Chapter 3, Question 1: Engine Efficiency

An aircraft engine company has two options to improve an engine - both options cost about the same to implement.

Option *1*) is to increase the bypass ratio enabling a drop in u_e/u_o of 10%. Specifically, u_e/u_o can be reduced from 2 to 1.8.

Option *2*) is to redesign the compressor and add new high temperature materials to the turbine to allow an increase in the total temperature rise across the inlet+compressor. The net total temperature ratio across these two components can be increased from 1.6 to 1.8.

Assuming that no other aspect of the aircraft changes (*e.g.* L/D, weight), which option would yield the bigger pay-off in terms of aircraft range?

1) Option 1

2) Option 2

3) They are the same

4) I don't know

L.O. C

Chapter 3, Question 1 Answer:

The correct answer is 2) Option 2

The principal figure of merit for the propulsion system that appears in the Breguet Range Equation is ηo, the overall efficiency. To answer the problem, we need to determine which option influences overall efficiency to a greater extent.

$$\eta_o = \eta_{TH}\,\eta_{prop} = \left(1 - \frac{T_1}{T_2}\right)\left(\frac{2}{1 + \frac{u_e}{u_o}}\right)$$

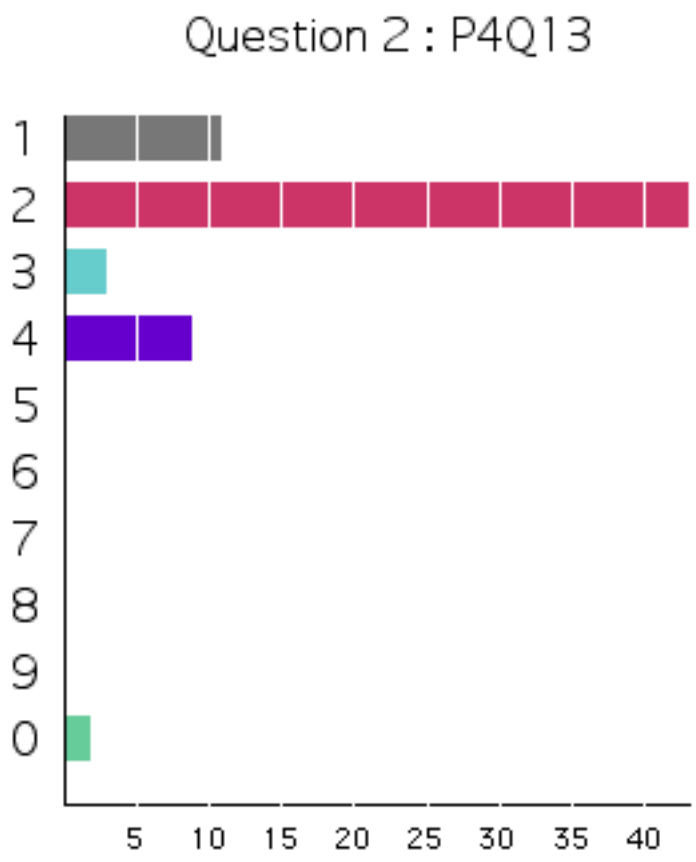
OPTION 1)

$$\eta_o = \left(1 - \frac{1}{1.6}\right)\left(\frac{2}{1+2}\right) = 0.25$$

OPTION 2)

$$\eta_o = \left(1 - \frac{1}{1.8}\right)\left(\frac{2}{1+1.8}\right) = 0.32$$

Class performance (2004):



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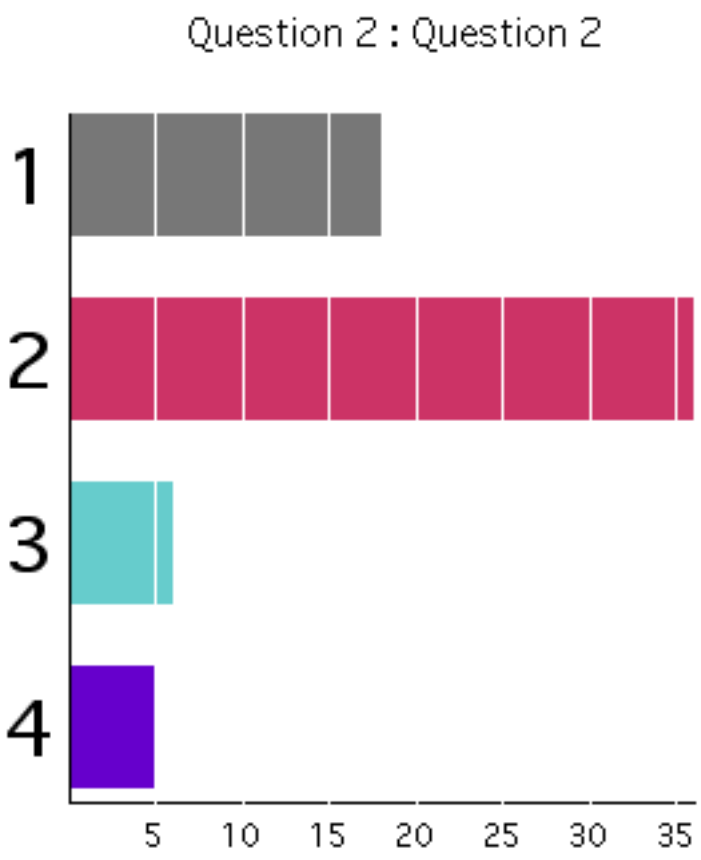

Class performance (2001):

Quiz 2 started at 9:51:33 AM

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