POF equations aide memoire

Continuity and Bernoulli

$A_1 V_1 rho_1 = A_2 V_2 rho_2 = A_3 V_3 rho_3$

$Pt = Ps + q$

Lift equations

$L = ½ rho V^2 S C_L$ or $L = q S C_L$ or $L α IAS^2 S C_L$

In S&L with a wing of constant area $IAS_1^2 C_{L1} = IAS_2^2 C_{L2}$

Stall speed (new) = Stall speed (old) x √(weight new/ weight old)

Load factor = lift/weight

Or use three step process between 2 pairs of variables eg V_s and LF :

Step 1 Will answer be larger of smaller (determines respectively if larger or smaller number on top in ratio in step 2)

Step 2 Write equation

eg. V_s new = V_s old x LF new/LF old

Step 3

Part 1 - I speed a variable? Y/N

Y = Go to part 2

N = Ignore Step 3

Part 2 - Is the speed change known? Y/N

Y = Square the ratio of speeds i.e. $(V\ new/V\ old)^2$

N = Square root the ratio i.e √(LF new/ LF old)

Drag equations

$D = ½ \text{ rho } V^2 S C_D$ or $D = q S C_D$ or $L \alpha IAS^2 S C_D$

Parasite drag αV^2
Induced drag $\alpha 1/V^2$

$C_{DI} \alpha C_L^2$/Aspect ratio

Drag is proportional to weight at V_{MD} only, so at V_{MD} $W_1/W_2 = D_1/D_2$

Aeroplane descriptions

Aspect ratio = span/chord or span^2/area (larger than 1)
Taper ratio = tip chord/root chord (smaller than 1)

Climbing

L= W cos ɤ, and LF is less than 1

T = D + W sin ɤ or Sin ɤ = (T-D)/W

At small angles of climb sin ɤ almost equals tan ɤ and therefore,

% gradient = (T-D)/W x 100

Descending

L= W cos ɤ, and LF is less than 1

D = T + W sin ɤ or Sin ɤ = (D-T)/W

% gradient = (D-T)/W x 100

Gliding

% gradient = D/W x 100

gradient = D/L therefore, Glide range = Height x L/D ratio

Turning

Remember V must be in m/s (multiply by 0.5144 or halve it will do to get knots)

LF = 1/ cos ϕ

Radius = $V^2/g \tan \phi$ (multiply by 2 for Diameter!)

Rate of turn = TAS/Radius (multiply by 57.3, 60 will do to get °/sec)

Rate 1 turn = 3°/sec ϕ for rate 1 turn = TAS/10 + 7
(TAS is in kts for this)

High Speed Flight

Local speed of sound (LSS or 'a') = 39 √K

Mach number = TAS/LSS

Mach cone angle - Sin μ = 1/Mach number

Stability

Stick force per g = stick force/change in LF from 1 g

Limitations

V_A new = V_A old √(weight new/weight old)

Gust Load Factor (GLF) is about the change in LF away from 1g and is proportional to speed

Use the first 2 steps in the '3 Step' method but remember to remove 1g from all load factors used, and once calculated add 1g back on to find actual GLF