SOLUTIONS C106 THERMODYNAMIC, FLUID AND PROCESS ENGINEERING Year 2004

Q7 A jet of water flows smoothly onto a stationary curved vane which turns it through an angle of 50° as shown. The jet flows onto the vane with a velocity of 40 m/s and a circular cross section of diameter 0.04 m. The water leaves the vane with a velocity of 36 m/s. Calculate the magnitude and direction of the force on the vane. Neglect gravitational effects.



The vector diagram is constructed as shown. Find the change in velocity Δv

 $C = 36 \sin 50 = 27.577$ $A = 36 \cos 50 = 23.14$

 $B = 40 - A = 16.86 \qquad \Delta V = \sqrt{(27.577^2 + 16.86^2)} = 32.32 \text{ m/s}$

Mass flow = $\rho A v = 1000 x \pi x 0.04^2/4 x 40 = 50.265 \text{ kg/s}$

 $F = m \Delta v = 1625 \text{ N}$ $\theta = \tan^{-1}(27.577/16.86) = 58.6^{\circ}$ The force on the vane is the opposite direction to ΔV

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