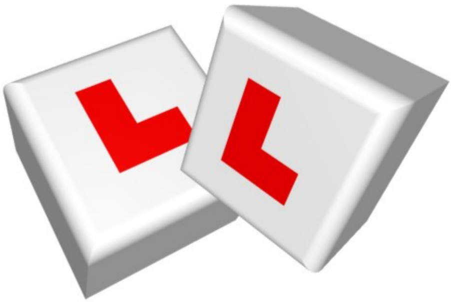
Clutch Control & Gears Explained



Learn the Easy Way to Drive a Manual (Stick Shift) Car and Pass the Driving Test With Confidence!

Martin Woodward

ISBN: 978-1-71680-939-2

1st Edition 2011

2nd Edition 2020

Enquiries: https://deep-relaxation.co.uk

Dedication

To the memory of my late father Cyril H. Woodward from where the majority of the information herein originated. His superb driving skills were unmatched by most (me included). He was also one of the first few people to pass the Institute of Advanced Drivers test. Thanks for everything Dad - *catch you later!*

Contents

Introduction

Driving consists primarily of two elements:

- *'control'* - the ability to put the vehicle wherever you want to or need to and
- *'road procedure'* - knowing where to put it!

However the majority of driving instruction books deal mainly with *'road procedure'* and only touch briefly on *'control'*.

Admittedly in order to master the control you must have in car tuition / practice, but with the correct understanding, this can be achieved ***much*** more quickly.

This short book deals only with *control* (mainly clutch control and gears) and aims to give the reader a thorough understanding of this. Having gained the necessary *controlling* ability, you can then focus your attention on the never-ending *'road procedure'*.

Also be aware that *'road procedure'* may vary throughout the world according to local laws, but *'control'* is the same worldwide - and as such this guide is applicable worldwide.

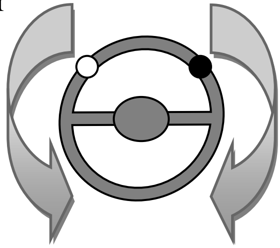
So how come you know so much?

I qualified as an ADI in 1973 and started my own school in Sheffield, which I built up from one car to one of the largest, most respected and most profitable schools on South Yorkshire. During this period I also achieved *grade 6* status (highest) as an instructor. After just over 30 years in the driving school business, I sold the school which is still running very successfully in my name. I am now semi-retired and no longer give personal tuition.

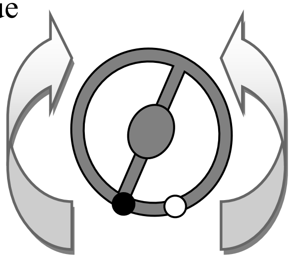
I am 100% confidant that the information and techniques herein will help any learner driver considerably, as they have done to countless personal pupils of mine from 1973 onwards.

The Steering Wheel

The steering wheel should be gripped lightly with both hands in a position corresponding to *'ten to two'* or *'quarter to three'* in relation to the clock face unless using one hand to temporarily operate another control. If you find this position uncomfortable check your seating position.

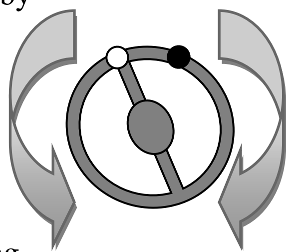


In the UK it's recommended that the wheel should be turned using a push pull technique ensuring that neither hands cross the *'six o'clock'* position.

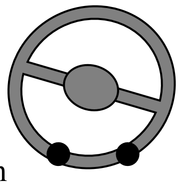


The diagrams to the right show this technique to make a 360 degree turn of the wheel to the right as follows:

Grip the wheel with the right hand as shown by the black dot in the first diagram and pull the wheel down at the same time as sliding your left hand down as shown by the white dot;



Grip the wheel with your *left* hand as shown by the black dot in the second diagram and push the wheel up at the same time as sliding your right hand up as shown by the white dot;



Grip the wheel again with the *right* hand as shown by the black dot in the third diagram and pull the wheel down at the same time as sliding your left hand down as shown by the white dot so that both hands end up as shown by the black dots in the fourth diagram;

Repeat to turn further (a full lock of the wheel is 1.5 - 2 full turns or 540 - 720 degrees);

Reverse the process to return the wheel and avoid allowing the wheel to spin on return as this could cause loss of control or a skid in extreme cases.

In all cases the black dots symbolise a gripping hand and the white dots a sliding hand!

Do not practice this technique by turning the wheel while the vehicle is stationary as this could damage the tyres and / or the steering linkages. The technique can easily be practised by using a round tin tray and it will only take a small amount of practice before you relate this back to the steering wheel. Even a gorilla could learn this in about 15 minutes, maybe even less if tempted with a banana!

Also please note that this is the technique used in the UK and although I agree that this is an excellent safe way of turning the wheel - there are other ways so if you live elsewhere be guided by your country's rules on this.

How much you need to turn the wheel to get around a corner is determined by:

a) how sharp the turning is;

b) the steering ratio of the vehicle.

What do you mean 'steering ratio'?

It's nothing that you particularly need to understand, but on some vehicles, you need to turn a bit more than on others. More often than not, you need to turn the wheel less on a smaller vehicle, but this amount is only slight. Similarly, different vehicles have different *turning circles* (how much road space is required to do a *'U'* turn).

When on the open road look well ahead and try to steer a steady course avoiding any sudden or erratic movements of the wheel. New drivers often suffer from self-induced *'tunnel vision'* where they look at the end of the bonnet instead of the road ahead. You need to look at the *'moving road'* ahead not any fixed points. But to be honest, it's rare that this takes more than a couple of hours to come right. If the problem does persist, it's possible that you could have a peripheral vision condition and will need to consult an optician.

Power Assisted Steering

Most modern vehicles tend to have power assisted steering (PAS) as a standard feature which effectively means that turning the steering wheel is physically easier than without it and is particularly useful at slow speeds when parking etc. When driving at speed, this makes little difference.

Note that if the engine cuts out whilst moving, the power assisted steering will be lost. This doesn't mean that you won't be able to steer, but it will become significantly heavier and consequently more difficult to turn.

Steering Locks

Most modern vehicles are fitted with factory built steering locks, which need to be de-activated before starting the engine. Often this is achieved by wobbling the wheel slightly as you turn the ignition key, but there could be many variations so consult the vehicle's handbook.

The Pedals

All manual motor vehicles have three foot pedals which from right to left are:

- the *'accelerator'* (used with the right foot only);
- the *'footbrake'* (also used with the right foot only) and
- the *'clutch pedal'* (used with the left foot only).

These pedals are always in the same relative position regardless of whether the vehicle is right or left-hand drive.

Automatic vehicles only have an accelerator and footbrake (no clutch pedal) and in this case the right foot is still used for both pedals although the left foot can be used on the footbrake when manoeuvring very slowly, but generally the left foot becomes redundant.

Ok, so now in more detail.

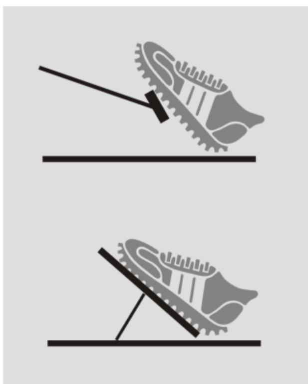
The Accelerator

The *'accelerator'* or *'gas'* pedal controls the amount of fuel that enters the engine via the carburettor or fuel injectors and consequently controls the engine speed of the vehicle and therefore also the road speed depending on the gradient, which gear is engaged and the gear ratio of the vehicle.

Don't worry if this sounds like gobbledegook, it will become perfectly clear later.

The *'accelerator'* pedal is extremely sensitive particularly in the lower gears where there is a much greater response, so extreme care must be taken with it.

When moving off uphill or level it's necessary to apply only a small amount of pressure (the first change in engine tone from tick-over) and then hold it steady while the rest of the work is carried out with the clutch pedal. This amount of pressure is referred to as *'set the gas'* or *'set the revs'*.



You will probably find that using the ball of your foot on this pedal while keeping your heel on the floor as a pivot will give you the best control, but it does depend on the design of the pedal.

The most common type is as per the top diagram shown here, but larger vehicles; particularly vans tend to have the lower design where you will probably find that the position shown will work best - but experiment.

It’s very rare that the accelerator is pushed right down to the floor in the lower gears, but perhaps so in the higher gears where it will be far less responsive.

Using too much acceleration when moving off can damage the clutch linings and / or make the vehicle shoot off out of control, whereas insufficient pressure will cause the engine to stall.

Initially, it appears to be the easiest pedal, but I assure you that this is not so, and considerable practice may be required to *thoroughly* master it.

The Footbrake

The *'footbrake pedal'* operates the brakes on all four road wheels via a hydraulic fluid system and also the rear brake lights.

The *only* time that the left foot is used on the footbrake on a manual vehicle would be to briefly dry out the brakes after travelling through flood water or a ford, which is normally an extremely rare occurrence.

Similar to the accelerator, the footbrake is extremely sensitive, but in a completely different way. Sometimes it's necessary to apply very firm pressure on this pedal, but it should never be *stamped* on. Pressure should be firm where necessary but *progressive.*

How much pressure you need to slow down or stop will be determined by the road speed, the gradient and the road surface.

Now it must make logical sense to you that more pressure will be required to stop from 70 mph than from 10 mph - Yes?

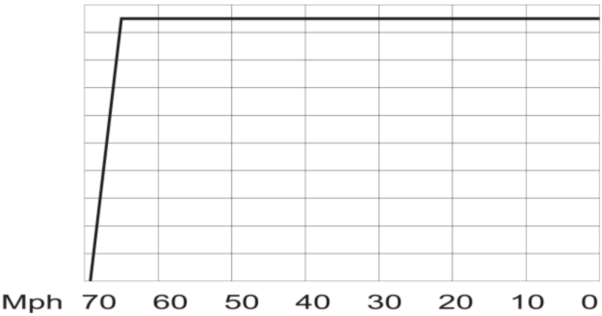
Yes of course.

And if the correct amount of pressure is applied at 70 mph at some time during the deceleration you will be doing 10 mph. Therefore if the original amount of pressure is maintained the vehicle will come to a halt with a massive jerk or possibly skid out of control.

In other words pressure should be applied firmly but *progressively* as necessary at first, but then relaxed during the deceleration so that little or no pressure is applied at the point of coming to a standstill - thus avoiding any jerks or loss of control.

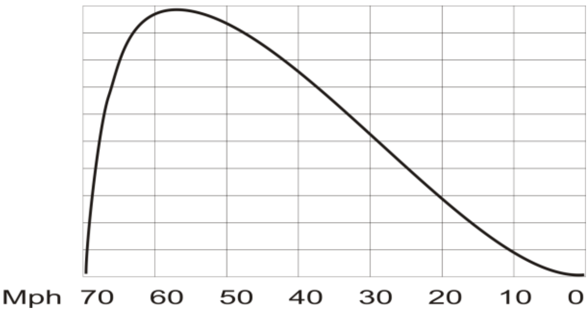
To make an efficient controlled stop even in an emergency the wheels must be turning right up to the point of stopping. Once the wheels are locked and skidding occurs the vehicle is out of control. To regain control brake pressure should be released and then re-applied more progressively.

The following two graphs show examples of correct and incorrect braking from 70 mph. The first one where full braking pressure is applied and maintained would certainly result in a skid (and total loss of control) even on a good dry road surface.



The second graph below shows a controlled progressive stop where braking pressure is released to nil at the point of stopping.

