LONG BRIEF

FLYING EFFECTS OF CONTROLS

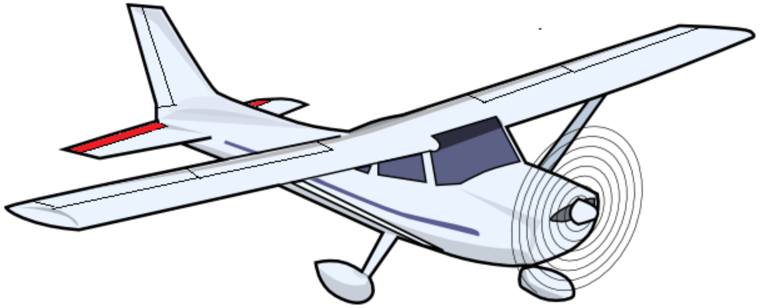
Exercises 4(1) and 4(2)

CONTENTS

AIRCRAFT CONTROL SURFACES

The aircraft is controlled by three main cockpit controls which move three main flying surfaces on the aircraft.

The elevators are situated on the horizontal tail plane. There is one elevator on each side, linked together.



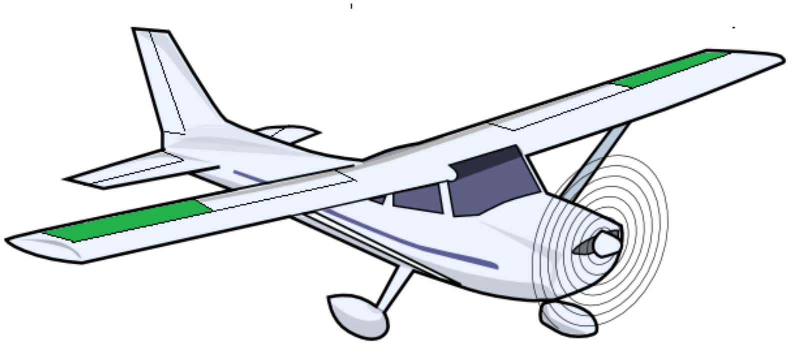
The pilot controls the position of the elevators by pushing and pulling on the control column (or stick)

Elevators cause the aircraft to pitch.

AIRCRAFT CONTROL SURFACES

The aircraft is controlled by three main cockpit controls which move three main flying surfaces on the aircraft.

The ailerons are situated at the ends of the wings. They move in opposite directions to each other.



The pilot controls the position of the ailerons by rotating the control column (or stick) left and right.

Ailerons cause the aircraft to roll.

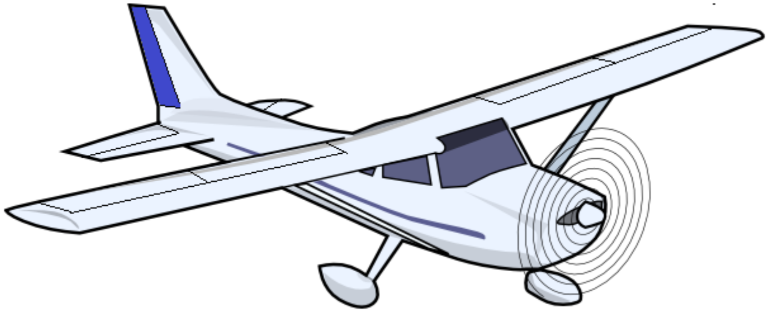
AIRCRAFT CONTROL SURFACES

The aircraft is controlled by three main cockpit controls which move three main flying surfaces on the aircraft.

The rudder is situated on the vertical stabiliser at the rear of the aircraft.

The pilot controls the position of the rudder by pushing on the left and right rudder pedals.

The rudder cause the aircraft to yaw.

