01. 0625_m23_ms_42 Q: 4

Question	Answer	Marks
(a)	delocalised / free / mobile electrons	**B1**
	electrons move through metal **OR** electrons collide with distant particles **OR** electrons carry energy through the metal	**B1**
	lattice vibrations transfer energy to neighbouring particles **OR** particles vibrate and cause nearby / adjacent particles to vibrate **OR** vibrating particles collide with particles transferring energy	**B1**
(b)(i)	(attractive) forces (between particles are much) greater in liquids (than in gases)	**B1**
	particles in gases are (much) further apart (than in liquids)	**B1**
(b)(ii)	occurs at a fixed temperature	**B1**
	takes place throughout the liquid	**B1**

Question	Answer	Marks
(c)	3.93 J / (g °C) OR 3930 J / (kg °C)	**A4**
	$\rho = m / V$ **OR** (m =) ρV **OR** 1.03×200 OR 206 SEEN	(C1)
	$c = E / m\Delta\theta$ **OR** (c =) $E / m\Delta\theta$ **OR** 60 700 / (206×75) **OR** 60700 / $(1.03 \times 200 \times 75)$	(C1)
	(m =) 206 (g) **OR** ($\Delta\theta$) = 75 (°C)	(C1)

02. 0625_s23_ms_42 Q: 5

Question	Answer	Marks
(a)(i)	$\rho = m / V$ **OR** $m = \rho V$	**B1**
	(m =) $1.2 \times 4.5 \times 6.1 \times 2.4$ (= 79 kg) **OR** (m =) 79.056 (kg)	**B1**
(a)(ii)	290 s	**A4**
	$c = (\Delta)E / m\Delta\theta$ **OR** (ΔE =) $mc\Delta\theta$ **OR** (ΔE =) $79 \times 1000 \times 4(.0)$ **OR** (ΔE =) 316 000 **OR** ($\Delta\theta$ =) 4(.0)	C1
	$P = (\Delta)E / t$ **OR** (ΔE =) Pt **OR** (ΔE =) $1100 \times t$	C1
	(t =) $mc\Delta\theta / P$ **OR** (t =) $79 \times 1000 \times 4(.0) / 1100$ **OR** (t =) 316 000 / 1100	C1
(a)(iii)	any **one** from: • (thermal) energy is transferred to furniture / walls / objects (in the room) • (thermal) energy is transferred through windows / doors / floor / ceiling / from the room	**B1**
(b)	conduction **AND** convection	**B1**

03. 0625_w23_ms_41 Q: 2

Question	Answer	Marks
(a)	*any three from:* • free / delocalised / mobile electrons • (electrons) gain (thermal) energy from hotplate / particles • (electrons) move through(out) copper / metal **OR** (electrons) move to distant particles • electrons transfer energy from higher temperature (region) to lower temperature (region) **OR** (electrons) collide with (distant) particles / transfer energy to (distant) particles	**B3**
(b)	(shiny surfaces are) poor emitters of radiation	**B1**
	reduces energy loss (from the pan / copper) **OR** less energy transferred to surroundings	**B1**
(c)	convection	**B1**

04. 0625_m22_ms_42 Q: 4

Question	Answer	Marks
(a)(i)	(mass = 1900 × 0.05) = 95 kg	**A2**
	(m =) ρV in any form OR 1900 × 0.05	**(C1)**
(a)(ii)	(= 95 × 1500) = 140 000 J / °C / 1.4 × 10^5 J / °C	**A2**
	(C =) m × c	**(C1)**

Question	Answer	Marks
(a)(iii)	34 000 s / 560 min / 9 h 20 min	**A3**
	Temperature rise = 12(°C) / 19–7 OR $E = C \times \Delta\theta$ in any form	**(C1)**
	(t =) E / P in any form OR (thermal capacity × 12) / 50	**(C1)**
(b)(i)	sand molecules gain KE OR vibrate more OR hit (other) molecules (when heated) OR (thermal energy is transferred by) conduction	**B1**
	Energy is transferred to molecules of plastic pot in contact with sand (through collisions) OR Energy OR (lattice) vibrations transferred to neighbouring molecules	**B1**
(b)(ii)	(sand is warmer than surroundings and so thermal) energy (constantly) is lost from the sand	**B1**
	(at a constant temperature) rate of (thermal) energy supplied to the sand is equal to rate of (thermal) energy lost from sand	**B1**

