Specimen

From 2018 the mark scheme design/layout has improved.
The content and marks remain the same.
mark scheme abbreviations

( ) the word, phrase or unit in brackets is not required but is in the mark scheme for clarification

accept accept the response

AND both responses are necessary for the mark to be allowed

c.a.o. correct answer only

e.c.f. error carried forward; marks are awarded if a candidate has carried an incorrect value forward from earlier working, provided the subsequent working is correct

ignore this response is to be disregarded and does not negate an otherwise correct response

NOT do not allow

note: additional marking guidance

/ OR alternative responses for the same marking point

owtte or words to that effect

underline mark is not allowed unless the underlined word or idea is used by candidate

units there is a maximum of one unit penalty per question unless otherwise indicated

any [number] from: accept the [number] of valid responses

max indicates the maximum number of marks
1 (a) table:
5 \( d \) values in cm (all < 50), recorded to nearest mm [1]
\( d \) values 30.0, 24.0, 20.0, 17.1, 15.0 each to ± 1.0 cm [1]
1/\( d \) values correct (note: at least 2 significant figures) [1]

(b) any one difficulty and corresponding solution from:
rule won’t balance exactly
allowing to tip one way then the other and take average

finding position of centre of the mass on the rule
marking centre of mass so it can be read against rule
OR take average of right hand and left hand readings for mass position

mass or rule slides
suitable means for preventing mass or rule sliding

OR other suitable difficulty and solution [max 2]

(c) graph:
axes labelled with quantity and unit [1]
scales suitable, plots occupying at least half grid [1]
plots all correct to ½ square (take centre of plot if large) [1]
well-judged thin line (≤ ½ square) [1]

(d) triangle method used and shown (any indication on graph) using at least half line (can be seen in calculation) [1]

(e) \( \mu = 27 – 33 \) (g) to 2 or 3 significant figures [1]

2 (a) table:
\( t \) in s, both \( \theta \) in °C (words or symbols) [1]
both tubes temperatures decreasing and to consistent precision [1]
both tubes temperatures decreasing at decreasing rate [1]

(b) statement matches readings (expect tube without cotton wool cooled most rapidly OR no significant difference)
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]

(c) quality poor due to small temperature differences [1]
any two improvements from:
increase initial temperature of water
ensure initial temperatures are identical (if they weren’t)
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]

(d) any two from:
laboratory temperature
draughts / open windows
accept temperature of hot water source [max 2]
3 (a) correct symbol [1]
correct position [1]

(b) table:
5 $l$ values range at least 50 cm [1]
5 $l$ values range at least 70 cm [1]
$V$ values all < 2.5 V and decreasing with increasing length [1]
all $V$ values to at least 0.1 V and same precision (same no. of decimal places) [1]

(c) (brightness) decreases (as length increases) [1]

(d) statement: no (must match readings) [1]
justification matches statement and by reference to results
  e.g. $V/l$ not constant, $V$ increases as $l$ decreases, $V$ does not double when $l$ doubles [1]

(e) any one from:
width of sliding contact
accept heating changes resistance of wire
accept other sensible practical reason [max 1]
NOT human error

(f) do not touch (bare/hot) wire
OR do not allow C to touch terminal between lamp and supply [1]

4 apparatus:
measuring cylinder/jug OR ruler OR balance (to measure amount of water) [1]
protractor OR rule to measure height of raised surface
OR other means of measuring angle of tilt
OR newtonmeter to apply variable force
OR other method of applying quantifiable force [1]

instructions:
method of tilting or applying variable force and measuring point at which bottle topples [1]
attention to accuracy, any two from:
just starts to topple
slowly
repeats / more than 10 values for quantity of water
very large protractor
or any other suitable precaution which would improve accuracy of data [2]

values:
at least 5 values with range at least 1500 cm$^3$ or 30 cm or 1500 g, approximately evenly spaced [1]

graph:
plot of measured variable (angle or height or force) against quantity of water (volume or height or mass) (accept vice versa) [1]