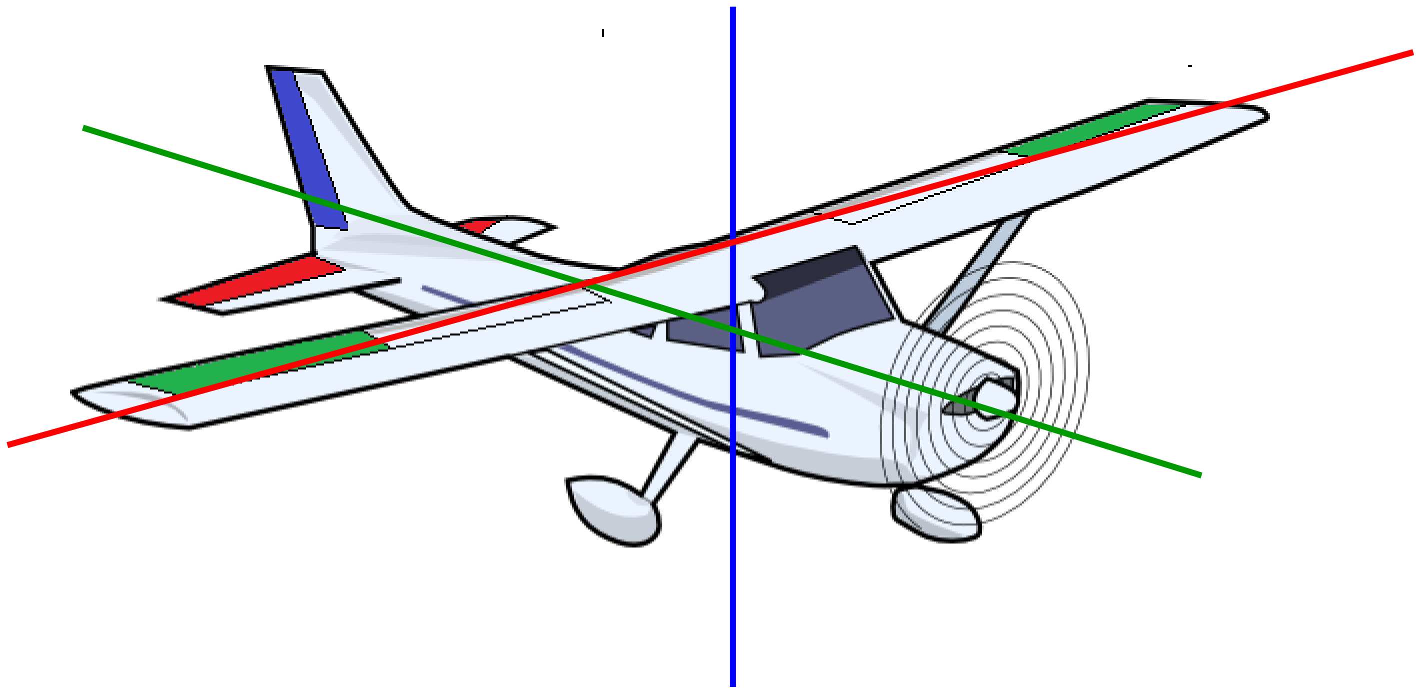


Exercise 4(1), (2): Effects of Controls

LONG BRIEF

AIRCRAFT AXES

The control surfaces rotate the aircraft about the three axes of the aircraft.