05. 0625_s22_ms_41 Q: 3

Question	Answer	Marks
(a)	fast(er) / high(er) speed / (more) energetic molecules escape (into air)	**B1**
	average speed / average kinetic energy of molecules decreases	**B1**
	temperature related to speed / energy of molecules **or** slow(er) / low(er) speed / less energetic molecules remain (in water)	**B1**
(b)	any **three** from: atoms / ions vibrate (vibrating) atoms / ions hit electrons electrons propelled / travelling through metal / moving through metal electrons hit (distant) atoms free electrons / delocalised electrons mentioned	**B3**

06. 0625_s22_ms_41 Q: 6

Question	Answer	Marks
(a)	any **three** from: radiation light / infrared / electromagnetic (radiation) travel through space / vacuum absorbed by road	**B3**
(b)	road / black surfaces are good absorbers (of radiation) **or** sea is a poor absorber (of radiation)	**B1**
(c)(i)	they / molecules speed up **or** gain kinetic energy	**B1**
	they / molecules move further apart	**B1**
(c)(ii)	density (of air above road) decreases **or** density (of hot air) decreases	**B1**
	air (above land / road) rises **or** air (that is hot) rises	**B1**
	air (above road) replaced by cool air / air from above sea	**B1**

07. 0625_w22_ms_42 Q: 5

Question	Answer	Marks
(a)	(E =) 410 000 000 J **OR** 410 MJ **OR** 4.1×10^8 J	**A3**
	$\Delta E = mc\Delta T$ **OR** (ΔE =) $mc\Delta T$ **OR** $1200 \times 960 \times 360$	C1
	(ΔT =) 360 (°C)	C1
(b)	(thermal) radiation	**M1**
	electromagnetic / e-m / infrared / IR (radiation emitted from block)	**A1**
	travels to worker **OR** is absorbed by worker **OR** travels without needing a medium	**A1**
(c)	conduction	**B1**
	delocalised / free / moving electrons	**B1**
	any one from: • (electrons) move (from outer surface) to interior (of rollers) • (electrons) travel through(out) the solid / large distances • (electrons) collide with distant particles • lattice vibrations transfer thermal energy to neighbouring particles **OR** particles vibrate and cause nearby / adjacent particles to vibrate **OR** vibrating particles collide with particles transferring energy.	**B1**

08. 0625_m21_ms_42 Q: 3

	Answer	Marks
(a)	renewable / yes	B1
	crops can be regrown (to replace resource) / waste materials don't run out	B1
(b)	water will cool (too much) / thermal energy lost (during transfer)	B1
	lag/insulate (pipes) OR transport in a poor conductor of thermal energy	B1
(c)	any two from: • air pollution / harmful gases / acid rain • CO_2 / greenhouse gases / contribution to global warming • not renewable • damage from mining / drilling or any valid environmental consequence of transport of coal	B2

09. 0625_s21_ms_41 Q: 4

	Answer	Mark
(a)	aluminium is a (good) conductor (of heat) **and** plastic is a poor conductor / does not conduct (heat)	B1
(b)(i)	increase in kinetic energy of molecules **or** increase in potential energy of molecules	B1
(b)(ii)	any **three** from: • atoms (touching the hotplate) / lattice vibrate (faster) • atoms pass on energy / vibration to neighbouring atoms / to other atoms by collision • atoms pass on energy to electrons • electrons hit distant atoms **or** electrons move (through lattice)	B3
(b)(iii)	molecules escape from the liquid (as a vapour)	B1
	bonds broken / (attractive) forces overcome	B1
	molecules gain potential energy **or** work done (to separate molecules / break bonds / overcome forces)	B1
(b)(iv)	840 W	A3
	(E =) ml_v in any form **or** $0.11 \times 2.3 \times 10^6$ **or** 2.53×10^5	C1
	(rate =) ml_v / t in any form **or** $0.11 \times 2.3 \times 10^6 / 300$ **or** $2.53 \times 10^5 / 300$	C1

10. 0625_s21_ms_42 Q: 5

	Answer	Mark
(a)	air good insulator / poor conductor	B1
	holder / it stops / reduces conduction OR no / less thermal energy conducted (to hand)	B1
	temperature (of outside of holder) lower (than cup) OR less energy to skin / hand / person	B1
(b)	(put a) lid / cover (on cup)	B1
	mention of convection	B1
	less / no convection (from surface)	B1
	alternative route for last 2 m.p.s	
	mention of evaporation	(B1)
	less / no evaporation (from surface / container)	(B1)
(c)	radiation	B1