Extra care should be taken with this pedal in any conditions other than a smooth dry road surface.



Power Assisted Braking

Most modern vehicles have power assisted brakes. This means that the effort of applying the footbrake is made easier due to a *servo assisted* mechanism. This is achieved by the system storing a vacuum in the unit which multiplies the force transferred to the brake master cylinder when the footbrake is applied.

Similar to power assisted steering, if the engine cuts out whilst the vehicle is in motion as soon as the vacuum pressure is lost, the power assistance will be lost which won't mean total brake failure, but *considerably* more braking pressure will be required.

ABS

ABS (Anti-lock braking system) is a feature which is now becoming standard even on budget priced vehicles.

Basically this prevents the wheels from locking as a result of braking too hard on bad road surfaces, by releasing and re-applying the brakes very quickly and thus *reducing* the possibility of skidding. But please don't think that this will enable you to drive any faster on bad road surfaces, it will just *help* you make a more efficient stop assuming you're not travelling too fast for the conditions to start with!

Hydraulic Fluid Reservoir

Check your vehicle's handbook for the location of the braking system hydraulic fluid reservoir.

Periodic checks should be made to see that the fluid level is between the high and low marks. It's normal for the level to go down as the brake pads wear down and topping up is *not normally* necessary. As soon as new brake pads are fitted the level will automatically increase to the higher level and will consequently overflow if topped up unnecessarily.

Should the level drop below the lower mark, do not drive the vehicle as brake failure will be imminent - seek immediate professional assistance. A warning light will normally illuminate if this occurs.

If any air or contamination mixes with the brake fluid, brake failure will result. Therefore the fluid and pipes should be checked and replaced periodically by a qualified mechanic.

The Handbrake

In the unlikely event of footbrake failure (which incidentally has happened to me several times even in brand new vehicles) there is a separate and separate means of stopping the vehicle which the law requires, and this is the *'handbrake'* which works generally by means of a cable system to the rear wheels only.

Its normal function as I'm sure you already know is to hold the vehicle from involuntary movement while stationary (whilst parked or at traffic lights or uphill junctions etc. But in the event of footbrake failure it can be used to help stop the vehicle and this is the *only* time that it should be used for this purpose. And in this case as it operates only on the rear wheels it won't be anywhere near as effective as the footbrake, but nonetheless could save your life (as it has done for me on a few occasions).

The handbrake lever is generally located between the two front seats, but there can be variations. Some new upmarket models have an electronic handbrake lever, in which case you will need to consult the handbook for operating instructions.

To release the usual type:

1. Firstly make sure that the vehicle is secured by some other means and won't roll away;
2. Raise the lever slightly to release the safety catch;
3. Push the button in;
4. Holding the button in, lower the lever to its lowest position (the floor). At this point the dashboard handbrake light will go out.

To Re-apply it:

1. Press the button in;
2. Raise the lever until there is some resistance;
3. Release the button and pull up one click - the handbrake should then be fully applied.

Avoid applying the handbrake by pulling it up on the ratchet (without pushing the button in) as this could eventually damage the mechanism.

Avoid pulling the handbrake on further than it needs to be as this will eventually stretch the cable but do make sure that it is applied *'firmly'*.

If parking on a hill as an additional precaution also ensure that the vehicle is left in *first gear* (if uphill), or *reverse gear* (if downhill).

Why?

Because the compression of the engine, even when not running will help prevent the vehicle from moving if the handbrake fails. Note that this actually is less effective as the engine cools down, but worthwhile, nevertheless.

Well what if that fails and the handbrake fails at the same time?

Another sensible precaution is to turn the wheels hard to the right if there's a kerb or hard to the left if there's no kerb, then in the unlikely event of everything else failing, the vehicle will be stopped by the kerb or hedge etc. The above statement assumes that the vehicle is parked *uphill,* if *downhill* the wheels will need to be turned the opposite way.

The Gear Lever

Most small to medium modern manual vehicles have five forward gears, one reverse and neutral (which is no gear). Larger vehicles now tend to have six gears. The gears are selected via the gear lever which is usually (but not always) located slightly forward of the mid front seat positions, but you probably know this already.

In order to *select* a gear, the clutch pedal must be depressed - I don't mean *'not happy'*, I mean pushed *fully* to the floor! Then when the clutch pedal is brought up the gear becomes *engaged* which then joins the engine to the drive wheels which you'll see later.

So let me just re-iterate this important point:

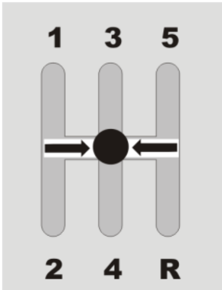
- a gear is *'selected'* when the clutch pedal is *'down'* and the gear lever is moved into the appropriate position;
- a gear becomes *'engaged'* when the clutch pedal is *'up'* after a gear has previously been selected.

Before starting the engine, you must always make sure that the handbrake is applied, and that the gear lever is in *'neutral'* position. Failure to comply with this essential requirement could result in the vehicle lurching forwards (or backwards) if the ignition key is turned with a gear engaged, which of course could cause serious injury to a pedestrian.

The most common gear lever layout is shown here. But as there are variations, you must check your vehicle's handbook.

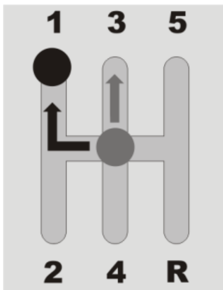
'Neutral' is the only position where the lever can be moved freely from side to side (along the white area shown), but most have

springs which make the lever return to and *'rest'* in the central position (as shown here by the large black dot).

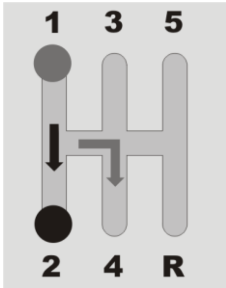


The following explanations for selecting the various gears on a standard 5 speed box assume that you are using a right-hand drive vehicle (as in the UK, Ireland, Malta, Cyprus, Australia and most Asian / African countries) and therefore will be using your left hand. If you drive a left-hand drive vehicle, (as in mainland Europe or America) then you would of course need to use your right hand and the *palm and push* positions described shortly will need to be reversed.

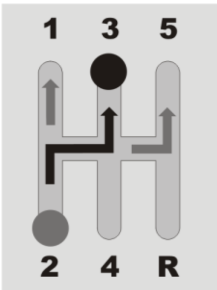
In all cases, when moving the gear lever, never use *force*, if it won't move easily, you are either pushing it somewhere where it doesn't want to go, or the clutch pedal is not fully disengaged (pedal should be down to the floor). It's a good idea to practice initially with the engine switched off and the handbrake applied, but even then, the clutch must still be disengaged (pedal down).



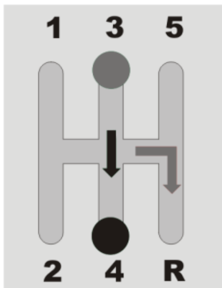
To select 1st gear from neutral, use the palm of your hand facing away from you and push gently over and up in two movements as shown by the black arrow. After pushing *'over',* you will need to keep the pressure on as you push *'up'*, to prevent the spring pushing back, which could result in you selecting 3rd by mistake (shown by the grey arrow which is the most common error). After the gear is selected, the clutch pedal can be engaged (allowed up) to engage the gear.



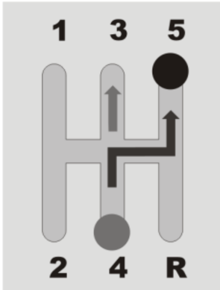
To change from 1st to 2nd gear, again use the palm of your hand facing away from you and push gently straight down as shown by the black arrow, but with pressure on to the left otherwise the spring will push back and you could end up in 4th (most common error shown by the grey arrow).



To change from 2nd to 3rd gear, this time use the palm of your hand facing downwards towards the floor and push gently up to the neutral position (not too far), which will then allow the spring to take the lever to the central position, then push gently straight forwards into 3rd gear as shown by the black arrow. If you push too hard initially you may end up in 1st, or if you push over to the right instead of just letting the spring take it, you could end up in 5th. Both these common errors are shown by the grey arrows.

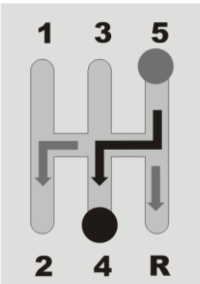


Changing from 3rd gear to 4th is one of the easiest changes and you would have to be a bit of a brute to get this one wrong. Again with your palm facing down simply guide the lever straight down using your four fingers only. If you are heavy handed it's possible that you could head for reverse. You will know if this happens as there will be a loud grating noise immediately followed by a punch in the face from your instructor!

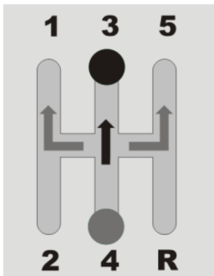


To change from 4th to 5th, you will need to have your palm facing towards you and push gently up to neutral then over to the right against the spring, then further forwards as shown by the black arrow. If you push too far initially, you will go straight into 3rd, which is the most likely error shown by the grey arrow.

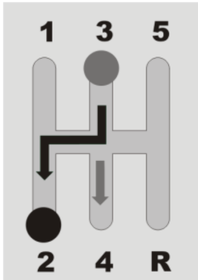
So that's dealt with changing up through the gears. Now we'll go the other way and change down.



To change from 5th to 4th, although not difficult, this is one that gave many of my pupils problems, probably because it wasn't used as often as the other changes. With your palm facing down, pull it out of 5th with your four fingers, (but not too far or too heavily), the spring will then take it to the central neutral position, then with your fingers only, tap the lever gently into 4th as shown by the black arrows. If you are too heavy pulling down initially, it will try and go into reverse and if you push to the left rather than letting the spring take it, you will end up in 2nd. Both common errors are shown by the grey arrows. And both could do serious damage to the gearbox at the speed that you would likely be travelling at in 5th gear. So make sure that you practice this one extensively while the vehicle is stationary.



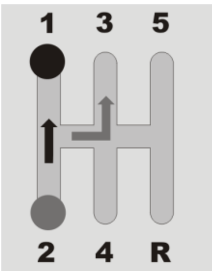
To change from 4th to 3rd is very easy and rarely carried out incorrectly. With your palm facing down simply push the lever gently forwards without any pressure to the right or left as shown by the black arrow. If you are an absolute brute, it's possible that you could select 1st or 5th by mistake, but this is extremely unlikely.



Changing from 3rd to 2nd is more difficult as you will need to push against the spring and could easily drop into 4th by mistake. Gently pull the lever back into neutral and then with your palm facing to the left push to the left against the spring and then down into position.

Probably the most common error is not keeping enough pressure on to the left (against the spring) and then hitting 4th instead.

Changing from 2nd to 1st is fairly simple, again with your palm facing to the left, push straight up while keeping pressure on to the left at the same time to prevent the spring guiding you into 3rd which is the most common error.



Be sure to practice all of these gear changes as directed while the vehicle is stationary until you can manage them easily without looking down at the gear lever. And remember - you never need force, just gentle guidance. If it needs force, you are either pushing the wrong way or the clutch pedal is not down far enough.

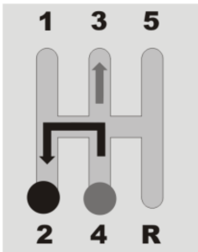
Surprisingly the gentlest of people (nurses etc.) are the most likely to be brutes with the gear lever - whereas bricklayers, steeplejacks and scaffolders tend to be quite gentle - a point that's always baffled me!