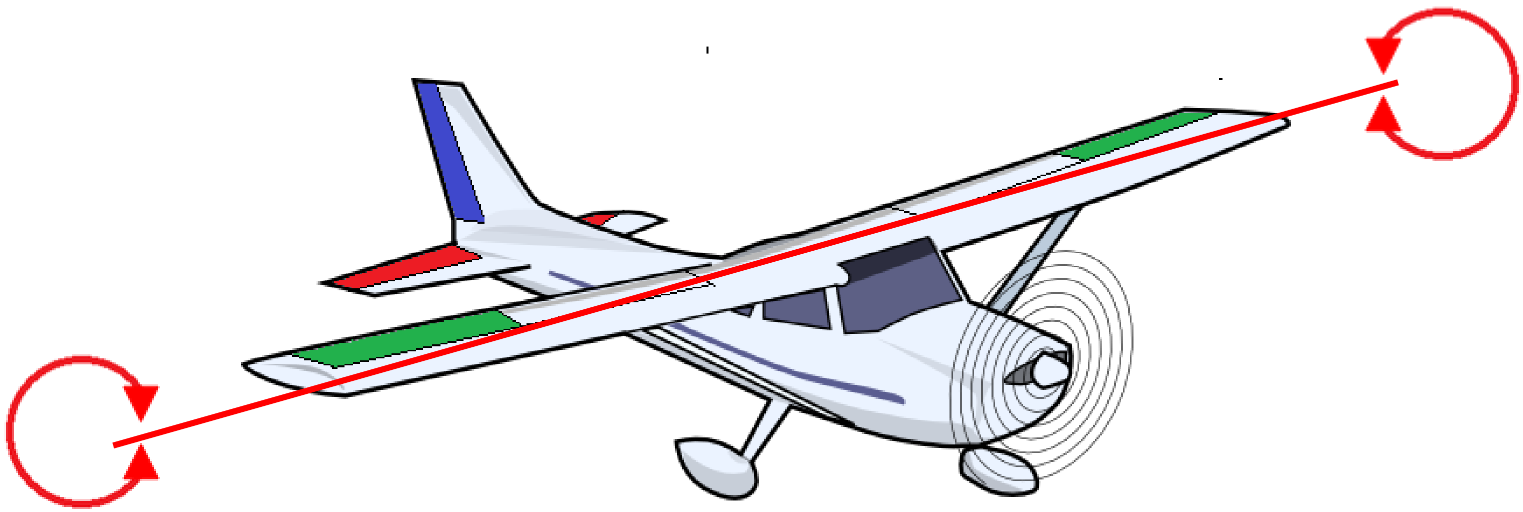


Exercise 4(1), (2): Effects of Controls

LONG BRIEF

AIRCRAFT AXES

The elevators pitch the aircraft around the lateral axis of the aircraft which runs from wingtip to wingtip.



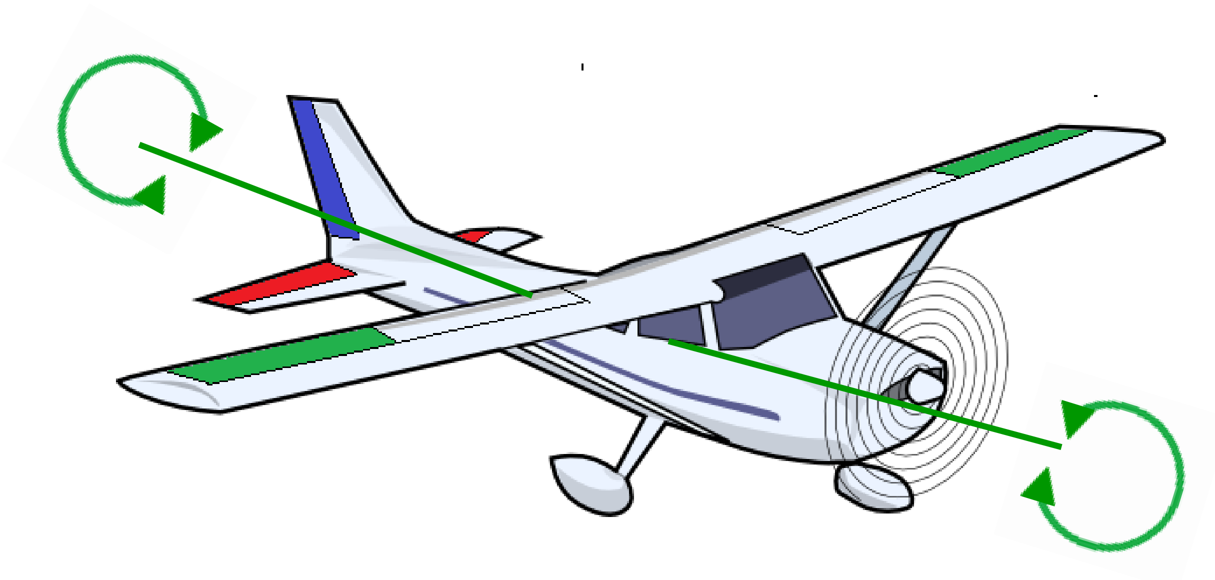
This is known as longitudinal motion.

