01. 0625_m20_MS_62 Q: 2

(a)	θ_R = 21 (°C)	**1**
(b)(i)	s, °C both correct in heading	**1**
(b)(ii)	suitable precaution e.g.: line of sight perpendicular to scale wait until reading stops rising (at start) stir before reading keep thermometer at same depth	**1**
(c)(i)	x_1 = 0.18	**1**
(c)(ii)	unit °C / s, seen in **(c)** and not contradicted	**1**
(c)(iii)	x_3 = 0.07 and x_2 = 0.12	**1**
(d)(i)	cooling rate decreases (over time) and justified by comparative values of cooling rate over suitable periods of time	**1**
(d)(ii)	$\theta_F = \theta_R$	**1**

(e)(i)	suggestion matching results	**1**
	explanation matching suggestion: EITHER: SUGGESTION: smaller cooling rates (at equivalent times) EXPLANATION: reference to cooling rate being smaller at lower temperatures and values stated OR SUGGESTION: smaller difference(s) in cooling rates (between equivalent times) EXPLANATION: clear reference to ($x_2 - x_3$) being smaller than ($x_1 - x_2$)	**1**
(e)(ii)	suitable control: (same) volume of water, (same) material of beaker, (same) duration of experiment, (same) room temp / named appropriate environmental condition	**1**

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02. 0625_p20_MS_60 Q: 2

(a) 23 (°C) [1]

(b) any one from:
wait for thermometer reading to stop rising
eye level with top of (mercury) thread owtte
stir water [max 1]

(c) s, °C, °C, words or symbols AND
30, 60, 90, 120, 150, 180 [1]

(d) uninsulated (owtte) OR no significant difference [1]
justified by reference to temperature differences and time [1]
relevant science, consistent with readings and conclusion
(e.g. therefore cotton wool is a good/not a good insulator OR most cooling is due to convection or radiation etc.) [1]

(e) quality poor due to small temperature differences [1]

any two improvements from:
increase initial temperature of water
ensure initial temperatures are identical
use a lid
stir to eliminate differences between top and bottom of the water
use thicker insulation
use more sensitive thermometer or datalogger [max 2]

(f) any two from:
laboratory temperature
draughts/open windows
accept temperature of hot water source [max 2]

(g) 5–50 cm^3 [1]

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03. 0625_s20_MS_61 Q: 4

	MP1 Diagram to show container and thermometer	**1**
	MP2 Hot water in a container. Record initial temperature and take temperature at intervals as it cools	**1**
	MP3 Repeat with at least three other colours	**1**
	Any **two** from: **MP4** Same starting temperature Same room temperature **MP5** Use of a lid At least three named colours Same thickness of paint	**2**
	MP6 Table with clear columns for temperature and / or time (to match method), with appropriate units	**1**
	MP7 Conclusion: Greatest temperature drop shows best radiator (or reverse argument)	**1**

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04. 0625_m19_MS_62 Q: 2

(a)	θ_R = 23 (°C)	**1**
(b)	s, °C, °C all correct	**1**
	30, 60, 90, 120, 150, 180	**1**
(c)	lid is more effective	**1**
	correct mention of comparative temperature change over 180 s, supporting conclusion	**1**
(d)	additional experiment with both insulation and lid / neither insulation nor lid	**1**
	compare result of (previous) experiment with additional / only one factor changed in (each) comparison	**1**
(e)(i)	x_A = 0.081	**1**
	°C / s	**1**
(e)(ii)	cooling more rapid at higher temperatures	**1**
	comparison of temperature difference over first 30 s and last 30 s supporting statement	**1**

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05. 0625_s19_MS_61 Q: 3

(a)	24 (°C)	1
(b)(i)	s, °C seen and not contradicted	1
(b)(ii)	Third box ticked to match readings	1
	Pairs of readings 94(°C), 89(°C) and 93 (°C), 87 (°C) quoted. OR differences 5(°C) and 6(°C) quoted	1
	Difference is only 1(°C) OR difference is small. owtte	1
(c)(i)	Use a black painted beaker (and black painted can)	1
	Use a shiny can (and unpainted beaker)	1
(c)(ii)	Any two from: Room temperature Volume of water Same starting temperature (of water)	2
(d)	Perpendicular viewing of the thermometer OR stirring OR thermometer not touching beaker.	1

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06. 0625_s19_MS_62 Q: 2

(a)	22(.0) (°C)	1
(b)(i)	s, °C seen in both tables	1
(b)(ii)	third box ticked to match readings	1
(b)(iii)	quoting temperatures from the table in the same time	1
(c)	any one from: higher room temperature lower starting/initial temperature insulation	1
(d)	perpendicular viewing of thermometer/view (reading) at eye level/stir the water/thermometer not touching the sides of the beaker/wait for the temperature to stop rising (initially)	1
(e)	any two from: room temperature/stated environmental condition starting/initial temperature of the (hot) water volume/mass/amount of water same beaker total time for experiment	2
(f)	third box ticked	1