Block Changes

Very often it becomes necessary or useful to miss a gear out, mainly when changing down. This is referred to as *block* changing. Don't worry about why and when you need to do this as this will become clear later.

Without doubt the most common block change is 4th to 2nd and if you only learn this one then that's fine, but the other possibilities are:

- 1st - 3rd;
- 3rd - 5th;
- 5th - 3rd and
- 3rd - 1st.



But in order to keep things as simple as possible I'll just cover 4th to 2nd as shown in the diagram. Initially have your palm facing forwards and push gently into neutral, then change your palm to face the left and push to the left against the spring and then down into position.

There are two likely faults; either pushing too far forwards initially and ending up in 3rd or not keeping enough pressure on to the left and ending up back in 4th.

Would you ever miss more than one gear out?

Not so often, but yes occasionally When slowing down 5th - 2nd or 4th - 1st may become useful. You can change from any gear to any gear as long as the speed and gradients are compatible.

Doing it for real

Ok, so having practiced moving the gear lever around while the vehicle is stationary, you'll then need to try it whilst moving.

Initially just try moving off (dealt with next) and changing into 2nd and then stop again. Then gradually progress through the gears on a variety of fairly gradual gradients.

So the technique for ***changing up*** is as follows:

1. Gather the correct amount of speed (which is minimal on a level road);
2. Place your hand on the gear lever correctly positioned as described previously;
3. Depress the clutch pedal and release the accelerator *together;*
4. Gently move the gear lever into the appropriate gear as described previously after which your hand must be immediately returned to the steering wheel;
5. Gently allow the clutch pedal back up to the top, remove your left foot completely and rest it to the side;
6. Accelerate as necessary.

The most common faults are:

a) Selecting an incorrect gear - engine will labour, roar or stall;

b) Not depressing the clutch pedal enough - the gear lever will not move easily;

c) Not releasing the accelerator - the engine will roar;

d) Allowing the clutch to partially engage before a gear is selected - gearbox will grate causing gearbox wear and possible damage;

e) Not allowing the clutch pedal back up quickly enough - vehicle will slow down and need the previous gear;

f) Not bringing the clutch pedal up smoothly enough - vehicle will jerk;

g) Not returning your hand to the steering wheel - possible loss of steering control.

Having progressed into 3rd gear a few times, rather than stopping, try slowing down again and changing back down into 2nd.

The procedure for changing down is more or less the same as changing up, although of course in many cases (although not in every case) you will be slowing down rather than speeding up. More information about this will be revealed in a later chapter.

The procedure for ***changing down*** is as follows:

1. Reduce speed if necessary, by braking or releasing the accelerator;
2. Place your hand on the gear lever correctly positioned as described previously;
3. Depress the clutch pedal and release the accelerator *together* if you are using the accelerator, but if you are slowing down it’s more likely that you will be using the footbrake in which case this *must not* be released;
4. Gently move the gear lever into the appropriate gear as described previously after which your hand must be immediately returned to the steering wheel;

5. Gently allow the clutch pedal back up to the top and remove your left foot completely and rest it to the side;
6. Accelerate or continue braking as necessary.

Note that at point 3, as the clutch is disengaged it's likely that there will be an increase in speed due to the engine braking being released, so you may even need to *increase* footbrake pressure slightly at this point to compensate for this.

The most common faults are:

a) Selecting an incorrect gear - engine will labour, roar or stall;
b) Not depressing the clutch pedal enough the gear lever will not move easily;
c) Not releasing the accelerator - the engine will roar;
d) Allowing the clutch to partially engage before a gear is selected - gearbox will grate causing gearbox wear and possible damage;
e) Releasing the brake when slowing down - speed will increase;
f) Not bringing the clutch pedal up smoothly enough - vehicle will jerk;
g) Not returning your hand to the steering wheel - possible loss of steering control.

Why and when to change gear and how to make smooth gear changes will be dealt with in detail in a later chapter.

What happens if I need to change down at the same time as turning a corner?

You don't! You must make sure that speed reduction and gear changing is done first.

Ok, now we'll move onto the clutch pedal.

Hang on, what about reverse gear?

Very often you will find reverse gear located in the position as indicated in the previous diagrams, *but not always*. This can vary considerably so you must check the vehicle's handbook for details. But nearly always there will be some sort of *'gate'* to help prevent you from selecting it by mistake. Having said this, many of my pupils attempted it! Usually the gate is passed by lifting or pushing down on the lever in addition to the other movements

When stopping a boat or landing an aeroplane it's normal to go into reverse to assist stopping - is this the same in a car?

No absolutely not! And even attempting this could cause serious and very expensive gearbox damage.

Curiously I've taught a few young men to drive who were also learning to fly at the same time. All had good aptitudes and all of them secured their flying licenses before passing in a car - *probably because there's less traffic up there!*

The Clutch

The *'clutch pedal'* operates the *'clutch',* which is a device which enables us to either connect or disconnect the engine from the drive wheels either totally or partially and is used for moving off, changing gear, and stopping (and clutch control - which is a combination of moving off and stopping).

Now I don't expect you understood a single word of the last statement, so I'll explain it slowly and, in more detail, using a series of diagrams.

Firstly, do you know the difference between a front wheel drive vehicle and a rear wheel drive?

No!

Ok, on a front wheel drive, the front wheels connect to the engine and the vehicle gets dragged along by the front wheels. On a rear wheel drive, the rear wheels connect to the engine and the vehicle is pushed along by the rear wheels. On a 4 x 4 (four-wheel drive) both front and rear wheels connect to the engine so that the vehicle is pushed and dragged at the same time. Do you understand now?

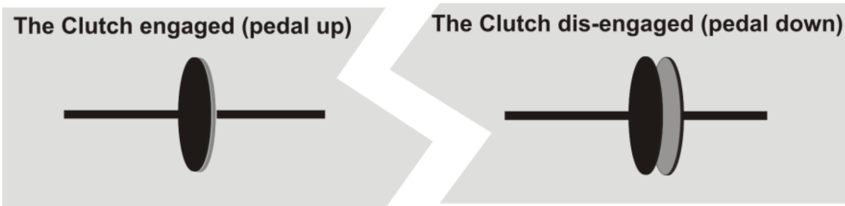
Yes!

Now most small cars are in fact *front wheel drive* but in my diagrams, we're going to show a *rear wheel drive*, because it's easier to illustrate and consequently easier for you to understand.

The power to make the vehicle move is transmitted from the engine to the drive wheels via the clutch, gearbox, drive (prop) shaft and back axle - collectively referred to as the *'transmission'*.

The *clutch* in its very simplest form consists of two circular plates (about the size of tea plates). One of these plates is connected to the engine and the other is connected to the gearbox. When the *clutch pedal* is up these plates are held firmly together by high pressure springs and the *clutch* is *‘engaged’*. When the *clutch pedal* is down the plates are separated and the *clutch* is then *‘disengaged’*.

The diagram here shows these two conditions.



Never think of the *clutch pedal* as being *‘in’* or *‘out’,* because when the pedal is *‘in’* in fact the *clutch* is *‘out’* (disengaged) and when the pedal is *‘out’* the *clutch* is *‘in’* (engaged). I’m sure you’ll see that this can lead to a certain amount of confusion - so it’s best to refer to the pedal as being *‘up’* or *‘down’!*

Now do you know what a *cog* is?

No!

Ok, it’s one of those things with teeth on them that you see in watches and clocks. Do you know now?

Yes, I’ve seen them!

Good, now in the gearbox there are many cogs, which are used to change into the various gears, but for our purposes here initially it’s only necessary that we see two of them. The first one is directly connected to the rear clutch plate (and turns with it) and the other is directly connected to the drive shaft (and turns with it).

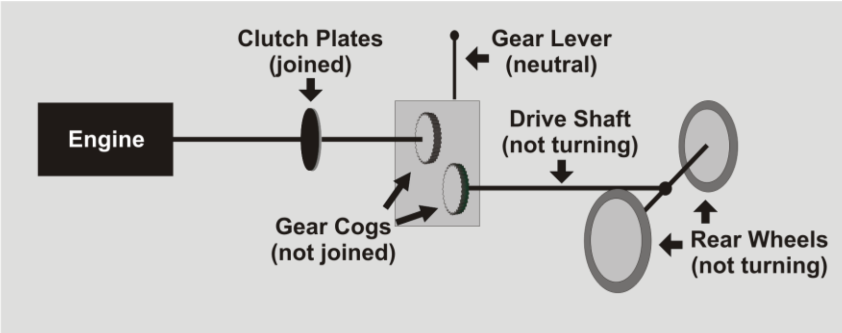
These can be seen in the diagrams below:

The only thing you need to understand about these right now is that when the gear lever is in neutral - the cogs are not joined, which means that either cog could turn either way without affecting the other.

In fact the cog which connects to the engine will of course turn as the engine is started, and the one connected to the drive shaft will turn if the vehicle was to roll backwards or forwards without any help from the engine i.e.; if the handbrake was released on a hill and the footbrake wasn't used to prevent this!

Now if you look at our next diagram, you will see that:

- the engine is turning;
- the two clutch plates are joined (pedal up);
- the top front gear cog is turning (gear lever in neutral);
- the lower rear gear cog is not turning;
- the drive shaft is not turning;
- the rear wheels are not turning.



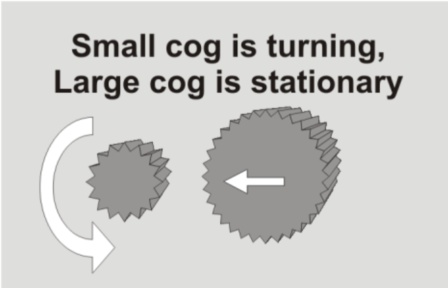
Assuming you have done everything correctly, this is how things will be when you first start the engine. *However, many new vehicles now will only allow the engine to be started when the clutch pedal is down (which would separate the two clutch plates as shown in the next clutch diagram a couple of pages on).*

Looking at the two gear cogs in this diagram, you will notice that the top one is turning at the same speed as the engine and of course if the engine speed increased (by accelerating) then so would the two clutch plates and the connected cog (top one). But the lower gear cog which is connected to the road (via the drive shaft, rear axle and rear wheels) will remain stationary.

Now what do you think would happen if we were simply to connect these two cogs now, bearing in mind that one is turning and the other isn't?

I'm not sure!

Well think about it, in fact we'll have a close look in the next diagram.



If we joined them, all the teeth would fly off in different directions and you'd end up with a knackered gear box. And if it was my car, you'd also get a punch in the face! So in order to join them more economically and less painfully, we have to make sure that both cogs are stationary when they join so that they can interlock easily, and this can be achieved by disengaging the clutch which is shown in the next diagram.

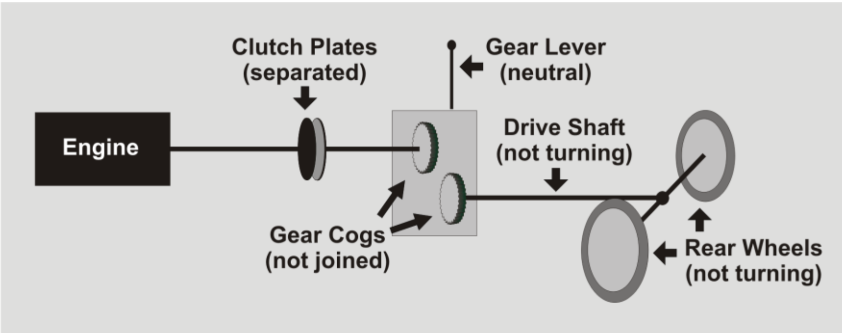
Now, after starting the engine, the first thing that we'd do in preparation for moving off, is to depress the clutch pedal fully (to disengage the clutch plates). This will separate the two plates leaving only the front plate connected to the engine, thereby disconnecting the rear plate and subsequently the top gear cog from the engine power.