Exercise 4(1), (2): Effects of Controls

LONG BRIEF

AIRCRAFT AXES

The ailerons roll the aircraft around the longitudinal axis of the aircraft which runs from the nose to the tail.



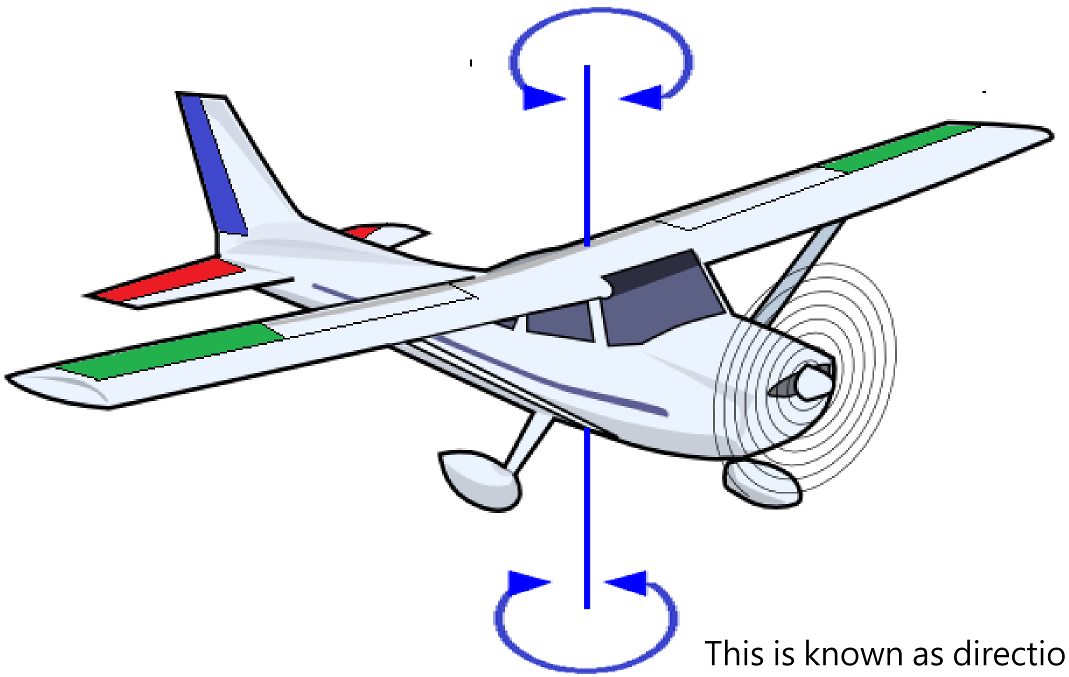
This is known as lateral motion.

Exercise 4(1), (2): Effects of Controls

LONG BRIEF

AIRCRAFT AXES

The rudder yaws the aircraft around the normal (or directional) axis of the aircraft which runs effectively through the pilot spine when they are sat in the aircraft.



