ENGINEERING TRIPOS PART IB

Paper 4: THERMOFLUID MECHANICS

ANSWERS

1(a)   (i) 9.93kJ/kg   (ii) 1950kJ/kg
        (iii) 99.6°C; two-phase with dryness fraction 0.731; 5.73kJ/kgK

(b)   (i) 0.0409   (ii) 36.6°C

(c)   (ii) 525kJ/kg added

2(a)   (i) 645K   (ii) 3.88   (iii) 183kW

(b)   (i) 372kW   (ii) 57.1kW

(c)   47.6kW

3(a)   0.0123K/W

(b)   (ii) 4990Pa/m

(c)   275Pa/m

4(a)   (i) $p = \rho g(h - y)\cos\theta$ (ii) $V(y) = \dfrac{\rho g \sin\theta}{\mu} y\left(h - \dfrac{y}{2}\right)$

(b) $V(y) = \dfrac{g\sin\theta}{\mu} y\left[M + \rho\left(h - \dfrac{y}{2}\right)\right]$

(c) $U = \dfrac{\rho g h^2}{6\mu}\sin\theta$

5(a) $H = \dfrac{Q^2}{g}\left[\dfrac{1}{2A_n^2} + \dfrac{32c_f L}{\pi^2 d^5}\right]$

(b)   (i) $7.14 \times 10^{-3}\,\mathrm{m}^2$; 0.176m   (ii) 38.9m
        (iii) 0.016m difference   (iv) 0.316m^3/s

6(a) $\dfrac{Q}{\rho \Omega^2 D^5} = f\left(\dfrac{\mu}{\rho \Omega D^2}, \dfrac{h}{D}\right)$, or equivalent

(b)   Model rotates 16 times faster

(c)   Model torque is 1/4 full-scale value

(d)   (i) 200W