11. 0625_w21_ms_43 Q: 5

Question	Answer	Marks
(a)(i)	1.2 kg	A2
	$(m =)\frac{7600\times0.41}{2600}$ volume constant so mass directly proportional to density	C1
(a)(ii)	0.37 J / °C	A2
	(thermal capacity =) mass × specific heat capacity	C1
(a)(iii)	48 J	A2
	(E =) mcΔT OR 1.2 × 0.50 × (100 – 20) in any form	C1
(b)	electrons mentioned	B1
	(metals have) electrons free to move / delocalised (which transfer thermal energy)	B1

12. 0625_m20_ms_42 Q: 5

(a)	conduction	B1
	conduction	B1
	radiation	B1
(b)	electrons move	B1
	lattice / molecular / particle vibration or w.t.t.e. OR free / delocalised electrons	B1
(c)	shiny white	M1
	best reflector	A1

13. 0625_w20_ms_41 Q: 5

Question	Answer	Marks
(a)	electrons mentioned	B1
	electrons travel (a great distance) through the metal **or** (vibrating) atoms hit (free) electrons	B1
	electrons hit (distant) particles **or** transfer energy (to distant atoms)	B1
(b)	shiny surfaces are poor emitters (of radiation)	B1
	infrared / radiation / mentioned	B1
	less energy lost **or** lost energy does not need to be supplied	B1
(c)	less thermal energy emitted **or** less space for energy to be lost	B1

14. 0625_w20_ms_43 Q: 5

Question	Answer	Marks
(a)	cork on black plate / side B falls off (before cork on shiny plate / side A)	B1
	black surface are better absorbers than shiny surfaces **or** shiny surfaces are better reflectors than black surfaces	B1
	black surface are better absorbers than shiny surfaces **or** shiny surfaces are better reflectors than black surfaces **AND** of (infrared) radiation	B1
	wax on black plate / plate B melts before wax on shiny plate / plate A	B1
(b)	conduction	B1

15. 0625_m19_ms_42 Q: 6

(a)	Convection	B1
(b)(i)	(E =) $mc\Delta\theta$ OR $65 \times 720 \times 7$	C1
	3.3×10^5 (J)	C1
	P = E/t in any form OR (t=) E/P OR $3.3 \times 10^6 / 1.5 \times 10^3$	C1
	220 s	A1
(b)(ii)	Two of: The heater warms walls, floor, ceiling, windows, furniture / objects. Thermal energy conducted through walls, floor, ceiling, windows (to exterior) Thermal energy used to raise temperature of air entering room via draughts / openings	B2

16. 0625_s19_ms_43 Q: 5

(a)	any mention of radiation/infra-red radiation wrt silvered surfaces	B1
	silvered surfaces are poor emitters / poor absorbers / (good) reflectors	B1
	glass is a poor conductor OR glass reduces thermal energy / heat gain by conduction	B1
	vacuum prevents thermal energy / heat gain by conduction OR convection	B1
	stopper reduces thermal energy / heat gain by convection	B1
(b)	any suitable insulator e.g. cork, plastic, rubber	B1

17. 0625_w19_ms_42 Q: 4

(a)	E = VIt in any form OR (E =) VIt OR (E =) $3 \times 12 \times 23 \times 60$	C1
	(E =) 50 000 (J)	C1
	C= E / ΔT in any form OR (C=) E / ΔT OR (C=) 49 680 / 50 OR 50 000 / 50	C1
	(C=) 990 J / °C	A1
(b)	1. larger sphere emits / radiates / loses thermal energy more	M1
	greater (surface) area	A1
	2. greater (rate of radiation)	B1

18. 0625_m18_ms_42 Q: 4

(a)	Molecules of hot liquid collide with (surface of) spoon	**B1**
	transfer energy / heat to (molecules of) spoon	**B1**
	(amplitude of) vibration of spoon's molecules increases / is faster (increasing spoon's temperature)	**B1**
(b)	Molecules of hot liquid (also) transfer energy to (free) electrons in the spoon	**B1**
	These (free) electrons move through the metal	**B1**
(c)	(Q =) $mc\Delta\theta$	**C1**
	$150 \times 4.2 \times (80 - 56)$	**C1**
	15000 J	**A1**

19. 0625_s18_ms_42 Q: 5

	diagram shows cans placed near heater	**1**
	put thermometers in water **AND** observe readings	**1**
	good detail e.g. cans equal distances from heater same water volumes/levels thermometers same positions in cans	**1**
	higher thermometer reading in black (painted) can **OR** black (surface) good/best/better absorber	**1**