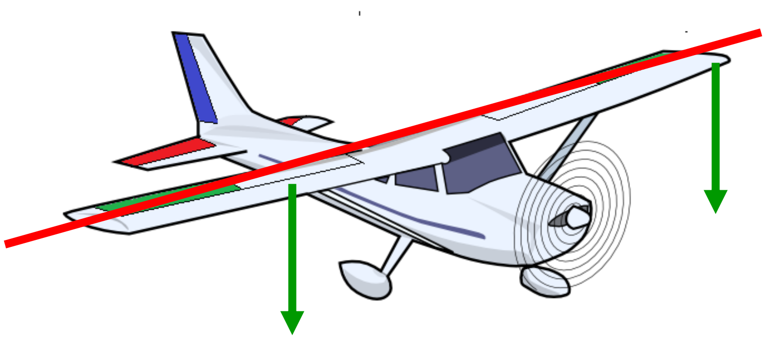
This is known as directional motion.

Exercise 4(1), (2): Effects of Controls

LONG BRIEF

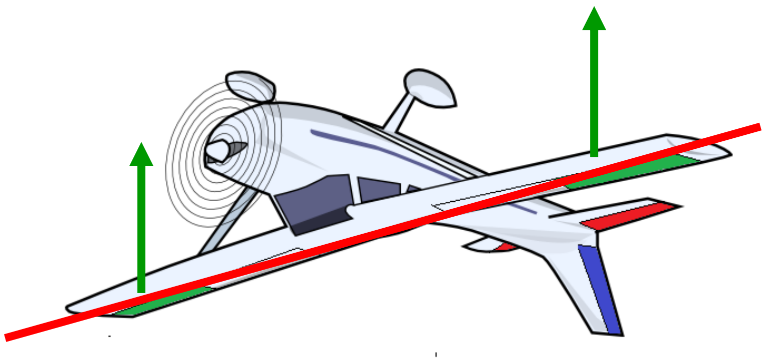
AIRCRAFT AXES

Remember that the reason the axes of the aircraft are an important piece of knowledge to understand is that the aircraft always moves around the axes.



Pulling the control column rearwards causes the aircraft to pitch up relative to the lateral axis.
Seen from the cockpit the nose rises relative to the horizon.

Pulling the control column rearwards causes the aircraft to pitch up relative to the lateral axis.
Seen from the cockpit the nose rises relative to the sky.

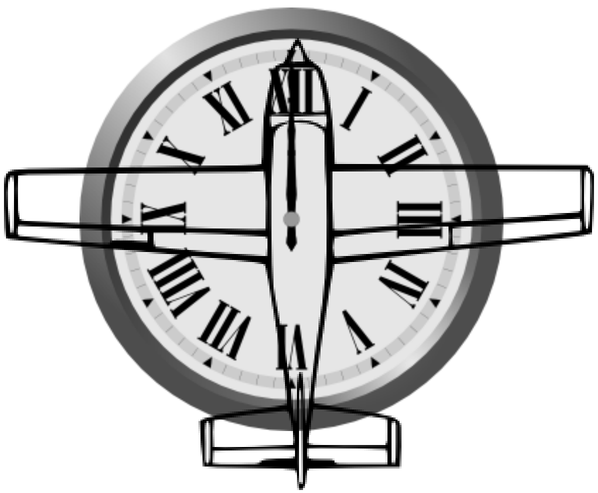


Exercise 4(1), (2): Effects of Controls

LONG BRIEF

CLOCK CODE

When describing the position of another aircraft or a ground feature when airborne, it is clearer to use the clock code to ensure that the correct area of the sky is looked at.



Imagine a clock face super-imposed upon the aircraft.

The 12 o' clock position would be over the nose of the aircraft.

The 6 o' clock position would be over the tail of the aircraft.

The 3 o' clock position would be over the right (starboard) wing.

The 9 o' clock position would be over the left (port) wing.

In this way, it does not matter which direction the aircraft is heading in – the clock code will remain the same.

For more definition you can also add "high" for aircraft higher that your aircraft, "low" for aircraft lower than your aircraft" or "same level" if they are at the same altitude / height as your aircraft

THE ENGINE CONTROLS

The engine is controlled by three main components – the throttle, the mixture, and the carburettor heat.

