Boundary** (FIR).

13 **Danger Area,** see notes on chart for more details. (Red).

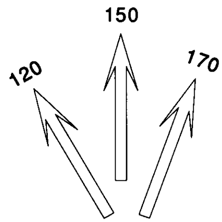
14 **Non-Directional Radio Beacon**

15 **VOR Compass Rose,** oriented on Magnetic North.

1

Course	Compass Heading	Reciprocal
North	0	180
South	180	0
East	90	270
West	270	90
North East	45	225
South East	135	315

2



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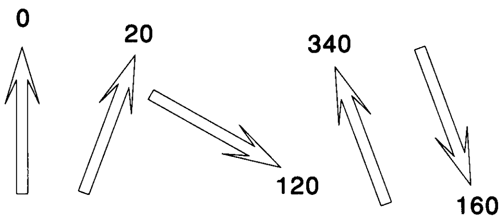

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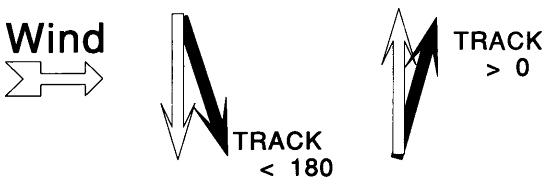


5 Being a magnet, if compass is in a position where other magnetic fields are present it will not be accurate, pieces of iron, steel and electrical equipment can all cause problems.

1 The compass aligns itself to the magnetic field by which it is influenced. In a glider this has two components; the Earths mag netic field and the magnetic field created by any ferrous metal or electrical equipment in the glider itself. **DEVIATION** is the angle by which the compass is deviated from the magnetic meridian by the magnetic influence of the glider. The value of deviation depends on the amount of magnetic material in the glider and the distance between the material and the compass and on the heading of the glider. The deviation is either **East E or West W,** depending on the side of the magnetic meridian towards which the compass has been deflected.

2 **VARIATION** is the angular difference between the true and mag netic meridian.

3 Variation changes both with position and time due to the movement of the magnetic North Pole.

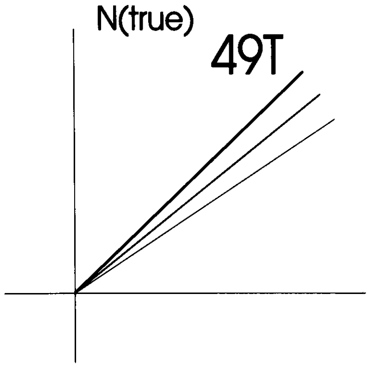
4 Lines joining two points where magnetic variation has the same value are known as **ISOGONALS.**

5 i) **TRUE, T** means the bearing or course is truly relative to the North pole and has been corrected for both Variation and Deviation.

ii) **MAGNETIC, M** means the bearing or course is relative to the MAGNETIC NORTH pole and has been corrected for Deviation.

iii) **COMPASS, C** means that the bearing or course is relative to the compass mounted in a perpendicular glider, it has NOT been corrected for variation or deviation.

6



From T to M add W Variation
From M to C add W Deviation

49T=49+5M=**54M**
54M=5+5C=**59C**

(Memory Aid is **CADET,**
Compass **ADD D**eviation if **E**ast to **T**rue)

Course to Steer is 59C

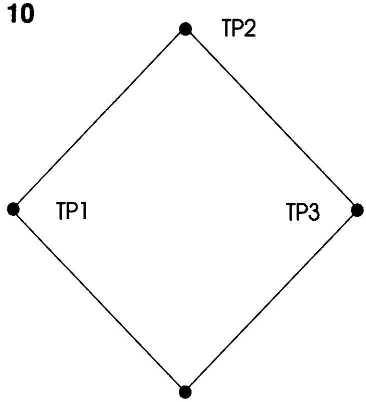
7 Return Course = 49 + 180=229T
Variation=5W
deviation +5E between 181-270 for your compass

229T=229 + 5M =234M =234 - 5C=**229C**

8 260C = Compass bearing along motorway
Variation=5w
Deviation =5E (Remember **CADET**)
260C=260 + 5M =265M =265 - 5T=**260T**

9 **265M** see working in Q8

10



Courses are
315T, 45T, 135T, 225T

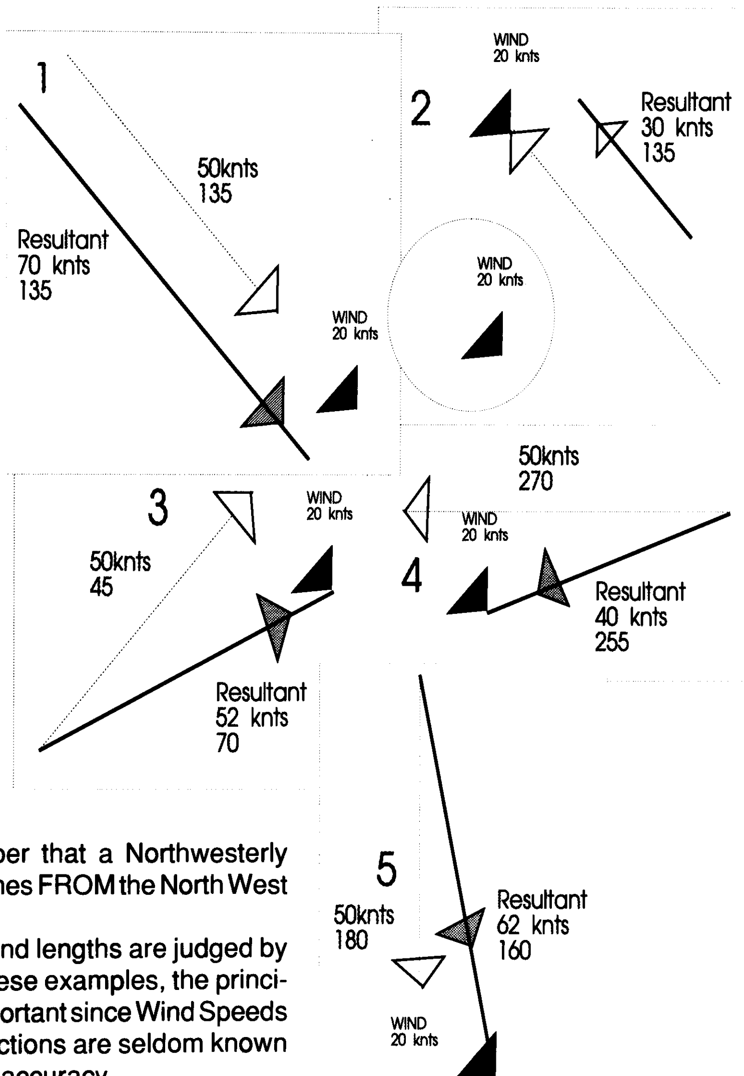
Variation is 5w

Course 315T
Deviation=0
315T=315 + 0M =315 +5=**320C**

Course 45T
Deviation=5W
45T=45 + 5 =50M =50 +5=**55C**

Course 135T
Deviation=0
135T=135 + 0=135M =135+5=**140C**

Course 225T
Deviation=5E
225T=225 + 5=230M =230 -5=**225C**



Remember that a Northwesterly wind comes FROM the North West

Angles and lengths are judged by eye in these examples, the principle is important since Wind Speeds and Directions are seldom known with any accuracy.

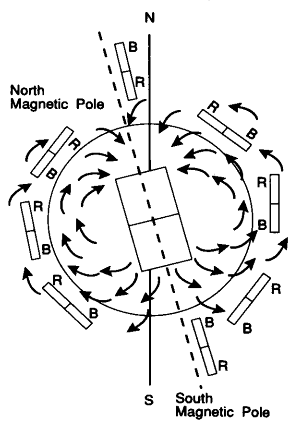
6 **Buys Ballots Law** states that in the Northern Hemisphere if you stand with your back to the wind HIGH pressure is to your right and LOW pressure on your left. Conversely in the Southern Hemi sphere. Since the UK is in the northern hemisphere then with a crosswind from the left you are leaving high a pressure area and moving into a low pressure area. Since the pressure is decreasing your altimeter will read **HIGH.**

7 The compass suspension is not ideal to resist the forces due to turning in a circle, these forces combine with the magnetic forces to, provide acceleration and turning errors. On an east to west leg as you accelerate out of the final turn to your cruising speed the compass indicates an apparent turn to the right, an acceleration error, there are no apparent turning errors in this direction but it will take several seconds for the compass to settle down once straight flight is resumed.

8 **Buys Ballots law** is reversed in the Southern Hemisphere, therefore you would be flying into HIGH pressure and your altimeter would read **LOW.**

9 Again in the Southern hemisphere the actions of your compass are reversed, the larger influence of the South pole being the larger attraction.

10 **Angle of dip** is the angle the lines of magnetic force make with the horizontal plane. The Earths magnetic field is not parallel to the Earths surface except close to the equator.



1 **MATZ,** a Military Air Traffic Zone, regulated airspace around a military aerodrome.

2 **FL65**, Flight Level 65, is a reference to an altitude defined as FL NUMBER x 100ft with the STANDARD altimeter sub-scale setting of 1013.2 Mb.

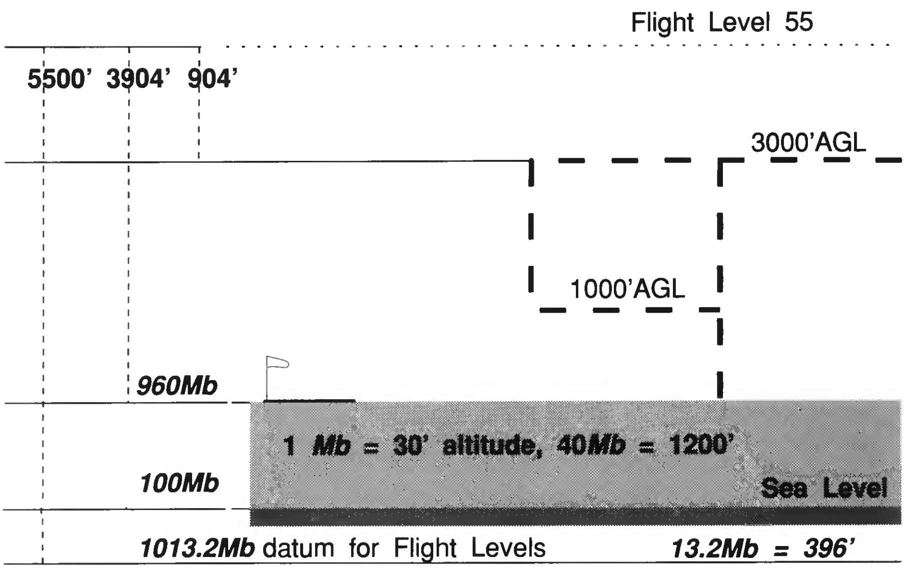
3 **ATZ,** Air Traffic Zone, Regulated airspace around a civilian aerodrome.In addition every MATZ contains a ATZ.

