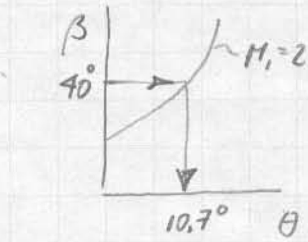
UE Fluids F16 + 17 Solution S'08

a) From normal-shock relations (App. B): for $M_1 = 2$, $\boxed{\frac{p_{o2}}{p_{o\infty}} = \frac{p_{o2}}{p_{o1}} = 0.7209}$

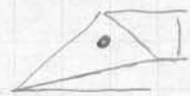
b) From oblique-shock chart, for $\beta = 40°$, $M_1 = 2$; $\boxed{\theta = 10.7°}$



$M_{n_1} = M_\infty \sin\beta = 2 \cdot \sin 40° = 1.2856$

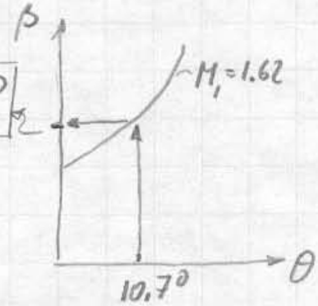
From App. B: for $M_{n_1} = 1.2856$, $M_{n_2} = 0.793$, $\frac{p_{o2}}{p_{o1}} = 0.982$

$\therefore \boxed{M_A = M_{n_2} / \sin(\beta - \theta) = 0.793 / \sin(40 - 10.7) = 1.620}$



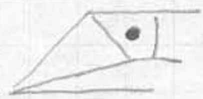
$\boxed{p_{oA} = p_{o\infty} \cdot \frac{p_{o2}}{p_{o1}} = 0.982}$

c) From oblique-shock chart, for $\theta = 10.7°$, $M_1 = 1.620$, $\boxed{\beta = 51°}$



$M_{n_1} = M_A \sin\beta = 1.259$, $M_{n_2} = 0.808$, $\frac{p_{o2}}{p_{o1}} = 0.986$

$\boxed{M_B = M_{n_2} / \sin(\beta - \theta) = 0.808 / \sin(51 - 10.7) = 1.249}$

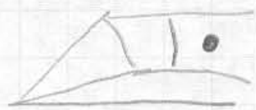


$\boxed{p_{oB} = p_{oA} \cdot \frac{p_{o2}}{p_{o1}} = 0.982 \cdot 0.986 = 0.968}$

d) From normal-shock relations: for $M_1 = M_B = 1.249$, $\frac{p_{o2}}{p_{o1}} = 0.987$, $M_2 = 0.813$

$\boxed{p_{oC} = p_{oB} \cdot \frac{p_{o2}}{p_{o1}} = 0.968 \cdot 0.987 = 0.956}$

Also, $\boxed{M_C = M_2 = 0.813}$



e) Total pressure (efficiency) comparison:

Normal-shock inlet: $p_{o_{inlet}} = 0.721$

Oblique-shock inlet: $p_{o_{inlet}} = 0.956$ ← <u>much</u> better