We shall look at each of these controls in turn…

THE ENGINE CONTROLS: THE THROTTLE

The throttle is the way in which the pilot controls how much air is entering the engine. It is usually controlled by a black knob or lever in the centre of the dashboard in the cockpit.

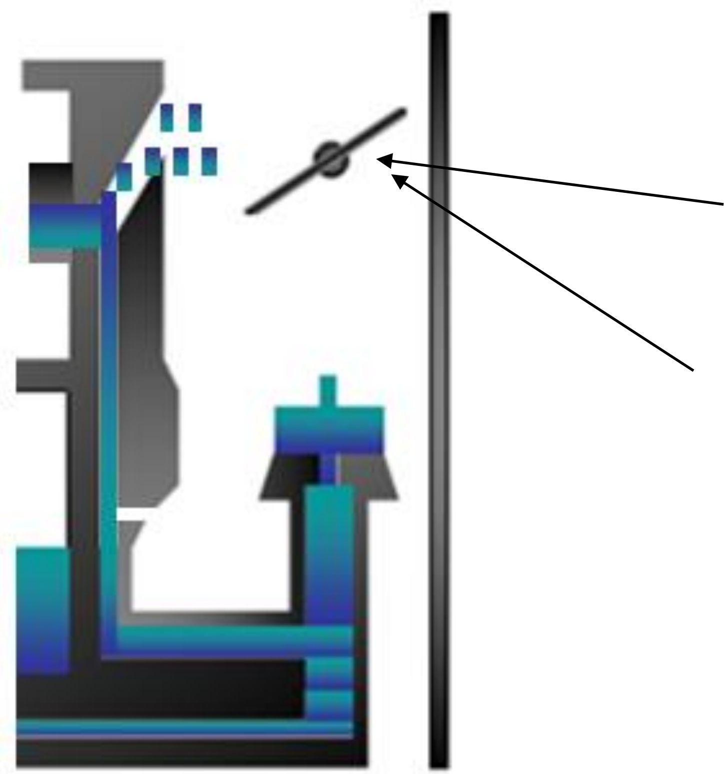
The throttle setting can be seen on the rpm gauge. The red line indicates the maximum rpm allowable. Every engine will have a maximum time that it can run at maximum rpm and also a maximum duration over the maximum rpm (this is not long!)

The throttle setting can be increased by pushing the throttle in towards the dashboard. This is also known as "opening" the throttle.

The throttle setting can be decreased by pulling the out from the dashboard. This is also known as "closing" the throttle.

THE ENGINE CONTROLS: THE THROTTLE

The movement of the throttle in the cockpit directly affects the setting of the throttle butterfly in the engine system.



When the pilot pushes the throttle in (opening the throttle) – the butterfly moves towards the position where the maximum air can flow past. The more air entering the engine the more power is produced.

When the pilot pulls the throttle out (closing the throttle) – the butterfly moves towards the position where the minimum air can flow past. The less air entering the engine the less power is produced.

It is very important when using the throttle to use it gradually. Harsh movements only serve to suddenly change the air entering the engine which can not only reduce engine life but also can cause the engine to run roughly or stutter.

THE ENGINE CONTROLS: THE MIXTURE

The mixture is the way in which the pilot controls how much fuel is entering the engine. It is usually controlled by a red knob or lever to the right of the throttle on the dashboard in the cockpit.

If you are flying in a Cessna aircraft, there are two ways of moving the mixture control – one is by using the "over-ride" knob which allows the knob to be moved like a throttle. For finer adjustments, the mixture control can be twisted in and out.

If you are flying in a PA28 aircraft the mixture is the lever next to the throttle. It is red and shaped differently from the throttle to help minimise confusion between the two levers.

Exercise 4(1), (2): Effects of Controls

LONG BRIEF

THE ENGINE CONTROLS: THE MIXTURE

Mixture controls are used for two main reasons – to make the engine more efficient by reducing fuel usage, and to shut down the engine at the end of a flight.

