

Name of the Student: _____

Max. Marks : 21 Marks

Time : 21 Minutes

Mark Schemes

Q1.

- (a) smooth curve of decreasing positive gradient through all 5 points ✓
shaky or fuzzy line does not gain mark

1

- (b) sensible tangent drawn at $b = 25$; correct read-offs for points (± 1 mm) from triangle with step sizes at least 8×8 ✓

substitution correct ✓

$$G = 0.11(2)$$

change in d divided by change in b for $_3$; don't penalise if change in d is given in m ✓

acceptable range if d is in mm 0.109 to 0.116 for d in m adjust accordingly; accept only 0.11 for 2 sf; accept ≥ 3 sf for 3 ✓

3

- (c) d in range 14.25 to 14.30 mm ✓

substitution correct ✓

$$R \text{ in range } 1.34 \text{ to } 1.38 \text{ m}$$

accept result for R in mm ; no ecf for incorrect or out of range G

3

[7]

Q2.

- (a) $\theta_1 = 61.0 \pm 0.5$ °C ✓
reject 2 sf θ_1

1

- (b) sensible tangent drawn at $t = 190$ s; correct read-offs for points (± 1 mm) from triangle with step sizes at least 8×8 ✓

$$G_1 = -9.57 \times 10^{-2}$$

for $_3$ insist on correct sign and POT; accept result in range 1.05×10^{-1} to -9.0×10^{-2}

3

- (c) substitution correct leading to $\theta_R = 17.3 \pm 2.0$ °C ✓

- (d) $\theta_0 - \theta_R$ correctly evaluated to ± 1 °C for θ_0 at suitable reference time $_1$ ✓

evaluates $\frac{\theta_0 - \theta_R}{e}$ $_2$ ✓

evaluates θ from $\frac{\theta_0 - \theta_R}{e} + \theta_0$; time constant deduced from graph with evidence of working (read offs to both axes are required) $_3$ ✓

time for object to reach room temperature in range 1900 to 2000 s $_4$ ✓

example for $_1$ ✓: $\theta_0 = 89$ °C at $t = 0$ gives $\theta_0 - \theta_R = 89 - 21 = 68$ °C

allow ecf for failure to take account of θ_R in $_1$ ✓

example for $_2$ ✓: $\frac{\theta_0 - \theta_R}{e} = \frac{68}{2.718} = 25$; allow ecf for failure to take account of θ_R in $_1$ ✓

example for $_3$ ✓: $\theta = 25 + 21 = 46$; time constant = 390 s

example for $_4$ ✓: time to reach room temperature = $5 \times 390 = 1950$ s;
no ecf for errors in $_1$ ✓ or in $_3$ ✓

4

- (e) the starting temperature was lower $_1$ ✓

the starting temperature was 86.5 °C compared to 89.0 °C $_2$ ✓

the room temperature was higher $_3$ ✓

the draught was less $_4$ ✓

the water had only cooled to 38.0 °C after 600 s $_5$ ✓

the sample rate of the data logger was lower $_6$ ✓

samples were recorded every 20 s (rate for original experiment was much higher) $_7$ ✓

other approaches are possible

allow ± 0.3 °C for any temperature quoted for $_2$ ✓ or for $_5$ ✓

MAX 5

[14]