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Vehicle Technology - M4X00394

14/5/2020

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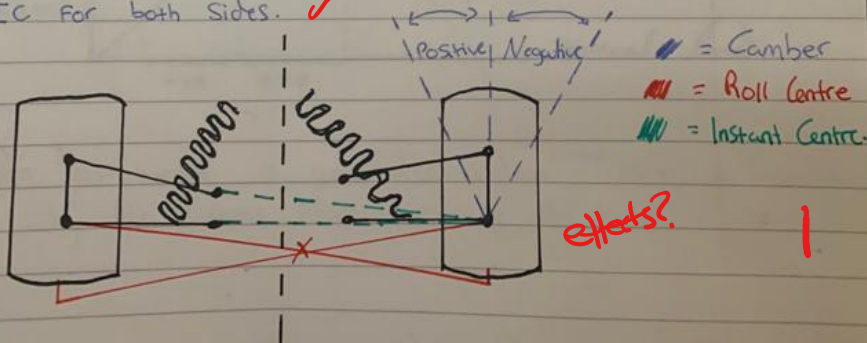
Question One:

Camber: Camber is the top to bottom angle of the tyres.
Adjusting the camber will affect your cars grip whether you are driving in a straight line or cornering. $\frac{1}{2}$
Negative camber means the tops of the tyre will be ~~leaning~~ inwards. $\checkmark$ It reduces understeer and increases cornering grip, but will reduce straight line speed. *Camber Inset* 1.5

Caster Angle: Caster angle is the forward or rearward angle of the steering axis. $\frac{1}{2}$
With positive caster angle the steering axis is inclined rearward. This will result in a straight up tyre while driving increasing stability. $\frac{1}{2}$ 1

Instant Centre: The instant centre is the virtual point at that specific moment in time that the $\frac{1}{2}$ wheel is moving about. *define + effect?* 0.5

Roll Centre Position: ~~Point~~ the meeting point between both wheels taken from the centre contact point of tyre and the IC for both sides. $\checkmark$



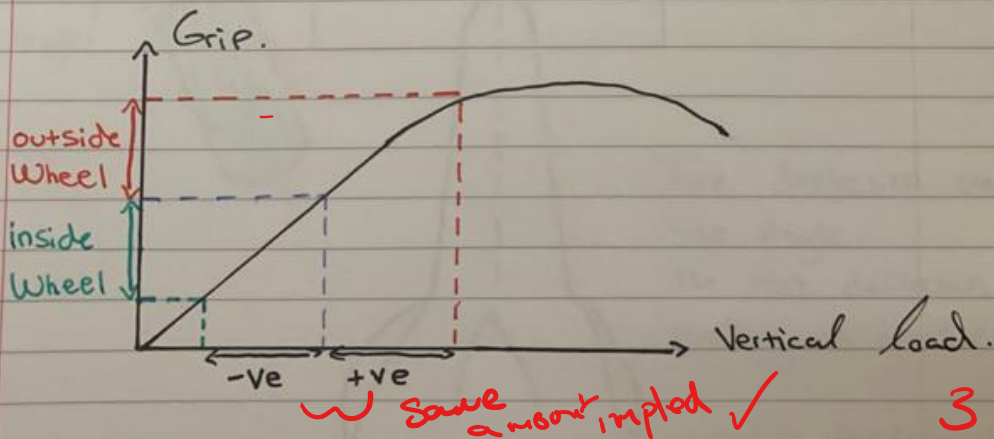
Question 2:

i). $m = 915 \text{ Kg}$ $h = 0.375 \text{ m}$
 $r = 130$ $L = 1.16 \text{ m}$
 $V = 25 \text{ m/s}$ $W = 2.65 \text{ m}$

Acceleration $= \frac{V^2}{r} = \frac{25^2}{130} = 4.81 \text{ m/s}^2$

ii). Lateral load transfer $= W_{\text{Lat}} = \frac{M a h}{L}$
 $= \frac{915 \times 4.81 \times 0.375}{1.16} = 1422.8 \text{ N}$

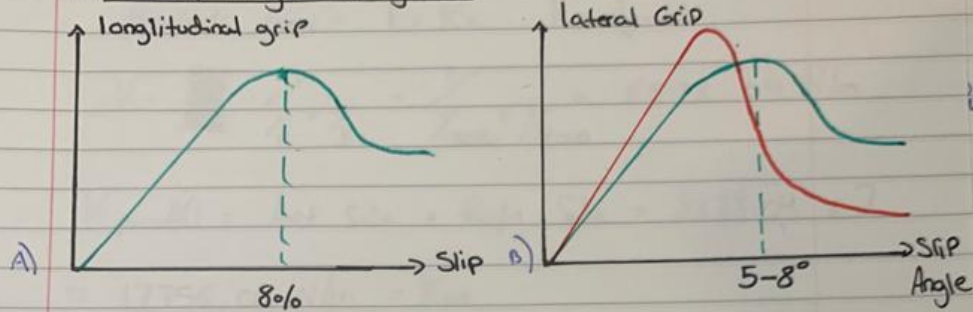
iii). As the weight transfers, the amount of grip at the end of the car is reduced depending on the tires. Although the outside wheel grip is increased by weight transfer, the inside wheel grip is reduced more, due to the non linear relationship between vertical load and tyre grip.



iv). Slip angle is generated when Steering is applied by the lateral force deflecting the tire.