"LEANING" THE MIXTURE

Most modern cars have computers which control how much fuel is allowed to flow into the engine depending on how much acceleration is required and dependent on the climate in which the car is being driven.

Simple aircraft engines do not have this system – the pilot has control over the fuel flow to the engine

The simplest way to lean the mixture is to use the rpm gauge. The pilot should note the rpm and then slowly pull out (twist if in a C152) the mixture control until a small rpm drop is observed. The mixture should then be returned to the position where maximum rpm was indicated. This is the perfect position.

It is good practice to then increase the mixture a small amount so that it is slightly on the rich side of lean – the small amount of excess fuel is used to help cool the engine.

THE ENGINE CONTROLS: THE MIXTURE

Leaning the mixture too much can cause the engine to run rough and may, in some cases, damage the pistons. If the mixture is not leaned, the aircraft will use too much fuel and will not be able to fly as long.

USING MIXTURE TO SHUT THE ENGINE DOWN

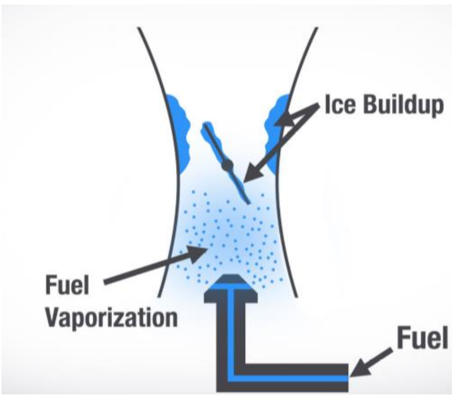
It is good practice to shut an aircraft down after flight using the mixture control rather than by turning the key to the "off" position.

This is because using the key may not fully shut off the ignition system and any fuel left in the cylinders could cause the engine to fire in certain circumstances – for example if someone were to move the propeller from the outside. This could be very dangerous.

It is safer to stop the engine by starving it of fuel. In this way it is virtually impossible for any external propeller movement to start the engine.

Remember though, always treat the propeller as "live"

THE ENGINE CONTROLS: THE CARBURETTOR HEAT



As air moves towards the engine, it speeds up. This is because the pathway includes a venturi (where there is a narrowing of the pipe).

As air speeds up, it cools down.

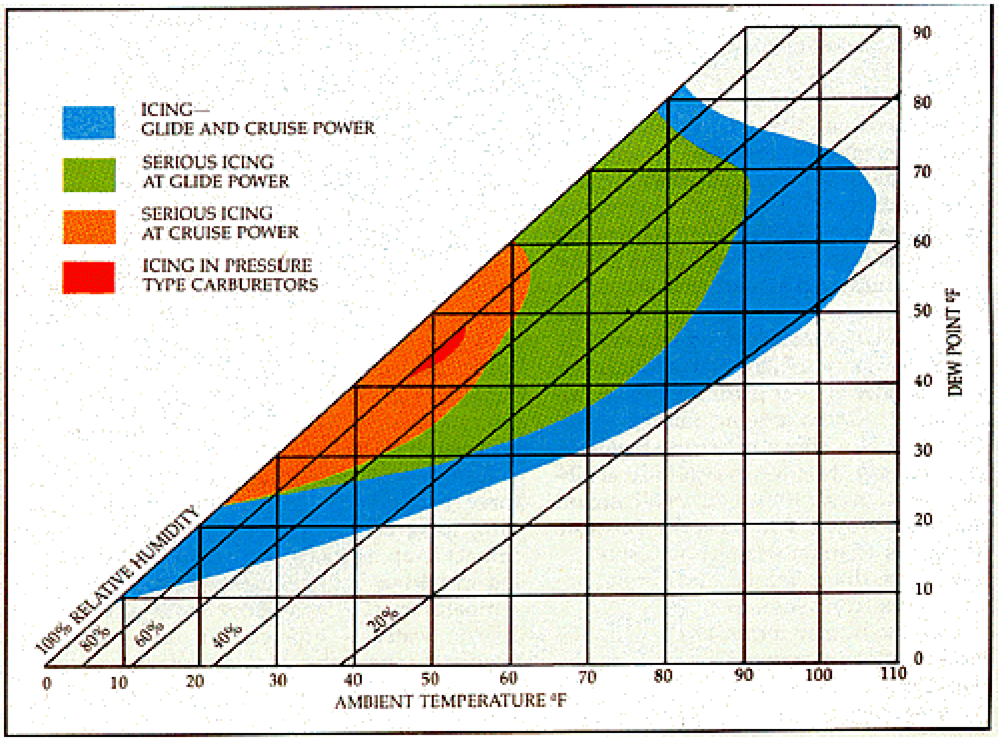
An example of this can be easily seen by blowing on your own hand. If you blow onto your hand with your mouth wide the air will feel fairly warm. If you nearly close your lips and then repeat, the faster air will feel much colder.

