1 **(a) (i)** water molecules hit copper/tank/atoms **or** copper atoms hit air molecules **or** radiation from water/tank/copper **or** describe/mention evaporation B1
vibrating (copper) atoms/molecules/particles hit neighbours pass on energy/vibration **or** vibrating (copper) atoms/molecules/particles hit electrons (through copper) B1
electrons strike copper atoms B1

(ii) smaller temperature <u>difference</u>/thermal gradient (between tank and air) **or** reduced vibrations of copper atoms **or** water molecules slower/less <u>kinetic</u> energy **or** reduced radiation (emitted) **or** less evaporation B1

(b) <u>diagram</u> of suitable vessel(s) (<u>one</u> shiny; <u>one</u> dark) B1
action – e.g. fill with hot water **and** same mass/volume B1
starting temperatures are the same B1
measure final temperature **and** compare drop **or** equivalent B1
allow detailed description of Lesley's cube method **and** measure emission rate (for a maximum of 4 marks) **[8]**

2 **(a)** matt black B1

(b) (i) L down and R up, equal amounts (by eye) B1

(ii) on black side or on left (more) energy / heat absorbed OR greater temp rise OR heats up quicker B1

on black side or on left greater expansion of air / greater pressure of air B1 [4]

3 **(a) (i)** good conductor (of heat) B1
(ignore electricity)

(ii) black is good absorber/bad reflector B1
(ignore emitter)

(iii) reduce heat lost/conducted away (from pipes/sheet) B1
NOT prevents heat loss o.w.t.t.e.

(iv) air heated OR glass reduces/prevents convection
OR greenhouse effect OR reference to far and near I.R.
OR glass prevents warm air being blown away OR traps air B1
Ignore traps heat

(b) 38 – 16 OR 22 C1
$mc\theta$ OR 250 × 4200 × his 22 C1
2.31×10^7 (J) e.c.f from previous line C1
9.24×10^7 J OR e.c.f from previous line × 4 correctly evaluated A1
No unit penalty if J seen anywhere in **(b)** clearly applied to an energy

[Total: 8]

4 **(a) (i)** heat for the same time B1

take temps on both thermometers B1 [2]

(ii) dull black box temp > white box temp OR black is hotter etc. B1 [1]

(b) (i) large expansion/change in reading for small change in temp B1 [1]
NOT detect/respond to small temp changes

(ii) temperature rise small and/or small difference between them B1 [1]

(iii) distance between each degree on scale is the same B1 [1]

[Total: 6]

5 **(a** take readings of the detectors B1
fill box with water B1
take readings (again) B1

(b) dull black best AND shiny white worst B1

(c) two different metals B1
two junctions (could be at meter) hot and cold need not be indicated B1
any cell, max B1,B0

[Total: 6]

6 **(a (i)** conduction B1

(ii) particles/atoms/ions vibrate or electrons move and carry energy B1
pass on energy from one particle to the next B1
[3]

(b) four surfaces facing <u>one</u> heat source B1
suitable detector e.g. thermometer behind surface-read all 4 B1
precaution e.g. equal distance/time B1
(Can not score last two marks if experiment is totally wrong) [3]

[Total: 6]

7 **(a (i)** Thermopile / thermocouple / (blackened) thermometer / infra red detector or use ammeter / voltmeter in supply circuit **B1**

(ii) One of: same distance of plate to detector or use two identical detectors or same time (after switching on) **B1**

(iii) Dull black better radiator / radiates more than silver / or emits more heat / radiation **B1**

(iv) Infra red (i.r.) **A1** **4**

(b) <u>any</u> correct example e.g. heating water or chimney **M1**
current clear and complete **A1**
direction shown correctly by arrows **A1** **3**
[7]