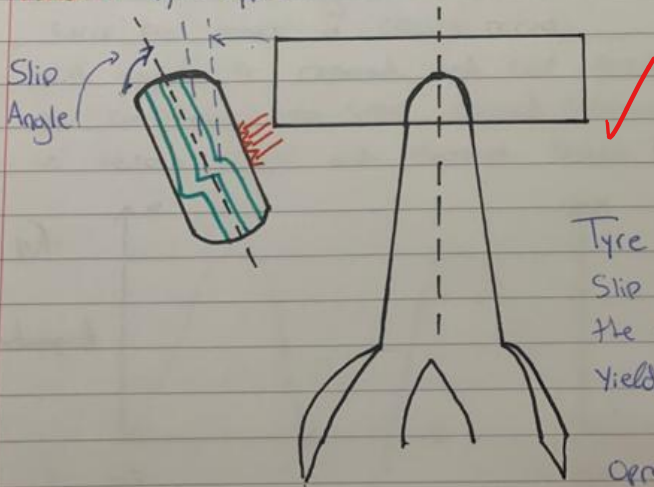
Question 2

iv) = Slip Angle diagrams.



The above diagrams show the limits to which grip is lost on the tyre curve in relation to the slip.

Diagram A shows that at 8% slip you lose all grip. Diagram B shows the slip angle for both **crossply** and **Radial** tyre types.



Tyre deflection creating Slip Angle.

The tyre deflection is yielding an opposite force

Opposite force → Grip

Question 3

i) = Spring rate = K

Hooke's law = $F = Kx$ $K = \frac{F}{x}$

$K = \frac{1}{\frac{1}{K_1} + \frac{1}{K_2}} = \frac{1}{\frac{1}{13000} + \frac{1}{28000}} = 8878.04 \text{ N/m}$

$K_{\text{parallel}} = \text{Left Side} + \text{Right Side} = 8878.04 \times 2$

$= 17756.08 \text{ N/m} = K_{\text{eff}}$

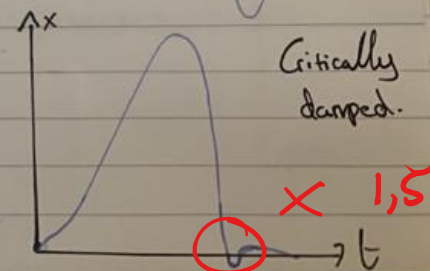
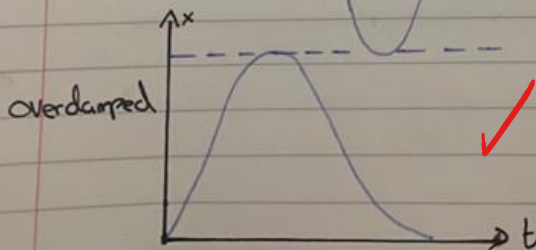
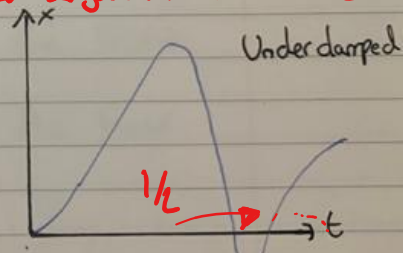
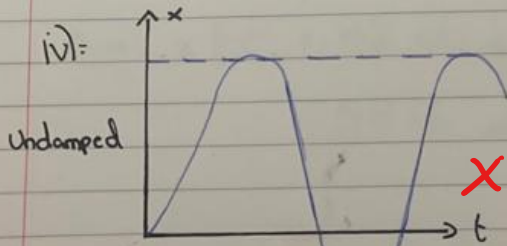
ii) = Natural Frequency = F_n $m = 215 \text{ Kg}$

$F_n = \frac{1}{2\pi} \times \sqrt{\frac{K}{m}} = \frac{1}{2\pi} \times \sqrt{\frac{17756.08}{215}} = 1.446 = 1.45 \text{ Hz}$

iii) = Very high performance race cars will tend to have a natural frequency of around 2 Hz. with 2 Hz being very stiff for track or circuit racing.

With regard to offroad and our results, 1.45 Hz would be considered too stiff. offroad suspension needs to be soft to absorb bumps and therefore should be closer to 1 Hz.

Fair argument



Question 5

i) = Bernoulli's Principle States that as velocity of air increases its pressure will drop. ✓
If velocity of air decreases the pressure will increase. ✓

ii) = $P = 1.223 \text{ Kg/m}^3$ Total downforce = $1115 + 1485 = 2600$ ✓
 $A = 1.1 \text{ m}^2$
 $V = 35 \text{ m/s}^2$ Lift = -2600 N ✓

Coefficient of Lift = $\frac{\text{Lift}}{\frac{1}{2} \rho A V^2} = \frac{-2600}{\frac{1}{2} \times 1.223 \times 1.1 \times 35^2} = -3.15$ ✓

iii) = Drag Force = $\frac{1}{2} \rho A C_d V^2 = \frac{1}{2} \times 1.223 \times 1.1 \times 0.67 \times 35^2 = 552.08 \text{ N}$ ✓

iv) = Centre of Pressure (CoP) %

Front downforce = 1115 N

Rear downforce = 1485 N

CoP % = $\frac{\text{Front downforce}}{\text{Total downforce}} \times 100 = \frac{1115}{2600} = 0.429$ ✓

$0.42 \times 100 = 42\%$ at the front

58% at the Rear.