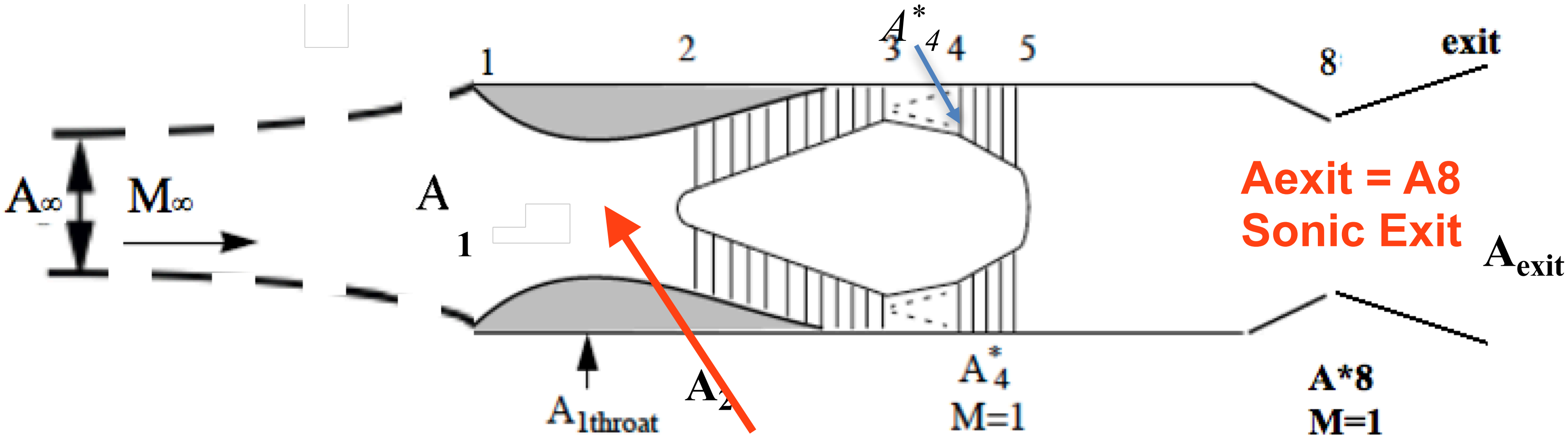
# Homework 5.4




- Engine operates at a free stream Mach number, $M_\infty = 0.8$.
- Cruise Altitude is in the stratosphere, 11 km so $T_\infty$ = 216.65 K.
- The design turbine inlet temperature, $T_{04} = 1944\ K$
- The design compressor ratio, $\pi_c = 20$ .
- Relevant area ratios are $A_2 / A^*_4 = 10$ and $A_2/A_{1throat} = 1.2$ .
- Inlet throat area $A_{1Throat} = 20\ cm^2$
- *Assume the compressor, burner and turbine all operate ideally.*
- *Nozzle is of a simple converging type with choked throat, $A^*_8 = A_{exit}$*
- *Stagnation pressure losses due to wall friction in the inlet and nozzle are negligible.*

$f \simeq 50$

- Calculate the Associated enthalpy of the fuel빵

→ *CALCULATE* **True & Corrected**

→ *a) ~~Correct~~ Compressor Massflow and $M_2$ at compressor face*

→ *b) Normalized exit pressure thrust, momentum thrust, and total thrust*

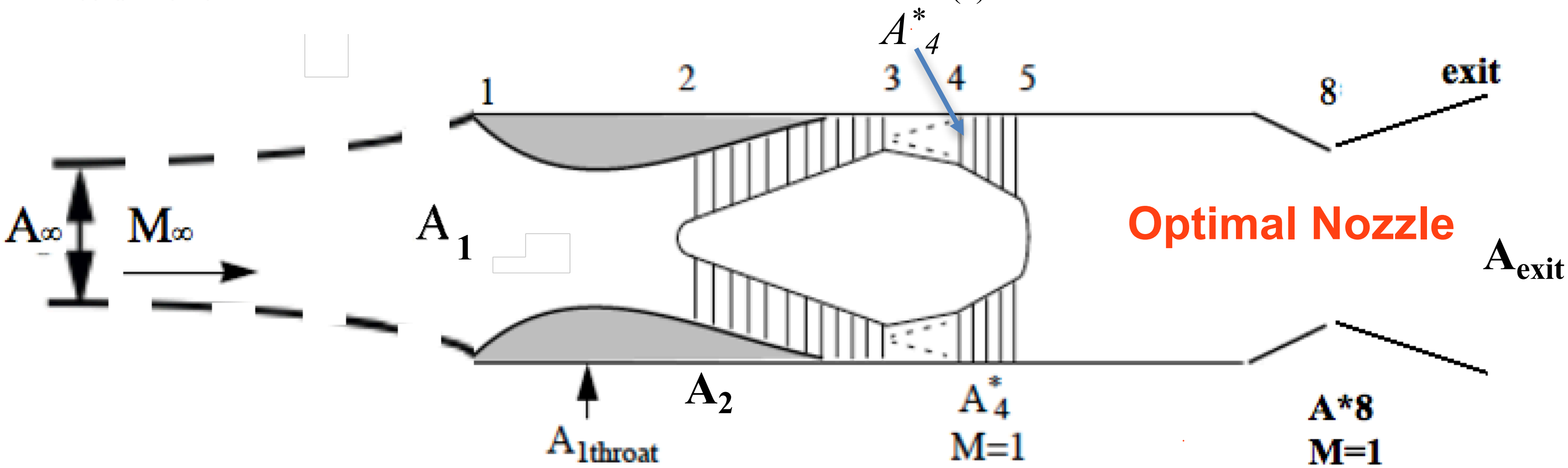
→ *c) Velocity ratio across Engine $V_{exit}/V_\infty$*

→ *d) Mach number at diffuser throat, $M_{1throat}$*

→ *e) Inlet capture area*

→ *f) Total Thrust, Isp, TSFC*

# Homework 5.4 (2)




- Now allow an expandable *Nozzle where,* $A_{exit} \geq A^*_8$

→ *CALCULATE*

→ *a) Optimal expansion ratio for nozzle* $A_{exit}/A^*_8$

→ *b) c) Velocity ratio across Engine* $V_{exit}/V_\infty$

→ *c) thrust, Isp, TSFC of optimal nozzle,*

**Optimal Nozzle**

→ *d) Assuming the same combustor temperature and inlet throat area as previous page*

→ *At what compressor demand* $\pi_c$ *does the inlet throat choke (@* $A1_{throat}$*)*

→ *Plot the Compressor operating line* → $\pi_c$ *vs corrected massflow,* $f(M_2)$ *for* $1 \leq \pi_c < \pi_{c\ @\ choke}$

→ *Plot the capture area* $A_\infty$ *vs corrected massflow,* $f(M_2)$ *for* $1 \leq \pi_c < \pi_{c\ @\ choke}$