$\therefore U_{design} = 1.2 \times 17.38$ (from Problem 1) $= 20.9$ kJ

$\therefore T = U/\Delta\theta = 20.9 \times 10^3/40 = 521$ Nm

$P_m = U/\Delta t = 20.9/(2/3) = 31.3$ kW

Assume Ferodo AM2 moulded asbestos lining

$\therefore \mu = 0.39$

R_W (eq (iv)) $= 8.5\, e^{\left(\frac{300}{195}\right)^{1.63}} = 64$ mm³/MJ

Take $R_P = 600$ kW/m² (normal duty)

$\therefore$ From (4) $A \geq P_m/R_P = 31.3/600 = 0.0522$ m²

(iii) $0.8 \leq \sqrt{0.0522}/r \leq 1.6$ $\therefore 143 \leq r \leq 286$ mm

Select $r = 180$ mm, say.

So $v_m = \omega_m r = 60 \times 0.18$ (Problem 1) $= 10.8$ m/s

& $p_m = 600 \times 10^3/0.39 \times 10.8$ – from (i) $= 142$ kPa.

Assume a brake similar geometrically to that of Problem 6. Scaling by drum radius, scale factor $= 180$ (mm)/10 (in) $= 18$ mm/in.

$\therefore D = 12.37 \times 18 = 225$ mm

$e_{left} = 28 \times 18 = 504$ mm $e_{right} = 22.8 \times 18 = 410$ mm.

Hence use program 'Brakes' with duty statement:

$T = 521$ Nm

$p_m = 0.142$ N/mm²

problem 7

drum diameter 360.0 mm		centre-to-hinge distance	225.0 mm
lining limits 6.0 136.0 deg		brake actuating force	0.351 kN
lining width 78.46 mm		coefficient of friction	0.390

	1 leads	2 trails		
ratio of shoe-to-brake actuating forces	4.00	4.12		
actuating force's moment arm about hinge	504.0	410.0		mm
actuating force's inclination	76.0	90.0		deg
inclination of 2's axis relative to 1		-28.0		deg
mean pressure on shoe lining	89.6	142.0		kPa
shoe's contribution to, and total torque	201.6	319.4	521.0	Nm
sensitivity of shoes and of brake	0.764	1.446	1.182	
shoe hinge and drum bearing reactions	3.984	5.572	1.622	kN

The output indicates that $w = 78$ mm and there is sufficient information to design the hinge & drum shaft bearings.

The lining area is:

$A = \frac{2 \times 130}{360} \times 2\pi \times 0.18 \times 0.078$

$= 0.0637$ m²

Turning now to lining thickness :-

Number of brake applications over life $= \frac{5 \times 10^3 \times 3600}{30} = 6E5$

$\therefore$ Total energy dissipated $= 6E5 \times 20.9 \times 10^{-3} = 12.5 \times 10^3$ MJ

So volume lost $= 64 \times 12.5 \times 10^3 = 0.803 \times 10^6$ mm³

$\therefore$ thickness lost $=$ volume/area $= 0.803 \times 10^6/0.0637 \times 10^6$

$= 12.6$ mm

Doubling this to allow for rivet fixing say, gives lining thickness of ~ 25 mm.

This is rather too thick, compared to drum radius, so may have to use other attachment, or other lining material. But this would depend upon thermal analysis to confirm or refute the 300°C cited.