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Question 1

a) $A = 24$ $AB \frac{118}{24}$ $CD \frac{132}{32}$ $EF \frac{104}{12}$
 $B = 118$
 $C = 32$ $= 4.917$ $= 4.125$ $= 8.667$
 $D = 132$ $= \frac{89}{12}$ $\frac{33}{8}$ $26/5$
 $E = 12$
 $F = 104$ $GR = 4.917 \times 4.125 \times 8.667$
 $= 175.79$

c) & b) $P_1 = \frac{2\pi N_1 T_1}{60} = \frac{2\pi \times (3000) \times (130)}{60}$
 $40840.70 \times = 40840.70 \text{ W}$
 $P_2 = 33,489.37 \text{ W (clockwise)}$

$N_2 = 3000 \div 175.79 = 17.07 \text{ RPM}$

d) $T_2 = P_2 / \omega_2 = 33,489.37 / \frac{2\pi (17.07)}{60}$
 $\omega_2 = 1.7876$

$T_2 = 18,734.26 \text{ N/m}$

$T_3 = -T_1 - T_2 = -130 - 18,734.26 = 18,864.26$

C is fixed

		(Anti-clockwise)			
e) Step	Action	A	B	C	D
1	Revolve all	1	1	1	1
2	Reverse C to 0	0	$\frac{-260}{32} = -8.125$	-1	$260/180 = 1.4$
3	total	1	-7.13	0	2.4

Ratio = 1:2.4

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Question 2

a) $r_1 = 0.0525 \text{ m}$ $\mu = 0.32$
 $r_0 = 0.095 \text{ m}$ $W = 6800 \text{ N}$

$$T = \frac{2}{3} \times \mu W \frac{(r_0^3 - r_1^3)}{(r_0^2 - r_1^2)}$$

$$T = \frac{2}{3} \times 0.32 \times 6800 \times \frac{(0.095^3 - 0.0525^3)}{(0.095^2 - 0.0525^2)}$$

$$T = 157.65 \text{ Nm}$$

b) worn by 1.2 mm $W = 6800 - (925 \times 1.2)$
 $= 5390 \text{ N}$

$$T = \mu W \frac{(r_0 + r_1)}{2}$$

$$= 0.32 \times 5390 \times \frac{(0.0950 + 0.0525)}{2}$$

~~$T = 36.62 \text{ Nm}$~~
 $= 127.02 \text{ Nm}$

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Question 2

$$c) \quad W = 7000 \text{ N} \quad \mu = 0.45$$

$$r_o = 0.0575 \text{ m}$$

$$r_i = 0.03 \text{ m}$$

Uniform wear

$$T = \frac{\mu W (r_o + r_i)}{2} \times 2\pi$$

$$T = \frac{0.45 \times 7000 \times (0.0575 + 0.03)}{2} \times 2\pi$$

$$572.96 = T \quad - \quad \text{calculated on page 4}$$

$$572.96 = 137.8125 \times 2\pi$$

$$\frac{572.96}{137.8125} = 2\pi$$

$$4.16 = 2\pi$$

$$n = 2.08$$

$$n = 2.08$$

∴ 3 plates required

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Question 2

d) $r_o = 0.0575 \text{ m}$ $P = 450,000 \text{ W}$
 $\mu = 0.45$

$r_i = 0.03 \text{ m}$ $\omega = 7000 \text{ rad/s}$

$\omega = 7500 \times \frac{2\pi}{60}$
 $= 785.4 \text{ rad/s}$

€

$T = P/\omega = \frac{450000}{785.4} = 572.96 \text{ Nm}$

$T = \frac{2}{3} \mu \omega \frac{(r_o^3 - r_i^3)}{(r_o - r_i)} \times 2\pi$
 $= 142.35 \text{ N/m} \times 2\pi$

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

$572.96 = 142.35 \times 2\pi$

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

$4.025 = 2\pi$ $n = 2.0125$

$\therefore$ 3 plates are needed

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Question 2

e) $D_o = 0.1 \text{ m}$ $W = 1200$
 $D_i = 0.095 \text{ m}$ $\mu = 0.15$
 $B = 6$

$$T = \frac{\mu W (D_o + D_i)}{L \times \sin B}$$

$$= \frac{0.15 \times 1200 (0.1 + 0.095)}{L \times \sin 6}$$

$$= 83.95 \text{ N/m}$$

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Question 3

$$a) \quad L_t = \frac{m a h}{w}$$

$$m = 650 \text{ kg} \quad h = 0.31$$

$$a = 0.8 (7.84) \quad w = 2.4$$

$$L_t = \frac{650 \times 7.84 \times 0.31}{2.4}$$

$$= 658.23$$

b) Static

$$g_{\text{front}} = \frac{650 \times 0.45}{2} = 146.25 \text{ kg} \quad \text{per wheel}$$

$$r_{\text{rear}} = \frac{650 \times 0.55}{2} = 178.25 \text{ kg} \quad \text{per wheel}$$

Dynamic

$$\text{front} = (146.25 \times 7.84) + \frac{658.23}{2} = 1475.715 \text{ N} \quad \text{per wheel}$$

$$\text{rear} = (178.25 \times 7.84) - \frac{658.23}{2} = 1072.285 \text{ N} \quad \text{per wheel}$$

$$\begin{aligned} \text{Front Axle force loads} &= 1475.715 \times 2 \\ &= 2951.43 \text{ N} \end{aligned}$$

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Question 3

c) Approximately 2000 N longitudinal force
per tyre

8000 N total reaction force

d) $T = f_{\mu} \times R = 2000 \times 0.265 = 530 \text{ Nm}$

$$F_s = 530 / 0.5 \times 0.165 = 6424.24 \text{ N}$$

$$F_s = P \times A_s \times n \quad A_s = \frac{\pi (0.045)^2}{2}$$

$$P = F_s / A_s \times n \quad A_s = 3.18 \times 10^{-3} \text{ m}^2$$

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

$$= 1010,094.34 \times A_m \quad A_m = \frac{\pi (0.0185)^2}{2}$$

$$F_m = P \times A_m \quad A_m = 3.302 \times 10^{-4} \text{ m}^2$$

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

$$= 333.5332 \text{ N}$$

$$FD = F_m / 4 = \frac{333.53}{4} = 83.39 \text{ N}$$

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e)

Question 3

i) Dynamic gear load

$$\frac{(178.75 \times 7.84) - 658.23}{2} = 1072.285 \text{ w per wheel}$$

ii) Gear load

$$\begin{aligned} & 1072.285 \times R R \\ & 1072.285 \times 0.265 \\ & = 284.155 \text{ Nm} \end{aligned}$$