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07. 0625_s19_MS_63 Q: 2

(a)	21 (°C)	1
(b)(i)	s, °C, °C, °C all correct	1
	30, 60, 90, 120, 150, 180	1
(b)(ii)	any one from: • place stop-clock and thermometers so seen easily • keep eyes at level to thermometer scales • use an audible 30 s alarm • read temperatures alternately every 15 s • use of data logger	1
(c)	greater temperature difference causes greater (rate of) heating	1
	comparison of temperature changes during same period in first half and in second half of experiment	1
(d)(i)	within range 64 to 72 (°C) inclusive	1
	justification with reference to hot and cold water trends	1
(d)(ii)	21 (°C) / room temperature	1
(e)	any **two** from: • thinner walls on tube • metal tube • bung/lid on tube • insulate sides of beaker/lid on beaker • higher initial hot water temperature • lower initial cold water temperature • increase volume of hot water • decrease volume of cold water • stirring	2

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08. 0625_w19_MS_61 Q: 3

(a)	24 (°C)	1
(b)(i)	Times 60, 120, 180, 240, 300	1
(b)(ii)	Units s and °C	1
(c)	10, 7	1
(d)(i)	Correct box ticked to match readings	1
(d)(ii)	Justification to match **(i)**, quoting figures	1
	Reference to same time	1
(e)	Two from: Insulate Lid Lower starting temperature Higher room temperature Smaller volume of water Smaller surface area	2
(f)	Clearly shown perpendicular line of sight	1
	Clearly shown bottom of meniscus	1

---

09. 0625_w19_MS_62 Q: 4

	MP1 method diagram: container, ice (cubes, thermometer and insulation)	**1**
	MP2 ice (in container), measure time (for all the ice) to melt	**1**
	MP3 repeat with different insulators	**1**
	MP4 control variables (total) mass / volume of ice cubes	**1**
	MP5 any **one** from: thickness / amount of insulation room temperature / other environmental condition size / shape / surface area of ice cubes initial temperature (of ice cubes)	**1**
	MP6 table table with headings of (named) insulator and time with correct units	**1**
	MP7 conclusion (use the table to) compare the insulator with the time taken for the ice cubes to melt	**1**

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10. 0625_w19_MS_63 Q: 4

	MP1 Apparatus beaker and (material for) lid and thermometer and stop clock (or alternative)	**1**
	MP2 Method pour (hot) water into container measure temperature of (hot) water over period of time	**1**
	MP3 Method repeat for different thicknesses of lid	**1**
	MP4 & MP5 Control variables any **two** from: • same initial/starting temperature of water ; • same volume of water ; • same size / material / thickness of beaker ; • same material for lid ; • same time for measuring temperature change / same temperature difference for measuring time taken • same room temperature / other environmental condition	**2**
	MP6 Table suitable column headings and units	**1**
	MP7 Analysis any **one** from: • comparison of temperature decrease / rates of cooling with thickness / different lids • draw a suitable graph with axes stated	**1**

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11. 0625_m18_MS_62 Q: 2

(a)(i)	θ for beaker **A** = 87(.0)(°C) and θ for beaker **B** = 89(.0)(°C)	**1**
(a)(ii)	s, °C, °C all correct	**1**
	30, 60, 90, 120, 150, 180	**1**
(b)	one precaution e.g.: read at 90° (to scale) / perpendicularly, stir (before reading) / wait until reading stops rising(at start)	**1**
(c)	conclusion matching results	**1**
	justification matching conclusion with correct mention of comparative temperature change over 0 to 180 s	**1**
(d)(i)	unit °C / s	**1**
(d)(ii)	x_1 = 0.094 / ecf and x_2 = 0.067	**1**
(e)	statement matching results with results used in explanation and reference to different (starting) temperatures for x_1 and x_2	**1**
(f)	experiment with lid and no insulation	**1**
	experiment with insulation and no lid	**1**

12. 0625_s18_MS_61 Q: 4

	Method to include: (Hot) water in copper can, time taken for temperature to drop	**1**
	Correct use of at least 3 larger outer containers, separately	**1**
	Some indication that size of air gap is measured	**1**
	Any **two** from: Use of something to cover air gap Use of lid on copper can Same starting temperature Same room temperature Same volume of hot water Use of 'control' with no outer container Inner container standing on an insulator Uniform air gap all round	**2**
	Table with clear columns for temperature and/or time (to match method) and air-gap, with appropriate units	**1**
	Conclusion: Least temperature drop **OR** longest time for temperature to drop shows lowest cooling rate **OR** best insulation **OR** plot temperature against time and least gradient shows lowest cooling rate (ora)	**1**

13. 0625_s18_MS_62 Q: 2

(a)	θ_R = 23(.0) (°C)	1
(b)(i)	ensure thermometer / bulb / alcohol / mercury has reached the temperature of the water	1
(b)(ii)	s / seconds, °C	1
(b)(iii)	*t* values 30, 60, 90, 120, 150	1
(b)(iv)	graph:	
	axes correctly labelled and right way round	1
	suitable scales (scales must start below θ_R)	1
	all plots correct to ½ small square	1
	good line judgement, thin, continuous line	1
(c)	horizontal line at θ_R correctly positioned	1
(d)	any **two** from: perpendicular viewing of thermometer stir (before taking temperature reading) don't let the thermometer (bulb) touch the sides / bottom of beaker wait for thermometer to reach θ_{MAX} before reading	2
(e)	any **two** from: higher starting temperature / use hotter water use of metal can instead of beaker / metal bench lower room temperature / cold water bath use of a fan container with a greater surface area / larger beaker	2