4 **MATZ (by NOTAM),** Matz regulations apply only when notified in **N**otices **T**o **A**irmen.

5 **Cromer 165(C),** signifies a Civilian Aerodrome at a ground eleva tion of 165 feet Above Mean Sea Level.

6 **180,** is a spot elevation.

7 **ASR,** Altimeter setting regions are areas in which QNH is set at a constant value for the period to give accurate altitude Datums.



8 As your altimeter shows **960Mb, QFE,** this signifies that the field is above Mean Sea level where the pressure on this day is **1000Mb, QNH.**
Since the change in pressure is 30ft per Mb, 40Mb equates to an elevation above sea level of 40 x 30=**1200ft.**

9 **FL55** signifies a Flight Level of 5500ft with altimeter set at 1013.2 Mb, on this day 1013.2 Mb sets a Datum 396' below Sea Level. 5500ft above this is FL55.
This is 5500 - 396 - 1200 above the site i.e. **3904 ft on your altimeter.**

10 The MATZ extends to 3000' above ground level leaving a separa tion of 3904 - 3000 =**904ft between it and FL55.**

1 Above Ground Level

2 Above Mean Sea Level

3 Flight Level

4 SurFaCe

5 Altimeter Setting Region

6 VHF Omnidirectional Radio

7 Distance Measuring Equipment

8 Non Directional Beacon

9 Lower Airspace Radar Service

10 High Intensity Radio Transmission Area

11 Danger (as in danger Zone D044)

12 Danger Area Cossing Service

13 Danger Area Activity Information Service

14 Area of Intense Aerial Activity

15 **A**erial **T**actical **A**rea

16 **U**nited **K**ingdom **A**ir **P**ilot

17 **NO**tices **T**o **A**ir**M**en

18 **A**eronautical **F**ixed **T**elecommunications **N**etwork

19 **U**pper **H**eyford **M**andatory **R**adio **A**rea

20 **F**light **I**nformation **R**egion

21 **D**epartment **o**f **T**ransport

22 **A**ir **T**raffic **C**ontrol

23 **M**illi**B**ar

24 **A**eronautical **I**nformation **S**ervice

25 **N**ational **A**ir **T**raffic **S**ervices

26 **C**ivil **A**viation **P**ublication

27 **C**ertificate of **A**irworthiness

28 **A**ir **N**avigation **O**rder

29 **C**ommission **I**nternationale de **V**ol a **V**oile

30 **F**ederation **A**eronautique **I**nternationale

1 **A WHITE dumbbell** means Aircraft and Gliders are confined to hard surfaces.

2 **A RED panel with a YELLOW cross** shows that the airfield is unsafe and prohibits landing.

3 **A WHITE T** means that take offs and landings shall be parallel to then shaft of the T and towards the cross arm.

4 **A WHITE disc at the head of the T** means that the direction of landing and take off may not be the same.

5 **Two or more WHITE crosses** on paved areas mean that the section marked is unfit for use by aircraft.

6 **A large WHITE L** indicates part of the airfield that should only be used by light aircraft.

7 **A WHITE H** indicates a helicopter operating area.

8 **A RED panel with a YELLOW bar** means that the landing area is in a poor state, special care should be taken.

9 **A WHITE dumbbell with BLACK bars** means that landings and take offs must be made on the runway but it is permitted to taxi on the grass.

10 **A WHITE double cross** means glider flying is in progress.

1 **Visual Flight Rules**, conditions being such that pilots themselves ensure the safe and expeditious flow of air traffic.

2 **Visual Meteorological Conditions**, weather conditions such that flight may be conducted in accordance with V.F.R.

3 **Instrument Flight Rules,** flight is controlled by a ground organi sation as opposed to V.F.R.

4 **Instrument Meteorological Conditions,** weather conditions in which it is not possible to comply with V.F.R.

5 Under V.F.R. above 3000' a fixed wing aircraft must remain at least one mile horizontally and 1000' vertically from cloud provided flight visibility is at least 5 Nautical miles.

6 To remain V.F.R. in these conditions, an aircraft must remain clear of cloud, in sight of the surface with a flight visibility of at least 1 Nautical mile.

7 **Control Zones** are areas where Air Traffic Control is provided. They extend from the ground to a specified height. Some are permanent I.F.R. and must never be entered without clearance.

8 **Control Areas** are areas of Airspace similar to Control Zones but which start at a specified height above the ground and have an upper limit.

9 **Airways** are Airspace in the form of a corridor 10 Nautical miles wide. Permanent I.F.R. applies but there is a special dispensation for gliders allowing them to cross if they maintain V.M.C.

10 **Purple Airway**s are temporary Airways of short duration for the purpose of safeguarding Royal Aircraft, they must NEVER be entered.

11 **Special Rules Zones and Areas.** Some airfields are surrounded by Special Rules Zones which whilst not strictly controlled airspace should be treated like one. Some may be penetrated by gliders without notification providing V.M.C. is maintained.

12 **Mandatory Radio Airspace.** Airspace which may only be entered after radio contact has been made to report time altitude and position at which the airspace is to be entered and left.

13 A glider should not fly over any congested area or town at a height which would not enable it to land clear of the area, or below 1500' above the highest fixed object within 2000'.

14 500' except during normal take-off or landing or when hill soaring.

15 **Aerodrome Traffic Zone** which extends from surface to 2000', dimensions depend on the length ofthe longest runway, for runways of 1850m or less the Zone has a radius of 2Nm from the centre of the runway while for longer runways the zones has a radius of 2.5Nm.

16 A standard **MATZ** has an ATZ at its core with the same dimensions as an ATZ and in addition a zone Radius 5Nm with two stubs each 4Nm wide and 5Nm long in line with the main runway. Vertically they extend from the surface to 3000' AAL in the circle and 1000'AAL to 3000'AAL in the stubs. Often two or more MATZs are combined to produce a CMATZ.

17 If no other information or signals are available a LEFT hand circuit should be flown i.e. all turns to the left.

18 Landing should be made to leave clear on their left those aircraft that have already landed.

19 The latest information is available in **Series B Class II Notams.**

20 On Motorways and dual carriageways **60mph**
On other roads **50mph**

1 U.K. frequencies exclusively for use by gliders are
130.1 Mhz
130.4 Mhz
130.125 Mhz 129.975 Mhz at approved sites for control purposes within a range of 10Nm and upto a height. of 3000'

2 **129.9 Mhz** is shared by other users but is available as a ground to ground frequency.

3 **Call sign** should be the registration letters of the glider (phonetic), or alternatively the competition number.

4 A glider should not be moved without crew on the **WINDWARD** wingtip, and at either the nose or the tail.

5 The downward cable should always be used first.

6 If the winch launch is **TOO FAST** then the pilot should lower the nose to ensure a safe speed and then **YAW** the glider from side to side with the rudder.

7

C	**CONTROLS**	Working freely and in the correct sense.
B	**BALLAST**	All secured and within the cockpit load limits.
S	**STRAPS**	All harness Straps correctly fastened and tight.
I	**INSTRUMENTS**	Working correctly, no broken glasses.
F	**FLAPS**	Set for take off.
T	**TRIM**	Set for take off
C	**CANOPY**	Shut and properly locked.
B	**BRAKES**	Checked, closed and properly locked.

8 Oxygen should be used for all flights above **12,000' a.m.s.l.,** However the BGA recommend its use from **10,000'.**

9 The parachute should be checked at least every **THREE Months** or if it has become wet or had oil or acid split on it. It should also be serviced and repacked if the release pins have become slightly bent.

10 Normally to the LEFT in UK, although the BGA recommend a turn such as to make it clear to the aeroplane pilot that the glider is free. Check with officials at club before flying to ascertain convention in use.

1 Signal means **you may land.**

2 Signal means **continue circling, give way to other traffic.** May not be practical in a glider.

3 Return to the airfield and **await permission to land.**

4 Signal means Airfield is **not available for landing.** Find another more suitable field.

5 You **may land after seeing continuous Green light,** wait for Green light before landing.

6 **Do NOT land,** wait for permission to land.

7 This is a warning signal, you are about to enter or have entered an active **DANGER AREA** take any necessary action to **leave or avoid the area.**

8 Fly a Left hand circuit if no other traffic is visible. attempting to call by radio could help if practical.

9 Aerodrome is **UNSAFE** do not land.

10 At night, i.e. half an hour after Sunset, a glider should how a steady RED light of at least 5 Candela showing in all directions or alternatively standard red, green and white aeroplane lights. However, in this case, the flight should be complete before this time so no lights are needed.

1 **Cumulus, LOW cloud,** Heaped, formed by convection and some times by oreographic ascent.

2 **Stratocumulus, LOW cloud,** Sometimes a complete cover of cloud showing rippling due to small undulations in the height of the cloud base.

3 **Altocumulus, MEDIUM cloud,** Greyish-white close packed lumps of cloud, larger than cirrocumulus. Often called the fale Mackerel Sky.

4 **Cirrocumulus, HIGH cloud,** Small numerous white lumps of cloud - an infrequent cloud type and the true Mackerel Sky.

5 **Cumulo-nimbus, LOW cloud,** the dangerous thunderstorm clod, a large version of the cumulus cloud it can extend upwards to 25,000' or more.

6 **Stratus, LOW cloud,** a thin, grey, very low layer (typically below 300m), often very ragged in appearance, sometimes extending over the whole sky.

7 **Altostratus, MEDIUM cloud,** a grey featureless layer of cloud covering the whole or most of the sky.

8 **Nimbostratus, LOW cloud,** a grey featureless layer of cloud, completely obscuring the sun. Base near the surface and its top close to the 20,000' level.

9 **Cirrostratus, HIGH cloud,** a whitish milky veil covering the whole or part of the sky; it often shows haloes and is the only cloud to do so.

10 **Cirrus, HIGH cloud**, wispy feather lines of white cloud, often called mares tails. Between 20,000' and 30,000'.

1 **Lapse Rate** is the rate of decrease in air temperature with height.