This condition can be seen in our next diagram where you will see that:

- the engine is turning;
- the front clutch plate is joined to and turning with the engine;
- the rear clutch plate stops turning as soon as the clutch pedal is pushed down;

- the top gear cog is not turning (gear lever in neutral);
- the lower gear cog is not turning;
- the drive shaft is not turning;
- the rear wheels are not turning.

So in this diagram there are two splits between the engine and the drive wheels: the *'clutch'* being disengaged (pedal down) and the gear lever being *'in neutral'* (cogs separated).

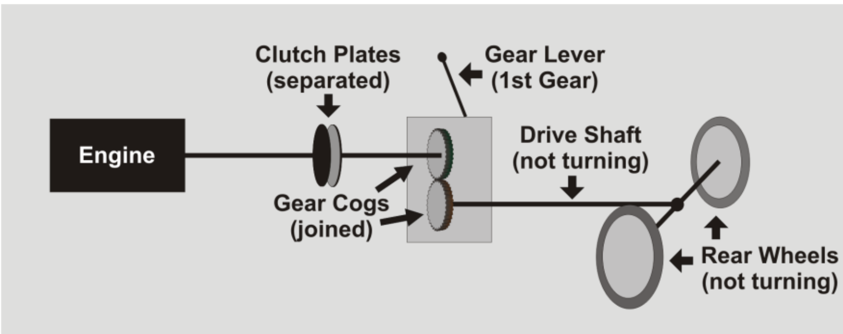


Now as there are *two splits in the circuit*, we can safely join one of these without anything horrible happening. And this is precisely what we do next by selecting first gear, which joins the two cogs, both of which are stationary so there's no fear of damaging the gearbox.

So in the situation illustrated in the next diagram, the only split in the circuit is in the fact that the clutch plates are separated *(disengaged),* therefore as soon as the clutch plates are allowed to join, the circuit will be complete and there will be a direct join between the engine and the drive wheels which will make either the engine stall or the vehicle move forwards.

This condition can be seen in our next diagram where you will see that:

- the engine is turning;
- the front clutch plate is joined to and turning with the engine;
- the rear clutch plate is not turning as the clutch pedal is fully depressed (down);
- the top gear cog is not turning (first gear selected);
- the lower gear cog is not turning although it is now joined to the top cog;
- the drive shaft is not turning;
- the rear wheels are not turning.



Now we're almost prepared for actually moving off, but of course the handbrake will have to be released first. Assuming we're on a gradual uphill gradient, what do you think would happen if the handbrake was to be released now?

I don't know!

Ok, if you had a ball and put it on the road, what would it do?

It would roll down the hill!

Correct! So what would happen to the vehicle if we released the handbrake?

It would roll down the hill backwards!

Correct!

And as the vehicle rolls backwards obviously the wheels would also turn *and* the rear axle *and* the drive shaft *and* both gear cogs *and* the *rear* clutch plate as they are all connected - as shown in the diagram.

So in that condition, one of the clutch plates would be turning one way (with the engine) and the other, the other way (with the road).

Now in order to prevent this from happening, if we could somehow hold the *rear* clutch plate still, then everything else along the line including the wheels (and consequently the vehicle) would remain still as well. And this is exactly what we do.

To achieve this firstly we need to increase the engine speed a little to have enough power which makes the front plate turn faster, then we gently allow the clutch pedal up *only* to a point where the front plate (which is turning) *grips* the rear plate, not enough to turn it, but enough to stop it from turning in reverse - this is called the *'biting point'*. You can *hear* this point clearly as there is a slight drop in engine tone and it can also be felt in the left foot - you'll soon get used to the *feel*.

Once this position is achieved, the handbrake can be released gently and the vehicle will stand still, but obviously you will have to keep your left foot steady as if the clutch pedal comes up even a fraction, the vehicle will move forwards and if the clutch pedal is depressed slightly, the vehicle will roll backwards.

You may need to adjust this slightly as necessary to ensure that the vehicle *does* stands still, and this could take a fair amount of practice.

It's a good idea to keep the heel of your left foot on the floor at this point to use as a pivot. Note that for anyone with small feet it can be useful to wear shoes with a small heel. Over 30 years of instructing experience has proved to me that ***this works***, despite it being *'common knowledge'* that you should wear flat shoes for driving!

Note that if you release the accelerator at this point the engine will stall. When this occurs (I say *when* because it *will* happen), the compression of the engine will prevent the vehicle from rolling back (even though it's not running), but the moment you depress the clutch pedal - the vehicle *will* roll back. This is why you must always apply the handbrake first (to secure the vehicle) *then* depress the clutch pedal and select neutral before restarting the engine.

Don't get too upset with yourself when you keep stalling, as this is an absolutely essential part of the learning process. Just think what a disaster it would be if you never stalled until the day of your test - you wouldn't know what to do would you?

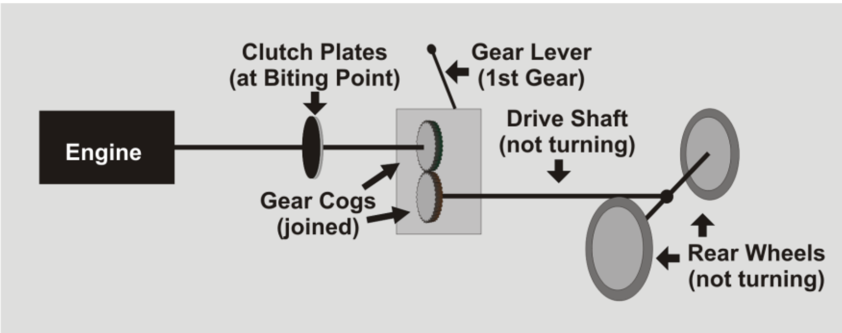
Remember the causes of stalling are:

a) not using enough acceleration or

b) not being gentle enough with the clutch pedal.

In our next diagram you will see that:

- the engine is turning;
- the front clutch plate is joined to and turning with the engine;
- the rear clutch plate is being gripped by the front plate at the *'biting point'* preventing the vehicle from rolling back;
- the top gear cog is not turning (first gear selected and partially engaged);
- the lower gear cog is not turning but connected to the top cog;
- the drive shaft is not turning;
- the rear wheels are not turning.



Having reached this point, you would then be in a position to; stand still, creep forwards (using clutch control), or move off all at a moment's notice.

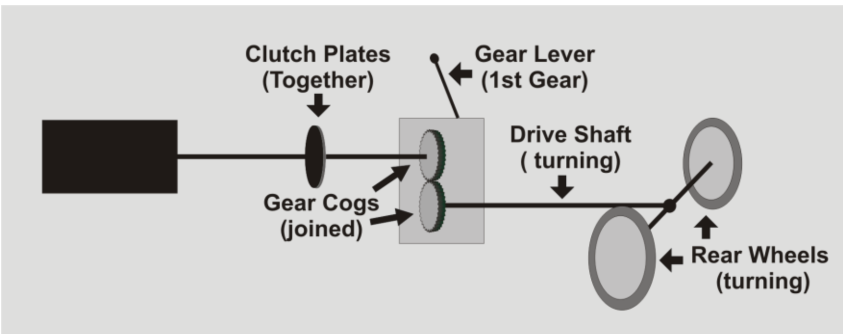
In order to move off from this point, all you need to do is relax pressure on the clutch pedal just a fraction and then KEEP BOTH FEET STILL as the vehicle moves forward, then once a little momentum has gathered you can remove your left foot from the clutch pedal and put it to the side.

Clutch control will be dealt with shortly.

Should you decide to stand still in this condition you must bear in mind that the clutch plates are burning against one another and if held for too long this could result in damage - so make about 5 seconds the limit. If you need to stand still any longer than this, then the handbrake should be re-applied, and the clutch disengaged to relieve the strain on the clutch linings. This will take you back to the position shown in the third clutch diagram.

Once the vehicle is moving this will take us to the position seen in the next diagram where you will see that:

- the engine is turning;
- the front clutch plate is joined to and turning with the engine;
- the rear clutch plate is joined to and being gripped by the front plate;
- the top gear cog is now turning (first gear fully engaged);



- the lower gear cog is now also turning (connected to the top cog);
- the drive shaft is turning;
- the rear wheels are turning; and consequently the vehicle MUST be moving (assuming all the wheels are on the ground).

I hope you've managed to understand at least some of this chapter. It may appear to be a bit complicated at first, but I assure you that if you read it again, you will eventually begin to understand it.

You probably think that I am extremely technically / mechanically minded, but I assure you that this is not the case. I've no doubt that engineering *'nerds'* could find all sorts of technical errors with my explanations, but for our purposes here they are as correct as they need to be!

I remember my father explaining all this to me many years ago when he taught me to drive. At the time I was totally baffled and never thought that I'd understand any of it, let alone one day be able to explain it to anyone else!

What's riding the clutch?

Driving with your left foot resting on the clutch pedal, which is bad practice as it puts unnecessary strain on the clutch release bearings and could also possibly cause the clutch to slip. After moving off or changing gear your left foot should be removed completely from the clutch pedal and put to rest at the side.

What's slipping the clutch?

Every time you move off or use clutch control, while the clutch plates are at the *'biting point'* they are *'slipping',* which is correct as long as it’s not used for too long - in which case the plates will begin to get too hot.

As just mentioned, *riding* the clutch could cause the clutch to *slip* while driving along and this could also cause clutch damage.

Finally, if the clutch linings are worn out or incorrectly adjusted *clutch slipping* would result.

To discover if your clutch linings are worn out or badly in need of adjustment, in a parked secure position:

1. Apply the handbrake firmly;
2. Attempt to move off (explained next) using 5th gear (or 4th if your vehicle doesn’t have 5th) *without releasing the handbrake.*

The engine should stall immediately and if it does everything is fine. But if the engine doesn’t stall and you can take your foot right off the clutch pedal, the clutch would be *slipping* due to a fault.

Wouldn’t this damage the vehicle?

If you did it continually at high rev’s then yes it would, but as a short *one-off* test this would cause no damage.

Note that the point of the exercise is NOT to actually try and make the vehicle move off, but to see that it *does* stall which should happen almost instantly. So *only* use the amount of revs that you would normally as explained next.

Moving Off - Stopping & Clutch Control

There are three starts: *'uphill'*, *'downhill'* and *'level'* and it's essential that you understand the difference between them. In all cases you need to be in a position so that you have both hands on the steering wheel as you move away. These will now be dealt with individually.

Uphill Start

The *'uphill'* start is the most difficult of the three as it's the only one where there is a fear of rolling backwards. It's therefore the only one where you have to co-ordinate finding the biting point with releasing the handbrake.

The last two diagrams in the clutch section, in fact explained the uphill start, but to summarise, here it is again in detail.

After safely starting the engine and doing all the other necessary checks, proceed as follows:

1. Depress the clutch pedal fully (to the floor);
2. Select 1st gear;
3. Set the engine revs' (just the first change in engine tone from tick over) and keep it steady;
4. Allow the clutch pedal to come slowly up to the biting point;
5. Keep both feet still;

6. Gently release the handbrake and make any slight adjustments to the clutch if necessary, to ensure that the vehicle *does* stands still;
7. Return your left hand to the steering wheel and make forward, rear and blind spot observations, then signal only if necessary;
8. When ready to move away, relax pressure on the clutch pedal a fraction, then keep both feet still - the vehicle will move forwards;
9. After the vehicle has gathered momentum, remove your left foot from the clutch pedal and put it to the side;
10. Accelerate to increase speed and change up as necessary.