14. 0625_s18_MS_63 Q: 1

(a)	21(.0) (°C)	1
(b)	s, °C, °C all correct	1
	30, 60, 90, 120, 150, 180	1
(c)	appropriate precaution e.g. avoidance of parallax (only if explained) / wait until reading stops rising (at start)	1
(d)(i)	beaker with lid **A** (has a greater rate of cooling)	1
	correct mention of comparative temperature change over 0 to 180 s	1
(d)(ii)	any suitable change to apparatus relating to comparison e.g. insulate sides / stand on mat use plastic beaker thicker lid use of fan use wider beaker	1
	matching explanation e.g. thermal energy only escapes from surface less transfer of thermal energy by sides / bottom less conduction through lid larger surface area (for evaporation to occur)	1
(e)	straight line	1
	through the origin	1
(f)	any appropriate factor e.g. volume of water initial temperature of water (same) lids type / material / size of beaker room temperature / appropriate environmental factor	

15. 0625_w18_MS_62 Q: 4

	method: **MP1** measure room / starting temperature	**1**
	MP2 measure time to raise water temperature to boiling point	**1**
	MP3 repeat with the other two containers	**1**
	control variables: **MP4** any two from: same starting temperature / same room temperature same volume / mass / amount of water **MP5** keep Bunsen burner flame constant / keep the distance from the flame to the bottom of the beaker constant	**2**
	table: **MP6** table to show container and heating time	**1**
	conclusion: **MP7** comparison of heating times and suitable comment made	**1**

16. 0625_m17_MS_62 Q: 1

(a)	θ_A = 18 and θ_B = 37 (°C)	**1**
(b)	units all correct (symbols or words)	**1**
	t values all present (30, 60, 90, 120, 150 and 180)	**1**
(c)	any 2 appropriate precautions: stir before reading, keep thermometer at same level, set eye to same level as / perpendicular / right angles to scale, wait until reading stops rising (at start), position clock so that thermometer and clock can be easily seen	**2**
(d)	conclusion matching results	**1**
	correct mention of comparative temperature change over 180 s	**1**
(e)	**any suitable improvement to apparatus or procedure relating to comparison, e.g.:** • measure water into test-tube / beaker, • use same volume of water in test-tube / beaker, use same starting temperatures in tubes, • ensure all water in tube below level of water in beaker, • use insulation / lid on beaker	**1**
	matching explanation, e.g.: • ensure same amount of water being used each time, • cooling rates different / owtte at different volumes / temps, • all water in tube has same surrounding temperature, • keeps water in beaker at (more) constant temperature	**1**
(f)	reading taken perpendicular to scale	**1**
	at bottom of meniscus	**1**
	Total:	**11**

17. 0625_s17_MS_61 Q: 3

(a)	23 with unit °C	**1**
(b)(i)	11 AND 8	**1**
(b)(ii)	Starting temperature closer to room temperature in the second case (or further from room temperature in the first case)	**1**
(c)	Two from: Increase draught (over surface of water) Increase temperature of hot water Increase surface area of water Longer time intervals Decrease room temperature Decrease volume of water Use metal can instead of glass beaker Stirring	**2**
(d)	Any 2 from: Uses bottom of meniscus Perpendicular (to reading) That is where the scale markings are, owtte	**2**
	Total:	**7**

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18. 0625_s17_MS_62 Q: 5

	method to include:	
MP1	measurements of temperature of hot water over a period of time/measurement of temperature at start and end of a specified cooling time /measurement of time for a specified temperature drop	**1**
MP2	repeat using variety of fan speeds (blowing air over water surface)	**1**
MP3 MP4	two from: room temperature initial/starting temperature of hot water volume/mass/amount of (hot) water distance of beaker to fan for each speed setting time of cooling (for a fixed temperature drop) temperature drop (for a fixed time) same beaker size/material	**2**
MP5	table with columns for fan speed, time and temperature with units in the table headings (not the body of the table) for time and temperature, but fan speed units not required	**1**
MP6	compare readings to find out which fan speed produces the greatest temperature drop / takes least time **or** plot a graph of temperature against time	**1**
MP7	in the same time / for same temperature drop **or** steepest gradient gives the fastest rate of cooling	**1**
	Total:	**7**

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19. 0625_s17_MS_63 Q: 4

4 MP1	**apparatus** beaker with insulation and thermometer and stopclock (or alternative) mentioned	**1**
MP2	**method** pour hot water into container measure temperature of hot water over period of time	**1**
MP3	repeat for additional layers	**1**
MP4	**results:** suitable table / graph / cooling curve	**1**
MP5	**control variables** any pair from: same initial temperature, same volume of water, same size/material/thickness of beaker, same thickness of each layer,	**1**
MP6 MP7	**additional points** any 2 from: how cooling rate calculated/how to compare cooling curves, read thermometer perpendicularly, thermometer at same depth (for repeat) thermometer not touching beaker, stir before reading thermometer, use of lid, minimum of 5 different thicknesses of insulation, repeat experiment with different sized beakers/different amount of water, sensible amount of water (50 cm^3 to 500 cm^3)	**2**
	Total:	**7**

