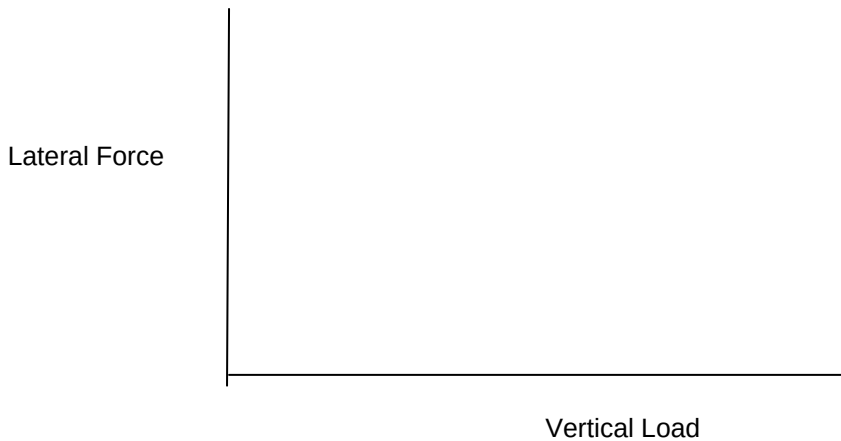


Mock Exam - Motorsport /Vehicle Dynamics

1.

A car is tested on a circular path turning **right** If the cross weight bias left front /right rear (wedge) were changed from 45% to 55% would you expect the handling balance to experience increased or reduced levels of understeer.

You should explain the reason for your prediction in terms of the load splits generated and a typical tyre's lateral performance characteristics using a sketch of this characteristic to illustrate your answer.



2.

The relationship between front and rear load splits has to be 'calibrated' to the actual car to relate the handling balance actually being achieved with the load split calculated.

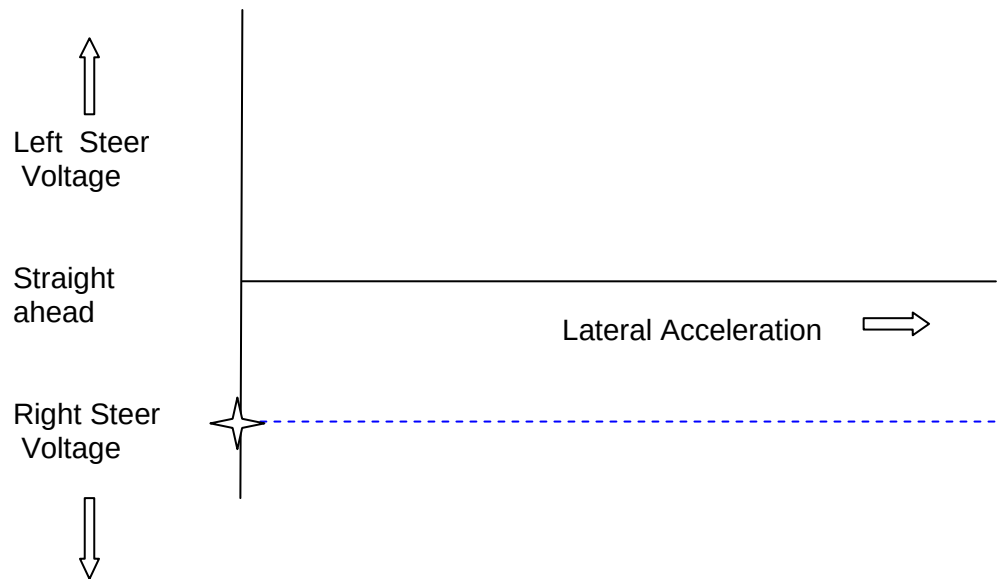
An example of the sort of data that may be obtained is an xy plot of lateral acceleration vs steering angle. The car is turning left and the system is calibrated such that increasing voltage is left turn and reducing voltage is right turn.

If steer voltage is plotted against lateral acceleration on an xy graph show the characteristics of an understeering car making a right turn where the degree of understeer increases with cornering acceleration.