The most common faults are:

a) Releasing the engine revs as the clutch comes up (*two left feet syndrome*) - the engine will stall;
b) Not being gentle enough with the clutch - vehicle will jerk or engine will stall;
c) Selecting incorrect gear (3rd instead of 1st) - engine will stall;
d) Not allowing the clutch up far enough before the handbrake is released - vehicle will roll back;
e) Allowing the clutch up too far before the handbrake is released - vehicle will move forwards too soon;
f) Applying too many revs - engine will *roar* and possibly move off too quickly, plus possible clutch damage.

Level Start

The *'level start'* is exactly the same as the *uphill* start except that as there is no fear of rolling backwards, the handbrake can be released earlier (after selecting 1st gear is a good time). But if the exact same technique as the uphill start is used, this is fine as well.

The same possible faults as above could occur, but of course the vehicle could not roll backwards.

Downhill Start

Although this is the simplest of the three starts, the *'downhill start'* is the one which is mostly performed incorrectly. Obviously as the vehicle is about to move with the gradient it will roll forwards as soon as the handbrake is released but remember to be in full control of the vehicle you need BOTH hands on the steering wheel at the point of moving.

The correct procedure is as follows:

1. Depress the clutch pedal fully (to the floor);
2. Select 1st or 2nd gear depending on how steep the gradient is (steeper gradients will require 2nd);
3. Depress the footbrake with the right foot;
4. Release the handbrake;
5. Return your left hand to the steering wheel and make forward, rear and blind spot observations, then signal only if necessary;
6. When ready to move away, simply release the footbrake and the vehicle will of course move forwards at a speed determined by the gradient;

7. Gently allow the clutch pedal right up before hardly any speed has gathered then remove your left foot from the clutch pedal and put it to the side;
8. Increase speed and change up as necessary.

The most common faults are:

a) Doing an uphill / level start instead and thereby moving off with only one hand on the steering wheel;
b) Allowing too much speed to gather before the clutch engages - vehicle will jerk;
c) Allowing the clutch up before the brake is released - engine will stall.

Stopping

If you are going to attempt any of this on your own (which I don't particularly recommend), please study this section thoroughly *before* you move off!

The correct procedure for stopping is as follows:

1. Use the mirror and warn any other road users or pedestrians of your intentions if necessary;
2. Reduce speed by releasing the accelerator and / or applying the footbrake progressively (how much of which will be determined by your speed and the gradient);
3. Depress the clutch pedal just before the vehicle comes to a halt and at the same time relax pressure on the footbrake so that little or no pressure is applied at the point of stopping;
4. Apply the Handbrake and put the gear lever back into neutral position *before* moving your feet;

5. Remove your feet or move off again as necessary.

Note that you can stop in any gear, but if you slow down to an inappropriate speed for the gear that is engaged and then change your mind about stopping, it will be necessary to change down into the appropriate gear for the reduced speed - more of this later!

The most common stopping faults are:

a) Being too late depressing the clutch pedal - resulting in the engine stalling;

b) Being too early depressing the clutch pedal - this could cause an *increase* in speed due to the engine braking being release too early - I'll explain more of this later;

c) Being too heavy on the footbrake which will cause a jerky halt at best or skidding and total loss of control in extreme cases. Be particularly careful on bad road surfaces (wet, snow, gravel, wet leaves etc.).

So which pedal goes down first the clutch or the brake?

Everyone asks this question, and the answer is that the clutch should be depressed just before the vehicle stops and the footbrake is applied depending on the speed and gradient, so may be needed before the clutch or possibly not at all. The two pedals have nothing to do with one another!

Clutch Control

'Clutch control' is a method used to move the vehicle slower than it will normally go in 1st or reverse gears and can be used on the level and uphill gradients only (not downhill).

This is mainly used when in the following situations:

- creeping forwards to gain vision at junctions etc.;

- moving slowly in traffic jams;
- parking (in forward and / or reverse gears);
- moving off at an angle.

The procedure for using *'clutch control'* is as follows:

1. Follow the same procedure as the uphill or level start up to point 8 where the vehicle first begins to move;
2. Before the vehicle gains momentum, re-apply pressure on the clutch pedal slightly which will make the vehicle stop again;
3. As the vehicle glides to a halt, relax pressure on the clutch pedal to allow the vehicle to move forwards again;
4. Repeat 2 & 3 as necessary until you are ready to either move away completely (keep both feet still) or stop (depress the clutch pedal).

The most common faults are:

a) Not keeping enough engine rev's on - resulting in the engine stalling;

b) Allowing too much speed to gather before re-applying the clutch pressure - which may result in the footbrake becoming necessary;

c) All other faults as with the *uphill* and *level* starts.

When needing to move extremely slowly on downhill gradients this is achieved by keeping the clutch pedal down and releasing and re-applying the footbrake as necessary - but as soon as speed is increased above an absolute crawling pace, the clutch must be fully engaged otherwise you would be coasting and possibly lose control (which I'll explain later).

So the clutch is like a brake then?

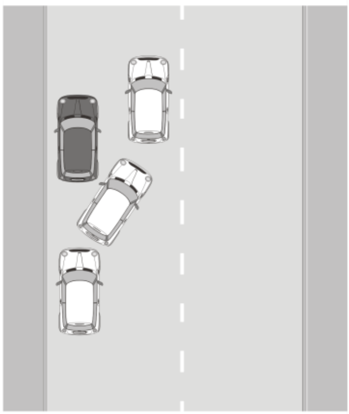
No it's not! When using clutch control and depressing the clutch pedal you are simply disconnecting the engine and allowing the gradient or lack of drive to stop the vehicle, which is why clutch control won't work downhill as the vehicle will simply roll down the hill however much you depress the clutch pedal. So no, it's not like a brake and not connected to the brake in any way. Do you understand now?

I think so maybe.

Well keep reading and re-reading this and I guarantee that you will eventually understand.

If you say so!

Moving Off at an Angle



The most common need for moving off at an angle is to emerge from a tight parking space at the side of the road and this is one of the times where clutch control will be necessary as you will need to move extremely slowly and turn the wheel at the same time - as well as making more observations than normal.

Here you will also see why it's essential to have both hands on the steering wheel at the point of moving as you will need to be turning (probably to full lock position) immediately.

Before attempting this manoeuvre from behind a parked vehicle, you would be wise to practice using clutch control and steering from lock to lock at the same time in an empty car park preferably with a gradual uphill gradient.

The procedure for moving off at an angle is as follows:

1. Prepare for the appropriate start (uphill, downhill or level) as described previously;
2. Make observations to the rear and offside blind spot;
3. Signal right (as it will take you longer to complete this manoeuvre signalling is advisable regardless of what is there or not);
4. Use clutch control (if uphill or level) or footbrake control (if downhill) to move extremely slowly as you manoeuvre around the obstruction;
5. As soon as the steering is returned to straight increase speed and change up as normal.

The most likely controlling faults are:

a) Incorrect use of clutch control or footbrake control - vehicle will move away too quickly allowing insufficient time to steer correctly or quickly enough;
b) All other faults associated with *clutch control*.

Note that if you are too close to the vehicle in front, you may need to reverse back a little before moving forwards.

On the UK driving test this is one of the manoeuvres that you will be expected to demonstrate, so when the examiner asks you to pull up behind a parked vehicle, *don't* get too close. If you are not near enough, he / she will ask you to move closer - but you don't want to make things unnecessarily difficult for yourself!

Changing Gears

Most modern cars have five forward gears and one reverse. Very basically, first gear is used for moving off and then as speed is increased, you progressively change up through the gears into fifth to reach the top speed - *easy!* But unfortunately you need a little more understanding of exactly what the gears do.

Now having read the above paragraph, which do you think is the most powerful forward gear?

5th?

That's what just about everyone says. This of course seems logical on the basis that the vehicle goes fastest in that gear, but in fact 5th is the *least* powerful gear! It's because you are getting *'speed'* mixed up with *'power' - big difference!*

To explain further, which do you think is the most powerful a tractor or a racing car?

I'm sorry, but I know whatever I say I'm going to be wrong - so I give in.

Probably just as well, because they're of course both powerful, but in opposite ways. In fact they may both have the same size engine, but the difference is that they are *'geared'* in completely different ways.

No one would dispute the fact that the racing car would go fastest, but if it ended up in a ditch, the *'low ratio'* geared tractor could pull it out!

In the clutch section I showed you just two of the cogs in the gearbox, one of which connected to the engine (via the clutch) and the other to the road (via the drive shaft etc.). Now we're going to add a few more cogs - *which are in fact 'gears'*.

But first, you will probably know that all cars have a speedometer which shows the road speed in mph (miles per hour) and / or kph (kilometres per hour) which is the speed that the vehicle is travelling at and having one of these is a legal requirement all over the civilized world. This speed relates to the gear cog which connects to the road illustrated in the clutch diagrams.

Now some cars also have another meter showing the engine speed - the *'rev counter'*. This shows the *'engine speed'* in rpm (engine revolutions per minute) and relates to the gear cog which connects to the engine and will always rotate at the same speed as the engine while ever the clutch is engaged (pedal up).

But the lower cog (in the clutch diagrams) which could be any of five depending on which gear is engaged, connects (ultimately) to the drive wheels and will consequently rotate at the speed of the wheels - the *'road speed'*.

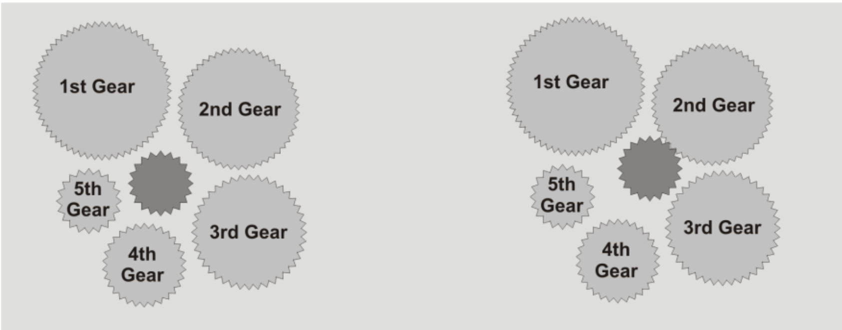
So the *engine speed* and the *road speed* are almost always completely different because of the gear ratio - the size of the cogs (and number of teeth).

I most point out that having a rev counter is not particularly necessary and is not a legal requirement. But if you do have one the important point to remember is that the higher that needle goes - the more fuel you are using. Beyond this for the average motorist it's nothing more than a toy!

So why mention it?

Because I want you understand the difference between *engine speed* and *road speed* - that's all!

Now to the cogs! Our next diagram shows the five gears (in a very simple form). The first diagram shows *'neutral',* where no gear is selected (no cogs are joined), and the second one shows second gear selected. As the gear is changed, the dark grey cog moves to engage with another cog (gear).



Assuming that the main drive (dark grey) cog has 20 teeth and the largest forward *road wheel cog* (1st gear) has 60 teeth, you should see that the one with 60 teeth will be driven 3 times slower than the one with 20 teeth in the ratio 1 : 3. Similarly the next cog down with say 50 teeth (2nd gear) will turn 2.5 times slower in the ratio 1 : 2.5 and in the other gears as there will be less teeth, the ratio would become proportionately reduced.

