Solution to Problem 332C:

[A] If correctly expanded (i.e. no shocks) then

$$\frac{\text{Pressure at diffuser exit}}{\text{Reservoir pressure}} = \frac{1}{31} = 0.032 \tag{1}$$

and from the isentropic flow table

$$\frac{\text{Area of the exit}}{\text{Throat area}} = 3.85 \tag{2}$$

[B] From the isentropic flow table, the Mach number at the exit is 2.9.

[C] The lowest pressure ratio at which the flow would be choked is that for which the flow in the diffuser is entirely subsonic. From the isentropic flow table for $A/A^* = 3.85$ in the subsonic range, this requires that $M_E = 0.16$ and $p_E/p_0 = 0.983$ and therefore the lowest pressure ratio is $p_0/p_E = 1/0.983 = 1.02$.

[D] The pressure ratio that gives rise to a normal shock at the exit would therefore have a Mach number at the exit of 2.9 and, from the normal shock table, the pressure ratio across the shock would be $p_2/p_1 = 9.645$. Consequently this overall pressure ratio would be $31/9.645 = 3.21$.