20. 0625_w17_MS_62 Q: 2

(a)	24 (°C)	**1**
(b)	34 (°C)	**1**
(c)	30 (°C) AND °C seen once in **2(a)**, **2(b)** or **2(c)**	**1**
(d)	to make sure that the temperature is the same throughout / to allow the water to mix and reach its final temperature faster	**1**
(e)	heat loss (to surroundings) / time delays in transferring the water / did not wait for thermometer readings to stabilise / (initial) temperatures of the (cold / hot) water not the same	**1**
(f)	insulation	**1**
(g)	same starting temperature (of hot / cold water) / same room temperature	**1**
(h)	recognisable measuring cylinder	**1**
	perpendicular viewing	**1**
	to bottom of mensicus	**1**

21. 0625_w17_MS_63 Q: 1

(a)	units ALL correct (symbols or words)	**1**
	t values all present (0, 30, 60, 90, 120, 150 and 180)	**1**
(b)	**two** appropriate precautions, e.g.: avoidance of parallax(only if explained), wait until reading stops rising at start, ensure thermometer not touching beaker	**2**
(c)(i)	conclusion matching results	**1**
	correct mention of comparative temperature change over 180 s	**1**
(c)(ii)	any suitable improvement relating to comparison: e.g. same volume of water, same initial temperature, insulate sides, use plastic beaker, stand on mat, use a thicker / more insulated lid,	**1**
	matching explanation: e.g. lid only factor changed, cooling more rapid for higher temperatures, cooling different for different volumes, thermal energy only escapes from surface, less transfer of thermal energy by sides, effect of lid more marked	**1**
(c)(iii)	any appropriate similarity: e.g. both cool more rapidly at the start	**1**
(d)(i)	23 (°C)	**1**
(d)(ii)	any suitable suggestion with a valid explanation greater temperature at end as cannot fall below room temperature, lower rate of cooling as temperature difference between water and room is smaller	**1**

22. 0625_m16_MS_62 Q: 4

apparatus: [1]
(set of) different sized beakers / containers, thermometer and stop clock / watch

method: [1]
pour hot water into container (and allow to cool)
and measure temperature and time

repeat for a second container with a different surface area [1]

precautions:
any two from: [2]
same volume of hot water
same initial hot water temperature
same room temperature or other environmental condition

graph:
temperature change / rate of cooling against surface area, [1]
temperature against time,
time to cool between fixed temperatures against surface area

additional point:
any one from: [1]
- at least 5 different surface areas,
- sensible range of container sizes given,
- sensible amount of water stated,
- use of lagging / insulating material for container walls,
- same type of container
- how surface area may be calculated

[Total: 7]

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23. 0625_p16_MS_60 Q: 2

(a) 23 (°C) [1]

(b) any one from:
wait for thermometer reading to stop rising
eye level with top of (mercury) thread owtte
stir water [max 1]

(c) s, °C, °C, words or symbols AND
30, 60, 90, 120, 150, 180 [1]

(d) uninsulated (owtte) OR no significant difference [1]
justified by reference to temperature differences and time [1]
relevant science, consistent with readings and conclusion
(e.g. therefore cotton wool is a good/not a good insulator OR most cooling is due to convection or radiation etc.) [1]

(e) quality poor due to small temperature differences [1]

any two improvements from:
increase initial temperature of water
ensure initial temperatures are identical
use a lid
stir to eliminate differences between top and bottom of the water
use thicker insulation
use more sensitive thermometer or datalogger [max 2]

(f) any two from:
laboratory temperature
draughts/open windows
accept temperature of hot water source [max 2]

(g) 5–50 cm^3 [1]

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24. 0625_s16_MS_61 Q: 4

	MP1 Uses same container throughout	**1**
	MP2 Hot water in container (any) and takes temperatures at intervals or at start and after a fixed time OR Hot water in container (any) and takes time for a fixed temperature fall.	**1**
	MP3 Repeats with different insulators (all three used)	**1**
	MP 4&5 Any two from: Constant room temperature Same starting temperatures (clearly stated) Same volumes of hot water (clearly stated) Same thickness/amount of insulator Use container without insulation Use of a lid Insulates bottom of container Uses the copper can only	**2**
	MP6 Table or tables as appropriate to method: Temperatures with unit °C and time with unit s (or min) and different insulators shown	**1**
	MP7 Use of readings: graph of temperature against time OR compare results and comment that longest time to cool = best insulator or smallest drop in temperature in fixed time = best insulator (or reverse arguments)	**1**
		Total 7

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25. 0625_s16_MS_62 Q: 5

(a)(i)	s, °C, °C, °C	**1**
(a)(ii)	83(°C)	**1**
(b)(i)	First box / sentence indicated	**1**
(b)(ii)	Clear reference to readings with examples of temperature differences	**1**
(c)	Any two from: • Room temperature (or suitable reference to draughts or similar) • Starting temperature (of water) • Density of packing / amount / type of insulation • Thickness of lids / identical lids	**max 2**
(d)	Card or any suitable insulating material Should be a good insulator / poor conductor	**1** **1**
(e)	Perpendicular viewing / view at right angles / eye level Reading to bottom of meniscus	**1** **1**
		Total: 10