20. 0625_s18_ms_43 Q: 4

(a)	more energetic molecules escape/evaporate	**B1**
	less energetic molecules remain	**B1**
	average kinetic energy of molecules decreases **OR** temperature depends on kinetic energy	**B1**
(b)	convection	**B1**
	surface/colder water more dense **OR** contracts	**B1**
	(cold water) sinks **OR** warmer water rises	**B1**
(c)(i)1	difference between the maximum temperature and minimum temperature it can measure	**B1**
(c)(i)2	distance moved by the thread per °C **OR** per unit temperature change	**B1**
(c)(ii)	(range) increases **and** less expansion/increase in volume (of mercury per unit temperature rise)	**B1**

21. 0625_m17_ms_42 Q: 4

(a)	Density of bulb A greater than the density of the water (and sinks) Density of other bulbs less than the density of water (and float)	**B1** **B1**
(b)(i)	Glass is a poor conductor of heat OR glass conducts heat at a slow rate OR water has a high (specific) heat capacity	**B1**
(b)(ii)	The water expands OR separation of water molecules increases	**B1**
	The water becomes less dense	**B1**
	Bulb B now has a greater density than the water (and sinks) OR Weight of bulb B more than buoyancy forces / upthrust	**B1**
(c)	24 °C – 26 °C	**B1**
	Total:	**7**

22. 0625_m17_ms_42 Q: 6

(a)	Visible / light and infra-red	**B1**
(b)	Any 4 of: Level of water in left-hand tube falls and level of water in right-hand rises Matt black bulb is a good absorber OR is better absorber than shiny bulb Shiny bulb is a good reflector OR is better reflector than matt black bulb Temperature rises more in left-hand tube OR less in right-hand tube Pressure rises more in left-hand tube OR less in right-hand tube Air expands more in left-hand hand tube OR less in right-hand tube	**B4**
	Total:	**5**

23. 0625_s17_ms_41 Q: 4

(a)(i)	60 W	**B1**
(a)(ii)	Radiation and either conduction or convection	**B1**
(b)(i)	Radiation mentioned	**B1**
	Higher reading or rises faster on thermometer A	**B1**
	Black (surface) is a good/better emitter (than polished surface) OR polished (surface) is a poor/bad/worse emitter (than black surface)	**B1**
(b)(ii)	(Compared with black bulb thermometer) readings rise more slowly OR readings are low(er)	**B1**
	Shiny (bulb) surfaces are good/better reflectors (of radiation) OR Shiny (bulb) surfaces are poor/bad/worse absorbers (of radiation)	**B1**
(c)	Firefighter does not get too hot/burned (from radiation)	**B1**
	Total:	**8**

24. 0625_s17_ms_42 Q: 5

(a)(i)	E = mc(Δ)T in any form or (E=) mc(Δ)T	C1
	(E= 0.6 × 4200 × 80 =) 200 000 (J)	C1
	E = VIt in any form or (t=)E / VI	C1
	(t= 201 600 / (12 × 240) =) 70 s	A1
(a)(ii)	no (thermal) energy losses	B1
(b)	put (hot) water in bottle AND place thermometers/measure temperatures each side of (centre of) bottle	M1
	put thermometers near bottle	A1
	good detail e.g. • thermometers equal distances from bottle • thermometer bulbs same height • record temperatures regularly	A1
	thermometer near black has higher reading/rises faster/larger temperature difference or reverse argument	A1
	Total:	9

25. 0625_s17_ms_43 Q: 5

(a)	white kit cooler OR black kit warmer	M1
	white poor absorber/good reflector of (IR)radiation/heat/thermal energy OR v.v. for black	A1
(b)(i)	any **two** pairs from: more/less wind; dries quicker/slower temperature increases/decreases/sunnier/cloudier; dries quicker/slower stops/starts raining; dries quicker/slower less/more humid; dries quicker/slower	B2
(b)(ii)	molecules with most (kinetic) energy (escape) OR water cools	B1
	escape liquid/break intermolecular bonds / molecules enter air / evaporate / become vapour	B1
	Total:	6

26. 0625_w17_ms_42 Q: 5

(a)	any **three** of these five: • any sensible mention of the sun (as source of energy) • (thermal / heat / *IR* / electromagnetic) radiation • white (or clearly implied) surfaces absorb less or don't absorb • white (or clearly implied) surfaces reflect more • to keep house cooler OR to reduce thermal energy / heat transferred to house	B3
(b)	decreases	B1