2 **Adiabatic Cooling** means The cooling takes place without loss of heat to the surroundings.

3 **Dew Point Temperature** is the temperature at which the air becomes saturated with moisture.

4 **Dry Adiabatic Lapse Rate** is the lapse rate of unsaturated air, about 3°C per 1000' increase in altitude.

5 **Wet Adiabatic Lapse Rate** is the lapse rate once condensation has started to occur.

6 **Stable Atmosphere** means that the lapse rate for the day is less than the dry adiabatic lapse rate.

7 **Unstable Atmosphere** means that the temperature difference be tween rising air and its surroundings becomes greater as its altitude increases.

8 **Latent Heat,** heat energy is required to change the state of a substance from solid to a liquid or from liquid to as without change of temperature. This heat energy is known as Latent Heat.

9 **Inversion**, this is an area with NEGATIVE lapse rate, i.e. tempera ture increasing with altitude.

10 **Depression** is an area of LOW pressure with winds that rotate about it in a clockwise direction in the northern hemisphere.

11 **Anticyclone** is an area of HIGH pressure with winds that rotate about it in a clockwise direction in the northern hemisphere.

12 **Diurnal Variations** are the differences in conditions due to the time of day (or night).

13 **Anabatic Wind** is wind caused by the warm air at the base of a hill expanding and rising up the slope against the effect of gravity.

14 In conditions, usually at night, where the sea is warmer than the land, the air over the sea rises and cooler air from the land flows into replace it, a **Land Breeze.**

15 On a hot day the land warms far faster then the sea, the air over the land rises causing cooler air from over he sea to flow in to replace it, a **Sea Breeze.**

16 **Oreographic Cloud is** formed when a range of hills or mountains causes the flow of air to rise over it, in turn cooling and if saturation is exceeded forming oreographic cloud.

17 **Isobars** are lines joining points of equal barometric pressure.

18 **Troposphere** is the lower part of the atmosphere. that contains almost all the weather phenomena.

19 **Tropopause** is the upper limit to the Troposphere, a temperature minimum occurs here.

20 **Geostrophic Force,** sometimes called the **Coriolis Force,** this is the effect of the rotation of the Earth on the atmosphere.

1 Temperature of the surrounding air changes from 17°C at surface to 2°C at 6000' therefore 15°C change in 6000'.
Lapse Rate for the day is 15°C / 6000' = 2.5°C /1000'

2 Condensation begins to occur at 4500',
temperature of the surrounding air is 17 - (4.5 x 2.5) = **5.75°C**

3 The rising air will cool to the Dew point 8°C at 4000 and cloud will form. The atmosphere is stable, small cumulus clouds will form.

4 The rising air will rise until the sir reaches the same temperature as its surroundings, in this case at 5000' however its temperature here will be 5°C, above the Dew Point, so no cloud will form.

5 The rising air will rise strongly due to the large difference in tempera ture until condensation takes place at 5000', wih a less stable atmosphere the clouds will form more vigorously and reach far higher then in Q3.

6 As the air rises the temperature difference with its surroundings gets greater, an unstable atmosphere, the dew point is reached at 5000' causing condensation. Rapid cloud development to great heights are possible.

7 Since the Inversion starts at 4000' where the condensation begins the cumulus will possibly spread out into a layer which may be burnt off by the sun or remain slowly blocking out the sun and cooling the surface stopping the thermal activity eventually.

8 The rising air will stop as its temperature reaches the same a that of the surroundings close to the 4000' inversion layer. The temperature will still be above the dew point giving no cloud.

9 As in Q8 the air will stop close to the 4000' inversion altitude, below the level at which condensation occur giving blue conditions.

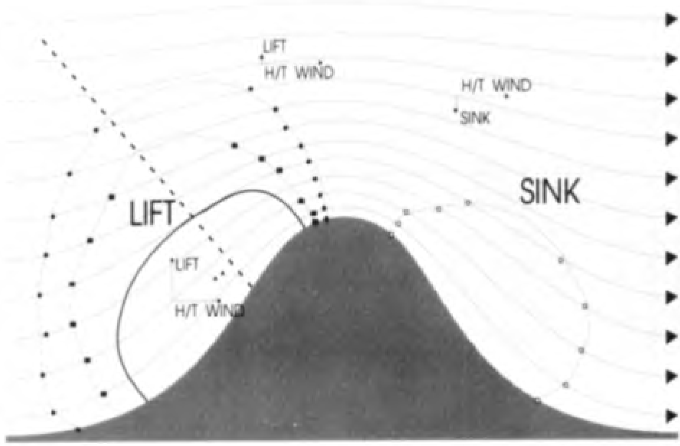
1

1	Cumulus	6	Stratocumulus
2	Cirrus	7	Nimbostratus
3	Cirrostratus	8	Altostratus
4	Altostratus	9	Cirrus
5	Nimbostratus	10	Cumulus

2 In the northern hemisphere, as the warm front approaches the wind strength begins to increase, the wind **BACKS** with height and the air pressure starts to fall. As its passes the pressure becomes constant and the surface wind **VEERS.**

3 In the northern hemisphere, as the cloud fromt approaches the wind strength increases close to the front, the pressure falls slowly . As the front passes, the wind **VEERS** and the pressure rises after its initial fall.

4 High pressure areas contain stable air at altitude, a large amount of dust and other particles is carried in the air, these refract the light giving the characteristic red sky.
Since, due to the Earths rotation the weather patterns move from West to East, red sky at night shows High pressure and hence good weather to the west, where the weather is coming from. Conversely Red sky at Dawn shows high pressure to the East where the good weather has gone!



1 The diagram shows points of equal slope, found by moving a ruler at a steady angle across the diagram and marking the tangents to the curves. Joining up the points gives rough lines of equal slope. The interesting result is that the areas of lift move back off the hill and not just higher above it.

2 The pattern is roughly symmetric for this idealised ridge but obviously in real situation it will vary with contour and surface texture of the slopes. Many ridges do however reflect the idealised patterns.

3 The line joining the mid points of lift is approximately perpendicular to the surface at the mid point of the slope, this gives a guide to the area of lift expected from a ridge.

4 The streamlines are similar to isobars, the closer they are together the stronger the wind. The components of the stream form the lift or sink and the head or tailwind as shown in the diagram.

5 If you get too far over the ridge to get back presents a problem because of as well as being in sink as you get lower and closer to the top of the ridge the streamlines are closer together representing a higher wind speed, in this case a headwind of about 35knts will be blowing close to the top of the hill.

No explanation is given, theory is covered in other parts of the book, or ask your instructor for assitance.

Theory of Flight

1	d	**4**	b	**7**	a
2	a	**5**	b	**8**	b
3	a	**6**	b	**9**	d
				10	d

Airmanship

1	a	**4**	d	**7**	d
2	c	**5**	a	**8**	b
3	c	**6**	a	**9**	d
				10	a

Navigation

1	d	**4**	b	**7**	c
2	c	**5**	c	**8**	b
3	a	**6**	b	**9**	a
				10	d

Air Law

1	c	**4**	b	**7**	c
2	a	**5**	d	**8**	d
3	c	**6**	d	**9**	d
				10	b

Meteorology

1	d	**4**	b	**7**	d
2	b	**5**	a	**8**	b
3	d	**6**	b	**9**	d
				10	c

NOTES FOR GLIDER PILOTS

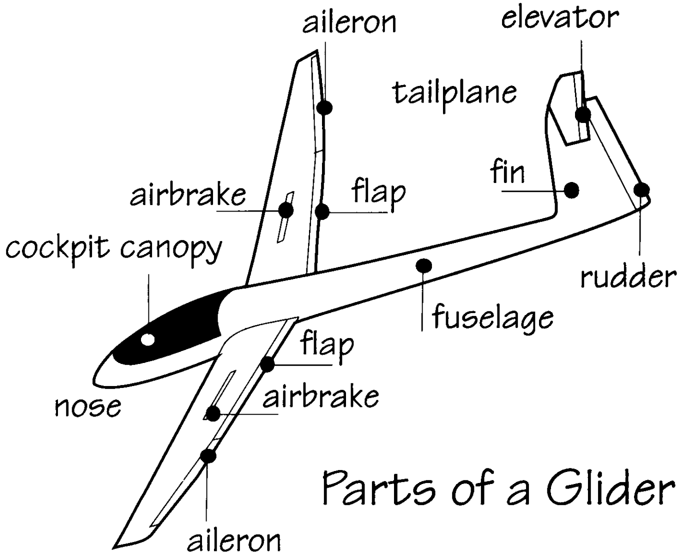
by

Eric Richards

CONTENTS

INTRODUCTION

Most new members of a gliding club are completely unaware of their club organisation, normal flying procedures and what they are expected to do. These notes are intended to give new members some idea of these matters.



Parts of a Glider

Usually you will have had a trial instruction flight or two before you decided to join the club, these will have enabled you to have a good look at the airfield and to see what flying a glider is like. Having paid your subscription and signed the membership and medical forms, which MUST be signed before you fly for insurance purposes, you will start your flying course. An outline of the pre-solo exercises are given later in these notes. In general, it will take about 35 - 45 Aerotows or 60 Winch launches to reach solo standard, but you must always remember that post-solo check flights will be a regular feature for some time after your first solo.

Most gliding clubs make a very slender profit, so your flying will usually be as cheap as possible. You will be interested to learn that most clubs do not charge for instruction, and that all instructors have attended an instructors course and hold a BGA Instructors Rating.

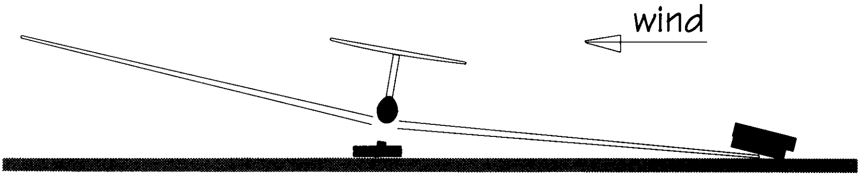
In order to keep the cost of flying down you will be expected to help in maintaining the aircraft and the other club facilities. This involves cleaning, polishing, greasing and many other small items. In addition to this there are many other jobs which have to be done, cleaning out the clubhouse, hangars, getting the fuel ready for the tug aircraft, winches and retrieve vehicles, and generally keeping the site tidy. Every member MUST do his or her share of the work if club operations are to be efficient. You must also remember that most clubs rig and de-rig the gliders every day, your help in this is expected. In most clubs the general rule is that if you are present at rigging then you will not be expected to stay to de-rig. If you arrive late in the day you will be expected to stay to help to de-rig the gliders.

