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Exam

Vehicle Dynamics

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16/05/22

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Vehicle dynamics exam

Question 1

a) AB = 118/24 = 4.92

CD = 132/32 = 4.13

EF = 104/12 = 8.6

GR = 4.92 × 4.13 × 8.6
= 174.75

b) N_2 = 3000 ÷ 174.75
= 17.17 RPM (clockwise)

c) $P_1 = \frac{2\pi N_1 T_1}{60} = \frac{2\pi(3000)(130)}{60} = 40840.70\ W$

$P_2 = 40840.70 \times 0.82 = 33489.38\ W$
(clockwise)

d) ~~[illegible]~~

$\omega_2 = 17.17 \times \frac{2\pi}{60}$

= 1.798 rad/s

$T_2 = P_2 / \omega_2$

$= \frac{33489.38}{1.798}$

= 18625.91 NM

T_1 = 130 NM

$T_3 = -T_1 - T_2$
= −130 − 18625.91
= −18755.91 (anti-clockwise)

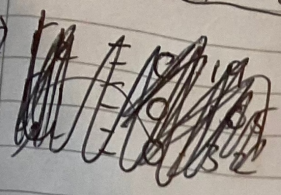
e) Gear C is Fixed

Step	Action	A	B	C	D
1	Revolve all	1	1	1	1
2	Revolve C by -1 rev	0	$\frac{-260}{32}$	-1	$\frac{266}{160}$
3	Total	1	-7.13	0	2.4

GR = 1 : 2.4

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Question 2

a) 

a) $r_2 = 0.0525m$
$r_1 = 0.095m$
$\mu = 0.32$
$W = 6500N$

$$T = \frac{2}{3}\mu W \frac{(r_2^3 - r_1^3)}{(r_2^2 - r_1^2)}$$

$$T = \frac{2}{3}(0.32) \times 6500 \times \frac{(0.095^3 - 0.0525^3)}{(0.095^2 - 0.0525^2)}$$

$$T = 157.65 Nm$$

b) worn by 1.2mm

$$W = 6500 - (925 \times 1.2)$$
$$= 5390N$$

$$T = \mu W \frac{(r_2 - r_1)}{2}$$

$$= \frac{0.32 \times 5390 (0.095 + 0.0525)}{2}$$

$$= 127.2 Nm$$

c) $r^2 = 0.0575$

$r^1 = 0.03$

$\mu = 0.45$

$P = 450000\,W$

$W = 7000\,N$

$\omega = 1500 \times \frac{2\pi}{60} = 785.398\ rad/s$

$T = P/\omega = \frac{450000}{785.398} = 572.96\,Nm$

$$T = \frac{\mu w (r_2 + r_1) \times 2n}{2}$$

$$572.96 = \frac{(0.45)(7000)(0.0575 + 0.03)}{2} \times 2n$$

$$572.96 = 137.81 \times 2n$$

$$\frac{572.96}{137.81} = 2n$$

$$4.16 = 2n$$

$$n = 2.08 \quad \therefore \quad 2 \text{ plates needed}$$

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(5)

d) $T = \frac{2}{3}\mu w \frac{(r_2^3 - r_1^3)}{(r_2^2 - r_1^2)} \times 2n$

$572.96 = \frac{2}{3}(0.45)(7000)\frac{(0.0575^3 - 0.03^3)}{(0.0575^2 - 0.03^2)} \times 2n$

$572.96 = 142.35 \times 2n$

$\frac{572.96}{142.35} = 2n$

$4.025 = 2n$

$n = 2.0125$ ∴ 3 Plates needed.

e) $D_o = 0.1m$ $W = 1200N$
$D_i = 0.095m$
$\beta = 6°$
$\mu = 0.15$

Uniform wear = $T = \frac{\mu W (D_o + D_i)}{4 \sin \beta}$

$T = \frac{(0.15)(1200)(0.1 + 0.095)}{4 \sin 6}$

$T = 83.95\ NM$

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(6)

Question 3

a) $m = 650\ kg$
$h = 0.31\ m$
$a = 0.8 = 7.85\ m/s^2$
$w = 2.4$

a) Load transfer $= \frac{mah}{w}$

$= \frac{650 \times 7.85 \times 0.31}{2.4}$

$= 659.07$

b) Static load front

$= \frac{650 \times 0.45}{2}$

$= 146.25\ kg$ per wheel

Dynamic load front

$= (146.25 \times 7.84) + \frac{659.07}{2}$

$= 1476.14\ N$ per wheel

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Front axle tyre load = 1476.14 × 2
= 2952.28 N

c) Approximately 2000 N longitudinal force on each tyre

Total reaction force is 8000 N from the tyres

d) $F_W = 8000/4 = 2000\,N$

$F_W = T/R \quad \therefore \quad T = F_W \times R$

$T = 2000 \times 0.265$
$T = 530\,Nm$

$T = F_S/\mu r \quad \therefore \quad F_S = T/\mu r$

$F_S = 530/0.5 \times 0.165$

$F_S = 6424.24$

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(8)

$$AS = \frac{\pi (0.045)^2}{2}$$

$$AS = 3.18 \times 10^{-3} m^2$$

$$FS = P \times AS \times n \quad \therefore \quad P = \frac{FS}{AS \times n}$$

$$= \frac{6424.2}{(3.18 \times 10^{-3}) \times 2}$$

$$= 1010094.32 N/m^2$$

$$AM = \frac{\pi (0.0145)^2}{2}$$

$$= 3.302 \times 10^{-4} m^2$$

$$P = FM / AM \quad \therefore \quad FM = P \times AM$$

$$FM = 1010094.34 \times 3.302 \times 10^{-4}$$

$$= 333.53 N$$

$$FD = FM / pR = \frac{333.53}{4}$$

$$= 83.38 N$$