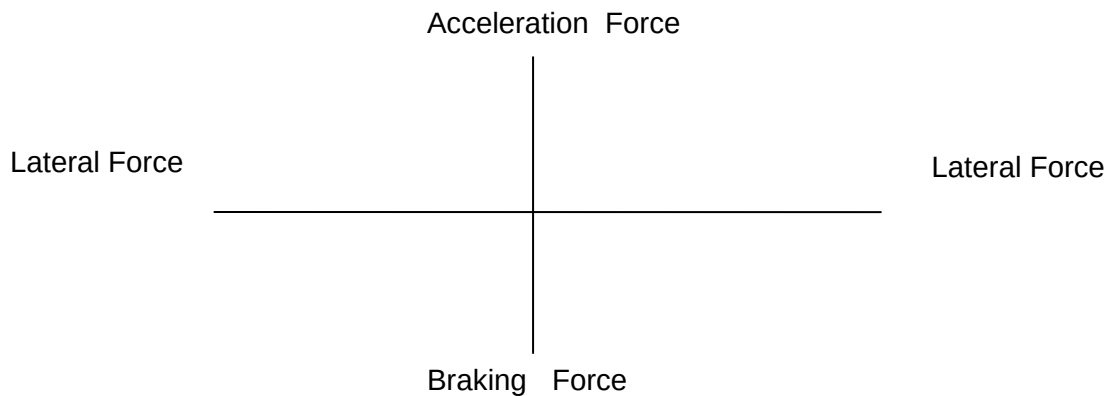
The Ackermann steer voltage for the corner radius the car is following is marked with



Mock Exam - Motorsport /Vehicle Dynamics



3. Sketch the 'circle of friction' of tyre grip explain how this characteristic demonstrates that a front wheel drive car cornering at the limit of lateral acceleration would understeer to a larger radius of turn if the driver floored the throttle



4 .

Mock Exam - Motorsport /Vehicle Dynamics

To be able to define a car as understeer or oversteer the ackerman steering angle needs to be known. Explain how to find the ackerman steering angle for a car on a circular path of known radius

a) by calculation

b) By a simple practical test

5 .

Explain how tyre temperature will influence grip and suggest ways in which this could affect the handling balance as a test progresses having started on cold tyres

6.

Using the vehicle data given at the end of this paper calculate the total roll stiffness of the car.

$K_{\phi_{total}} =$ [] units

Mock Exam - Motorsport /Vehicle Dynamics

7.

Calculate the overturning moment produced, with H_{sra} as an unknown (H_{sra} = the distance of the centre of gravity of the sprung mass above roll axis) at a lateral acceleration 4 m/s^2

Overturning Moment = $\quad \quad \quad \times H_{sra} \quad [\quad \quad]$ units

8.

When the car is cornering at a lateral acceleration of 4 m/s^2 the roll angle developed is 0.3°). Using the values for roll stiffness and overturning moment calculated in 1) and 2) above, find the height of the centre of gravity above the roll axis for the car.

Height of the CG above the Roll Axis = $\quad \quad \quad$ [units]

9.

To obtain the data required for the previous questions a track test would have to be carried out to find the roll angle at a given lateral acceleration. If a live axle car was being tested describe the the Maths Channel needed to find rear axle roll angle from suspension pot readings [LR Pot] and [RR Pot] assuming the separation of the two potentiometers was 0.975 m . Remember the potentiometer read out is in mm.

Mock Exam - Motorsport /Vehicle Dynamics

Explain how the required values of roll angle and lateral acceleration needed to find H_{sra} would be obtained from the data:

a) Using a time/distance plot

b) Using an xy plot

10.

Calculate the front and rear load splits produced due to sprung mass acting about roll centre axis and resisted by the springs and tyres in series at the front and rear of this car at a lateral acceleration of 4 m/s^2 when a roll angle of 0.3° is being generated.

WTsf = [] units WTsr= [] units

Mock Exam - Motorsport /Vehicle Dynamics

VEHICLE DATA

Tf	Front track	= 1.5 m
Tr	Rear track	= 1.6 m
L	Wheelbase	= 2.45 m
Hsra	Height of CG of sprung mass above roll axis	
Msf	Total front sprung mass	= 420 kg
Msr	Total rear sprung mass	= 450 kg
Musf	Total front unsprung mass (ie 2 wheels)	= 85 kg
Musr	Total rear unsprung mass (ie 2 wheels)	= 92 kg
r	Rolling radius of tyre	= 0.29m
Kwf	Front wheel rate	= 30000 N/m
Kwr	Rear wheel rate	= 43000 N/m