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26. 0625_s16_MS_63 Q: 1

(a)	θ_R = 21(°C)	**1**
(b)	s, °C , °C time values correct 30, 60, 90, 120, 150, 180	**1** **1**
(c)(i)	'thermometer **A** cools more rapidly' and 'greater overall temperature change' reference to 'in the same time'	**1** **1**
(c)(ii)	rate increases then decreases OR cooling is less in first 30 s than in subsequent 30 s periods	**1**
(d)(i)	makes comparison fair / only one factor changed	**1**
(d)(ii)	causes start temperature to be lower	**1**
(e)	any two appropriate factors: e.g. start temperature, room temperature, draughts, humidity, amount of insulation, type of thermometer	**2**
		Total: 10

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27. 0625_w16_MS_61 Q: 2

(a)(i)	88 (°C)	**1**
(a)(ii)	θ_{AV} = 53.5 (°C)	**1**
(b)	Perpendicular viewing of scale OR stirring OR wait until temperature stops rising, OR avoid delay (between adding water and taking temperature) Allow thermometer not touching beaker, owtte	**1**
(c)	Correct diagram with lid drawn Insulation placed round beaker	**1** **1**
(d)	Statement and justification to match results. A number or numbers must be seen. Comment must include yes or no or 'too close to call'; owtte	**1**
(e)	Two from: Room temperature (or other environmental condition) Temperature of cold water Temperature of hot water Volumes of water Size/shape/material/surface area of beaker	**2**
	Total:	**8**

28. 0625_w16_MS_62 Q: 4

	clock / stopwatch and source of heat	**1**
	heat to boiling with and without lid	**1**
	measure time taken to reach **boiling point/boil**	**1**
	same volume / mass / amount of water	**1**
	same starting temperature	**1**
	suitable table with column headings and units (seconds or minutes)	**1**
	conclusion drawn	**1**
	Total:	**7**

29. 0625_w16_MS_63 Q: 1

(a)(i)	θ = 82(.0), 80(.0)	**1**
(a)(ii)	units all correct (symbols or words) *t* values all present (30, 60, 90, 120, 150 and 180)	**1** **1**
(b)	any 2 appropriate precautions: e.g. viewing perp. to thermometer scale (to avoid parallax) stir before reading keep thermometer at same level / not touching beaker walls wait until reading stops rising at the start	**2**
(c)(i)	Conclusion and explicit quoting of figures from the table which relate to the *whole* 180 s period (eg 15.0 and 9.5 °C, or 5.5 °C more) statement that B cools more quickly / its temperature drops faster / its temperature falls more in the same time	**1** **1**
(c)(ii)	any suitable improvement to apparatus relating to comparison: e.g. insulate sides, use plastic beaker, stand on mat matching explanation: e.g. thermal energy only escapes from surface, surface area only variable changed, less transfer of thermal energy / heat by sides appropriate effect on values of θ: e.g. all higher	**1** **1** **1**

(d)	any appropriate factor: e.g. volume of water, initial temperature of water, similar ratio of surface areas, type / material / size of beaker, room temperature	**1**
	Total	**11**

30. 0625_m15_MS_62 Q: 2

(a) units correct, accept symbols or words [1]
t values correct: 0, 30, 60, 90, 120, 150, 180 [1]

(b) statement matching results with comparison of temperature changes over whole available range OR for 120 s from 71 °C [1]

justification with mention of 'in the same time' owtte [1]

(c) two precautions relating to temperature measurement,e.g. [2]
- thermometer at same depth
- read thermometer with reading at eye level/90° to scale/explain parallax
- wait until thermometer has stopped rising (at the start)

(d) two improvements to apparatus or procedure, e.g. [2]
- insulation all way up side of test-tube/covering bottom of test-tube
- start taking measurements at same temperature/same initial temp. of water
- same volume of water/use measuring cylinder for water
- plot cooling curves
- use metal/thinner glass test-tubes
- more layers of insulation
- make sure insulation is dry
- avoid overlapping insulation
- use same tube/same tube thickness in each experiment

[Total: 8]

31. 0625_m15_MS_62 Q: 5

(a) θ_H = 74 AND θ_C = 23(°C) [1]

(b) **(i)** suitable reason, e.g. [1]
- temperature not able to reach max θ_H (in 30s)
- temperature dropped on transfer
- conduction/transfer to metal tongs

matching improvement, e.g. [1]
- leave block in hot water longer
- transfer more quickly
- use insulated tongs/cotton round block

(ii) suitable reason, e.g. [1]
- some (thermal) energy transferred to beaker,
- some (thermal) energy transferred to surroundings,
- evaporation/convection (into atmosphere)

matching improvement, e.g. [1]
- use a less conducting material for beaker/owtte
- insulate beaker
- allow for beaker in any calculation
- lid on beaker

[Total: 5]

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32. 0625_s15_MS_61 Q: 2

(a) 85 (recorded in table) [1]

(b) s, °C [1]

(c) Graph:
- axes correctly labelled, right way round and with units [1]
- suitable scales, plots occupying at least half grid in both directions [1]
- all plots correct to within ½ small square [1]
- good best-fit line judgement [1]
- single, thin, continuous line [1]