Always remember to pay your flying charges before you leave the site, if you forget it usually causes the treasurer much inconvenience. Every now and again you will be asked to be duty pilot and maintain the flying log, this is an important and essential job and one that MUST be done properly.

You will be expected to help at the launch point - this will involve wing tip holding and attaching cables to gliders. Do not attempt to do these jobs without first being shown how to do them. Do not be afraid to ask for more help if it is not clear the first time. You must also learn the signals which are passed between the pilot to the tug pilot or winch driver. At the same time you will learn how to handle a glider, these are expensive and are easily damaged by incorrect handling. Repairs are very expensive and time consuming.

Gliders can be moved on the ground by towing slowly behind a car, using a cable and the glider tow hook. It is necessary for someone to walk close to the nose of the glider and for another person to hold the wing tip that is into wind. Gliders can also be moved by pushing, usually it is easier to push them backwards. This can be done by pushing on the leading edge of the wing with the wings held horizontally. Near the tail there are often handles for lifting the tail clear of the ground.

With their large wing-span gliders can easily be blown over, in strong wind conditions gliders have to be moved with great care and it may be necessary to have a member sitting in the cockpit.
Gliders may be parked, when not required, by turning the glider so that one wing is into wind with the wing tip on the ground. A suitable number of car tyres should be placed on the wing tip, if the ground is rough it is a good idea to place a tyre under the wing, in strong wind conditions a glider may require 3-4 tyres on the wing and one or two behind the tail to prevent it from swinging.



Remember that when you fly you are responsible for the safety of the glider, when you land remain in the cockpit until help arrives and never leave the glider until it is parked properly, or handed over to the next pilot.

When you are flying from an airfield make sure that you know all the rules and regulations in force. For example, find out how to reach the launch points and where cars are to be parked if they are allowed on the airfield.

Finally, remember that if there is anything that you do not understand or know, please ask one of the instructors on the site.

2 AIR INSTRUCTION EXERCISES

These exercises form the training required to go solo, they do not represent a teaching order, some exercises are far more difficult than others. All will be repeated many times.

1. Preparation for flight
2. Primary effects of controls
3. Further effects of controls
4. Straight and level flight
5. Use of trimmer
6. Flying at different speeds
7. Medium turns
8. Aerotow and / or winch climb and take off
9. Aerotow and / or winch release
10. Emergency signals and procedure aerotow and winch launch
11. Cable breaks (low, medium and high)
12. Use of airbrakes/spoilers
13. Approach and landing
14. Circuit planning (LH & RH Circuits)
15. Stall recognition
16. Stall recovery
17. Stall with wing drop
18. Spin and recovery
19. High circuit and landing
20. Low circuit and landing
21. Crosswind take-off and landing
22. 1st Solo signature
23. 2nd Solo signature
24. 1st Solo

Advanced Training

25. Steep turns
26. Descending aerotow
27. Stall and recovery - solo
28. Spin and recovery - solo
29. Use of flaps
30. Soaring techniques
31. Aerobatics
32. Instrument flying
33. Pilot navigation
34. Field landings
35. Cross country techniques

3. EXERCISE BRIEFINGS

Preparation for Flight

Clearance - Permission of the Duty Instructor to fly the glider.

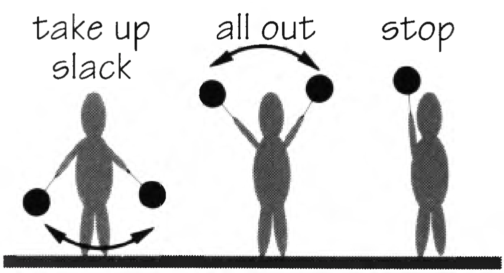
Daily Inspection (D.I.) - Check D.I. book, or do D.I. (if cleared to do so) Check Parachute (if used).

Comfort - Able to see out, and reach the controls, when in the cockpit - make careful adjustments of rudder pedals, straps, etc.

Pre Take-off Checks and Launch Procedure (with wings level)

C -	**Controls**	-	Full and free movement, control surfaces moving in the correct directions.
B -	**Ballast**	-	within limits.
U -	**Undercarriage**	-	**LOCKED**
S -	**Straps**	-	Tight.
I -	**Instruments**	-	ASI servicable, Altimeter set as required, Electrics all servicable.
F -	**Flaps**	-	Set for take off.
T -	**Trim**	-	Set forward for takeoff.
C -	**Canopy**	-	Closed and **LOCKED.**
B -	**Brakes**	-	Closed and **LOCKED.**

Learn the above **CB - U - SIFT - CB**



BGA Standard Launch Signals

CABLE ON - Make sure correct hook position and weak link is being used and test release if first flight (under tension, back release and free drop)

ALL CLEAR ABOVE AND BEHIND

TAKE UP SLACK

ALL OUT (If **STOP** is necessary, release cable at once)

Winch Launch

Keep straight with wings level and when airbourne prevent the glider climbing too quickly at first (in case of a cable break). Gradually increase the rate of climb until the chord of the wings makes an angle of about 40° with the horizon. (The optimal climb angle varies with wind conditions, type of winch and the winch driver.) Keep the wings level using aileron and rudder in the usual way. Monitor your speed carefully throughout the launch. In cross wind conditions the into wind wing should be held down to ensure that the track of the glider is **at least** straight down the winch run.

Winch Release

Towards the top of the launch the rate of climb should be gradually reduced. When the glider is no longer climbing the nose should be lowered to remove the tension in the cable and the release pulled firmly, but **NOT** violently twice. After release regain normal flying speed and retrim the glider to this speed.

Cable Breaks

Immediately lower the nose of the glider and release the cable - always give two pulls on the release even if you **THINK** the cable has gone. Assess the height available and proceed accordingly.

Low Break (below 150') land straight ahead only using airbrakes after a careful check of glider speed.

Medium Break (150' - 300') "S" turns and land ahead as before.

High Break (above 300') Carry out a restricted circuit in the most appropriate direction.

Aerotow Launch

Glider in line with the tug fuselage. Keep the glider in such a position that the tug appears slightly above the horizon. In turns use sufficient bank to maintain the correct relative position of the glider and tug.

Aerotow Emergency Procedure

TUG - ROCKS WINGS - glider MUST release **immediately.**

GLIDER - FLY TO LEFT, ROCK WINGS - tug will return to airfield and release rope.

Aerotow Release

Pull yellow release knob twice in the normal tow position giving a firm but not violent, pull. Check positively that the rope has released.
Climb gently, and turn through 90 degrees (usually left but check direction at ridge sites).

Use of Trimmer

Trimming for Different Speeds

ATTITUDE - first select nose attitude for new speed and hold.

SPEED - wait for speed to settle; if wrong, select new attitude.

TRIM - when attitude/speed is correct, use trim lever to remove stick loads.

Straight Glide

Choose a point well ahead to aim for - use rudder and ailerons together to keep the wings level and to maintain constant direction. Keep the speed constant by selecting the correct attitude using the elevators - trim the glider for this attitude and speed. Initially the exercise should be performed with the glider flying into wind or downwind, (Why?).

Medium Turns

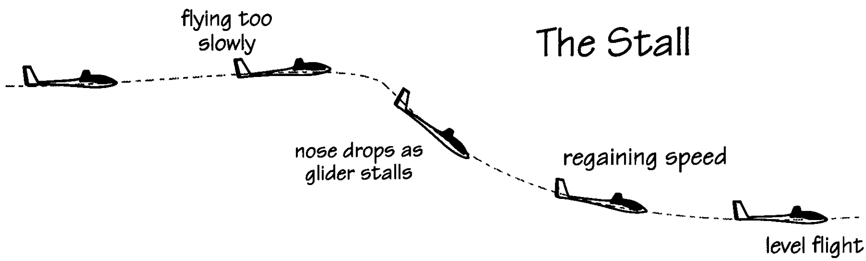
Look around, look ahead and check attitude and speed - then turn using ailerons and rudder. Remember you will require rather more rudder to initiate the turn than you will require when turning - this is because of Aileron drag. Keep bank constant using ailerons and use rudder to counteract slipping or skidding.

If the glider is skidding - less rudder
If the glider is slipping - more rudder

Keep attitude constant and speed correct using the elevators. To straighten up use aileron and rudder together and centralise both controls when the wings are level.

Stall and Spin Check

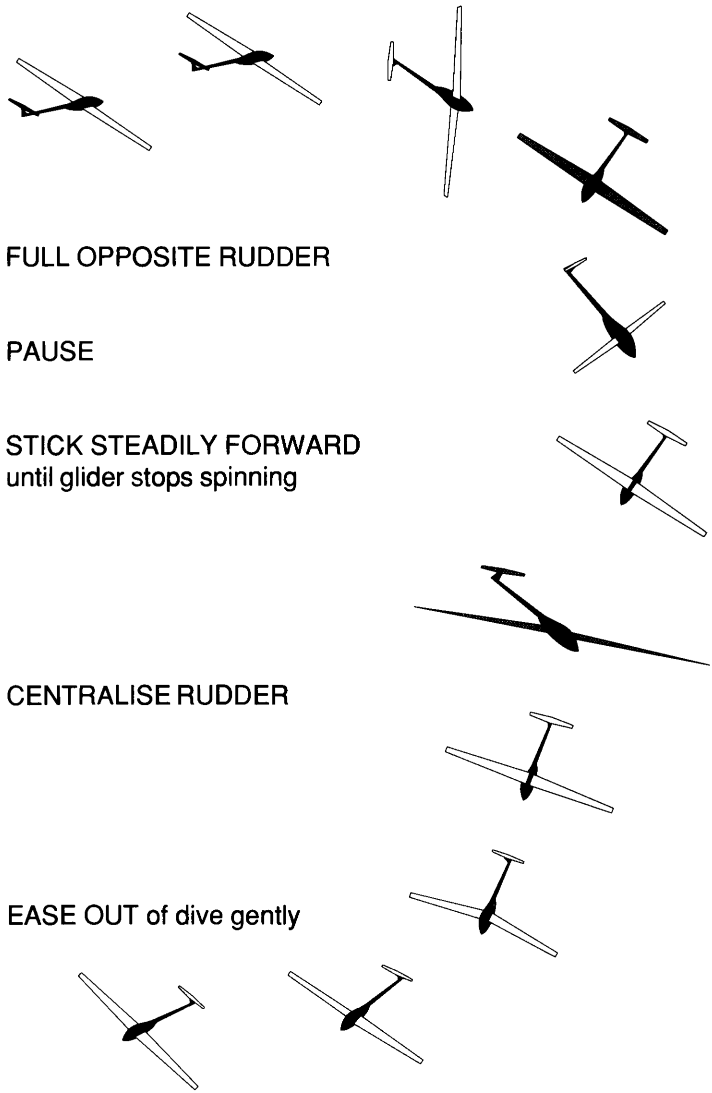
H -	Height	- Sufficient height for the exercise and return to airfield.
A -	Airframe	- Suitably stressed for the exercise - check limitations on the cockpit placard.
S -	Security	- Straps tight and no loose articles.
L -	Location	- Clear of controlled airspace and built up areas.
L -	Lookout	- Clear around and below - do an "S" turn NOT a 360° turn (why?)