Please note that the figures in the examples that I've given are purely hypothetical and if you happen to be an absolute *'nerd'* and measure the circumference of the rear wheels, convert the rpm to mpg and take into account other factors that you don't really need to know about such as the differential and back axle gearing, you will find that in actual practice my figures probably wouldn't work.

In reality the first gear ratio would need to be more like 1 : 15 or more, but for our purposes here - it makes no difference - I'm just trying to keep things as simple as possible.

All you need to know is that the largest forward gear cog is 1st gear and this will transmit the *most* power to the drive wheels but won't allow the vehicle to go very fast. And 5th gear is the smallest cog which transmits the *least* power to the drive wheels but will enable the vehicle to reach its top speed. All the other gears (2nd, 3rd & 4th) vary in performance proportionately according to their cog sizes.

Obviously, the difference in gear ratios between a tractor and a racing car is enormous as they are the two opposite ends of the spectrum. Different makes and models of *normal* road vehicles have slightly different gear ratios, but in most cases the difference is virtually imperceptible especially to a novice. In over 50 years of driving I've never once looked at the gear ratio figures when buying cars, I've judged them by how they *'feel'* when test driving them.

Changing Up

Have you ever pushed a car or anything heavy with wheels?

Yes, I think so!

Well you may have noticed that the initial *'shove'* was the hardest, then when you got the thing rolling it became easier, but of course you had to run faster to keep up with it! Yes?

Yes!

Well that initial hard *powerful* push can be compared to 1st gear - *the power to get it moving*. Then as speed is increased, less power is needed so it becomes necessary to progressively change through the gears at least up to 4th. You may not need 5th until you get to a really open stretch of road where your speed is probably over 40mph (depending on the gradient).

So exactly what speeds should I be doing to change up?

Some people might tell you that you should change to 2nd gear at 10mph, 3rd at 20mph and 4th at 30mph, but in fact this is far from correct although it may often work.

So why is this not correct?

Because the *gradient* and *gear ratio* must also be considered! The correct answer is that you change up as soon as you can!

Going back to physically pushing a car, everyone should understand that it's harder to push a vehicle up a hill than on the level. And of course going downhill it will simply roll off on its own.

So clearly, it's possible and correct to change up much sooner going downhill as less *power* is required, and of course the opposite is true going uphill where it will be necessary to stay in the low gears longer.

In fact on reasonably steep downhill gradients it's better to move off in 2nd, or when moving off in first, to change directly from 1st to 3rd.

Wouldn't this harm the gearbox?

No not at all. When the gear and speed are compatible - there is less wear on the engine and gearbox!

But I still don't know when to change up!

Ok. Well basically you change up as soon as it's going *easily* in the lower gear, but as I've said, you will need to leave it in the lower gears longer going uphill and although the differences are only slight in normal cars - the gear ratio is also a factor.

If I want to can I just stay in 1st gear, to save all this confusion?

As long as you don't want to pass a test and you don't want to go much faster than 10mph, but then you might as well get a push bike - *but make sure you get one without gears!*

If you stayed in 1st gear over its maximum speed, the rev counter would be in the red (assuming you had one) to warn you that engine / gearbox damage is imminent, and you would also be wasting an enormous amount of fuel.

Well isn't there any gear that I could just stay in - 3rd maybe?

No there isn't!

The chart on the next page will give you a better idea but remember this is *only* a rough guide so don't take it as gospel as all gradients vary to different degrees as do the gear ratios of different vehicles (albeit slight). But basically remember: the steeper the uphill gradient - the more speed you need to increase before changing up and the steeper the downhill gradient - the sooner you can change up.

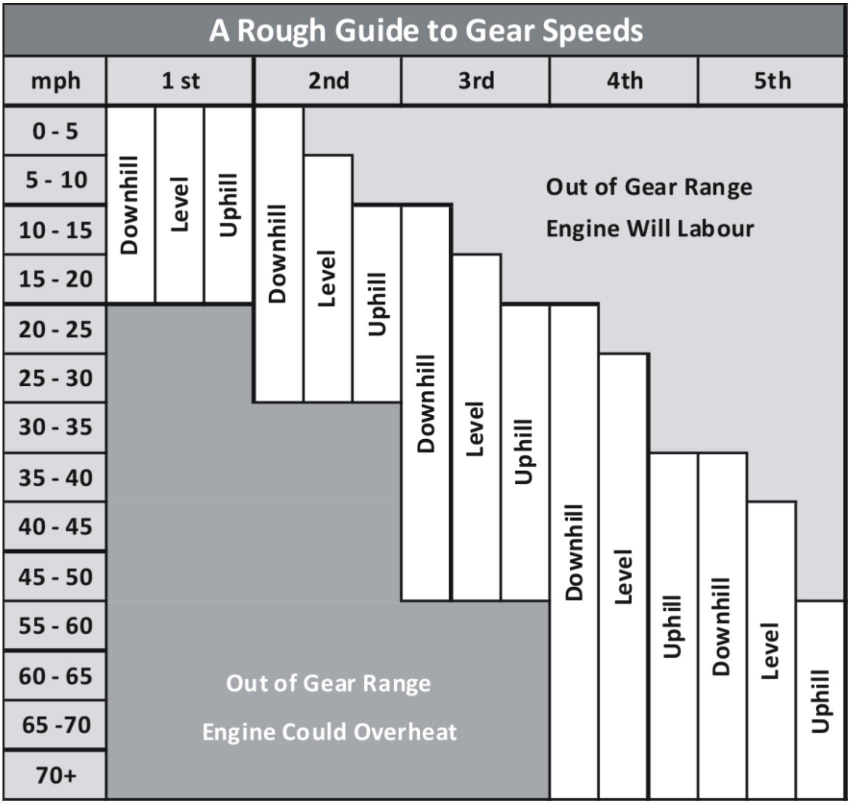
BUT just to confuse you more, sometimes when going downhill, you will need to stay in a lower gear to assist the braking.

You're right I was just beginning to understand it and you've just thrown another spanner in the works!

Well don't worry, we'll be dealing with this shortly and you will understand it - *I promise!*

If you say so - but what will happen if I get it wrong?

Looking at the chart, if you changed up in the *light grey* area, there wouldn't be enough power, so the engine would *'labour'* and / or stall. And before you ask, when the engine *labours* it will feel totally unresponsive (nothing would happen as you tried to accelerate) and it would also make a distinctive *'grumbling'* noise.



Another common mistake that you're bound to make early on is to take too long changing gear when travelling uphill, when it must be remembered that due to the gradient, for the length of time the clutch is disengaged (pedal down) there will be a speed *loss.* And this will be more pronounced on steeper gradients, but generally expect to lose between 5 - 10 mph when changing up uphill.

Looking at the chart again you will see that in order to change from 1st - 2nd uphill, you may need to increase speed to as much as 20mph in 1st, to take into account this speed loss and still have enough power to continue by the time 2nd gear becomes engaged (clutch pedal up).

Contrarily when going downhill, there will be a speed *in*crease during the gear change (due to gravity), so it can be possible and quite correct to change direct from 1st - 3rd virtually straight away as even if you're not going fast enough as you start the gear change, by the time you finish it you will be. Or of course you can move off in 2nd.

In all cases try and change up as soon as you can - when you get it wrong the car will let you know!

At the other end of the spectrum (the *dark grey* area on the chart) you will see that the gradient makes no difference. If you're going too fast for a particular gear, you will hear the engine *rev* excessively and you will be wasting fuel to an enormous degree as well as causing possible engine / gearbox damage.

So which is worst being too late changing up, or being too early?

Both are as bad as the other but being a *bit* too early or too late won't make any difference. Don't be afraid to experiment - *the worst that can happen is you'll get a punch in the face!*

Changing Down

As I said earlier as you speed up - you change up, and as you slow down - you change down, but there are also other situations where you may need to change down which we'll deal with here.

In all cases when changing down, you'll be doing it to *gain power*, but you will often need to gain power for different reasons, i.e.:

- to increase speed again after slowing down;
- to deal with a hazard;
- to *ascend* a hill;
- to accelerate;
- to *descend* a hill;
- to change from 2nd - 1st and gain clutch control.

We'll now deal with each of the above, and in addition:

- coasting; and
- use of gears in snow & ice.

Changing down to continue after slowing down

If you are slowing down and coming to a complete stop, it's not always necessary to change down - just stop in the gear you're in as described earlier.

But if you want to reduce speed and then continue at a slower speed, you will probably need to change down to a gear compatible for the lower speed and gradient.

What do you mean 'probably'?

Well if the speed reduction is only slight, and / or perhaps if you are travelling downhill, a gear change may not be necessary - look at the chart, but *don't* print it out and stick it to the windscreen!

How much you change down is entirely dependent on the speed and the gradient, or to put it another way:

- the vision or situation determines the speed;
- the speed (and gradient) determines the gear!

For instance if you are travelling along a level road at 30mph and intend making a left-hand turn at a speed of 10mph, you will need to change down to 2nd gear after reducing speed (by using the brakes or releasing the accelerator depending on the gradient).

As mentioned earlier it's quite possible and correct to change direct from 4th - 2nd. Unless you need 3rd for some other reason on approach, it would be pointless changing into it. This is often referred to as *block* gear changing.

So why might I need 3rd?

To deal with a hazard or potential hazard.

I don't wish to appear too thick and I know you've mentioned it before, but exactly what is a hazard?

Never be afraid to ask a question however stupid you may think it appears. If you don't understand something - you must ask. I've spent a lifetime not understanding calculus, because I was too embarrassed to ask! Anyway, I will be dealing with hazards very shortly which will answer your question in detail, but I doubt if I'll ever understand calculus!

But going back to what we're dealing with right now, if the turn was only very gradual, you wouldn't need to slow down as much and consequently wouldn't need to change down as much, so 3rd gear may suffice. Conversely, if the turn was extremely sharp, or steeply uphill, you may need to slow down more and may possibly need 1st gear.

Changing down to deal with a hazard

When approaching a hazard or bend in 4th gear, it's often a good idea to change down to 3rd gear, which will basically give you more *flexibility* to deal with the situation appropriately i.e., to be able to slow down and continue at a slower speed; or to be able to return to the original speed again quickly; or even to accelerate out of the problem.

But again the rule is *the more you need to slow down - the more you need to change down.* I know I've only just said it on the previous page, but this point is so important:

- the vision or situation determines the speed;
- the speed (and gradient) determines the gear!

Ok we'll now deal with *'what is a hazard?'*

Now remember that this book is all about *'control'*, not *'road procedure'* and hazards come into the latter category. But as you've asked and as they are so closely related, we'll deal with this one bit of *'road procedure'*.

A hazard is basically any situation which may cause you to slow down. Not all hazards will require changing down for, but all will call for the *preparation* for changing down (and of course the gear that you're already in is a factor that may make changing down unnecessary).

Every (European) triangular hazard warning sign or hazard warning line is there to warn you of a potential hazard ahead and therefore a possible gear / speed reduction.