(d) **(i)** decreases owtte, no ecf [1]

(ii) statement justified by reference to the graph [1]

[Total: 9]

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33. 0625_s15_MS_62 Q: 2

(a) **(i)** θ_H = 92 (°C) [1]

(ii) any one from:
- wait for thermometer reading to stop rising
- perpendicular viewing of scale
- stirring
- thermometer bulb in middle of water/not touching beaker [1]

(b) θ_A = 21 (°C) allow ecf from **(i)** [1]

(c) θ_B = 14, correct unit seen, °C or deg C NOT C° or °C, and not contradicted [1]

(d) any two from:
- room temperature/other environmental statement
- initial hot water temperature
- heat loss to surroundings /evaporation/conduction through sides of beaker
- time delays in adding water [max.2]

(e) perpendicular viewing/eye level with meniscus [1]

reading to bottom of meniscus [1]

[Total: 8]

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34. 0625_s15_MS_63 Q: 2

(a) 21(°C) [1]

(b) *t* values correct: 30, 60, 90, 120, 150, 180, 210, 240, 270 [1]

(c) x_1 = 0.083 [1]

°C/s [1]

x_2 = 0.061 AND x_3 = 0.05(0) [1]

(d) prediction less than x_3 [1]

justification with specific mention of (average) cooling rate decreasing with time/temperature [1]

(e) any two precautions relating to temperature measurement e.g: [2]

- stir before reading
- keep thermometer at same depth
- read thermometer 90° to scale/with reading at eye level
- wait until thermometer has stopped rising (at the start)
- thermometer in middle of water/not touching beaker

[Total: 9]

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35. 0625_w15_MS_61 Q: 4

(a) θ_C = 22 °C [1]

(b) view thermometer at right angles OR stirring OR wait for reading to stop rising OR thermometer (bulb) not touching sides / bottom of beaker owtte [1]

(c) θ_A = 52.5 (°C) OR e.c.f. [1]

(d) any two from:

- heat loss to surroundings / beaker OR heat loss / drop in temperature by evaporation
- delays in taking readings
- reference to uncertainty in volume measurements [2]

(e) (i) 78 (cm^3) [1]

(ii) EITHER:
Student 1 (80) – read to top of meniscus OR scale not read at right angles
OR Student 2 (79) – divisions are every 2(cm^3) not 1(cm^3)
OR Student 2 (79) – scale not read at right angles [1]

[Total: 7]

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36. 0625_w15_MS_62 Q: 2

(a) θ_1 = 82 (°C) [1]

(b) (i) s, °C, °C [1]

(ii) 10, 20, 30, 40, 50, 60 [1]

(c)(i)(ii) $\Delta\theta_1$ = 39 (°C) AND $\Delta\theta_2$ = 8 (°C) [1]

(iii) temperature θ_2 at time t = 0 less than θ_1 [1]

(d) view thermometer at right angles [1]

(e) any one from:

- room temperature / other environmental factor
- volume / mass / quantity / amount of hot water
- initial temperature of the hot water
- initial temperature of the cold water
- initial temperature of the water [1]

[Total: 7]

37. 0625_w15_MS_63 Q: 1

(a) 22(.0) AND 88(.0) [1]

(b) units correct and consistent (symbols or words) [1]

(c) conclusion which matches the temperature changes [1]

(d) any two from: [2]
- volume / level of hot water
- initial temperature of hot water
- initial temperature of cold water
- same type of boiling tube
- room temperature / draughts / appropriate environmental condition

(e) any two improvements relating to apparatus: [2]
- lid on beaker
- insulation on beaker
- lid / cotton wool in boiling tube
- thinner / metal walls on tube
- all cold water in boiling tube below hot water level
- greater contact area of tube
- use of water bath

explanation matching first improvement, including: [1]
- reduces loss of thermal energy from beaker
- reduces loss of thermal energy from boiling tube
- better thermal conduction
- not affected by variation in hot water temperature

[Total: 8]

38. 0625_s14_MS_61 Q: 2

(a) stopwatch / stopclock [1]

(b) any three from:
- length of rod
- diameter / thickness / area (of cross-section) of rod
- amount of wax / type of wax
- weight / size/mass of marker
- position for the markers
- (Bunsen) flame / (rate of) heating
- position of Bunsen / flame
- position of rod on tripod [max 3]

(c) temperature too high
or thermometer only measures up to about 100 °C
or small range [1]

thermometer / bulb can't make proper contact [1]

[Total: 6]

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39. 0625_s14_MS_61 Q: 3

(a) θ_H = 92 (°C) [1]

(b) **(i)** table: s, °C, °C [1]

(ii) decreases [1]

justified by reference to results, giving numbers referring to temperature drops [1]

(c) any two from:
- room temperature / air conditioning / draughts / environmental conditions
- starting temperature (of thermometer) / temperature of (hot) water
- density of packing / amount of cotton wool / dryness of cotton wool [max 2]

[Total: 6]

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40. 0625_s14_MS_62 Q: 2

(a) (i) 88 (°C) [1]

(ii) s, °C [1]