Stall Recovery - with minimum loss of height

KEEP STRAIGHT - with rudder
STICK FORWARD - to lower nose and unstall wings
EASE OUT - of dive gently.

Spin Recovery - with minimum loss of height

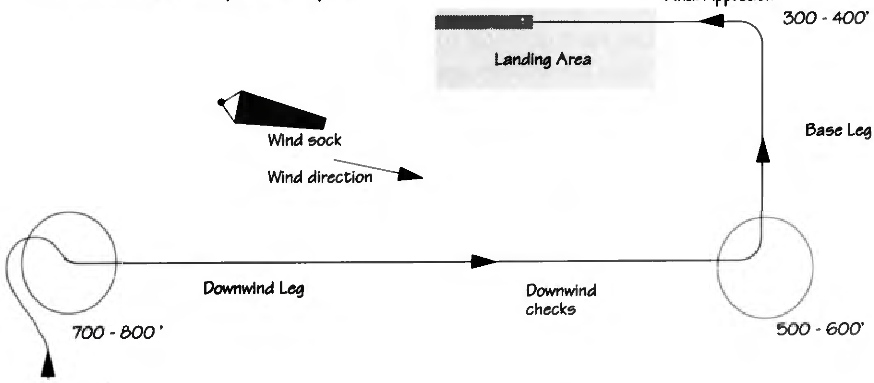


Circuit Planning

At 1000ft. fly to one side of field and decide on wind direction, landing area, and plan circuit. At, and below, 1000ft. always be upwind of the landing area.

Aim Your aim is to arrive in a position to one side, and a little downwind of the landing area at about 500-600 ft. AGL. This is most easily done by leaving a position well upwind of this point at about 700-800 ft. AGL.

The Circuit, a simple example.



Downwind Leg

On the way downwind, you can use up any **excess height** by turning out and widening the circuit, or by using airbrakes. If losing height rather too quickly, you should turn towards the position you have chosen for the final turn, thus cutting the corner off the circuit (dotted line). On the downwind leg you should do the following checks;-

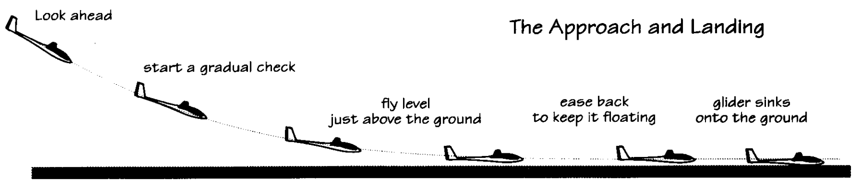
U	-	**Undercarriage** down and locked
F	-	**Flaps** 0° setting
S	-	**Speed** increase speed to 50 kt
T	-	**Trim** for this speed
A	-	**Airbrakes** hand on airbrake lever until after landing
A	-	**Altitude** disregard altimeter and judge height by eye
L	-	**Lookout** landing area, final approach, **power lines**

Base Leg

Gradually increase speed to final approach speed and retrim if necessary. Final turn should be at about 300ft.

Final Approach

Do an accurate, well coordinated, medium turn to line up with the landing area. Then approach at the correct speed, using flaps and air brakes to steepen the glide path. For most sailplanes a final approach speed of 55kt. is suitable. In strong wind conditions the final approach speed should be increased to give improved penetration. As a general rule 50 kt. plus one third of the head-wind component should give a suitable approach speed.

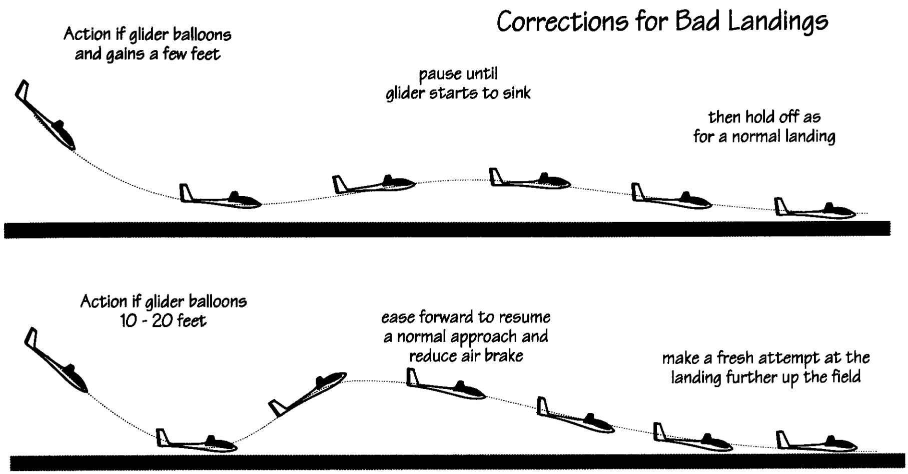


Landing

Ensure that you are lined -up correctly and that your approach speed is right. Look well ahead and at about 10' from the ground raise the nose of the glider GENTLY. This will check your rate of descent. Continue to do this at short intervals until the glider is flying level with the ground and about 6" to 1'from it. At this point keep the wings level and the glider straight. If there is a slight cross - wind keep the into wind wing a little lower than the other.

If, by any chance, you bounce after touching the ground it will be because you gave flown the glider into the ground. After bouncing on no account push the stick forward - hold the glider so that it flies parallel to the ground and let it slowly sink back to the ground. If you find that your airspeed is slow, and you have bounced quite high, close the airbrakes gently.

The so called round out should not be a sudden action it should be gentle and gradual.



After Landing

1. Switch off instruments.

2. In strong winds stay strapped in until help arrives.

3. In light winds stay at nose and picket glider, wing into wind.

Remember it is your responsibility to look after the glider until the next pilot takes over.

4. Elementary Soaring Techniques

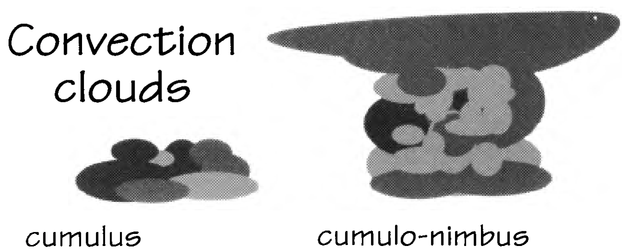
To maintain its forward speed a glider must gradually lose height in still sir. If the glider happens to be flying in air which is rising faster than rate at which the glider sinks in still air, the glider will gain height - i.e. it will soar. Such rising air (lift) is produced in a number of ways:-

1. **Thermals**
2. **Ridge Lift**
3. **Wave Lift**
4. **Sea-breeze fronts**

There being no ridge lift near our site, we have to content ourselves with thermal soaring, together with the occasional sea-breeze front. Wave clouds are occasionally seen over and near the site, but usually the high winds, which produce these wave clouds, prevent exploration.

Thermal Soaring

In the Northern hemisphere between March and September the elevation of the sun is sufficiently great to produce a differential heating effect at ground level which will cause bubbles of air to break away and rise. In general a 2°K temperature difference seems sufficient to produce this effect, and providing that the temperature of the surrounding air is always less than the air bubble, the bubble will continue to rise. As the bubble rises the air cools adiabatically (it neither gains heat from nor looses heat to, the surroundings) at the dry adiabatic lapse rate of about 3°K/1000ft. (this is about 10k/km). Eventually the air, which it is saturated. Further cooling will result in the formation of cloud with the release of latent heat, which further heats the air and causes it to continue to rise and form **Cumulus** clouds. The air will now cool at the wet adiabatic lapse rate of 1.5°K/1000 ft.



This action will stop as soon as the rising air is the same temperature as the surrounding air. When the vertical development of the cloud is considerable the cumulus cloud will develop into a **Cumulo - nimbus** cloud. These are **VERY dangerous** clouds to enter as electrical discharge takes place within them, between them and from them to the ground. They can be distinguished from the relatively harmless **Cumulus** cloud by the characteristic anvil which they develop.

Beneath a **Cumulus** cloud it is possible to encounter a thermal. The rising column of air will be up-wind of the cloud so you should note the wind direction, which may not be the same at ground level. Note the direction of any smoke, or observe the track of the cloud shadows on the ground. Assuming that you have an aerotow launch, you will probably fly through one or two thermals before you reach 2000' - clearly this will depend on the weather conditions. As the tug enters a thermal it will suddenly gain height and within a few seconds you will enter the thermal.

This should give you a good idea of the thermal strength. Do not be in a hurry to pull off. Remember that thermals below **1500'** and particularly below **1000'** are rather ragged and you may have difficulty in remaining in it. The height at which you release will also depend upon the sailplane that you are flying. At low altitudes it is easier to centre on thermals in a 15m sailplane because of greater rate of roll and manoeuvrability. Beware also of the tug-pilot whose gyrations produce what appear to be thermals!

Soaring from a winch launch is a little more difficult as the time and height available for the location of a thermal is restricted. However, most pilots soon learn where the local thermal sources are and it is not unusual to release in or near a thermal which is marked by a Cumulus cloud above.

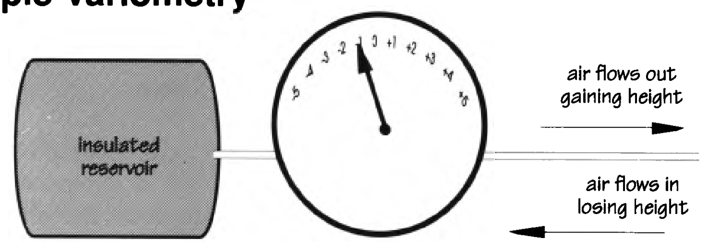
It is essential that the desire to find a thermal does not endanger the safety of the pilot and glider - do not for example, continue to search for a thermal below a height or in a position which will make it impossible to rejoin the circuit in a normal manner. In the same way it is inadvisable to "scratch" in weak broken thermals until out of range of the site - this can easily happen on windy days.