But of course not all hazards have road signs or warning lines before them. Other typical hazards are:

- unattended animal or child on road or pavement;
- any obstruction which may reduce vision or road width;
- any potential blind area (shop doorways etc.);
- the brow of a hill or bend;
- traffic lights (regardless of colour);
- pedestrian crossings;
- school or school bus;
- hospital or old people's home;
- tram lines (particularly in the wet);
- emergency service vehicle(s);
- railway crossing;
- road works;
- accident;
- low flying aircraft;
- arched or humpback bridge;
- any vehicle or pedestrian behaving strangely or erratically;
- fallen tree or rocks or other obstructions;
- cyclist or skateboarder (on road or pavement);

- bad road surface (wet leaves, loose chippings, snow, rain, ice, potholes etc.);
- flood or ford;
- fog, smoke or wind;
- bin lorries, delivery vans, buses etc.;
- ice cream van or mobile shop;
- a learner driver;
- UFO's (scraping the barrel now) etc., etc.

Any of the above could cause a speed reduction and possible gear change.

What if I'm already in 3rd gear?

It's possible that you may already be in the correct gear and at the correct speed to deal with the hazard in which case that's fine, but if you need to slow down further - you may need to change down further or stop.

Changing down to ascend a hill

Let's assume that you are driving along a level clear road in 5th gear at 50mph. Now look at the chart shown previously, and you will see that the speed, gear and gradient are all compatible. You will also notice that it will feel correct and the accelerator will still be *'responsive'* in the fact that it will allow you to increase speed further should you so wish.

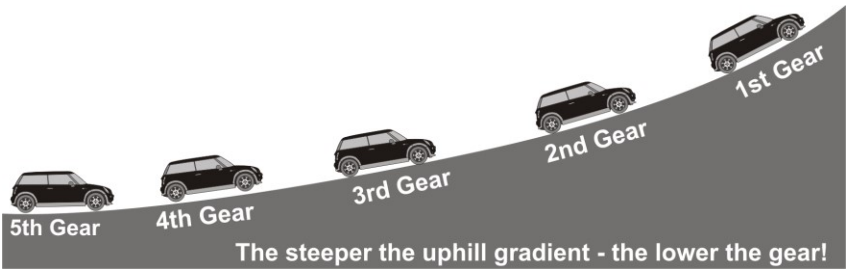
Now unless you are in South Lincolnshire, the road is not going to stay level indefinitely. Sooner or later you're going to come to a gradient which may be up or down, slight or severe.

You said earlier that I should ask if I'm not sure of something - so what's a gradient?

I think you might be taking the Mickey now! A gradient is an alteration in altitude - *a hill!*

Now, when coming to an uphill gradient if it's only slight, it's quite probable that no gear change will be necessary - which is fine. You'll of course simply need to accelerate a bit more to ascend the hill.

But if the gradient is more severe, it will be necessary to change down to 4th gear to gain enough power to maintain your speed as you ascend the hill.



How will I know and what will happen if I get it wrong?

You will feel a lack of response in the accelerator and the vehicle will begin to lose speed even as you accelerate more. When this occurs, if you are not quick enough re-acting (i.e. changing down to 4th) you will lose even more speed and will consequently need to change down further to 3rd. If the gradient is steep, this may happen anyway.

On extremely steep hills, it may not be possible to change up beyond 2nd or even 1st gear. And of course in these events, you wouldn't be able to go very fast either.

So to recap, the steeper the hill - the more power you will need and hence the lower the gear required.

If ever you are faced with a situation where the gradient is so steep that there isn't enough power even in 1st gear to get up it, firstly turn off everything electrical (especially air con and / or heater etc.), which may be enough to make a difference. Failing this, remember that reverse is more powerful than 1st, so you may have to reverse up. But please remember that this would never happen on a *'road',* - but could occur on a steep track or driveway. I've personally experienced this many times, but mainly *off road* in Spain and Cyprus.

What's 'off road'?

Off road driving is what silly people do for fun in 4 x 4's and involves driving across muddy tracks, rocky terrain, extreme gradients and shallow rivers to see if they can get into a total mess. Then they call their equally silly friends to rescue them in the hope that they get stuck too!

Changing down to accelerate

Often there's a need for increased power to accelerate out of a problem, or more likely to overtake another moving vehicle.

When overtaking on a two-way road and you need to *'borrow'* the other side of the road, you will need to complete the manoeuvre quickly in order to return to safety as soon as possible. Bear in mind that if you are travelling at 50mph and an approaching vehicle is also doing 50mph, you will be on a head on collision course at 100mph! - So extreme care is essential and if you are in any doubt or if the vision is limited - DON'T DO IT!

Head on collisions as a result of careless high speed overtaking are without doubt one of the highest causes of road deaths in the UK and probably everywhere else too!

Assume that we are travelling on a level road at 35mph in 4th gear and want to overtake a slower vehicle. Looking at our chart you will see that we could be in either 3rd or 4th gear without putting undue strain on the engine or gearbox at this speed.

Now the advantage of being in 4th gear is that less fuel will be used as the engine revs will be lower. By changing down to 3rd you will increase the engine revs and consequently use more fuel, but the trade-off will be that you'll gain *power* which will give you more *flexibility / acceleration* to increase speed quickly to do whatever it is you want to do, after which you could change back up to 4th in order to lower the engine revs and resume fuel economy.

Similarly if you were travelling at 60mph in 5th gear, in order to overtake or accelerate quickly for any other reason, you would be wise to change down to 4th etc.

Does this also apply to changing down on motorways?

Only to a certain extent. Unless you are driving something really heavy or towing a caravan, probably the only time that you will need to change down on a motorway is when traffic slows down due to road works, accidents or congestion etc. But for normal overtaking on motorways you would normally remain in 5th gear. But of course in this situation (and also on dual carriageways) you won't have to worry about oncoming traffic - so there wouldn't be the same degree of urgency.

Changing down to descend a hill

As well as changing down to gain power to *ascend* a hill, it's also often necessary to change down to *descend* a hill. Now this may sound a little confusing as obviously you don't need *power* to propel the vehicle down a hill, it will simply go down on its own even with the engine switched off.

So you may ask - why change down? Basically to assist the brakes and thereby maintaining more *control* over the vehicle. Or to put it another way, to make sure that you don't go down the hill too quickly and lose control.

Surely the brakes will do this won't they?

Yes of course to a point, and on a gradual short to medium descent, changing down would not be necessary (apart from in ice or snow which we'll be dealing with shortly), but on a long, steep descent the brakes could get very hot and even burn out (brake fade). The first time this happens to you (and it will), you'll immediately understand the reason for changing down.

Some people suggest that you should use the same gear to go down a hill that you'd use to go up it. Personally, I think this is a little extreme, but possibly correct in wet slippery conditions. You should, however, never be in the situation where changing down makes it necessary to *accelerate* down a hill - this would be ridiculous! If you find the need to accelerate when descending a hill - don't - just change up (which will release the engine braking as soon as the clutch is depressed) and use the footbrake as necessary to prevent too much speed gathering.

Changing from 2nd - 1st to gain clutch control

After you've read this section please read it again, then again ***and then again***. I doubt if you will see this information written anywhere else, yet it's of the utmost importance and the main reason that I bothered to write this book.

Learning and understanding this technique will save you a great deal of pain and pounds in driving lessons. But of course as well as reading and understanding it, you must practice it extensively.

Ok right now you probably don't know what I'm talking about anyway, so I'll begin by describing the situations where it's most necessary.

If you stop normally on an uphill road using the footbrake and clutch as described earlier - before you move off again it will be necessary to use the handbrake to prevent the vehicle from rolling back. Or in other words, you would be compelled to do a normal uphill start as previously described.

Now if you wanted or needed to stop uphill for just one or two seconds, going through all this *handbrake* procedure would be boring to say the least. Agree?

Yes!

Good.

Now the technique I'm going to show you will avoid all this nonsense and put you in a position so that you can:

a) stand still;

b) creep forwards; or

c) move off - all at a moment's notice without pratting about with the handbrake.

It’s most likely that you’ll need this technique at uphill junctions or in traffic jams etc., but when practising initially, choose a quiet gradual uphill road where you won’t disturb anyone.

Then proceed as follows:

1. If not already moving, move off and change up to 2nd gear;
2. Reduce speed to a crawling pace by releasing the accelerator (not by braking);
3. Depress the clutch pedal before the vehicle glides to a halt;
4. Select 1st gear;
5. While the clutch pedal remains depressed, set the engine revs (the same as with moving off) and keep them steady;
6. Allow the clutch pedal to come up to the biting point just as the vehicle glides to a halt (use your left heel on the floor as a pivot);
7. Adjust the clutch pedal up or down slightly to ensure that the vehicle stands still.

From this position if you want to:

a) stand still - keep your feet still. But if you need to stand still for more than 5 seconds, apply the handbrake, depress the clutch and then re-commence with a normal uphill start when safe to do so;

b) move off - proceed as with a normal uphill start as described earlier - relax pressure on the clutch a fraction and ***keep both feet still;***

c) creep forwards - use clutch control as described earlier (relax and apply pressure on the clutch pedal as necessary).

This all sounds very difficult, what will happen when I get it wrong?

I'm sorry if this sounds a bit complicated, but I suppose this is because it is - *at first anyway,* but if you practice as directed it shouldn't take you too long to crack it and then you'll be really glad that you bothered to read all this.

Believe me once you get this - you will master the control of the vehicle - I promise! And remember I've taught this technique to countless pupils successfully over a 30+ year period.

The most likely faults you'll make are as follows:

- If you don't have enough acceleration (revs / gas) - the engine will stall - and when it does, make sure that you apply the handbrake immediately to secure the vehicle;
- If you use too much acceleration - the engine will *'roar',* but more importantly the clutch linings will suffer 'burning' due to excessive friction (caused by the increased engine speed);
- If you select an incorrect gear - the engine will stall. It's surprisingly easy to select 3rd gear instead of 1st;
- If you allow the clutch up before you set the engine revs - it won't work, you'll just move away in 1st gear before you are ready;
- If you don't bring the clutch up far enough - you will roll back;

- If you allow the clutch up too far enough - the vehicle will move forwards.

Initially when practising this, you'll find it difficult to stop in a chosen position, but with practice you'll be able to pick the spot precisely. I know I said not to use any brake at point 2 above and on your first attempts don't, but when you begin to know what you're doing, it is ok to use a *dab* of brake if necessary (to prevent the vehicle from going too far forwards) as long as you understand that it must be released before you actually stop, otherwise you'll defeat the object of the exercise and force yourself to need the handbrake and do a normal uphill start!

To master this, you will need a fair amount of practice, but I must warn you that excessive practice will damage the clutch linings - so you should limit this to no more than 2 minutes in every 15 and don't hold it at the biting point for more than about 5 seconds.

If you start smelling anything unusual, this will be the clutch burning. If this occurs - stop doing it immediately and leave it for at least an hour to cool off. However you can drive the car during this time, just don't use clutch control.

Hill Start Assist

'Hill start assist' is a system becoming more widely fitted to *some* modern vehicles which enables the driver to stop on a hill using the footbrake; release the footbrake without the vehicle rolling back, giving enough time to set the engine revs (gas) and gain clutch control. As it only activates for a second or two, you would still need to be fairly quick, but no doubt this feature is loved by many.

But I strongly urge you to learn he clutch control procedure described above in order to thoroughly master the control.

Coasting

'Coasting' is something that you shouldn't do, but in order not to do it, it's of course necessary to know what it is!

Basically coasting occurs any time the vehicle is *freewheeling* i.e. when the drive wheels are not connected to the engine and the vehicle is moving.

Going back to our clutch diagrams, if the vehicle is moving in any of the first three diagrams - the vehicle is coasting. Or to put it simply - if the clutch is depressed or when the gear lever is in neutral or both and the vehicle is moving - then it's *coasting!*

So every time I change gear or stop, I'm coasting then!