(b) axes correctly labelled with quantity and unit [1]

suitable scales on both axes, occupying more than half the grid [1]

all plots correct to ½ small square [1]

good line judgement, not through all points [1]

thin, continuous line and neat plots (penalise large 'blobs') [1]

(c) (i) statement to match candidate's graph line (expect curve) [1]

(ii) statement to match candidate's graph line (expect (rate) decreases) [1]

(d) description or diagram to show one from:
- perpendicular line of sight
- reading to bottom of meniscus [1]

[Total: 10]

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41. 0625_s14_MS_63 Q: 2

(a)(b) 87 and 89, both correct answer only [1]

(c) units correct in symbols or words, s, °C, °C [1]

t values correct 0, 30, 60, 90, 120, 150, 180 [1]

(d) appropriate pattern which fully matches results
e.g. rate of temperature drop greater at start than at end
NOT stated pattern which partly matches results [1]

(e) statement matching temperature changes
(expect 'Yes' but accept 'No' or 'no significant difference' if ecf) [1]

justification referring to results and involving comparative change in temperature with specific mention of in the same time [1]

(f) any two from:
- room temperature / external temperature (but not outside temperature) / environmental factor such as draughts / sunshine
- initial water temperature / start temperature
- same amount of stirring / wait same time before reading
- keep thermometer at same depth
- same size/thickness / material / surface area of beaker
- same volumes of water [2]

[Total: 8]

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42. 0625_w14_MS_61 Q: 2

(a) 21 (°C) [1]

(b) table: s, °C, °C [1]

(c) no significant effect, justified by some reference to results [1]

wording that communicates the idea that the temperatures are the same within the limits of experimental accuracy OR almost the same rate [1]

(d) lid/cover/smaller cross-sectional area [1]

(e) any one from:
room temperature (or equivalent environmental condition)
initial water temperature
volume of water
same/dry insulation [1]

[Total: 6]

---

43. 0625_w14_MS_62 Q: 2

(a) 19 (°C) cao [1]

(b) table:
cm^3, °C [1]
NOT C°, centigrade

correct *V* values 10, 20, 30, 40, 50 [1]

(c) lid / insulation / polystyrene cup / minimal time delay [1]

(d) R_1 = 2.(00) R_2 = 1.4(3) [1]
note: do not give the mark if using incorrect stopwatch reading e.g. 35.5 rather than 35.05

cm^3 / s [1]

(e) rate / flow is not constant [1]

(f) any two from:
room temperature / air conditioning
initial / hot water temperature
volume / quantity / amount of hot water
cold water temperature
intervals / time between adding volumes of water [2]
ignore draughts / humidity / pressure

[Total: 9]

44. 0625_w14_MS_63 Q: 2

(a) θ for **A** 76 (°C) and for **B** 79 (°C) [1]

(b) units all correct [1]

t values correct 0, 30, 60, 90, 120, 150, 180 [1]

(c) statement matching temperature changes with justification referring to results and involving correct comparative change in temperature [1]

justification has specific mention of temperature change in the same time owtte [1]

(d) appropriate source of inaccuracy associated with procedure e.g. any one from:
- water levels not the same
- thermometer scales not read at 90°
- initial temperatures different
- not able to stir water
- not waiting for temperature to stabilise initially / waiting time not long enough [1]

(e) any two factors relating to apparatus from:
- keep thermometer at same depth
- same size/thickness/material of test-tube / same test-tube
- same water levels/volume/quantity/amount of water
- same thickness/surface area of surface material [2]

[Total: 8]

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45. 0625_s13_MS_62 Q: 2

(a) θ_C = 19 (°C) [1]

(b) s, °C, symbols or words [1]

(c) 12 cm^3 (unit needed) [1]

(d) 40–50 (cm^3), (expect 42 cm^3 e.c.f. **(c)**) [1]
estimate given to nearest 1 cm^3 only and sensible method [1]

(e) two from:
room / surrounding temperature / other environmental condition
initial hot water temperature
initial cold water temperature
volume / mass / amount of hot water
time delay on adding cold water / same time for cooling [2]

[Total: 7]

(a) 24 (°C) [1]

(b) units all correct (symbols or words) [1]
times 1, 2, 3, 4, 5, 6 (allow seconds if compatible with heading) [1]

(c) thermometer near bottom/no significant difference
and justification matching statement (words or figures) with mention/implication of temperature change [1]
in same time [1]

(d) appropriate precaution:
e.g. stir before reading / keep thermometer at same depth [1]
matching explanation:
e.g. ensure temperature is the same throughout / temperature different at different depths [1]

(e) appropriate precautions relating to comparison
any two of:
same size/thickness/surface area of beaker
same volume of water
same initial temperature (of water)
same room temperature / appropriate environmental condition [2]

[Total: 9]

47. 0625_w13_MS_61 Q: 2

(a) 87 (°C) [1]

(b) **(i)** s, °C, °C [1]

(ii)(iii) **B** and greater temperature difference
OR numbers quoted, *must see* 21 and 8 or 24 and 5 [1]

(iv) **A** 23(°C) and **B** 40(°C) [1]

(v) 20 – 26 (°C) [1]

(c) EITHER viewing thermometer at right angles
OR reference to being ready on time [1]