Of course there are days when only "blue thermals" are available. In this case the rising air encounters a layer of air that is warmer than itself, an inversion layer, and therefore stops rising. If this happens before the dew point is reached then no cloud will form. The inversion layer is usually fairly low in the morning and rises gradually throughout the day. Often it will rise enough for cloud to form in the afternoon.

To locate a blue thermal you will have to rely on the tug pilot to fly through one. If this happens at a suitable height (you must have sufficient height to get back to the airfield if you fail to contact the thermal) pull off as soon as you see the tug hit the thermal and turn hard left. Do not wait until you actually hit the thermal - if you do , by the time you have pulled the release and turned you will probably have missed the thermal.

Having found your thermal you must now find the area of best lift and stay in it. On very hot days with strong thermals (6+kts) this is not too difficult as the thermals are quite wide. It is possible that you will only have to re-centre two or three times, sometimes not at all going to cloud base. The technique of staying in a thermal is usually developed over a period of years and varies from person to person. However, there are a few basic rules on which you can base your technique, and this technique will depend to some extent on the instruments you have available.

Simple Variometry



The variometers fitted in a wide variety of sailplanes depend on the air flow into or out of a thermally insulated reservoir flask. There are two types both giving indications of "lift" or "sink", one uses an airflow meter for the display the other an electrical meter. The latter can also be used in conjunction with a small speaker which gives an audible indication. These instruments do, in general give a reasonably rapid response and in some cases the "lag" can be almost negligible. In this case, the technique described in (1) may well be successful. However when the "lag" is serious due to the variometers slow response you will have to use the technique described in (2) below:-

1) Let us suppose that the thermal strengths are such that the "surge" on flying into the core is not felt. This means that you will have to rely on the variometer and you should turn steeply to the left or right (left If your left wing is picked up and vice versa) as soon as you obtain a clear indication of lift.

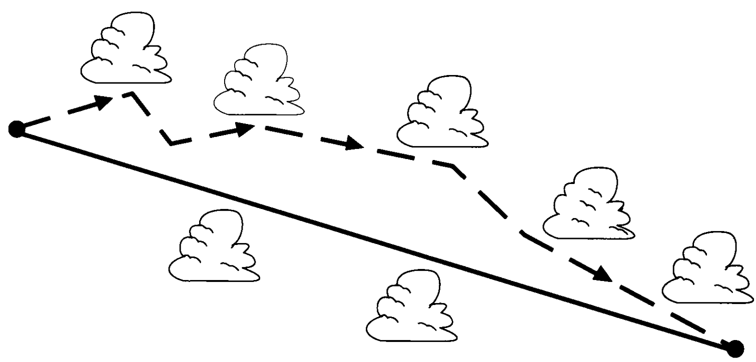
Make sure that this is not "Stick lift". Even if the variometers are on "total energy" you may encounter this. As you circle note the variometer reading and when this starts to increase immediately level the wings and then immediately resume the same direction of turn. Of course if you are flying an aircraft with a poor rate of roll you may only have time to take off half the bank and then return to the original angle of bank. This is often done with the larger sailplanes. If you repeat this every time the variometer reading goes down you should, with luck, remain in your thermal. If the thermal strength is great enough you may be able centre by merely levelling the wings as soon as you feel the start of the surge. Do not worry about the increase in your airspeed when you hit the core - just maintain your attitude and you will find that the airspeed will sort itself out.

2) If you have to use a slow response variometer then you will have to allow for the lag - you can get a good idea of this by observing the response when the surge in the thermal can be felt. As soon as an indication of "lift" is indicated on the vario the glider should be turned left or right, depending on which wing is lifted. When the maximum lift is registered the glider should continue in the turn for a further 300 degrees at which point the wings should be levelled briefly and then the turn should be resumed in the same direction. If the glider is then not established in the thermal the process should be repeated.

There are a number of variations to these methods and details will be found in a number of books on gliding. (See section 9).

It is worth remembering that one of the easiest ways to destroy what lift is available is to fly badly in your turns - with slip or skid. It is also undesirable to fly at high speeds as the glider's performance suffers and the turning circle becomes much greater. Never forget to trim the glider for the turn - this makes flying much easier!

Once you have mastered the technique of soaring and have gained experience in moving from one thermal to the next and so on , it is time to consider cross country flying. Start with short out and returns. It is very easy to thermal within sight of the airfield but it is an entirely different matter when the airfield is a good 10 miles away and you are down to **1200'**. At these times your flying technique is really under pressure, for you have other things on your mind, apart from the necessity of remaining airborne.



When considering a cross country flight always soar locally for a short time to get an idea of the average thermal strength, the distance between thermals and the wind direction and strength. When you set off in the desired direction make for what looks like a good active cloud. It should have a firm base, preferably concave upwards, and firm crisp tops. Fly under it and you should find good lift (remember the lift will be upwind of the cloud). If you are near cloud base you will probably find the lift towards the centre of the cloud. As you fly towards a strong thermal the air becomes much rougher and there is often strong sink. Do not be put off - press on!

On early cross countries my advice is to stay as high as possible, never ignore lift (even initially poor lift often becomes very good after a short while) and do not fly at high speeds between thermals - too much height can be lost in this way. Of course this does not mean that you should fly slowly through 10knts down!! Always try to work your way into the core of the thermal. If lift is hard to find and you get down to 2000' search for a thermal in an area that looks like it might contain landable fields. At 1500' definitely locate such an area and examine the fields. At 1000' you should have selected your field. At this stage of the flight do not leave the vicinity of your chosen field unless you pick up a good thermal. Whatever you do not scrape around at 300' hoping for the impossible. It is at this height that trouble overtakes brave pilots. Start your circuit at usual circuit height - don't forget that your altimeter was set to airfield height.

East Anglia is not one of the best areas in which to make Cross-country flights during the corn growing season - the time of the year and the state (height) of the crops should be considered before attempting such a flight.

By gradually building up experience with short out and return or small triangle flights you will prepare yourself for your first Silver C attempt. With these longer flights there are a number of other matters to be considered - not the least of which is to know where you are at all times. Such Flights are dealt with later together with cloud flying.

Ridge Soaring

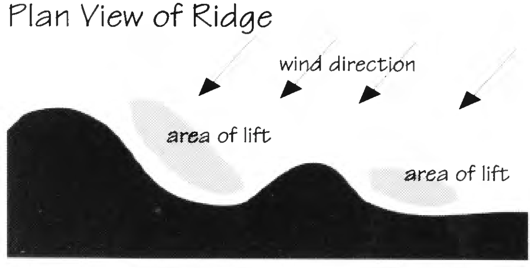
Whenever the wind strength exceeds 10knts. ridge lift can usually be found in front of a ridge. For the best possible lift the ridge height should be 300'+ and depending on the wind strength, lift can usually be found from the lower part of the ridge to 1000' or more above it.

Great care must be exercised whilst flying close to the ridge at, and below , ridge height and on some ridges this is not allowed.

There are standard rules for flying on ridges:-

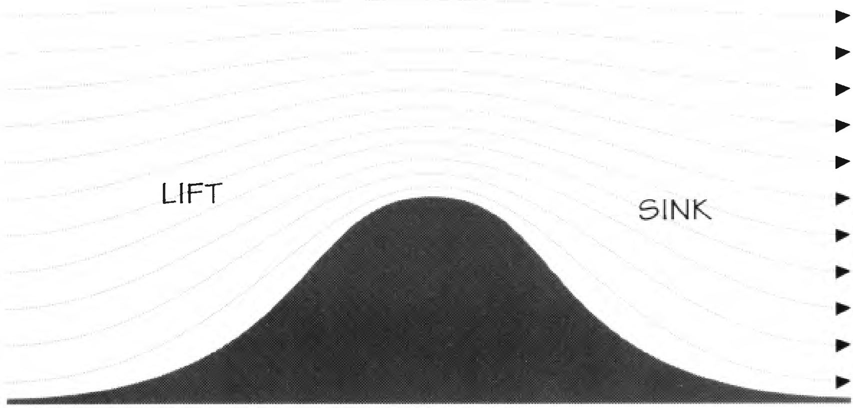
1. All turns must be made into wind when flying along the ridge.
2. All overtaking of other sailplanes must be made between theother sailplane and the ridge.
3. Approaching sailplanes obey the usual rule - both turn slightly to the right.
4. As ridges often give thermals as well it is sometimes permitted to thermal after a series of tight "S" turns all turns being made into wind. You are advised to enquire about this beforehand.
5. At the conclusion of ridge soaring flight the circuit joining procedure varies from place to place. Usually it involves flying out from the ridge into wind before rejoining.

The position of lift on ridge sites varies with the wind direction and shape of the ridge. In general lift is found in front of the ridge where it is at right angles to the wind direction. A small change in the wind direction may cause the region of lift to change quite a lot - see diagram below. If a wind sock is available you should watch this carefully for signs of a wind change.



Avoid flying to the rear of the ridge as you may encounter very strong sink in the curl over. Considerable height can be lost in this region in a very short time. Whenever possible, all turns should be made in lift.

Windflow across a Ridge



When in lift your best speed to fly will be the minimum sink speed of your glider (do you know this speed?) You will be well advised to increase your speed to the normal cruising speed when turning, even if you are still in lift. When leaving one area of lift for another, increase your speed when you encounter sink.

It will be necessary For you to keep a close watch on your airspeed throughout the flight, as you will be flying much closer to the stall than you usually do. A good lookout is very essential, as ridge sites are often very congested and all sailplanes will be operating in a narrow height band - under these conditions an audio variometer is very useful as it is unnecessary to watch the variometer dial.

Pilots are advised to gain ridge soaring experience at all times when the ridge is not congested. You will find that a number of dual flights with an instructor experienced in ridge flying will be very useful, if not essential.

Sea-Breeze Fronts

Sea-breeze fronts are not uncommon in Great Britain and the conditions necessary are as follows:-

1. Off the sea airstream, a Westerly in East Anglia
2. Hot sunny day with strong convection

Under these conditions a fairly strong sea-breeze will be experienced on the coast and, as time passes, the colder air from the sea will gradually push inland, forcing up the warmer air over the land.

