

第十四章：热的传递 (2003年-2017年)

选择题

① $\frac{y}{B} = \frac{3\alpha}{2\alpha}$
 $= 1.5$

C

② $Q = KA \frac{T_2 - T_1}{L} t$

$Q = \pi r^2 K \frac{T_2 - T_1}{L} t$

$\frac{Q}{t} = \pi K (T_2 - T_1) \times \frac{r^2}{L}$

D

③ $Q = KA \frac{T_2 - T_1}{L} t$

$K = \frac{QL}{KA(T_2 - T_1)}$

$K = \frac{Q}{KA} \times \frac{L}{T_2 - T_1}$

C

作答题：

① (i) $Q = KA \frac{T_2 - T_1}{L} t$
 $\frac{Q}{t} = 0.01 \times 1.2 \times \frac{32-0}{0.02}$
 $= 19.2 \text{ Js}^{-1}$

(ii) $PLt = mLf$

$19.2 \times 24 \times 3600 = m \times 3.34 \times 10^5$
 $m = 4.97 \text{ kg}$

(iii) 热传导

② (i) $Q = KA \frac{T_2 - T_1}{L} t$
 $\frac{Q}{t} = KA \frac{T_2 - T_1}{L}$
 $= 400 \times 6 \div 100^2 \times \frac{120-50}{2}$
 $= 8.4 \text{ W}$

(ii) $\frac{Q}{t} = KA \frac{T_2 - T_1}{L}$
 $8.4 = 80 \times 6 \div 100^2 \times \frac{50-0}{L}$
 $L = 0.286 \text{ m}$

③ $B = \frac{A_2 - A_1}{A_1(T_2 - T_1)}$

$2\alpha = \frac{A_2 - A_1}{A_1(T_2 - T_1)}$

$A_2 = 2\alpha A_1 (T_2 - T_1) + A_1$

$A_2 = A_1 (2\alpha T_2 - 2\alpha T_1 + 1)$

钢 铝

$A_1 (2\alpha T_2 - 2\alpha T_1 + 1) = A_1 (2\alpha T_2 - 2\alpha T_1 + 1)$

$\pi r_1^2 (2\alpha T_2 - 2\alpha T_1 + 1) = \pi r_2^2 (2\alpha T_2 - 2\alpha T_1 + 1)$

$0.05^2 (2 \times 1.2 \times 10^{-5} T_2 - 2 \times 1.2 \times 10^{-5} \times 293 + 1) = 0.04995^2 (2 \times 1.6 \times 10^{-5} T_2 - 2 \times 1.6 \times 10^{-5} \times 293 + 1)$

$2.4824 \times 10^{-3} + 6 \times 10^{-8} T_2 = 2.4716 \times 10^{-3} + 7.984 \times 10^{-8} T_2$

$T_2 = 545.36 \text{ K} / 272^\circ\text{C}$

④ (i) $\frac{Q}{t} = KA \frac{T_2 - T_1}{L}$

(ii) 热流通过圆筒侧壁保温套，流出外界时，热传导面积不断扩大，故取平均半径 $r = 6 \text{ cm}$ 。

有效热传导面积

$= 2\pi r h + \pi r^2$

$= 2\pi \times 0.06 \times 0.25 + \pi \times 0.06^2$

$= 0.106 \text{ m}^2$

(iii) $\frac{Q}{t} = KA \frac{T_2 - T_1}{L}$

$= 0.15 \times 0.106 \times \frac{100-30}{0.02}$

$= 55.65 \text{ W}$

(iv) 30°C 时，热流率 = 0 W

平均热流率 = $\frac{100^\circ\text{C}$ 的热流率 + 30°C 的热流率

$= \frac{55.65 + 0}{2}$

$= 27.825$

水 铜

$PLt = mc\Delta\theta + mc\Delta\theta$

$-27.825 t = 1.8 \times 4200 \times (30-100) +$

$0.8 \times 460 \times (30-100)$

$t = 19944 \text{ s} / 332.4 \text{ min}$