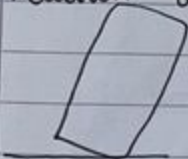


14th May 2020 1pm
1901843 M4X00394
page 1 of 5

32
40

Question One - suspension and chassis system.

i) Camber is an inclination of wheel axis in relation to the road surface. ✓



this compensates for roll angle during cornering and creates small auxiliary side forces. ^{1/2} ~~None?~~ 1.5

ii) Caster angle is the angle from the steering axis and the vehicle. More caster gives more forces.

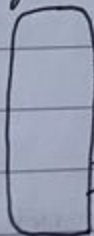


caster angle

mechanical trail. ✓

This causes a downwards ^x force making the car more stable to the road. ^{1/2} 1.5

iii) An instant centre is a rotation point where width defines camber change and height defines scrub. ✓



instant centre. ✓

Good!

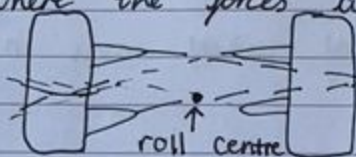
making this higher or lower will result in changes in scrub. 2

14th May 2020 1pm

1901843 M4X00394

page 2 of 5

iv) The roll centre is the part in the suspension where the forces acts on the vehicle.....



Could be clearer.

Jacking forces?

2

A higher RC decreases the amount of roll.

Question three - Springs and dampers.

$$M_s = 215 \text{ kg}$$

$$K_1 = 13000 \text{ Nm}^{-1}$$

$$K_2 = 28000 \text{ Nm}^{-1}$$

$$i) K = 2 \times \left(\frac{1}{1/K_1 + 1/K_2} \right)$$

$$K = 2 \times \left(\frac{1}{1/13000 + 1/28000} \right)$$

$$= 17756.1 \text{ Nm}^{-1}$$

3

$$ii) f_n = \frac{1}{2\pi} \sqrt{\frac{K}{m}}$$

$$f_n = \frac{1}{2\pi} \sqrt{\frac{17756.1}{215}}$$

$$= 1.45 \text{ Hz}$$

2

iii) As the frequency is between 1-1.5 Hz the vehicle is comfortable, therefore unlikely to be an offroad performance vehicle too stiff or soft?

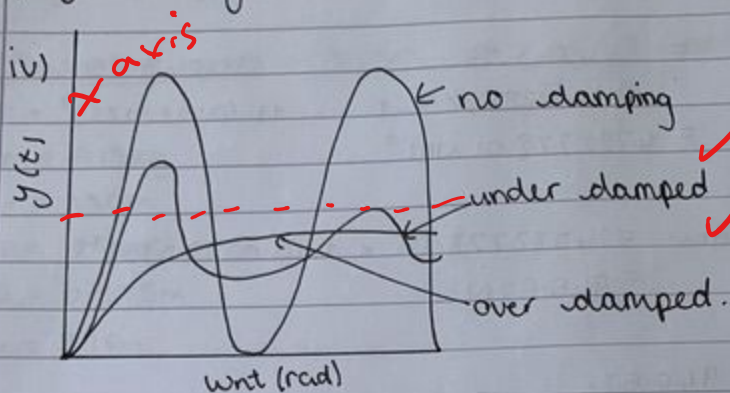
✓

1

14th May 2020 1pm

1901843 M4X00394

page 3 of 5



Question four - brakes.

$$m = 875 \text{ kg}$$

$$a = -7.5 \text{ m/s}^2 \text{ (braking)}$$

$$\begin{aligned} \text{i) } f &= ma \\ &= 875 \times 7.5 \\ &= 6562.5 \text{ N} \end{aligned}$$

$$\text{ii) force for 1 wheel} = \frac{6562.5}{2}$$

$$= 3281.25 \text{ N}$$

$$\begin{aligned} T &= F_w \times R = 3281.25 \times 0.285 \\ &= 935.16 \text{ Nm} \end{aligned}$$

$$\begin{aligned} F_s &= \frac{T}{\mu \times r} = \frac{935.16}{0.42 \times 0.15} \\ &= 14843.75 \text{ N} \end{aligned}$$

14th May 2020 1pm
1901843 M4X00394

page 4 of 5

$$P = \frac{F_s}{A_s \times n} = \frac{14843.75}{\pi (0.022225)^2 \times 2} = 4782778.01 \text{ NM}^{-2}$$

$$F_m = P \times A_m = 4782778.01 \times \pi (0.0079375)^2 = 946.67 \text{ N}$$

$$F_p = \frac{F_m}{PR} = \frac{946.67}{4782778.01 \times 4} = 236.67 \text{ N}$$

Question five (aerodynamics).

Very good
Taylor!

$$\text{frontal area} = 1.1 \text{ m}^2$$

$$a = 35 \text{ ms}^{-2}$$

i) Bernoulli's theorem - if you increase the velocity of the air, the pressure decreases.

$$P = \frac{F}{A}$$

$$\text{ii) downforce} = C_L \times \frac{\rho v^2}{2} \times A$$

14th May 2020 1pm
1901843 M4X00394
page 5 of 5

Question two - tyres and weight transfer.

$$m = 915 \text{ kg}$$

$$r = 130 \text{ m}$$

$$v = 25 \text{ ms}^{-1}$$

$$h = 0.375 \text{ m}$$

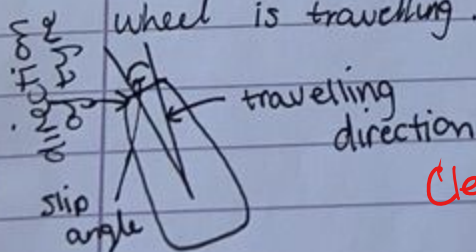
$$t = 1.16 \text{ m}$$

$$i) a = \frac{v^2}{r} = \frac{25^2}{130} \\ = 4.81 \text{ ms}^{-2}$$

$$ii) wt = \frac{m a h}{t} = \frac{915 \times 4.81 \times 0.375}{1.16} \\ = 1422.89 \text{ N}$$

iii) due to the outer ~~most~~ tyre load increasing, the inner wheel load decreases by the same amount. ~~the~~ the grip increases on the outer but also ~~the~~ decreases on the inner. Therefore no grip is actually gained. ... Needed to say amounts of grip change different.

iv) The slip angle is the angle between the direction the wheel is pointing and the direction the wheel is travelling.



Clearer diagram required.