The approach of the colder air can usually be seen for some distance - a distinct haze line can be seen reducing visibility in that direction. As the warmer, and less dense, air is forced up-wards condensation will eventually take place and cumulus cloud will be formed. The vertical development with a very active front - i.e. one that is moving fairly quickly - can be quite large and heights of 5000' to 9000' have been obtained locally in East Anglia.

On flying towards the area of haze, smooth lift should be found. As soon as you find such lift it is best to turn and fly more or less parallel with the front, gradually working closer to the haze area where the lift should be strongest. Above you will probably see 'curtain clouds' - ragged streamers hanging down in front of the cumulus cloud. If you keep in front of these clouds you should be able to climb above them and enter the cumulus clouds formed above.

If you fly into the region of colder air, behind the haze line, you will encounter strong sink for a short time. The boundary between the area of lift and sink is quite turbulent and serves as a warning sign that you have flown too close to the front. Once you pass through the area of turbulence into the colder air there will be little, if any thermal activity and the sky should be clear. This is sometimes quite useful after a cloud climb. When you wish to emerge from cloud all you need do is to turn towards the coast and you should emerge from cloud. However, be careful !

In East Anglia sea-breeze fronts sometimes approach from the N.E. However, as these fronts have usually travelled some distance they are not very active. In most cases the haze area can be seen, but as it is more or less stationary, very little lift, if any, is to be found. There will be some traces of the cumulus cloud left but this will eventually die away as the frontal activity ceases.

With very active fronts it is often possible to fly for considerable distances along the front at quite high speeds. Whenever you are on a cross-country flight, and near the coast, you should watch carefully for signs of approaching front. Depending on where you wish to go, they can be very useful, particularly late in the evening, when thermal activity is dying.

Sea-breeze fronts are found all around our coastline and, in Cornwall and Devon, sea-breeze fronts sometimes approach from both sides of the peninsular giving rise to a mass of active cumulus in the middle.

Wave Flying

Although wave conditions do exist in East Anglia the high winds associated with this effect often prevent glider flying. Nevertheless a number of local pilots have contacted wave lift at heights of about 5000', but as might be expected, the lift found was not very strong.

Wave lift is found in the lee of mountain ranges - to some extent the higher the mountain range and the stronger the wind the greater will be the wave effect. Wave lift is produced as follows:-

Imagine a large stone being placed in a stream of water which is flowing fairly fast. Behind the stone there will be waves, or ripples. This means that the water behind the stone has impressed on it oscillations which are at right angles to the direction of the water flow. Exactly the same thing happens to the air in the lee of a mountain range - the air oscillates in the same way and these oscillations are transmitted to the layers of air above. Provided that you can locate your glider in the region where the air is oscillating upwards and keep it there your glider will soar.

The position of this wave lift is frequently marked by stationary lenticular clouds - long sausage-like clouds. Actually they are not always stationary and can move to and fro. The lift is to be found in front of the lenticular cloud - behind it is very strong down. The wave lift produced is parallel to the mountain.

In this country more and more wave flights are being made and height climbs in excess of 15,000' have been made. Many of these flights have been the subject of articles in "Sailplane and Gliding", and you should try and borrow some old copies of "Sailplane and Gliding" if you wish to learn more of these flights. Quite spectacular wave flights have been made in the lee of the Rocky Mountains in the U.S.A. and it seems probable that the wave lift could as high as 80,000 - 100,000' in suitable conditions. The conditions for wave are described in "Sailplane and Gliding" issues February to May 1971. The strongest lift is to be found just in front of the first, or primary wave. The lift produced by the secondary and other waves, gradually falls off. Movement from one wave system to another is often difficult because of the very strong sink between adjacent wave systems. Extreme turbulence is often found in the lee of the primary wave - the rotor - accompanied by very, very strong sink. For this reason many glider pilots prefer to fly into the first wave behind the primary, and after a good climb, move forward, if possible, to the primary wave. To do this often requires quite high speed flying as the wind conditions necessary for wave are high in any case. At heights where the wave lift is strong it is not exceptional to have to fly at 60kt. or more, to maintain position in the wave lift.

There are a number of well-known wave sites in this country - Portmoak and Aboyne, to name but two. Any site situated in the lee of the Welsh mountains, the Pennines or the Scottish mountains should, provide that it has suitable launching facilities, be able to contact wave conditions when they exist.

Wave flying is in practice more complicated that I have indicated. The presence of 'ridge lift', thermals and wave combine to present a complicated picture to the glider pilot. Considerable experience is required for successful wave flights and with an experienced club instructor are essential at such sites.

Dolphin Flying

The basic theory of dolphin soaring has been known and used for a considerable time. The advent of high-performance fibre-glass gliders with high rough-air VNE has enabled the technique to be used more effectively on crosscountry flights. because even a modest gain of height enables these gliders to cover a considerable distance. In this way much higher ground speeds are attainable on crosscountry flights.

All glider pilots are that very strong lift can be found under well established cloud streets and a fast flying glider can, on encountering such lift, pull up steeply and gain sufficient height to avoid the necessity of thermalling in the conventional manner.

After the initial height gain, it is essential to increase speed agin before reaching the ares of sink. Delay in doing this can result in considerable height loss as speed has to be increased in sink.
If the lift along the cloud street is not strong enough to maintain a flight path in the required height band one or two turns can be made in lift after the initial climb before speed increased as the glider leaves on the chosen course.

When flying in this manner a fast-response variometer on total energy is essential. Alternatively, there are now on the market a number of devices designed specially for dolphin flying, which give information relating to the vertical motion of the air in which the glider flying, in effect an "air-mass read-out", over a wide range of speeds.

A word of warning when flying in this way - remember that you are flying fast near cloud-base and there may be other gliders doing exactly the same flying towards you. So keep a good look-out at all times and keep clear of cloud with good forward viability. In other words DON'T "dolphin" in and out of cloud.

5. CLOUD FLYING

The secret of successful cloud flying is practice. When cloud base is reached it is sometimes rather difficult to enter cloud as the position of the lift often changes at this point. The on;y thing to do is to search until it is found or try another cloud.

Before you enter cloud you should have permission from your C.F.I. to do so and the glider should have suitable cloud flying instruments. These are:-

1. Electric Turn and Slip.
2. Artificial Horizon Electrically operated.

Basically only the T & S is needed and you should NEVER enter cloud if it is u/s. The reason is simple,e - A.H. are notoriously unreliable, mainly because of battery trouble, whilst the T. & S. can generally be relied upon. Needless to say, you should, before a cloud flight check on the battery state - did the previous pilot use the A.H. etc.

The A.H. should be erected well before cloud is entered - preferably on the ground with the glider wings level. Do NOT switch the A.H. on and off as the starting current is quite large and will rapidly discharge the battery.

Whilst climbing to cloud base trim the glider for a medium turn - when you are in cloud this will be a great help in maintaining the correct altitude. At the same time note the position of the image glider relative to the A.H horizon - sometimes this can be adjusted so that the centre of the image glider cuts the horizon -and the position of the turn needle on your T. & S. Remember that the turn indicator only gives the rate of turn and NOT the angle of bank, so when you are using this instrument you must avoid slip or skid.

When you enter cloud maintain the same angle of bank (rate of turn) and do NOT make rapid and continual changes in attitude to maintain a constant airspeed. Make all such changes fairly slowly - in cloud you will find the airspeed fluctuates due to changes in the lift - rapid changes can easily leads to spiral; dive or a spin. If you can maintain your normal airspeed +3 or 4KT you are doing quite well.

Another point which is worth remembering is that it is not always easy to locate your exact position when coming out of cloud. For your first cloud flights choose a day when the cloud base is 3,5000' + this will then give you a better chance of returning to your site.

At first a few minutes in cloud will be sufficient - straighten up, open your airbrakes, descend into clear air then enter cloud again. Make sure that other club pilots know you are going to do this so that they can keep well clear of your glider. In this way you can build up experience and confidence in your ability to fly blind.

At this stage make sure that the T. & S. is your main instrument - unless you can fly in cloud on this instrument alone you should **NOT** attempt a big climb in cloud.

Once you are proficient in the simple technique you should try to centre on the best lift in the usual way. If you have an Audi-Crossfell you will find that it is most useful as you will not have to look at The variometer. Also try straightening up on a given bearing - with some compasses this is much harder than you may think.

At some stage in cloud you may experience the feeling that you are turning in the opposite direction. Whatever you do at this point **ALWAYS** believe your instruments - if you do not, work out for yourself what will happen. If excessive changes in altitude cause you to enter a spiral dive or to spin - Do **NOT** panic but:-

1. **In the case of a spiral dive**
   a) Open your airbrakes and level the wings
   b) Raise the nose of the glider and resume normal airspeed
   c) Close the airbrakes

2. **In the case of a spin**
   a) Open your airbrakes
   b) Observe your T.&S.and correct the spin (what indication will you get?)
   c) Resume normal flight and close the airbrakes

If in doubt treat it as a spin and use the T.&S. - the AH may be unreliable under these conditions. When you have recovered your composure resume the climb. Eventually you may achieve your object and reach the top of the cloud which will usually be some distance below the real cloud tops. At this point you will probably experience moderate to severe turbulence, increase your speed slightly and straighten up. You might just well abandon the attempt to climb higher. If you do not emerge from the cloud in a few minutes change direction and fly towards the lightest part of the cloud. If you still do not emerge from cloud then open your airbrakes and descend on a suitable bearing as shown below:-

Before contemplating a cloud flight observe the Cu clouds and try to estimate the height of the cloud tops. Make sure that none of them are developing into Cu-Nb and listen for the sound Of distant thunder. If in doubt DO NOT ENTER cloud. In general if all the Cu clouds have crisp tops not above 12,000' you are not likely to get any Cu-Nb forming before 3-4 pm. It is always advisable to have a word with the Met. Office if there is any doubt.

Even in large Cu clouds you are likely to encounter quite adverse weather conditions, including icing. This may cause your ASI Pitot to freeze. If you have an AH you could, of course, carry on, or better, descend on your AH with airbrakes open losing about 500' per minute. If you only have a T. & S. you have a problem so:-

1. Level the gliders wings
2. Open you airbrakes
3. Trim forward
4. Adjust your rate of descent by altimeter to be about 500' per minute. (5 Knts. down)

If you are still keen on cloud flying - Good luck and do not forget the barograph!