(d) any two from:
room temperature
water / starting temperature
distance of thermometer bulb from water surface
relevant reference to draughts / fans / air conditioning [2]

[Total: 8]

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48. 0625_w13_MS_62 Q: 2

(a) 78 °C c.a.o. unit needed [1]

(b)(c) both thermometer readings correct 69, 61 [1]
correct differences 9, 17 allow e.c.f. [1]

(d) order matches results (expect D, B, C, A) allow e.c.f. [1]

(e) any two from:
room temperature (or other environmental condition)
initial (hot) water / starting temperature (accept initial temperature)
volume / mass / amount / level of (hot) water
same type / thickness / material / size / volume of beaker
time delays during operations [2]

(f) same time of cooling for each experiment [1]

[Total: 7]

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49. 0625_w13_MS_63 Q: 2

(a) **A** = 87(°C) and **B** = 88(°C) [1]

(b) units correct (symbols or words) [1]
times correct (0, 30, 60, 90, 120, 150, 180) [1]

(c) statement matching temperature changes (accept 'no significant difference' if justified) and justification matching statement (comparison of temperature changes) [1]
including specific mention of temperature change in same time [1]

(d) appropriate condition relating to comparison
i.e. any one from:
same size/thickness of beaker
same volume of water
same initial temperature
same room temperature / appropriate environmental condition
same time for cooling [1]

(e) any sensible alteration e.g.
put lid on/cover top of **A**
extra experiment without insulation or lid / take lid off **B** [1]
matching explanation e.g.
most thermal energy loss by convection or o.w.t.t.e.
have only changed one factor or o.w.t.t.e. [1]

[Total: 8]

50. 0625_s12_MS_61 Q: 2

(a) θ_R = 22(°C) [1]

(b) Table:
mm, °C [1]
Correct *d* values 100, 80, 60, 40, 20, 10 [1]

(c) Temperature difference = 3(°C), higher [1]

(d) Draughts [1]
Room temperature/humidity [1]

(e) One from:
Relevant avoidance of parallax explained, in using rule or thermometer
Waiting time between readings
Wait for steady thermometer reading
Allow lamp to cool/warm up
Repeats and average [1]

[Total: 7]

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51. 0625_s12_MS_62 Q: 2

(a) 23 °C need unit for the mark [1]

(b) Axes correctly labelled with quantity and unit [1]
Suitable scales [1]
All plots correct to ½ small square [1]
Good line judgement [1]
Thin, continuous line [1]

(c) Two from:
Room temperature/humidity/sun through window/air conditioning
Draughts
Initial water temperature [2]

[Total: 8]

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52. 0625_s12_MS_63 Q: 2

(a) 23 °C need unit for the mark [1]

(b) Axes correctly labelled with quantity and unit [1]
Suitable scales [1]
All plots correct to ½ small square [1]
Good line judgement [1]
Thin, continuous line [1]

(c) Two from:
Room temperature/humidity/sun through window/air conditioning
Draughts
Initial water temperature [2]

[Total: 8]

---

53. 0625_w12_MS_61 Q: 2

(a) θ_R = 24(°C) [1]

(b) **(i)** Table:
s, °C, °C [1]

(ii) About the same [1]
Justified with reference to numbers in table [1]

(c) Any two from:
Volumes of water
Room temperature/draughts
Same beaker
Initial water temperature [2]

[Total: 6]

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54. 0625_w12_MS_62 Q: 2

(a) θ_R = 23 [1]
°C [1]

(b) (i) θ_A = 63 and **(ii)** θ_H = 14 (unit not required) ecf θ_R from **2(a)** [1]

(c) (i) θ_B = 36 and **(ii)** θ_W = 15 (unit not required) ecf θ_R from **2(a)** [1]

(d) Ratios calculated 4.5 and 2.4 ecf **2(b)** and **2(c)** [1]
Expect NO and ratios too different/not close enough (owtte), matching statement ecf wrong values from **2(b)** and **2(c)** [1]

(e) Any two from:
Room temperature/draughts/humidity/air conditioning (i.e. environmental factor)
Initial (water) temperature (cold or hot)
Amount of stirring
Time interval
Mass/volume/amount of water/water level
Size/surface area/material of beaker [2]

[Total: 8]

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55. 0625_w12_MS_63 Q: 2

(a) 23 seen in correct place in table [1]

(b) (i) Units all correct (symbols or words) [1]

(ii) 10°C (or ecf from **2(a)**) and 23°C [1]

(iii) Statement matching temperature changes (expect 'black') with supporting comparative comment [1]

(iv) Statement matching results (expect 'Yes') [1]
Figures from table matching correct statement
and time interval mentioned at least once [1]

(c) Any one from:
same (type of) lamp/same brightness
same distance/height
same (type of) thermometer
same area of card
same thickness of card
good contact between card and thermometer (owtte)
same start temperature/allow thermometer to cool
allow lamp to cool [1]

Appropriate matching explanation:
power output may not be the same (owtte)
different intensity of radiation (owtte)
respond differently/different heat capacity
different surface area to absorb radiant heat (owtte)
different rate of conduction (owtte)
rate of rise different at different temperatures
heating starts at different times [1]

[Total: 8]

56. Not applicable