Technically yes, but as this only occurs for a very short period of time and there's no other way of doing it, this is not considered to be coasting.

Does coasting save fuel?

Over the years some of the powers that be have claimed that coasting doesn't save fuel - but I'm not going to lie to you - of course it does! Just as if you *freewheeled* down a hill in a wheelchair or on a soapbox cart, you wouldn't need anything to propel you - gravity would do it for you.

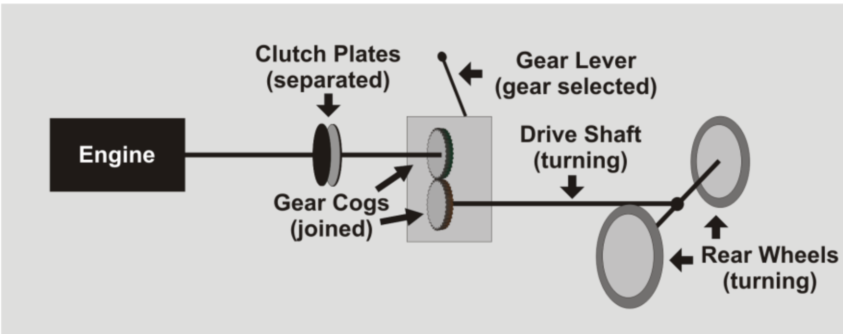
Anyone who tries to convince you that coasting doesn't save fuel is lying plain and simple!

But make no mistake about it - coasting can be dangerous (especially for the inexperienced), as you could lose proper control of the vehicle. And if you were stupid enough to switch the engine off going down a hill (to save even more fuel) you'd immediately lose the power assisted brakes and steering and as soon as you turned even slightly, the steering lock would activate, and you'd probably crash! - *But you would save fuel!* And if you weren't too badly damaged, whilst lying in your hospital bed, you'd have plenty of time to calculate exactly how much fuel you would have saved!

Making Smooth Gear Changes

After only a little practice you may notice that some of your gear changes are quite smooth whereas others are quite jerky. If you analyse this will probably conclude that changing up in the lower gears, mainly downhill and level are likely to be the jerkiest. Understanding why this is will help you correct it.

Going back to our clutch diagrams; during a gear change for the period that the clutch is *disengaged* and before the newly selected gear is *engaged* the vehicle will be in the situation as shown in the diagram below.



Both of the clutch plates will be turning at different speeds:

- the front one turning at the engine speed and

- the rear one turning at the road speed, probably much faster.

So as the clutch is engaged, however gently; as both plates are turning at different speeds there will be a jerk, more so in the lower gears as there is more power there.

To eliminate the jerk and make a perfectly smooth gear change, all you have to do is increase the speed of the front plate slightly by adding just a little *gas* (the same as when moving off), so that both clutch plates will be turning at same speed when they join therefore eliminating any jerks - simple!

However do not do this when changing up going uphill as you won't have enough time due to the potential speed loss and for the same reason, you don't need it anyway as the rear plate will be slowing down.

When changing down and slowing down, you will probably have your right foot on the brake, so just be as gentle as possible when engaging the clutch, and as you will be slowing down you will have more time for this without having to worry about speed loss.

Experiment with all this and you will find that with only a little practice, your gear changes will be perfect. But every time you get a jerk try and figure out why? - *There's always a reason!*

Yes but surely the faster I'm travelling the more gas will have to be added at this point, so how do I know how much this should be?

Yes this is correct, but the amount is always slight, through experimentation and experience you will eventually get it perfect.

Double de-clutching

What is double de-clutching?

Double de-clutching is something that was necessary over 50 years ago in vehicles that didn't have synchromesh. In order to prevent the gears from grating it was necessary to:

- de-clutch;
- move the gear lever into neutral position;
- engage the clutch;
- rev the engine;
- de-clutch again;
- select the appropriate gear;
- engage the clutch.

All of the above had to be carried out quickly. But all of this is now totally unnecessary so you can forget it!

So what is synchromesh?

I haven't got a clue, but I know that if you don't have it your gears will grate if you don't double de-clutch! But believe me unless you intend taking a gearbox to pieces and putting it together again, you don't need to know about it!

Use of Gears in Snow & Ice

The Highway Code states that you should be in a higher gear when driving in snow or ice; which is only partially correct. I'm not suggesting that the Highway Code is wrong, just incomplete on this particular point and if misunderstood this is a very dangerous bit of miss-information.

What it should say is: 'when *accelerating* in snow or ice you may need to be in a higher gear'. But of course in snow or ice unless you've got a death wish you're not going to *accelerate* very much!

In snow or ice you've got two main problems:

- getting the vehicle moving in the first place;
- stopping it!

And if you happen to get it going too quickly, you're going to have one hell of a job stopping it!

Before we go further, we'll look at a few different road surface conditions where you may need a *higher gear* to get moving. I'll list them in order of how dangerous they are, with the most dangerous first:

- black ice;
- compacted un-gritted snow / ice;
- wet leaves;
- oil (or similar) spillage;
- freshly fallen snow;
- wet slippery mud;

- gritted snow / slush.

The average learner driver sees snow as the most dangerous, but this is not the case. Freshly fallen snow can actually be quite easy and fun to drive on if you know what you're doing. Sure you might get stuck, but only if you're inexperienced, or unless it's unusually deep, or unless you drive across the Alps in a blizzard! - *Been there and got the T shirt!*

So what exactly is black ice?

The very worst condition is when you are travelling on an apparently ice-free road and then come across patches of ice which are totally invisible in the dark. This could occur through bad drainage on a previously wet road or when a stream runs across the road. Heed the warning if your vehicle has an ice warning light when the outside temperature reaches 4 degrees or lower!

Now the reason we sometimes need a higher gear to accelerate in these conditions is because (as stated earlier): the lower the gear - the more power is transmitted to the drive wheels. And often in the conditions listed above, this power will simply make the drive wheels *spin* instead of *gripping* the surface and moving the vehicle.

By using a *higher* gear - *less* power is transmitted to the drive wheels and thereby lessens the chance of *wheel spin* and increases the chances of *traction*.

So basically when in any of the above conditions *and accelerating* it's often necessary to move off in 2nd gear (even on level or slightly uphill gradients), then change to 3rd sooner than you would normally if conditions permit. However, depending on how bad the conditions are, you may not increase your speed enough to get into 4th or even 3rd gear. If you get too much speed up on ice - the only thing that will stop you is what you eventually hit! - And there might be a whole row of them and there's not a thing that you could do about it!

If after attempting to move away in 2nd gear you still fail to gain traction, reducing the tyre pressures in the drive wheels (by letting some air out) might just do the trick. This has got me out of trouble numerous times, but don't forget to re-inflate the tyres again as soon as you can.

Now contrary to what the Highway Code appears to say, coming down a hill in the worst of the above conditions, you certainly wouldn't want to be in a higher gear - this could be extremely dangerous as this is the one time that you need the engine braking more than ever.

In extreme cases (ice) the safest way to descend a steep hill (if you really must) is to remain in 1st gear and proceed very slowly with no acceleration and (if possible) no brakes - just let it tick over slowly to take you down the hill.

If actually on solid ice, the moment you start braking, you'll almost certainly skid and lose control - however clever you are. Descending steep hills on solid ice *should be avoided* by even the most experienced of drivers unless using studded tyres or other gripping accessories.

Another factor that you should know is that some vehicles perform far better than others in these conditions. Due to the fact that the engine weight is over the drive wheels, *front wheel drives* are considerably better than *rear wheel drives* (unless the engine is in the back). And of course *four-wheel drives* are far superior, but even in these - don't get complacent on ice, you can still easily lose control.

Also don't confuse a gritted road with ice. Once a road has been gritted, it's hardly more dangerous than a normal wet road, but of course you must be on your guard for areas that haven't been gritted. The worst conditions will be found in rural areas where the gritters don't get to.

If you are fortunate enough to be offered some driving lessons in snow or ice, you would be wise to jump at the chance or alternatively take some potentially lifesaving skid pan lessons.

The majority of problems in these conditions are as a result of inexperienced drivers getting stuck, which often could be so easily avoided. And remember it only takes one idiot at the front of the queue to bring the whole country to a standstill! - *Don't let it be you!*

Correcting a Skid

I can't teach you skid control in a book and neither can anyone else. But firstly remember that ice, snow or any other bad road surface does not cause skidding or accidents - it's entirely caused by *the drivers* through:

- braking too hard for the conditions;
- steering too suddenly for the conditions;
- accelerating too aggressively for the conditions; or
- a combination of all of them and basically simply *going too fast for the conditions*.

In extreme cases where you are travelling much too fast, there is nothing you can do but if you are aware of the situation early enough many skids can be corrected by:

a) releasing whichever pedal is causing the skid, which should help regain traction;

b) turning into it - (if the back of the vehicle is skidding to the right - turn to the right).

Surprisingly, to many of my past pupils this has been an instinctive re-action. But of course the best advice is to avoid the situation in the first place by awareness of the conditions and driving at the correct speed.

Automatics

To be honest I find just about everything that you've mentioned about as understandable as Chinese, can I forget all this if I drive an automatic?

If you persevere you will understand, I guarantee it, but if you physically can't do it for whatever reason *then I would* recommend an automatic.

But when driving an automatic, you *can* forget most of the information herein, but not *all* of it. You must realise that although they are *automatic,* they still have gears, which are changed *automatically!*

So the one thing that you must occasionally do is lock the gear into *Low* when descending a steep hill so that the engine assists the braking.

The advantages of automatics are that they:

- are much easier to drive (particularly for learners);
- are virtually impossible to stall;
- are ideal for individuals suffering from certain disabilities (one arm, one leg etc.);
- are generally more pleasurable to drive, particularly in congested traffic where continual clutch control is normally necessary.

The disadvantages of automatics are that they:

- are more costly if bought from new;
- use approximately 10% more fuel;

- cannot be bump started;
- are less controllable in bad weather;

Also, if passing the driving test in an automatic in the UK, you would not be licensed to drive a manual without taking a further test.

Personally I have to say that I prefer automatics and clearly, they will eventually take over completely especially when we go all electric, but until then, this book will be useful.

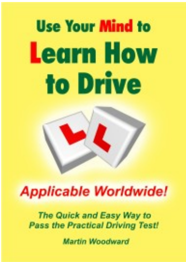
Thank You

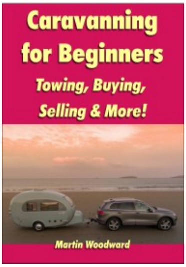
Well, that's it folks! But last but not least I'd like to thank you sincerely for buying this book. It's been my sincere wish to provide more value in real terms than the cost of this book. I hope that you think that I've succeeded, if so your positive feedback at Amazon, iBooks, Kobo, Nook or Lulu etc., would very much be appreciated.

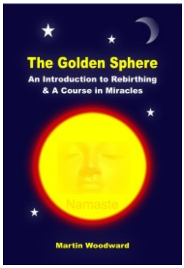
Kind Regards and thanks again,

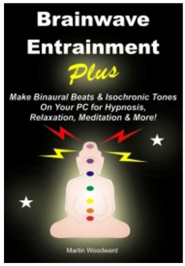
Martin

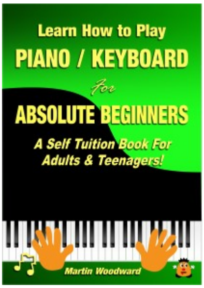
Other Books by Martin Woodward











All of these and many more can be found at:

- https://deep-relaxation.co.uk or
- https://learn-keyboard.co.uk