6. CROSS COUNTRY FLYING

Before setting out on a cross-country flight you should:-

1. Have a Bronze C and the permission of your C.F.I.
2. Be confident in your ability to remain airborne in reasonably good thermal conditions.
3. Have made a number of short out-and-return flights and small triangular flights successfully.
4. Have been briefed by an instructor with a full rating who will want to know your retrieve arrangements and details of your fight plan.
5. Have the appropriate maps and a sealed barograph signed by an Official Observer. Make sure you switch on the barograph.

If you flight requires photographic turning point evidence make quite sure that the FAI requirements are met and that you now how to photograph a turning point.

Your pre-flight planning is of the utmost importance and remember it is of no use to plan a flight without first getting an p-to-date met. report. Make a careful study of your route making a careful note of all towns, airfields and other prominent features on your route. It is always a good idea to note possible landing sites on your route, should conditions force you to land. Note that disused airfields may have had their runways removed - unless you know the airfield it should always be inspected very carefully before landing. You should choose your goal, bearing in mind the wind strength and direction. For your first few cross-country flights it is advisable to fly down-wind - only in very light wind conditions should you contemplate an into-wind cross-country. Work out your maximum permissible aero-tow height, bearing in mind the 1% rule. In the case of a winch launch it I unlikely that you will not conform to the 1% rule.

Finally you should work out your compass course as near as possible by using a navigational computer or a simple vector triangle. If you do not know how to do this you should find out before you consider cross-country flying. It must be appreciated that the compass course you calculate will only be an approximate one. This is due to the fact that it is difficult to set the correct wind speed in view of the fact that you will be operating at continually changing heights.

However, an approximate course is better than no course at all. Set the average wind speed between 2000' and cloud-base. Once you are airborne fly locally for some time and test the thermal strength. Conditions may not be as good as they seem and thermals may be far apart. Look carefully for any signs of approaching topcover, which will tend to stop thermal activity. Remember also that he Cu clouds form early in the day over-convection may occur and the continuous cloud may cause thermal activity to cease. The cloud base should be high -say in excess of 3500'. If it is much lower than this you only have to make a few mistakes in thermalling and you are in danger of having to land.

Supposing that conditions are right you can set off on course, choosing as you go, a Cu cloud in the right direction. While you are flying straight and level study your map and locate your first check point on your ground track - say an airfield or large town. Once you are certain of your position you can concentrate on the clouds ahead and plan your next move. Always select a Cu cloud which has a well defined base - preferably concave upwards - these are usually working. If the base of the cloud is ragged and ill-defined you may will find no lift. When you reach a check point is a good idea to make a note of the time on the map.This will eventually enable you to estimate your ground speed and the distance which you should be able to cover, provided conditions remain suitable.

Glider navigation is really continuous map reading. Steering a set course is difficult as you usually have to divert to Cu clouds. The result is a rather zig-zag course on either side of the required track. However, if you are reasonably high and the visability is good you should be able to identify your check points a long way off.

On your first cross-country flights do not enter cloud - this is without doubt the easiest way to get lost. If you do get lost steer the compass course which you worked out previously and try and identify on your map a prominent feature on the ground.

Assuming that the flight goes according to plan and you arrive at your goal do not under any circumstances overfly it just because conditions are still good. Plan a careful circuit, allowing ample height for this. As you know your goal height your can adjust your circuit height to the normal 700 - 800' height band. It is possible may be no wind sock at your goal if it is not an airfield or gliding site. In this case;-

1. Remember the wind direction at your own site.
2. Note the direction of any smoke.
3. Observe the direction of the cloud shadows over the ground
4. Note the direction of drift of the glider.

When you have landed make sure that you do not break the barograph seal and obtain a landing certificate signed by two witnesses or by one official observer. The information required on the landing certificate is as follows;-

Name of pilot, BGA number of glider, date, place and time of landing, signatures of witnesses with their addresses. The barograph seal can only be broken by an official observer.

It is possible that you may not reach your goal due to deterioration in conditions. In flight conditions may change for a variety of reasons - over - convection, already mentioned, is one. Others are;-

1 Encroachment of sea air
2 Approaching frontal systems
3 Approach of evening

The first sign of a decline in thermal activity is usually an increase in the inter thermal distances and a falling off in the rate of climb in existing thermals. If and when you suspect that you will be unable to fly much further you should move towards one of your selected emergency landing sites. If none are near you should fly towards an area which appears suitable. You should arrive in the area with about 1500 AGL giving you about 500' to select a suitable field.

The availability of landing sites depends on the area in which you are flying and also the time of year. For example in mid summer East Anglia is not noted for suitable landing sites as so much as so much of the land is covered with standing crops, there are some suitable sugar beet fields and a few fields here and there with grass. Standing crops should always be avoided as the sailplane will usually be seriously damaged. Some of the small fruit bushes are just as bad, if not worse. They are not easy to pick out from the air and can be confused with sugar beet.

It is worth noting that where there are grass fields in many areas they are often near the rivers. The good fields however, often contain cattle. Beyond Exeter the grass fields are smaller and hedges are replaced by stone walls. Being a more mountainous region many otherwise suitable fields have very steep slopes. When you are travelling around the country it is useful to take note of the types of crops grown and the availability of good grass fields.

However, to return to the field landing problem-

By the time you have reached 1000' AGL you should have selected a suitable field. In making your selection the following points should be considered;-

1. **Wind** direction and strength.
2. **S**ize of field - use and average sized house and garden as a rough guide if there is one nearby.
3. **C**ondition - no standing corn, animals, or other obstructions such as electric fences.
4. **A**pproaches - telephone poles, HT cables, trees present?
5. **R**etrieve facilities - is there good access by road for the trailer?
6. **F**latness - a steep slope may make landing impossible.

You can remember these items by the following;-

Wind - SCARF

If your field appears suitable you can then make a normal circuit and landing. You should allow enough height on your final turn to enable you to make a steep. full airbrake approach just in case you see, at the last moment, telegraph wires of HT cables. By partially or fully closing the airbrakes you will have something in hand to adjust your point of touchdown.

Once you are safely down secure the glider with its wing down into the wind with the steel and nylon pickets (make sure they are in the cockpit before take off). By this time you will probably have collected an admiring crowd who have come to see the "crash!" They will usually tell you who owns the field and once you have obtained your landing certificate, you should leave an adult in charge of the glider and visit the owner of the field. Address him with respect and apologise for your unannounced arrival. Assure him that you have done no damage or, if you have, assure him that you will pay for it. Landowners when approached in the right way become most helpful and friendly offering telephone facilities and light refreshments.

When you contact your retrieve crew make sure that you give the following information;-

1. Exact location of field and best access for trailer.

2 Your telephone number should it be necessary to contact you again.

3. Local assistance available for wing holding in the case of an AT retrieve. In this case make sure you speak to the tug pilot and give him the dimensions of the field, details of the approaches and the field surface, together with the wind direction. Move the glider, if possible to the end of the intended take off run.

Finally when you get home write a letter of thanks to the landowner. This will ensure that the next visiting glider pilot will be welcome.

8. BRONZE C. ENDORSEMENT

The Bronze Badge can only be issued if the applicant has already qualified and applied for a gliding certificate with the A Badge Endorsement. It is not necessary to hold a B Badge Endorsement before qualifying for the Bronze.

REQUIREMENTS

Flying Test

1. Two soaring flights, each at least 30 minutes when launched by car, winch or bungey, or 60 minutes after release from an aerotow to a height not exceeding 2,000 ft. Landings must be normal and within the boundary of the landing field as specified by the instructor in charge. The candidate must be alone in the aircraft for each flight. Each soaring flight must be under the supervision of a BGA Instructor or Official Observer, who must complete and certify the report required. The evidence must be by a barograph trace to the satisfaction of an Official Observer or alternatively may be by continuous visual observation.

2. A minimum of two flights in a dual control glider with the CFI or a nominated Full Rated Instructor or ATC A Category Instructor. The Instructor is to satisfy himself that the candidate is proficient in the following exercises;-

(a) Well co - ordinated and accurate general flying, especially the keeping of a good lookout.

(b) Understanding and recognition of the symptoms of a stall, incipient spin and full spin, followed by the correct recovery.
If sufficient height is not available for a full spin, then practice to the incipient stage is acceptable, through not ideal.

(c) Two field landings into a field or, if a suitable field is not adjacent to the Club site, into a marked area of the airfield. The altimeter should be covered or the millibar scale offset for this practice. If a marked area of the airfield is used, it must be so chosen that there is little, or not undershoot and that the circuit and approach does not coincide with the normal circuit and approach to the airfield. Where a suitable two seater is not available the field landings only may be flown solo.

7. SYLLABUS FOR THE BRONZE C. EXAMINATION

A. Principles of Flight

1. Elementary understanding of:

a) Aerofoils
b) Lift and drag
c) Forces acting during flight
d) Turning
e) Stalling
f) Spinning
g) Loading, placard speeds

2.

a) Effects of controls - axes
b) Further effects of controls
c) Stability

B. Meteorology

1. Elementary understanding of:

a) Fronts (recognition of approach, associated pressure changes, passage)
b) Convection
c) Cloud formations (lapse rates, condensation levels)
d) Weather maps (basic understanding of signs, etc.)
e) Gliding aspects - wave, hill, lift soaring

C. Navigation

1.

a) Map reading - conventional signs
b) Appreciation of cross-country flying, effect of wind on track and groundspeed
c) Field landings

2.

a) Compass - deviation and variation, turning and acceleration errors
b) Vector triangles

3.

a) Geographical appreciation, - i.e. true and magnetic North Poles, lines of latitude and longitude, northern and southern hemisphere pressuredistribution

D. Instruments

1. Elementary understanding of construction and principles of:

a) A.S.I.
b) Altimeter
c) Variometer

2.

a) Errors
b) Over/under reading - causes and effects

E. Airmanship/General

1. Full knowledge of Air Law

2. Ground handling - all aspects

9. RECOMMENDED READING

BEGINNING GLIDING -Derek Piggott

GLIDING -Derek Piggott

GOING SOLO -Derek Piggott

UNDERSTANDING GLIDING -Derek Piggott

ELEMENTARY GLIDING -Paul Blanchard

KNOW THE GAME - GLIDING -Ann Welch

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- Ray Stafford-Allen

NOTES

NOTES

It is well established that the top surface of an aerofoil produces about twice the lift of the lower surface

If you invert the glider this lift will act downwards

When the wing is upside down it produces drop not lift

Birds cannot fly inverted

It is therefore clear that

INVERTED FLIGHT IS CLEARLY IMPOSSIBLE!

The above argument may be true!
Compare with practical experience
and form your own conclusions!

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