Qu.6 (cont.)

from (ii) $0.23(J_1 - J_2) + 0.77(J_3 - J_2) = \phi$

$\therefore J_2 = 0.23 J_1 + 0.77 J_3$

substitute in (i)

$1.5(E_1 - J_1) + 0.77(J_3 - J_1) + 0.23\left((0.23 J_1 + 0.77 J_3) - J_1\right) = \phi$

$\therefore 1.5(32934 - J_1) + 0.77(390 - J_1) + 0.23^2 J_1 + 0.23 \times 0.77 \times 390 - 0.23 J_1 = \phi$

$\therefore J_1\left(1.5 + 0.77 + 0.23 - 0.23^2\right) = 1.5 \times 32934 + 0.77 \times 390 + 0.23 \times 0.77 \times 390$

$\therefore J_1 = 20338 \text{ W/m}^2$

$\therefore J_2 = 0.23 \times 20338 + 0.77 \times 390 = 4978 \text{ W/m}^2$

$J_2 = \dot{E}_{b_2}'' = \sigma T_2^4$

$\therefore T_2 = \left(\frac{4978}{5.67 \times 10^{-8}}\right)^{1/4} = 544 \text{ K} \text{ or } 271^\circ\text{C}$

$\dot{Q}$ from (1) $= \dfrac{\dot{E}_{b_1}'' - \dot{J}_1''}{\frac{\rho_1}{A_1 \varepsilon_1}} = \dfrac{32934 - 20338}{\frac{0.4}{0.6 \times 1 \times 0.8}}$

$= 15115 \text{ W}$

or 15.1 kW