If the air in the venturi is cooled to below freezing point, any water being held in the air will freeze and this can block the throttle butterfly from moving and can even block airflow to the engine. In this case, the engine will stop.

Carburettor heat mixes warm air with outside air and can prevent ice build up, or can even melt ice that has begun to form.

CARBURETTOR ICING & ITS AVOIDANCE

It does not need to be a cold day for carburettor icing to occur. The graph below will be seen many times during your training, and the instructors assess the carburettor icing potential every day in their morning weather brief – it is that important!



If any of the following apply, think carburettor ice:

Temperature below 30˚C

Visible moisture (clouds etc)

Flight within 200nm of a sea surface

Power settings below the green arc on the rpm gauge

You will soon be introduced to a regular check in the aircraft which will include a carburettor ice check.

THREAT & ERROR MANAGEMENT

We shall now examine some of the threats that may occur during the cruise phase of flight and errors that may be made by the pilot. We will also examine how these can be reduced to a minimum.

Symbols used throughout this section are as shown below.

The threat being discussed.

or

The error being discussed.

The management of the threat and/or error that mean it is reduced to the lowest possible risk.

THREAT & ERROR MANAGEMENT

In a dual-controlled aircraft it is highly undesirable to have either no-one flying the aircraft, or both occupants believing that they are in charge of flying the aircraft.

-

By using standardised phrases such as "you have control" and "I have control" both front seat occupants will be consistently clear on who is in charge of flying the aircraft at any point in the flight.

On days with a temperature below +30°C the risk of engine or carburettor icing exists. As a worst case example, this may cause the engine to stop.

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If the pilot carries out a carburettor heat check every 10 – 15 minutes this will minimise the risk of carburettor icing in most flight conditions.

THREAT & ERROR MANAGEMENT

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The flap mechanism of the aircraft may be damaged if they are used when the aircraft is too fast and does not adhere to the limitations published in the Pilot Operating Handbook or Flight Manual for the aircraft being flown.

By confirming speeds are within limit (and preferably calling them out) prior to selection of the flap lever mechanism the usage of the flaps outside the design limit is minimised.

Exercise 4(1), (2): Effects of Controls

LONG BRIEF

SUMMARY

The elevators pitch the aircraft about the aircraft lateral axis.

The ailerons roll the aircraft about the longitudinal axis.

The rudder yaws the aircraft about the normal (or directional) axis.

The clock code may be used to enhance communication between aircraft occupants.

The throttle control of the aircraft controls the air input to the engine. An increase in throttle rpm causes the aircraft to pitch up and yaw left

The mixture control of the aircraft controls to fuel input to the engine. The mixture may be adjusted to ensure that the fuel-burn of the aircraft is as efficient as possible for a given altitude and temperature.

The carburettor heat control diverts warm air into the engine in order to prevent or reduce ice accumulation in the aircraft carburettor and should be used every 10 – 15 minutes for at least 30 seconds.

You should now attempt the Progress Check for this exercise.