

ID: 1801396

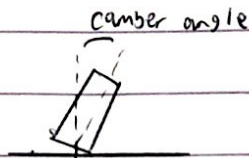
Date: 14/05/20

Code: MHX00394

Time: 13:00

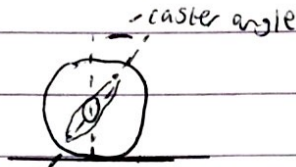
Q1

i)



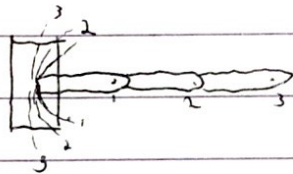
Camber angle makes camber thrust which increases grip laterally to a point where it reduces the contact patch which lowers overall grip

ii)



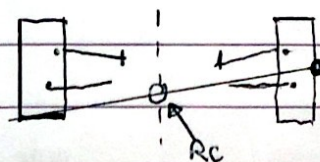
Caster angle can affect self centering via torque and induces camber change with steer

iii)



Instant centre is the point where the suspension rotates at that instant time, long swing arm length reduces camber change with bump (3) and short increases it (1)

iv) A roll centre is the point the chassis rotates at that time, A low roll centre increases body roll and a high roll centre reduces body roll



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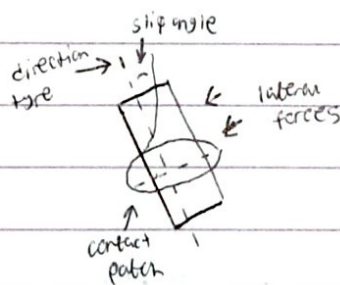
Q2

$$\text{i) } a_c = \frac{v^2}{r}$$
$$a_c = \frac{25^2}{130} = 4.81 \text{ m/s}^2$$

$$\text{ii) } W_t = \frac{mah}{\epsilon}$$
$$= \frac{915 \times 4.81 \times 0.375}{1.16} = 1422.79 \text{ N}$$

iii) the outside vertical load on the tyre increases by the same amount as the inside tyre load reduces. The non linear relationship of the tyre between vertical load and lateral grip, there is not as much grip increase on outside wheel as there is lost by the inside tyre. Hence why grip/available grip reduces.

IV)



A slip angle is created by deflecting the tyre via steering or lateral force. The deflection created by lateral load means tyre path is not the same as the wheel heading due to deflection.

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Q3

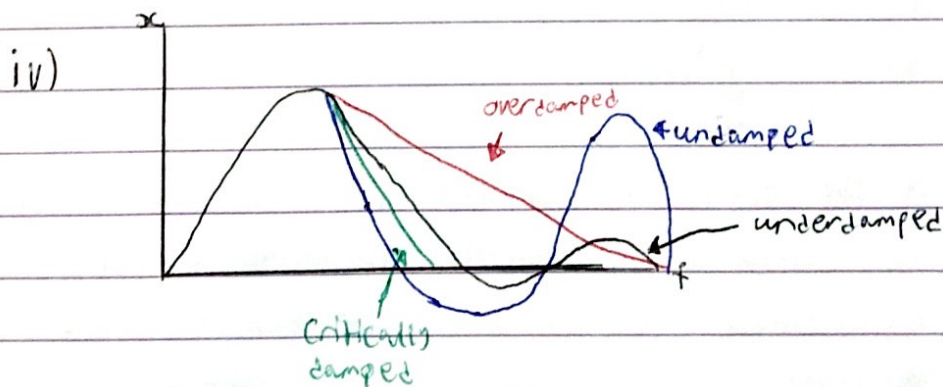
$$\begin{aligned} \text{i) } K_{\text{series}} &= \frac{1}{\frac{1}{K_1} + \frac{1}{K_2}} \\ &= \rightarrow \frac{1}{\frac{1}{13000} + \frac{1}{28000}} = 8878.04 \text{ N/m} \end{aligned}$$

Due to there being 2 in parallel

$$K = \underset{\text{parallel}}{2} \times 8878.04 = 17756.08 \text{ N/m}$$

$$\begin{aligned} \text{ii) } f_n &= \frac{1}{2\pi} \sqrt{\frac{K}{m}} \\ &= \frac{1}{2\pi} \sqrt{\frac{17756.08}{215}} = 1.45 \text{ Hz} \end{aligned}$$

iii) natural frequency for this offroad car is 1.45 Hz which means it's a soft system which is considered nice as a good frequency for this type of car. If it was at 2 Hz the ride would be more harsh as the ride is more stiff.



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Q5

i) Bernoulli's principle states as velocity of air increases its pressure will drop,
if the velocity of air decreases, the pressure increases

ii) Total downforce = front + Rear
 $= 1115 + 1485 = 2600 \text{ N}$

Lift = $\frac{1}{2} \rho C_L A V^2$
 $\downarrow C_L = \frac{\text{Lift}}{\frac{1}{2} \rho A V^2} = \frac{-2600}{\frac{1}{2} \times 1.223 \times 1.1 \times 35^2}$
 $= -3.16$

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

iv) Centre of pressure % = $\frac{\text{front downforce}}{\text{Total downforce}} \times 100 =$
 $= \frac{1115}{2600} \times 100 = 42.88\%$