1 **(a (i)** conduction B1

(ii) molecules at hot end vibrate more/have high/more energy
OR knocked by molecules/free electrons at hot end have more energy B1

energy/vibration transferred to neighbours/shared
OR (energetic) electrons move along rod B1

(b) copper is a bett**er** conductor OR iron is a poor**er** conductor
(**ignore** electrical)

(c) iron conducts heat slowly OR poor conduction by iron sideways from flame B1

above gauze: flame retains its energy OR gas hot enough to burn B1

copper conducts heat rapidly OR good conduction by copper sideways from flame B1

above gauze: gas not incandescent above gauze OR gas not hot enough to burn B1

[Total: 8]

2 **(a** heat/energy to raise/change temperature M1
of 1 kg/g/unit mass through 1°C/1K/unit temperature A1

(b) darker colours absorb more OR lighter/shiny colours absorb less B1

(ii) **1.** 182 B1
2. (mass of $1m^2$ =) volume × density OR $D = M/V$ OR (1 ×) 0.01 × 7800 C1
78 kg A1
3. $Q = mc\theta$ B1
$182 = 78 \times 450 \times \theta$ (e.c.f. from **1**,**2**) C
0.00519 °C/s OR 5.19×10^{3} °C/s (e.c.f. from **1**,**2**) A

[Total: 9]

3 **(a)** water AND liquids expand more than solids B1

(b) steel M1
(steel) expands at same rate / has same expansion (as concrete) A1
different expansion AND cracks / breaks / damages / destroys concrete A1 [4]

4 **(a** EITHER OR
copper constantan
copper constantan
constantan copper B1

(b) galvanometer OR <u>milli</u>voltmeter OR <u>milli</u>ammeter OR <u>digital</u> ammeter OR <u>digital</u> voltmeter B1

(c) rapid response)
small area)
can measure high / low temperatures)
small thermal capacity (idea of)) any 1 B1
remote reading)
large range)
data logging / continuous monitoring possible)
takes temperature of a surface)
N.B. (very) sensitive not accepted

[3]

5 **(a** (quantity of) heat/energy to raise temp by 1 °C/1degC/1K/unit temp rise M1
1 kg OR 1 g OR unit mass (Mention of change of state gets M0 A0) A1

(b) long time to heat up/cook)
long time to cool down) any 1 B1
expensive to heat)
takes a lot of energy to heat up)

(c) 1.8 degC OR 1.8 °C OR 1.8 K
AND 77.1 degC OR 77.1 °C OR 77.1K B1

(ii) (Q =) mcT in any form, seen anywhere B1
0.2 × 4200 × 1.8 e.c.f. from **(c) (i)** C1
1512 J (minimum 2 s.f.) c.a.o. A1

(iii) 1512 = 0.05 × c × 77.1 in any form e.c.f. from **(c) (i)** and/or **(c) (ii)** C1
392 J/kg K (N.B. must be to 3 sf ; A0 for wrong s.f.) e.c.f. A1

(iv) heat lost during transfer)
boiling water not at 100 °C / reason for not boiling
at 100 °C e.g. water not pure/ not standard pressure)
energy lost to cup etc. / surroundings) any 1 B1
thermometer not accurate / sensitive enough)
temperature / mass(es) not accurately measured)

[10]